Active targeted delivery of immune therapeutics to lymph nodes

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Harvard Medical School
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Scopus rating (2008): SNIP 0.187 SJR 0.25
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A facile molecularly imprinted polymer-based fluorometric assay for detection of histamine

Histamine is a biogenic amine naturally present in many body cells. It is also a contaminant that is mostly found in spoiled food. The consumption of foods containing high levels of histamine may lead to an allergy-like food poisoning. Analytical methods that can routinely screen histamine are thus urgently needed. In this paper, we developed a facile and cost-effective molecularly imprinted polymer (MIP)-based fluorometric assay to directly quantify histamine. Histamine-specific MIP nanoparticles (nanoMIPs) were synthesized using a modified solid-phase synthesis method. They were then immobilized in the wells of a microplate to bind the histamine in aqueous samples. After binding, o-phthalaldehyde (OPA) was used to label the bound histamine, which converted the binding events into fluorescent signals. The obtained calibration curve of histamine showed a linear correlation ranging from 1.80 to 44.98 mM with the limit of detection of 1.80 μM. This method was successfully used to detect histamine in spiked diary milk with a recovery rate of more than 85%.

General information
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Organisations: Department of Micro- and Nanotechnology, NanoChemistry
Authors: Feng, X. (Intern), Ashley, J. (Intern), Zhou, T. (Intern), Halder, A. (Intern), Sun, Y. (Intern)
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ISI indexed (2013): ISI indexed yes
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Scopus rating (2012): SJR 0.872 SNIP 0.619 CiteScore 2.4
ISI indexed (2012): ISI indexed no
Web of Science (2012): Indexed yes
We demonstrate a microfluidic reaction chamber that mimics a microcentrifuge tube where reagents can be mixed sequentially at a known stoichiometry. The device has no moving parts or valves and is made by hot embossing in a polymer foil. Sample and reagents are filled in the reaction chamber by controlled guiding of the air/liquid interface in a rectangular array of pillars. The operation of the device is demonstrated by performing isothermal DNA amplification in nL volumes. In our device, 28 pg of DNA from λ-phage, a virus with a 48 kilo base genome, is amplified 500 times thus the amplification product is suitable for library preparation for second generation sequencing. We show that fabrication by hot embossing does not introduce significant contamination and that our device is performing comparably well to test tube amplification and current PDMS-based chip technology.
A multi-chamber microfluidic intestinal barrier model using Caco-2 cells for drug transport studies

This paper presents the design and fabrication of a multi-layer and multi-chamber microchip system using thiol-ene 'click chemistry' aimed for drug transport studies across tissue barrier models. The fabrication process enables rapid prototyping of multi-layer microfluidic chips using different thiol-ene polymer mixtures, where porous Teflon membranes for cell monolayer growth were incorporated by masked sandwiching thiol-ene-based fluid layers. Electrodes for trans-epithelial electrical resistance (TEER) measurements were incorporated using low-melting soldering wires in combination with platinum wires, enabling parallel real-time monitoring of barrier integrity for the eight chambers. Additionally, the translucent porous Teflon membrane enabled optical monitoring of cell monolayers. The device was developed and tested with the Caco-2 intestinal model, and compared to the conventional Transwell system. Cell monolayer differentiation was assessed via in situ immunocytochemistry of tight junction and mucus proteins, P-glycoprotein 1 (P-gp) mediated efflux of Rhodamine 123, and brush border aminopeptidase activity. Monolayer tightness and relevance for drug delivery research was evaluated through permeability studies of mannitol, dextran and insulin, alone or in combination with the absorption enhancer tetradecylmaltoside (TDM). The thiol-ene-based microchip material and electrodes were highly compatible with cell growth. In fact, Caco-2 cells cultured in the device displayed differentiation, mucus production, directional transport and aminopeptidase activity within 9-10 days of cell culture, indicating robust barrier formation at a faster rate than in conventional Transwell models. The cell monolayer displayed high TEER and tightness towards hydrophilic compounds, whereas co-administration of an absorption enhancer elicted TEER-decrease and increased permeability similar to the Transwell cultures. The presented cell barrier microdevice constitutes a relevant tissue barrier model, enabling transport studies of drugs and chemicals under real-time optical and functional monitoring in eight parallel chambers, thereby increasing the throughput compared to previously reported microdevices.

General information
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Organisations: Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology, Colloids and Biological Interfaces, Novo Nordisk A/S, University of Copenhagen
Authors: Tan, H. (Intern), Trier, S. (Ekstern), Rahbek, U. L. (Ekstern), Dufva, M. (Intern), Kutter, J. P. (Ekstern), Andresen, T. L. (Intern)
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.11 SJR 1.236 SNIP 1.101
Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 1.427 SNIP 1.136 CiteScore 3.32
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.559 SNIP 1.148 CiteScore 3.54
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.772 SNIP 1.153 CiteScore 3.94
ISI indexed (2013): ISI indexed yes
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BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.982 SNIP 1.156 CiteScore 4.15
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.425 SNIP 1.233 CiteScore 4.58
ISI indexed (2011): ISI indexed no
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 2.705 SNIP 1.178
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 2.614 SNIP 1.046
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 2.506 SNIP 1.006
Web of Science (2008): Indexed yes
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A multifunctional molecularly imprinted polymer-based biosensor for direct detection of doxycycline in food samples

In this study, we developed a new type of multifunctional molecularly imprinted polymer (MIP) composite as an all-in-one biosensor for the low-cost, rapid and sensitive detection of doxycycline in pig plasma. The MIP composite consisted of a magnetic core for ease of manipulation, and a shell of fluorescent MIPs for selective recognition of doxycycline. By simply incorporating a small amount of fluorescent monomer (fluorescein-Oacrylate), the fluorescent MIP layer was successfully grafted onto the magnetic core via a surface imprinting technique. The resultant MIP composites showed significant doxycycline-dependent fluorescence quenching in an aqueous environment. Good linearity ranging from 0.2 to 6 μM was achieved, and the limit of detection was determined to be 117 nM. The biosensor also showed good selectivity towards doxycycline when compared to other common antibiotic residues. The multifunctional MIP composites were used to directly extract doxycycline from spiked pig plasma samples and quantify the antibiotics based on the quenched fluorescence signals. Recoveries of doxycycline were found in the range of 88–107%.
An automated flow-injection enzyme-linked immunosorbent assay for the detection of Zearalenone

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Lund University
Authors: Jantra, J. (Ekstern), Zor, K. (Intern), Hedström, M. (Ekstern), Mattiasson, B. (Ekstern)
Publication date: 2018
Main Research Area: Technical/natural sciences
Zearalenone, Flow-ELISA, Biosensor

Association between polycyclic aromatic hydrocarbon exposure and peripheral blood mononuclear cell DNA damage in human volunteers during fire extinction exercises

This study investigated a number of biomarkers, associated with systemic inflammation as well as genotoxicity, in 53 young and healthy subjects participating in a course to become firefighters, while wearing personal protective equipment (PPE). The exposure period consisted of a 3-day training course where the subjects participated in various live-fire training exercises. The subjects were instructed to extinguish fires of either wood or wood with electrical cords and mattresses. The personal exposure was measured as dermal polycyclic aromatic hydrocarbon (PAH) concentrations and urinary excretion of 1-hydroxypyrene (1-OHP). The subjects were primarily exposed to particulate matter (PM) in by-stander positions, since the self-contained breathing apparatus effectively prevented pulmonary exposure. There was increased dermal exposure to pyrene (68.1%, 95% CI: 52.5%, 83.8%) and sum of 16 polycyclic aromatic hydrocarbons (ΣPAH; 79.5%, 95% CI: 52.5%, 106.6%), and increased urinary excretion of 1-OHP (70.4%, 95% CI: 52.5%; 106.6%) after the firefighting exercise compared with the mean of two control measurements performed 2 weeks before and 2 weeks after the firefighting course, respectively. The level of Fpg-sensitive sites in peripheral blood mononuclear cells (PBMCs) was increased by 8.0% (95% CI: 0.02%, 15.9%) compared with control measurements. The level of DNA strand breaks was
positively associated with dermal exposure to pyrene and ΣPAHs, and urinary excretion of 1-OHP. Fpg-sensitive sites were only associated positively with PAHs. Biomarkers of inflammation and lung function showed no consistent response.

In summary, the study demonstrated that PAH exposure during firefighting activity was associated with genotoxicity in PBMCs.

General information
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Organisations: Department of Micro- and Nanotechnology, Danish Technological Institute, Bispebjerg University Hospital, University of Copenhagen, National Research Center for Working Environment
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BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.42 SJR 1.093 SNIP 0.884
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.304 SNIP 1.405 CiteScore 3.41
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Scopus rating (2013): SJR 1.195 SNIP 1.564 CiteScore 3.6
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.353 SNIP 1.337 CiteScore 3.51
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.092 SNIP 1.458 CiteScore 3.48
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.246 SNIP 1.431
Web of Science (2010): Indexed yes
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Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.133 SNIP 1.15
Scopus rating (2007): SJR 0.866 SNIP 1.091
Scopus rating (2006): SJR 0.947 SNIP 1.122
Scopus rating (2005): SJR 0.684 SNIP 0.908
Scopus rating (2004): SJR 0.672 SNIP 0.825
Scopus rating (2003): SJR 0.696 SNIP 0.692
A Viscoelastic Catastrophe

We use a differential constitutive equation to model the flow of a viscoelastic flow in a cross-slot geometry, which is known to exhibit bistability above a critical flow rate. The novelty lies in two asymmetric modifications to the geometry, which causes a change in the bifurcation diagram such that one of the stable solutions becomes disconnected from the solution at low flow speeds. First we show that it is possible to mirror one of the modifications such that the system can be forced to the disconnected solution. Then we show that a slow decrease of the flow rate, can cause the system to go through a drastic change on a short time scale, also known as a catastrophe. The short time scale could lead to a precise and simple experimental measurement of the flow conditions at which the viscoelastic catastrophe occurs. Since the phenomena is intrinsically related to the extensional rheology of the fluid, we propose to exploit the phenomena for in-line extensional rheometry.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Department of Chemical and Biochemical Engineering, The Danish Polymer Centre, Fluidan APS
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Bulk and surface morphologies of ABC miktoarm star terpolymers comprised of PDMS, PI and PMMA arms

DIM miktoarm star copolymers, composed of polydimethylsiloxane [D], poly(1,4-isoprene) [I], and poly(methyl methacrylate) [M], were synthesized using a newly developed linking methodology with 4-allyl-1,1-diphenylethylene as a linking agent. The equilibrium bulk morphologies of the DIM stars were found to range from {6.6.6} tiling patterns to alternating lamellar and alternating cylindrical morphologies, as determined experimentally by small-angle X-ray scattering and transmission electron microscopy and confirmed by dissipative particle dynamics and self-consistent field theory based arguments. The thin film morphologies, which differ from those found in the bulk, were identified by scanning electron microscopy, coupled with oxygen plasma etching. Square arrays of the PDMS nanodots and empty core cylinders were formed on silica after oxygen plasma removal of the poly(1,4-isoprene) and poly(methyl methacrylate) which generated nanostructured substrates decorated with these features readily observable.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, University of Copenhagen, Oak Ridge National Laboratory, University of Massachusetts
Authors: Chernyy, S. (Intern), Kirkensgaard, J. J. K. (Ekstern), Mahalik, J. P. (Ekstern), Kim, H. (Ekstern), Arras, M. M. L. (Ekstern), Kumar, R. (Ekstern), Sumpter, B. G. (Ekstern), Smith, G. S. (Ekstern), Mortensen, K. (Ekstern), Russell, T. P. (Ekstern), Almdal, K. (Intern)
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Main Research Area: Technical/natural sciences
Publication information
Journal: Macromolecules
CD11c-targeted Delivery of DNA to Dendritic Cells Leads to cGAS- and STING-dependent Maturation

Immunotherapeutic activation of tumor-specific T cells has proven to be an interesting approach in anticancer treatment. Particularly, anti-CTLA-4 and anti-PD-1/PD-L1 treatment looks promising, and conceivably, even better clinical results might be obtained if such treatment could be combined with boosting the existing tumor-specific T-cell response. One way to achieve this could be by increasing the level of maturation of dendritic cells locally and in the draining lymph nodes. When exposed to cancer cells, dendritic cells may spontaneously mature because of dangerassociated molecular patterns derived from the tumor cells. Doublestranded DNA play a particularly important role in the activation of the dendritic cells, through engagement of intracellular DNA sensors, and signaling through the adaptor protein STING. In the present study, we have investigated the maturational response of human monocyte-derived dendritic cells (moDC) and human monocytic THP-1 cells to targeted and untargeted DNA. We used an anti-CD11c antibody conjugated with double-stranded DNA to analyze the maturation status of human moDCs, as well as maturation using a cGAS KO and STING KO THP-1 cell maturation model. We found that dendritic cells can mature after exposure to cytoplasmic double-stranded DNA delivered through CD11c-mediated endocytosis. Moreover, we show that THP-1 cells matured using IL-4, GM-CSF, and ionomycin upregulate DC-maturation markers after CD11c-targeted delivery of double-stranded DNA. This upregulation is completely abrogated in cGAS KO and STING KO cells.
Cellular effects and delivery propensity of penetratin is influenced by conjugation to parathyroid hormone fragment 1-34 in synergy with pH

The cell-penetrating peptide (CPP) penetratin, has demonstrated potential as a carrier for transepithelial delivery of cargo peptides, such as the therapeutically relevant part of parathyroid hormone, i.e. PTH(1-34). The purpose of the present study was to elucidate the relevance of modifying the pH for PTH(1-34)-penetratin conjugates and for co-administered penetratin with PTH(1-34) in terms of transepithelial permeation of PTH(1-34) and cellular effects. Transepithelial permeation was assessed using monolayers of the Caco-2 cell culture model, and effects on Caco-2 cellular viability kinetics were evaluated by using the Real-Time-GLO assay as well as by microscopy following Trypan blue staining. Morphological Caco-2 cell changes were studied exploiting the impedance-based xCELLigence system as well as optically using the oCelloscope setup. Finally, the effect of pH on the folding propensity of the PTH(1-34)-penetratin conjugate and its ability to disrupt lipid membranes were assessed by circular dichroism (CD) spectroscopy and the calcein release assay, respectively. The transepithelial PTH(1-34) permeation was not pH-dependent when applying the co-administration approach. However, by applying the conjugation approach, the PTH(1-34) permeation was significantly enhanced by lowering the pH from 7.4 to 5, but also associated with a compromised barrier and a lowering of the cellular viability. The negative effects on the cellular viability following cellular incubation with the PTH(1-34)-penetratin conjugate were moreover confirmed during real-time monitoring of the Caco-2 cell viability as well as by enhanced Trypan blue uptake. In addition, morphological changes were primarily observed for cells incubated with the PTH(1-34)-penetratin conjugate at pH 5, which was moreover demonstrated to have an enhanced membrane permeating effect following lowering of the pH from 7.4 to 5. The latter observation was, however, not a result of better secondary folding propensity at pH 5 when compared to pH 7.4.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, University of Copenhagen
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Co-delivery of resveratrol and docetaxel via polymeric micelles to improve the treatment of drug-resistant tumors

Co-delivery of anti-cancer drugs is promising to improve the efficacy of cancer treatment. This study was aiming to investigate the potential of concurrent delivery of resveratrol (RES) and docetaxel (DTX) via polymeric nanocarriers to treat breast cancer. To this end, methoxyl poly(ethylene glycol)-poly(D,L-lactide) copolymer (mPEG-PDLA) was prepared and characterized using FTIR and $^1$H NMR, and their molecular weights were determined by GPC. Isobolgram analysis and combination index calculation were performed to find the optimal ratio between RES and DTX to against human breast adenocarcinoma cell line (MCF-7 cells). Subsequently, RES and DTX were loaded in the mPEG-PDLA micelles simultaneously, and the morphology, particle size distribution, in vitro release, pharmacokinetic profiles, as well as
Cytotoxicity to the MCF-7 cells were characterized. IC$_{50}$ of RES and DTX in MCF-7 cells were determined to be 23.0 μg/ml and 10.4 μg/ml, respectively, while a lower IC$_{50}$ of 4.8 μg/ml of the combination of RES and DTX was obtained. The combination of RES and DTX at a ratio of 1:1 (w/w) generated stronger synergistic effect than other ratios in the MCF-7 cells. RES and DTX loaded mPEG-PDLA micelles exhibited prolonged release profiles, and enhanced cytotoxicity in vitro against MCF-7 cells. The AUC(0→t) of DTX and RES in mPEG-PDLA micelles after i.v. administration to rats were 3.0-fold and 1.6-fold higher than that of i.v. injections of the individual drugs. These findings indicated that the co-delivery of RES and DTX using mPEG-PDLA micelles could have better treatment of tumors.

**General information**

State: Accepted/In press
Organisations: Department of Micro- and Nanotechnology, Shenyang Pharmaceutical University, Liaoning University of Traditional Chinese Medicine, University of Copenhagen
Authors: Guo, X. (Ekstern), Zhao, Z. (Ekstern), Chen, D. (Ekstern), Qiao, M. (Ekstern), Wan, F. (Ekstern), Cun, D. (Ekstern), Sun, Y. (Intern), Yang, M. (Ekstern)
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Scopus rating (2014): CiteScore 0.69 SNIP 0.492 SJR 0.296
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**Colorimetric sensing of dopamine using hexagonal silver nanoparticles decorated by task-specific pyridinium based ionic liquid**

A simple and sensitive platform was introduced for detection of dopamine (DA) based on morphology transition and etching strategy of hexagonal platelet shaped silver nanoparticles (Ag NPs) functionalized with task-specific ionic liquid (TSIL). In this study, a pyridinium based TSIL was used for surface functionalization. According to the etching strategy, hexagonal TSIL-Ag NPs were converted to round-shape nanoparticles in the presence of DA. This etching process caused a blue shift in the localized surface plasmon resonance (LSPR) peak of TSIL-Ag NPs. The maximum absorption band shifted from 585 nm to 500 nm. Color change from green to red was also observed as a consequence of morphology transition of TSIL-Ag NPs. The color change and change in the A$_{500}$/A$_{585}$ ratio versus DA concentration were linear in the range of 0.1–7.5 μM with a detection limit of 0.031 μM. Moreover, the developed approach was applied for detection and determination of DA in human serum sample. This simple, rapid and selective method provided a promising sensing probe for detection of DA in biological fluids.

**General information**

State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Nanocarbon, K.N. Toosi University of Technology, Iranian National Institute for Oceanography and Atmospheric Science, Amirkabir University of Technology
Authors: Rostami, S. (Ekstern), Mehdinia, A. (Ekstern), Jabbari, A. (Ekstern), Kowsari, E. (Ekstern), Niroumand, R. (Ekstern), Booth, T. J. (Intern)
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Main Research Area: Technical/natural sciences

**Publication information**

Journal: Sensors and Actuators B: Chemical
Colorimetric detection, Dopamine, Etching strategy, Localized surface plasmon resonance, Morphology transition
Complete long-term corrosion protection with chemical vapor deposited graphene
Despite numerous reports regarding the potential of graphene for corrosion protection, examples of chemical vapor deposited (CVD) graphene-based anticorrosive coatings able to provide long-term protection (i.e. several months) of metals have so far been absent. Here, we present a polymer-graphene hybrid coating, comprising two single layers of CVD graphene sandwiched by three layers of polyvinyl butyral, which provides complete corrosion protection of commercial aluminum alloys even after 120 days of exposure to simulated seawater. The essential role played by graphene in the hybrid coating is evident when we compare the results from a polymer-only coating of the same thickness, which fails in protecting the metal after less than 30 days. With the emergence of commercially available large-area CVD graphene, our work demonstrates a straightforward approach towards high-performance anticorrosive coatings, which can be extended to other two-dimensional materials and polymers, for long-term protection of various relevant metals and alloys.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, Department of Chemical and Biochemical Engineering, CHEC Research Centre, The Hempel Foundation Coatings Science and Technology Centre (CoaST), University of Manchester
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Scopus rating (2017): SJR 2.226 SNIP 1.666
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 6.49 SJR 2.091 SNIP 1.648
Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 1.988 SNIP 1.71 CiteScore 6.53
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.132 SNIP 1.976 CiteScore 6.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.289 SNIP 2.114 CiteScore 6.54
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.518 SNIP 2.102 CiteScore 5.95
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.193 SNIP 2.048 CiteScore 5.23
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Concentrating and labeling genomic DNA in a nanofluidic array

Nucleotide incorporation by DNA polymerase forms the basis of DNA sequencing-by-synthesis. In current platforms, either the single-stranded DNA or the enzyme is immobilized on a solid surface to locate the incorporation of individual nucleotides in space and/or time. Solid-phase reactions may, however, hinder the polymerase activity. We demonstrate a device and a protocol for the enzymatic labeling of genomic DNA arranged in a dense array of single molecules without attaching the enzyme or the DNA to a surface. DNA molecules accumulate in a dense array of pits embedded within a nanoslit due to entropic trapping. We then perform ϕ29 polymerase extension from single-strand nicks created on the trapped molecules to incorporate fluorescent nucleotides into the DNA. The array of entropic traps can be loaded with λ-DNA molecules to more than 90% of capacity at a flow rate of 10 pL min⁻¹. The final concentration can reach up to 100 μg mL⁻¹, and the DNA is eluted from the array by increasing the flow rate. The device may be an important preparative module for carrying out enzymatic processing on DNA extracted from single-cells in a microfluidic chip.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Optofluidics, XGenomes, NIL Technology ApS
Authors: Marie, R. (Intern), Pedersen, J. N. (Intern), Mir, K. U. (Ekstern), Bilenberg, B. (Ekstern), Kristensen, A. (Intern)
Pages: 1376-1382
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information
Journal: Nanoscale
Volume: 10
ISSN (Print): 2040-3364
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.442 SJR 2.934
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Conductance quantization suppression in the quantum Hall regime
Conductance quantization is the quintessential feature of electronic transport in non-interacting mesoscopic systems. This phenomenon is observed in quasi one-dimensional conductors at zero magnetic field $B$, and the formation of edge states at finite magnetic fields results in wider conductance plateaus within the quantum Hall regime. Electrostatic interactions can change this picture qualitatively. At finite $B$, screening mechanisms in narrow, gated ballistic conductors are predicted to give rise to an increase in conductance and a suppression of quantization due to the appearance of additional conduction channels. Despite being a universal effect, this regime has proven experimentally elusive because of difficulties in realizing one-dimensional systems with sufficiently hard-walled, disorder-free confinement. Here, we experimentally demonstrate the suppression of conductance quantization within the quantum Hall regime for graphene nanoconstrictions with low edge roughness. Our findings may have profound impact on fundamental studies of quantum transport in finite-size, two-dimensional crystals with low disorder.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, Theoretical Nanotechnology
Authors: Caridad, J. M. (Intern), Power, S. R. (Intern), Lotz, M. R. (Intern), Shylau, A. A. (Intern), Thomsen, J. D. (Intern), Gammelgaard, L. (Intern), Booth, T. J. (Intern), Jauho, A. (Intern), Bæggild, P. (Intern)
Number of pages: 6
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information
Journal: Nature Communications
Volume: 9
Issue number: 1
Article number: 659
ISSN (Print): 2041-1723
Ratings:
BFI (2018): BFI-level 2
Bone tissue engineering is considered an alternative approach for conventional strategies available to treat bone defects. In this study, we have developed bone scaffolds composed of hydroxyapatite (HAp), gelatin and mesoporous silica, all recognized as promising materials in bone tissue engineering due to favorable biocompatibility, osteoconductivity and drug delivery potential, respectively. These materials were coupled with conductive polypyrrole (PPy) polymer to create a novel bone scaffold for regenerative medicine. Conductive and non-conductive scaffolds were made by slurry casting method and loaded with a model antibiotic, vancomycin (VCM). Their properties were compared in different experiments in which scaffolds containing PPy showed good mechanical properties, higher protein adsorption and higher percentage of VCM release over a long duration of time compared to non-conductive scaffolds. Osteoblast cells were perfectly immersed into the gelatin matrix and remained viable for 14 days. Overall, new conductive composite bone scaffolds were created and the obtained results strongly verified the applicability of this conductive scaffold in drug delivery, encouraging its further development in tissue engineering applications.
Confined Growth of ZIF-8 Nanocrystals with Tunable Structural Colors

Zeolitic imidazolate frameworks (ZIF-8) have promising applications as sensors or catalysts due to their highly porous crystalline structures. While most of the previous studies are based on ZIF-8 crystals either in isolated particles in aqueous environments or in a compact colloidal form, here a facile method is reported to achieve wafer-based isolated ZIF-8 nanocrystals to facilitate their integration in microsystems and as surface coatings for catalysis. The fabrication process includes the growth of compact zinc oxide film by atomic layer deposition that functions as the Zn source for the ZIF-8 synthesis, and the dispersion of gold nanoparticles as inhibitors for the following crystallization transformation of ZIF-8 crystals. By choosing the concentration of gold nanoparticles, the density of ZIF-8 nanocrystals can be controlled and the sizes of individual ZIF-8 crystals can be scaled down to ≈100 nm. A wide range of structural colors generated by the ZIF-8 nanocrystals is also observed, which can be attributed to the size-dependent resonant scattering as verified by finite-difference time-domain simulations and classical Mie theory. The scalable fabrication of wafer-based ZIF-8 nanocrystals empowered with tunable optical properties paves a new way to explore the promising applications in nanophotonics and bionanotechnology.

Confined-interface-directed synthesis of Palladium single-atom catalysts on graphene/amorphous carbon

The maximized atomic efficiency of supported catalysts is highly desired in heterogeneous catalysis. Therefore, the design and development of active, stable, and atomic metal-based catalysts remains a formidable challenge. To tackle these problems, it is necessary to investigate the interaction between single atoms and supports. Theoretical calculations indicate that the Pd binding strength is higher on graphene/amorphous carbon (AC) than that on graphene or AC substrate. Based on these predictions, we present a facile confined-interface-directed synthesis route for the preparation of single-atom catalysts (SACs) in which Pd atoms are well-dispersed on the interface of double-shelled hollow carbon nanospheres with reduced graphene oxide (RGO) as the inner shell and AC as the outer shell. Owing to the synergetic effect of the RGO/AC confined interface and the atomically dispersed Pd, the as-made RGO@AC/Pd SAC achieves the maximum atomic efficiency (catalytic activity) of Pd species and exhibits an excellent stability in chemical catalysis. This confined-interface-directed synthesis method provides a novel direction to maximize the atomic efficiency, improve the
activity, and enhance the stability of metal-based catalysts.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Huazhong University of Science and Technology, Beijing Computational Science Research Center
Authors: Xi, J. (Ekstern), Sun, H. (Intern), Zhang, Z. (Ekstern), Duan, X. (Ekstern), Xiao, J. (Ekstern), Xiao, F. (Ekstern), Liu, L. (Ekstern), Wang, S. (Ekstern)
Pages: 291-297
Publication date: 2018
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Applied Catalysis B: Environmental
Volume: 225
ISSN (Print): 0926-3373
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SJR 3.152 SNIP 2.359
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 8.86 SJR 2.693 SNIP 2.185
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.326 SNIP 2.16 CiteScore 7.72
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.322 SNIP 2.206 CiteScore 6.92
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.391 SNIP 2.154 CiteScore 6.42
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.65 SNIP 2.234 CiteScore 6.08
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.606 SNIP 2.351 CiteScore 6.14
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.479 SNIP 1.904
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.323 SNIP 2.245
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.514 SNIP 2.297
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.536 SNIP 2.532
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.315 SNIP 2.272
Web of Science (2006): Indexed yes
Curvilinear 3-D Imaging Using Row–Column Addressed 2-D Arrays with a Diverging Lens: Phantom Study

A double-curved diverging lens over the flat row–column-addressed (RCA) 2-D array can extend its inherent rectilinear 3-D imaging field-of-view (FOV) to a curvilinear volume region, which is necessary for applications such as abdominal and cardiac imaging. Two concave lenses with radii of 12.7mm and 25.4mm were manufactured using RTV664 silicone. The diverging properties of the lenses were evaluated based on simulations and measurements on several phantoms. The measured FOV for both lenses in contact with tissue mimicking phantom were less than 15% different from the theoretical predictions, i.e., a curvilinear FOV of 32°×32° and 24°×24° for the 12.7mm and 25.4mm radii lenses. A synthetic aperture imaging sequence with single element transmissions was designed for imaging down to 140mm at a volume rate of 88 Hz. The performance was evaluated in terms of signal-to-noise ratio (SNR), FOV, and full-width-at-half-maximum (FWHM) of a focused beam. The penetration depths in a tissue mimicking phantom with 0.5 dB/(cm MHz) attenuation were 100mm and 125mm for the lenses with radii of 12.7mm and 25.4 mm. The azimuth, elevation, and radial FWHM at 43mm depth were (5.8, 5.8, 1)λ and (6, 6, 1)λ. The results of this study confirm that the proposed lens approach is an effective method for increasing the FOV, when imaging with RCA 2-D arrays.
CVD Graphene/Ni Interface Evolution in Sulfuric Electrolyte

Systems comprising single and multilayer graphene deposited on metals and immersed in acid environments have been investigated, with the aim of elucidating the mechanisms involved, for instance, in hydrogen production or metal protection from corrosion. In this work, a relevant system, namely chemical vapor deposited (CVD) multilayer graphene/Ni (MLGr/Ni), is studied when immersed in a diluted sulfuric electrolyte. The MLGr/Ni electrochemical and morphological properties are studied in situ and interpreted in light of the highly oriented pyrolytic graphite (HOPG) electrode behavior, when immersed in the same electrolyte. Following this interpretative framework, the dominant role of the Ni substrate in hydrogen production is clarified.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Politecnico di Milano
Authors: Yivlialin, R. (Ekstern), Bussetti, G. (Ekstern), Duò, L. (Ekstern), Yu, F. (Intern), Galbiati, M. (Intern), Camilli, L. (Intern)
Pages: 3413–3419
Publication date: 2018
Main Research Area: Technical/natural sciences
Development of a β-Lactoglobulin Sensor Based on SPR for Milk Allergens Detection

A sensitive and label-free surface plasmon resonance (SPR) based sensor was developed in this work for the detection of milk allergens. β-lactoglobulin (BLG) protein was used as the biomarker for cow milk detection. This is to be used directly in final rinse samples of cleaning in-place (CIP) systems of food manufacturers. The affinity assay was optimised and characterised before a standard curve was performed in pure buffer conditions, giving a detection limit of 0.164 µg mL⁻¹ as a direct binding assay. The detection limit can be further enhanced through the use of a sandwich assay and amplification with nanomaterials. However, this was not required here, as the detection limit achieved exceeded the required allergen detection levels of 2 µg mL⁻¹ for β-lactoglobulin. The binding affinities of the polyclonal antibody for BLG, expressed by the dissociation constant (KD), were equal to 2.59 × 10⁻⁹ M. The developed SPR-based sensor offers several advantages in terms of label-free detection, real-time measurements, potential on-line system and superior sensitivity when compared to ELISA-based techniques. The method is novel for this application and could be applied to wider food allergen risk management decision(s) in food manufacturing.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Cranfield University, Colworth Science Park, University of Manchester
Authors: Ashley, J. (Intern), D'Aurelio, R. (Ekstern), Piekaraska, M. (Ekstern), Temblay, J. (Ekstern), Pleasants, M. (Ekstern), Trinh, L. (Ekstern), Rodgers, T. L. (Ekstern), Tothill, I. E. (Ekstern)
Number of pages: 11
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information

Journal: Biosensors
Volume: 8
Issue number: 2
ISSN (Print): 2079-6374
Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): SNIP 1.122 SJR 0.829
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 2.83 SJR 0.788 SNIP 1.185
Scopus rating (2015): SJR 0.579 SNIP 0.653 CiteScore 2.37
Scopus rating (2014): SJR 0.554 SNIP 0.659 CiteScore 2.04
Scopus rating (2013): SJR 0.463 SNIP 0.829 CiteScore 1.93
ISI indexed (2013): ISI indexed no
Scopus rating (2012): SJR 0.556 SNIP 1.249 CiteScore 1.9
ISI indexed (2012): ISI indexed no
Scopus rating (2010): SJR 0.102
Scopus rating (2009): SJR 0.102
Scopus rating (2008): SJR 0.102
Original language: English
Allergen, Biosensor, Milk protein, Surface plasmon resonance (SPR), β-lactoglobulin (BLG)

Electronic versions:
biosensors_08_00032.pdf
DOIs:
10.3390/bios8020032

Bibliographical note
Development of electrosprayed mucoadhesive chitosan microparticles

The efficacy of chitosan (CS) to be used as drug delivery carrier has previously been reported. However, limited work has been pursued to produce stable and mucoadhesive CS electrosprayed particles for oral drug delivery, which is the aim of this study. Various CS types with different molecular weight (MW), degree of deacetylation (DD), and degree of polymerization (DP) were assessed. In addition, the effect of the solvent composition was also investigated. Results showed that stable CS electrosprayed particles can be produced by dissolving 3% w/v of low MW CS in mixtures of aqueous acetic acid and ethanol (50/50% v/v). The stable CS particles displayed diameters of approximately 1 μm as determined by dynamic light scattering. The zeta potential of these particles was found to be approximately 40 mV confirming the mucoadhesion properties of these CS electrosprayed particles and its potential to be used as drug delivery carrier.

General information
State: Published
Organisations: National Food Institute, Research Group for Nano-Bio Science, Department of Micro- and Nanotechnology, Nanoprobes, University of Munster
Authors: Moreno, J. A. S. (Intern), Mendes, A. C. (Intern), Stephansen, K. (Intern), Engwer, C. (Ekstern), Goycoolea, F. M. (Ekstern), Boisen, A. (Intern), Nielsen, L. H. (Intern), Chronakis, I. S. (Intern)
Pages: 240-247
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information
Journal: Carbohydrate Polymers
Volume: 190
ISSN (Print): 0144-8617
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.733 SJR 1.428
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 5.15 SJR 1.419 SNIP 1.75
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.44 SNIP 1.819 CiteScore 4.86
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.587 SNIP 1.955 CiteScore 4.69
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.346 SNIP 1.945 CiteScore 4.39
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.394 SNIP 2.025 CiteScore 3.93
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.291 SNIP 1.974 CiteScore 4.08
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Differentiation of human-induced pluripotent stem cell under flow conditions to mature hepatocytes for liver tissue engineering

Hepatic differentiation of human-induced pluripotent stem cells (hiPSCs) under flow conditions in a 3D scaffold is expected to be a major step forward for construction of bioartificial livers. The aims of this study were to induce hepatic differentiation of hiPSCs under perfusion conditions and to perform functional comparisons with fresh human precision-cut liver slices (hPCLS), an excellent benchmark for the human liver in vivo. The majority of the mRNA expression of CYP isoenzymes and transporters and the tested CYP activities, Phase II metabolism, and albumin, urea, and bile acid synthesis in the hiPSC-derived cells reached values that overlap those of hPCLS, which indicates a higher degree of hepatic differentiation than observed until now. Differentiation under flow compared with static conditions had a strong inducing effect on Phase II metabolism and suppressed AFP expression but resulted in slightly lower activity of some of the Phase I metabolism enzymes. Gene expression data indicate that hiPSCs differentiated into both hepatic and biliary directions. In conclusion, the hiPSC differentiated under flow conditions towards hepatocytes express a wide spectrum of liver functions at levels comparable with hPCLS indicating excellent future perspectives for the development of a bioartificial liver system for toxicity testing or as liver support device for patients.

General information
State: Accepted/In press
Organisations: Department of Micro- and Nanotechnology, BioLabChip, Bioanalytics, Fluidic Array Systems and Technology, University of Groningen, Takara Bio Europe AB, Technical University of Denmark
Number of pages: 12
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Tissue Engineering and Regenerative Medicine
ISSN (Print): 1932-6254
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.01 SJR 0.88
Digital resonant laser printing: Bridging nanophotonic science and consumer products

Nanophotonics research relies heavily on state-of-the-art and costly nano and microfabrication technologies. While such technologies are fairly mature, their implementation in large-scale manufacturing of photonic devices is not straightforward. This is a major roadblock for integrating nanophotonic functionalities, such as flat optics or high definition, ink-free color printing, into real-life applications. In particular, optical metasurfaces – nanoscale textured surfaces with engineered optical properties – hold great potential for a myriad of such applications. Digital laser printing has recently been introduced as a low-cost lithography solution, which allows the fabrication of high-resolution features on optical substrates. By exploiting resonant opto-thermal modification of individual nanoscale elements, laser printing can achieve nanometer-sized resolution. In addition, the concept of digital resonant laser printing at the nanoscale supports mass-customization and may therefore convert nanophotonic science into everyday consumer products.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Hebrew University of Jerusalem, University of Southern Denmark
Authors: Zhu, X. (Intern), Keshavarz Hedayati, M. (Intern), Raza, S. (Intern), Levy, U. (Ekstern), Mortensen, N. A. (Ekstern), Kristensen, A. (Intern)
Pages: 7-10
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information
Journal: Nano Today
Volume: 19
ISSN (Print): 1748-0132
Ratings:
BFI (2018): BFI-level 2
Dip coating of air purifier ceramic honeycombs with photocatalytic TiO$_2$ nanoparticles: A case study for occupational exposure

Nanoscale TiO$_2$ (nTiO$_2$) is manufactured in high volumes and is of potential concern in occupational health. Here, we measured workers exposure levels while ceramic honeycombs were dip coated with liquid photoactive nanoparticle suspension and dried with an air blade. The measured nTiO$_2$ concentration levels were used to assess process specific emission rates using a convolution theorem and to calculate inhalation dose rates of deposited nTiO$_2$ particles. Dip coating did not result in detectable release of particles but air blade drying released fine-sized TiO$_2$ and nTiO$_2$ particles. nTiO$_2$ was found in pure nTiO$_2$ agglomerates and as individual particles deposited onto background particles. Total particle emission rates were 420 × 10⁹ min$^{-1}$, 1.33 × 10⁹ μm² min$^{-1}$, and 3.5 mg min$^{-1}$ respirable mass. During a continued repeated process, the average exposure level was 2.5 × 10⁴ cm$^{-3}$, 30.3 μm² cm$^{-3}$, <116 μg m$^{-3}$ for particulate matter. The TiO$_2$ average exposure level was 4.2 μg m$^{-3}$, which is well below the maximum recommended exposure limit of 300 μg m$^{-3}$ for nTiO$_2$ proposed by the US National Institute for Occupational Safety and Health. During an 8-hour exposure, the observed concentrations would result in a lung deposited surface area of 4.3 × 10⁻³ cm² g⁻¹ of lung tissue and 13 μg of TiO$_2$ to the trachea-bronchi, and alveolar regions. The dose levels were well below the one hundredth of the no observed effect level (NOEL$_{1/100}$) of 0.11 cm² g⁻¹ for granular biodurable particles and a daily no significant risk dose level of 44 μg day⁻¹. These emission rates can be used in a mass flow model to predict the impact of process emissions on personal and environmental exposure levels.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, National Research Center for Working Environment, Netherlands Organisation for Applied Scientific Research - TNO, China Jiliang University, Istituto di Scienza e Tecnologia dei Materiali Ceramici, Colorobbia Consulting s.r.l.
Direct nanoimprinting of moth-eye structures in chalcogenide glass for broadband antireflection in the mid-infrared

Fresnel reflection at the boundary between two media of differing refractive indices is a major contributing factor to the overall loss in mid-infrared optical systems based on high-index materials such as chalcogenide glasses. In this paper, we present a study of broadband antireflective moth-eye structures directly nanoimprinted on the surfaces of arsenic triselenide (As$_2$Se$_3$)-based optical windows. Using rigorous coupled-wave analysis, we identify a relief design optimized for high transmittance (12%) in the 5.9–7.3 μm spectral range as well as improved omnidirectional properties. Finally, we demonstrate the adaptability of nanoimprinted surface reliefs by tailoring the nanostructure pitch and height, achieving both extremely broadband antireflective and highly efficient antireflective surface reliefs. The results and methods presented herein provide an efficient and scalable solution for improving the transmission of bulk optics, waveguides, and photonic devices in the mid-infrared.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Department of Photonics Engineering, Fiber Sensors and Supercontinuum Generation, Surface Engineering
Authors: Lotz, M. R. (Intern), Petersen, C. R. (Intern), Markos, C. (Intern), Bang, O. (Intern), Jakobsen, M. H. (Intern), Taboryski, R. J. (Intern)
Pages: 557-563
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information
Journal: Optica
Volume: 5
Issue number: 5
ISSN (Print): 2334-2536
Ratings:
Web of Science (2018): Indexed yes
Web of Science (2017): Indexed Yes
Scopus rating (2016): CiteScore 8.05
Web of Science (2016): Indexed yes
Scopus rating (2015): CiteScore 7
Web of Science (2015): Indexed yes
Web of Science (2014): Indexed yes
Original language: English
Electronic versions:
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DOIs:
10.1364/OPTICA.5.000557
Source: FindIt
Source-ID: 2434121305
Publication: Research - peer-review › Journal article – Annual report year: 2018

Direct observation of oxygen configuration on individual graphene oxide sheets
Graphene oxide (GO) is an interesting material that has the potential for a wide range of applications. Critical for these applications are the type of oxygen bond and its spatial distribution on the individual GO sheets. This distribution is not yet well understood. Few techniques offer a resolution high enough to unambiguously identify oxygen configuration. We used a new, label free spectroscopic technique to map oxygen bonding on GO, with spatial resolution of nanometres and high chemical specificity. AFM-IR, atomic force microscopy coupled with infrared spectroscopy, overcomes conventional IR
diffraction limits, producing IR spectra from specific points as well as chemical maps that are coupled to topography. We have directly observed oxygen bonding preferentially on areas where graphene is folded, in discrete domains and on edges of GO. From these observations, we propose an updated structural model for GO, with C[dbnd]O on its edge and plane, which confirms parts of earlier proposed models. The results have interesting implications. Determining atomic position and configuration from precise imaging offers the possibility to link nanoscale structure and composition with material function, paving the way for targeted tethering of ions, polymers and biomaterials.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, Department of Photonics Engineering, Structured Electromagnetic Materials, University of Copenhagen
Authors: Liu, Z. (Ekstern), Nørgaard, K. (Ekstern), Overgaard, M. H. (Ekstern), Ceccato, M. (Ekstern), Mackenzie, D. M. (Intern), Stenger, N. (Intern), Stipp, S. L. (Ekstern), Hassenkam, T. (Ekstern)
Pages: 141-148
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information
Journal: Carbon
Volume: 127
ISSN (Print): 0008-6223
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 2.226 SNIP 1.666
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 6.49 SJR 2.091 SNIP 1.648
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.988 SNIP 1.71 CiteScore 6.53
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.132 SNIP 1.976 CiteScore 6.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.289 SNIP 2.114 CiteScore 6.54
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.518 SNIP 2.102 CiteScore 5.95
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.193 SNIP 2.048 CiteScore 5.23
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 2.392 SNIP 2.034
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 2.121 SNIP 2.103
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 2.126 SNIP 1.938
Scopus rating (2007): SJR 1.835 SNIP 1.798
Web of Science (2007): Indexed yes
Dispersive solid-phase imprinting of proteins for the production of plastic antibodies

We describe a novel dispersive solid-phase imprinting technique for the production of nano-sized molecularly imprinted polymers (nanoMIPs) as plastic antibodies. The template was immobilized on in-house synthesized magnetic microspheres instead of conventional glass beads. As a result, high-affinity and template-free MIPs were produced in higher yields.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NanoChemistry
Authors: Ashley, J. (Intern), Feng, X. (Intern), Halder, A. (Intern), Zhou, T. (Intern), Sun, Y. (Intern)
Pages: 3355-3358
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication Information
Journal: Chemical Communications
Volume: 54
Issue number: 27
ISSN (Print): 1359-7345
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SJR 2.555 SNIP 1.127
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.06 SJR 2.538 SNIP 1.16
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.601 SNIP 1.295 CiteScore 6.7
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.692 SNIP 1.436 CiteScore 6.83
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.752 SNIP 1.372 CiteScore 6.73
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.118 SNIP 1.35 CiteScore 6.21
Disulfide polymer grafted porous carbon composites for heavy metal removal from stormwater runoff

The emerging concern of heavy metal pollution derived from stormwater runoff has triggered a demand for effective heavy metal sorbents. To be an effective sorbent, high affinity along with rapid sorption kinetics for environmental relevant concentrations of heavy metals is important. Herein, we have introduced a new composite suitable for trace metal concentration removal, which consists of cheap and common granular activated carbon covered with polymers containing soft bases, thiols, through acyl chlorination (DiS-AC). Material characterization demonstrated that the polymer was successfully grafted and grown onto the surface of the carbon substrate. The distribution coefficient for Cd\textsuperscript{2+} bonding was 89·10\textsuperscript{3} L/kg at a solution concentration of 0.35 mg/L, which is notably higher than sorption affinities for Cd\textsuperscript{2+} seen in conventional sorbents. The sorption isotherm is well described by the Freundlich isotherm and within an hour, half of the initial trace (0.2 mg/L) concentration of Cd\textsuperscript{2+} was removed by the DiS-AC at a sorbent loading of 2 g/L. Therefore, the novel material DiS-AC promises to be an ideal candidate for filters treating stormwater runoff.

General information
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Organisations: Department of Environmental Engineering, Water Technologies, Department of Micro- and Nanotechnology, Surface Engineering, Korean Advanced Institute of Science and Technology (KAIST), University of Copenhagen
Publication date: 2018
Do planetary seasons play a role in attaining stable climates?

A simple phenomenological account for planetary climate instabilities is presented. The description is based on the standard model where the balance of incoming stellar radiation and outward thermal radiation is described by the effective planet temperature. Often, it is found to have three different points, or temperatures, where the influx of radiation is balanced with the out-flux, even with conserved boundary conditions. Two of these points are relatively long-term stable, namely the point corresponding to a cold climate and the point corresponding to a hot climate. In a classical sense these points are equilibrium balance points. The hypothesis promoted in this paper is the possibility that the intermediate third point can become long-term stable by being driven dynamically. The initially unstable point is made relatively stable over a long period by the presence of seasonal climate variations.
Drug loaded biodegradable polymer microneedles fabricated by hot embossing

This study demonstrates a fast low temperature method for fabrication of drug loaded polymer microneedles (MN). First, arrays of tapered pillar MNs with a length of 275 ± 3 μm (mean ± SD) and a diameter of 84 ± 1 μm were fabricated in Si with a three-step deep reactive ion etching (DRIE) process. The Si MNs were used as a template for fabrication of polydimethylsiloxane (PDMS) stamps. The stamps were applied for replication of the MNs in spin coated poly-ε-caprolactone (PCL) films by hot embossing at 60 °C and a pressure of 1.4 MPa for 3 min. The resulting PCL MNs perfectly resembled the Si MNs and had a length of 270 ± 5 μm and a diameter of 84 ± 3 μm. The MNs had sufficient mechanical strength to penetrate the surface of a 10 w/w% gelatine gel without deformation. Finally, PCL MNs containing 20 w/w% of furosemide were fabricated and drug release by diffusion was demonstrated.
Microneedles, Transdermal, Drug delivery, Hot embossing, Poly-ε-caprolactone (PCL)

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Editorial: dose-dependent ZnO particle-induced acute phase response in humans warrants re-evaluation of occupational exposure limits for metal oxides

Epidemiological studies link inhalation of particles to increased risk of cardiovascular disease. Inhaled particles may induce cardiovascular disease by several different mechanisms including translocation of particles to systemic circulation, activation of airway sensory nerves resulting in autonomic imbalance and particle-induced pulmonary inflammation and acute phase response. The acute phase response is the systemic response to acute and chronic inflammatory states caused by for example bacterial infection, virus infection, trauma and infarction. It is characterized by differential expression of ca. 50 different acute phase proteins including C-reactive protein and Serum amyloid A, which are the most differentially up-regulated acute phase response proteins. Blood levels of these two acute phase proteins are closely associated with risk of cardiovascular disease in epidemiological studies and SAA has been causally related to the formation of plaques in the aorta in animal studies. In a recent paper in Particle and Fibre Toxicology, Christian Monse et al. provide evidence that inhalation of ZnO nanoparticles induces dose-dependent acute phase response in humans at dose levels well below the current mass-based occupational exposure limits in a number of countries including Germany, The Netherlands, UK, Sweden, Denmark and the US. Given the evidence suggesting a causal relationship between increased levels of serum amyloid A and atherosclerosis, the current results call for a re-evaluation of occupational exposure limits for a number of particle exposures including ZnO taking induction of acute phase response into account. Furthermore, it underscores cardiovascular disease as an occupational disease.

General information
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Organisations: Department of Micro- and Nanotechnology, Utrecht University
Effect of alginate size, mannuronic/guluronic acid content and pH on particle size, thermodynamics and composition of complexes with β-lactoglobulin

Alginate is an anionic polysaccharide capable of forming insoluble particles with proteins. Hence, alginate has potential as a protein carrier. However, the role of physical properties of the polysaccharide, such as degree of polymerization (DPn),
and mannnuronic/guluronic acid ratio, remains to be fully explored. Particle formation of a high and a low molar mass alginate (ALG) with β-lactoglobulin (BLG) at pH 2-8 depends on the average DPn (HMW-ALG: $1.59 \cdot 10^3$; LMW-ALG: $0.23 \cdot 10^3$) and the mannnuronic/guluronic acid ratio (1.0; 0.6) as supported by using ManA6 and GulA6 as models. Dynamic light scattering (DLS) showed that particles of BLG with either of the two ALGs have essentially the same hydrodynamic diameter ($D_H$) at pH 3 and 2, while at pH 4 particles of LMW-ALG/BLG have larger $D_H$ than of HMW-ALG/BLG. At pH 5-8 no significant particle formation was observed. ManA6 did not form insoluble particles at pH 2-8, while GulA6 formed insoluble particles, albeit only at pH 4. $K_d$ was approximately 10-fold higher for LMW-ALG/BLG than HMW-ALG/BLG and 3 orders of magnitude higher for an alginate trisaccharide/BLG complexation as determined by isothermal titration calorimetry (ITC). The alginate trisaccharide did not form insoluble particles with BLG at pH 3 and 4, though interaction still occurred. $\delta H_{app}$ and molar stoichiometry of BLG in the complexes with the two ALGs differed by a factor of 7, as did their DPn, which thus affected the interaction strength, but not the BLG content. At pH 4 the BLG content doubled in the particle due to BLG dimerization. The findings emphasize the importance of DPn, mannnuronic/guluronic acid ratio and pH in formulations containing alginate/whey protein particles.
Effects of water-absorption and thermal drift on a polymeric photonic crystal slab sensor

A photonic crystal slab (PCS) sensor is a universal refractive index sensor with possibilities and performance very similar to surface plasmon resonance (SPR), which represents the gold standard of biosensing. Cheap PCS sensors can be made vacuum-free entirely out of polymers, but come with additional challenges, besides those relating to temperature-variations, which must be considered in any refractive index based method: The polymeric waveguide core was found to swell by 0.3% as water absorbed into the waveguide core over 1.5 h. This was investigated by monitoring the wavelength of resonant reflection during absorption, by monitoring the release of water using ellipsometry, and by rigorous coupled-wave analysis (RCWA). The approach presented here enables monitoring of water uptake and thermal fluctuations, for drift-free, high-performance operation of a polymeric PCS sensor.
Efficiency enhancement of InGaN amber MQWs using nanopillar structures

We have investigated the use of nanopillar structures on high indium content InGaN amber multiple quantum well (MQW) samples to enhance the emission efficiency. A significant emission enhancement was observed which can be attributed to the enhancement of internal quantum efficiency and light extraction efficiency. The size-dependent strain relaxation effect...
was characterized by photoluminescence, Raman spectroscopy and time-resolved photoluminescence measurements. In addition, the light extraction efficiency of different MQW samples was studied by finite-different time-domain simulations. Compared to the as-grown sample, the nanopillar amber MQW sample with a diameter of 300 nm has demonstrated an emission enhancement by a factor of 23.8.

General information
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Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, King Abdullah University of Science and Technology, Sun Yat-Sen University
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Electroluminescence enhancement for near-ultraviolet light emitting diodes with graphene/AZO-based current spreading layers
Near-ultraviolet light emitting diodes with different aluminum-doped zinc oxide-based current spreading layers were fabricated and electroluminescence (EL) was compared. A 170% EL enhancement was achieved by using a graphene-based interlayer. GaN-based near-ultraviolet light emitting diodes (NUV LEDs) have attracted significant research interest due to their intensive applications in various areas where indium tin oxide (ITO) is one of the most widely employed transparent conductive materials for NUV LEDs. Compared to ITO, indium-free aluminum-doped zinc oxide (AZO) has similar electrical and optical properties and is low-cost, nontoxic and more stable at high temperatures, therefore offering an attractive alternative to ITO. Meanwhile, the performance of AZO in NUV applications still needs further improvement. Hence, this work focuses on electroluminescence (EL) enhancement in NUV LEDs with a new type of current spreading layer (CSL) which combines AZO and a single-layer graphene (SLG) as an effective transparent CSL [1]. In the present work, LEDs with solo AZO CSL in Fig.1(a) and SLG/AZO-based CSL in Fig.1(b) were both fabricated for EL comparison. Standard mesa fabrication including photolithography and an inductively coupled plasma (ICP) GaN etch was applied on a NUV epi-wafer which mainly consists of a 2.5µm n-GaN layer, 9 pairs of 2nm InGaN/8nm GaN multiple quantum wells (MQWs) and a 130nm p-GaN layer. Afterwards, two types of CSLs, 250nm AZO and SLG/2nm Ni/250nm AZO, were formed on the mesas, respectively. AZO was deposited through a sputtering process followed by a 5-min annealing at 800°C in N2 whereas Ni was deposited through an e-beam evaporation process to protect the SLG during the AZO sputtering process followed by a 5-min annealing at 550°C in air. Finally, 30nm Ti/200nm Au layers were e-beam evaporated as p- and n-pads. Afterwards, EL measurements from the top of the fabricated LEDs in a probe station and
spectrometer setup shows that the LED with the SLG/Ni/AZO-CSL has 170% stronger intensity than that of the LED with the AZO-CSL as seen in Fig.2. In addition, the AZO-CSL and the SLG/Ni/AZO-CSL were also fabricated on sapphire for transmittance measurements LEDIA1-3 by an integrating sphere system. Fig.3(a) shows that AZO-CSL presents a 71% transmittance at 388nm while SLG/Ni/AZO-CSL presents a 66% transmittance, indicating an acceptable sacrifice of around 5%. Furthermore, work function measurements were performed on AZO-CSL and SLG/Ni/AZO-CSL using Bruker's PeakForce Kelvin probe force microscopy. As shown in Fig.3(b), graphene has a higher work function (4.85-4.9 eV) than that of AZO (4.7-4.75 eV). In summary, a 170% EL enhancement was achieved by the SLG/2nm Ni/250nm AZO-CSL in comparison with the 250nm AZO-CSL. The enhancement can be attributed to the higher work function of graphene which reduces the potential barrier hence allowing easier carrier injection through the p-GaN layer.

Electron Waiting Times of a Cooper Pair Splitter

Electron waiting times are an important concept in the analysis of quantum transport in nanoscale conductors. Here we show that the statistics of electron waiting times can be used to characterize Cooper pair splitters that create spatially separated spin-entangled electrons. A short waiting time between electrons tunneling into different leads is associated with the fast emission of a split Cooper pair, while long waiting times are governed by the slow injection of Cooper pairs from a superconductor. Experimentally, the waiting time distributions can be measured using real-time single-electron detectors in the regime of slow tunneling, where conventional current measurements are demanding. Our work is important for understanding the fundamental transport processes in Cooper pair splitters and the predictions may be verified using current technology.
Enabling real-time detection of electrochemical desorption phenomena with sub-monolayer sensitivity

Electrochemical reactions play an increasingly important role in sustainable energy conversion and chemical synthesis. Better understanding of catalytic mechanisms at electrode surfaces is thus important for the transition to a clean-energy economy, but is hindered by the difficulty of real-time detection of reaction products and intermediates during electrochemistry experiments. Herein, we present a new type of electrochemistry mass spectrometry (EC-MS) based on a versatile gas inlet to vacuum fabricated onto a silicon microchip, and compare it to established techniques with focus on sensitivity, time response, and mass transport. The inlet system is able to capture reactant molecules directly from an electrode surface and pass them on to a mass spectrometer on a sub-second time scale with 100% collection efficiency for quantitative analysis with unprecedented sensitivity. The high sensitivity and fast time-response, coupled with well-characterized mass transport of both reactants and products in this setup enables sub-turnover resolution for analysis of electrochemical reactions. The technology and concepts presented here can serve as a platform to improve in-situ mass spectrometry in electrochemistry as well as other fields.

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  Web of Science (2011): Indexed yes
  BFI (2010): BFI-level 1
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Endothelial Protein C–Targeting Liposomes Show Enhanced Uptake and Improved Therapeutic Efficacy in Human Retinal Endothelial Cells

PURPOSE. To determine whether human retinal endothelial cells (HRECs) express the endothelial cell protein C receptor (EPCR) and to realize its potential as a targeting moiety by developing novel single and dual corticosteroid–loaded functionalized liposomes that exhibit both enhanced uptake by HRECs and superior biologic activity compared to nontargeting liposomes and free drug.

METHODS. EPCR expression of HRECs was investigated through flow cytometry and Western blot assays. EPCR-targeting liposomes were developed by functionalizing EPCR-specific antibodies onto liposomes, and the uptake of liposomes was assessed with flow cytometry and confocal laser scanning microscopy. The therapeutic potential of EPCR-targeting liposomes was determined by loading them with prednisolone either through bilayer insertion and/or by remote loading into the aqueous core. The carrier efficacy was assessed in two ways through its ability to inhibit secretion of interleukins in cells stimulated with high glucose and angiogenesis in vitro by using an endothelial cell tube formation assay.

RESULTS. HRECs express EPCR at a similar level in both human aortic and umbilic vein endothelial cells. The EPCR-targeting liposomes displayed at least a 3-fold higher uptake compared to nontargeting liposomes. This enhanced uptake was translated into superior antiinflammatory efficacy, as the corticosteroid-loaded EPCR-targeting liposomes significantly reduced the secretion of IL-8 and IL-6 and inhibited the development of cell tube formations in contrast to nontargeting liposomes.

CONCLUSIONS. We show that HRECs express EPCR and this receptor could be a promising nanomedicine target in ocular diseases where the endothelial barrier of the retina is compromised.
Entangled Polymer Melts in Extensional Flow: Synthesis, Rheology, Neutron Scattering
This thesis contains 5 chapters and reprints in Appendices, combined of both published and unpublished materials. The first chapter is an introduction to the goals, methods and problem identification of the project of the entangled polymer melts in extensional flow, which is aimed to shed some light on certain aspects of polymer physics. This became possible because of a valuable opportunity of collaboration of scientists, whose main research areas are polymer synthesis, rheology of complex fluids and small-angle neutron scattering. Consequently, the second chapter describes the model polymer syntheses, made by living anionic polymerization. It contains the description of well-established, as well as new block copolymer syntheses. The third chapter briefly touches the area of the extensional rheology of complex fluids and has the description of an innovative method, filament stretching rheometry, which can measure the extensional rheology of non-Newtonian fluids during a homogeneous uniaxial elongation, providing the results for the tensile stress and molecular conformations. Forth, the fourth chapter delineates the area of SANS, provides the characteristics of the instruments from the different beamlines and depicts some issues that are significant and specific to the quenched polymer samples. It also contains the computational algorithms of the polymer structure factors and shows the way to procure essential parameters of the macromolecular conformations. The conclusion, Chapter 5, briefly recapitulates the progress in the area of the project.

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Authors: Dorokhin, A. (Intern)
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Fabrication of nanostructured functional surfaces on polymer and silicon using self-assembly lithographic methods
We employed block copolymer nanolithography to fabricate transparent anti-fogging surfaces in poly(methyl methacrylate) (PMMA). The resulting surfaces comprised a dense array of hexagonally packed pillars of dimensions below the light diffraction limit, with pillar diameters (55±2) nm, pitch size of (73±1) nm, and height to diameter aspect ratio of about one. The surface chemistry was tuned by treatment with low-pressure atmospheric Ar plasma to increase the surface free energy of PMMA from (44.8±0.8) mNm-1 to (53.7±0.5) mNm-1 and to, as a consequence, decrease the intrinsic Young contact angle from θγ=(68±2)°, for pristine PMMA samples, to below 50° for plasma treated samples. This led to a superwetting and thereby an anti-fogging behavior of nanotextured PMMA surface. To confirm the anti-fogging effect over a large area, we present water vapour condensation performance over treated materials, conducted in the customized environmental chamber of controlled humidity and temperature. While the Ar plasma induced superwetting property had a limited lifetime of about four hours, the thin layer deposition approaches were proposed, comprising coating by plasma assisted vapor deposition with inorganic SiOH-rich silica (SiOx) and high resolution sputtering with tungsten (W), separately. This treatments enabled a considerably prolonged lifetime of the superwetting property of almost three months.

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Authors: Telecka, A. (Intern)
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Field-dependent dynamic responses from dilute magnetic nanoparticle dispersions

The response of magnetic nanoparticles (MNPs) to an oscillating magnetic field outside the linear response region is important for several applications including magnetic hyperthermia, magnetic resonance imaging and biodetection. The size and magnetic moment are two critical parameters for the performance of a colloidal MNP dispersion. We present and demonstrate the use of optomagnetic (OM) and AC susceptibility (ACS) measurements vs. frequency and magnetic field strength to obtain the size and magnetic moment distributions, including the correlation between the distributions. The correlation between the size and the magnetic moment contains information on the morphology and intrinsic structure of the particle. In OM measurements, the variation of the second harmonic light transmission through a dispersion of MNPs is measured in response to an oscillating magnetic field. We solve the Fokker-Planck equations for MNPs with a permanent magnetic moment, and develop analytical approximations to the ACS and the OM signals, which describe the change in the curve shapes with increasing field strength. We describe the influence of induced magnetic moments on the signals, by solving the Fokker-Planck equation for particles, which apart from the permanent magnetic moment may also have an induced magnetic moment and shape anisotropy. Using the results from the Fokker-Planck calculations we fit ACS and OM measurements on two multi-core particle systems. The obtained fit parameters also describe the correlations between the magnetic moment and size of the particles. From such an analysis on a commercially available polydisperse multicore particle system with an average particle size of 80 nm, we find that the MNP magnetic moment is proportional to the square root of the hydrodynamic size.
Generation and Characterization of Cell-Derived Microvesicles from HUVECs

Microvesicles (MVs) are of great interest for the biomedical field as novel diagnostics biomarkers. MV research, however, is still impaired by the lack of standardization of the analysis methods. In this study, our goals were to develop a method for the reproducible generation of an MV population from cell culture, to compare the sizing of MVs by atomic force microscopy (AFM) and nanoparticle tracking analysis (NTA) and to develop an MV array allowing the sizing and phenotyping of MVs simultaneously with the AFM as a read-out. MVs were isolated from apoptotic human umbilical vein endothelial cells (HUVECs) and had a mean size of 115 nm as measured by AFM and of 197 nm as measured by NTA. MVs isolated from apoptotic and control HUVECs could not be distinguished by their size ($p > 0.05$). HUVECs and their released MVs shared the same phenotype (positive for endothelial markers CD31 and CD146 and negative for platelet marker CD42b). Our method generated MVs with a concentration which was reproducible within a range of 20%. This is a relevant model system for medical applications. The size of the MVs was larger as measured using NTA compared to that using AFM. The MV array was efficient to characterize the surface markers of MVs and has the potential to identify the cellular origins of MVs in patient samples.
Gold Nanoparticles Sliding on Recyclable Nanohoodoos-Engineered for Surface-Enhanced Raman Spectroscopy

Robust, macroscopically uniform, and highly sensitive substrates for surface-enhanced Raman spectroscopy (SERS) are fabricated using wafer-scale block copolymer lithography. The substrate consists of gold nanoparticles that can slide and aggregate on dense and recyclable alumina/silicon nanohoodoos. Hot-spot engineering is conducted to maximize the SERS performance of the substrate. The substrate demonstrates remarkably large surface-averaged SERS enhancements, greater than $10^7$ ($>10^8$ in hot spots), with unrivalled macroscopic signal uniformity as characterized by a coefficient of variation of only 6% across 4 cm. After SERS analyses, the nanohoodoos can be recycled by complete removal of gold via a one-step, simple, and robust wet etching process without compromising performance. After eight times of recycling, the substrate still exhibits identical SERS performance in comparison to a new substrate. The macroscopic uniformity combined with recyclability at conserved high performance is expected to contribute significantly on the overall competitiveness of the substrates. These findings show that the gold nanoparticles sliding on recyclable nanohoodoo substrate is a very strong candidate for obtaining cost-effective, high-quality, and reliable SERS spectra, facilitating a wide and simple use of SERS for both laboratorial and commercial applications.
Granular activated carbon with grafted nanoporous polymer enhances nanoscale zero-valent iron impregnation and water contaminant removal

Granular activated carbon was customized with a chemical grafting procedure of a nanoporous polymeric network for the purpose of nanoscale zero-valent iron impregnation and subsequent water contaminant remediation. Characterization of the prepared composite material revealed that not only was the polymer attachment and iron impregnation successful, but also that the polymeric shell acted as a protective barrier against the effects of oxidation from the surrounding environment, nearly 99% of total iron content was in the form of zero-valent iron. When applied towards the remediation of two common water contaminants, nitrobenzene and nitrate, the composite material exploited the qualities of both the activated carbon and the polymeric network to work together in a synergistic manner. In that the increased protection from oxidation allowed for increased reactivity of the nanoscale zero-valent iron, and that the adsorption abilities of both the carbon and the polymer achieved a higher amount of total removal of the contaminants.
Hall effect measurement for precise sheet resistance and thickness evaluation of Ruthenium thin films using non-equidistant four-point probes

We present a new micro Hall effect measurement method using non-equidistant electrodes. We show theoretically and verify experimentally that it is advantageous to use non-equidistant electrodes for samples with low Hall sheet resistance. We demonstrate the new method by experiments where Hall sheet carrier densities and Hall mobilities of Ruthenium thin films (3-30 nm) are determined. The measurements show that it is possible to measure Hall mobilities as low as $1 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ with a relative standard deviation of 2-3%. We show a linear relation between measured Hall sheet carrier density and film thickness. Thus, the method can be used to monitor thickness variations of ultra-thin metal films.
High-quality graphene flakes exfoliated on a flat hydrophobic polymer

We show that graphene supported on a hydrophobic and flat polymer surface results in flakes with extremely low doping and strain as assessed by their Raman spectroscopic characteristics. We exemplify this technique by micromechanical exfoliation of graphene on flat poly(methylmethacrylate) layers and demonstrate Raman peak intensity ratios I(2D)/I(G) approaching 10, similar to pristine freestanding graphene. We verify that these features are not an artifact of optical interference effects occurring at the substrate: they are similarly observed when varying the substrate thickness and are maintained when the environment of the graphene flake is completely changed, by encapsulating preselected flakes between hexagonal boron nitride layers. The exfoliation of clean, pristine graphene layers directly on flat polymer substrates enables high performance, supported, and non-encapsulated graphene devices for flexible and transparent optoelectronic studies. We additionally show that the access to a clean and supported graphene source leads to high-quality van der Waals heterostructures and devices with reproducible carrier mobilities exceeding 50,000 cm² V⁻¹ s⁻¹ at room temperature.
Laser printing with a spatial light modulator (SLM) has several advantages over conventional raster-writing and dot-matrix display (DMD) writing: multiple pixel exposure, high power endurance and existing software for computer generated holograms (CGH). We present a technique for the design and manufacturing of plasmonic metasurfaces based on ultrafast laser printing with a SLM. As a proof of principle we have used this technique to laser print a plasmonic metalens as well as high resolution plasmonic color decoration. The high throughput holographic laser printing approach enables on-demand mass-production of customized metasurfaces.

**Holographic Resonant Laser Printing of Metasurfaces Using Plasmonic Template**

Laser printing with a spatial light modulator (SLM) has several advantages over conventional raster-writing and dot-matrix display (DMD) writing: multiple pixel exposure, high power endurance and existing software for computer generated holograms (CGH). We present a technique for the design and manufacturing of plasmonic metasurfaces based on ultrafast laser printing with a SLM. As a proof of principle we have used this technique to laser print a plasmonic metalens as well as high resolution plasmonic color decoration. The high throughput holographic laser printing approach enables on-demand mass-production of customized metasurfaces.

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Organisations: Department of Photonics Engineering, Optofluidics, Department of Micro- and Nanotechnology, University of Southern Denmark
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How to Characterize Individual Nano-Size Liposomes with Simple Self-Calibrating Fluorescence Microscopy

Nano-size lipid vesicles are used extensively at the interface between nanotechnology and biology, e.g. as containers for chemical reactions at minute concentrations and vehicles for targeted delivery of pharmaceuticals. Typically, vesicle samples are heterogeneous as regards vesicle size and structural properties. Consequently, vesicles must be characterized individually to ensure correct interpretation of experimental results. Here we do that using dual-color fluorescence labeling of vesicles—of their lipid bilayers and lumens, respectively. A vesicle then images as two spots, one in each color channel. A simple image analysis determines the total intensity and width of each spot. These four data all depend on the vesicle radius in a simple manner for vesicles that are spherical, unilamellar, and optimal encapsulators of molecular cargo. This permits identification of such ideal vesicles. They in turn enable calibration of the dual-color fluorescence microscopy images they appear in. Since this calibration is not a separate experiment but an analysis of images of vesicles to be characterized, it eliminates the potential source of error that a separate calibration experiment would have been. Non-ideal vesicles in the same images were characterized by how their four data violate the calibrated relationship established for ideal vesicles. In this way, our method yields size, shape, lamellarity, and encapsulation efficiency of each imaged vesicle. Applying this procedure to extruded samples of vesicles, we found that, contrary to common assumptions, only a fraction of vesicles are ideal.
Hydrogen Treatment and FeOOH overlayer: Effective approaches for enhancing the photoelectrochemical water oxidation performance of bismuth vanadate thin films

The water oxidation capability of the promising photoanode bismuth vanadate (BiVO₄) is hampered by poor bulk electron transport and by high rates of charge recombination at the semiconductor/electrolyte interface. Here, we demonstrate that a dual modification of BiVO₄ by: (i) annealing in a hydrogen-containing environment and (ii) coating with FeOOH overlayer substantially enhances the water oxidation ability of BiVO₄ photoanodes. Hydrogen treated, FeOOH coated BiVO₄ photoanodes exhibit a water oxidation photocurrent density of 2.16 mA cm⁻² at 1.23 V_RHE, which is 5 times higher than for untreated BiVO₄ films. Moreover, they showed an impressive low photocurrent onset potential of −0.11 V_RHE. A stable photocurrent was observed for 1 h of water oxidation measurement at 1.23 V_RHE under 1 Sun illumination. The enhanced photocurrent of FeOOH/H:BiVO₄ photoanode is ascribed to an improved bulk charge transport, as confirmed by impedance spectroscopy measurements and Mott-Schottky analysis. The cathodic shift of the onset potential originates from a lowering of the flat band potential and from an improvement of the charge transport at the semiconductor/electrolyte interface. The dual modification strategy used here offers a simple but effective approach of improving the water oxidation performance of BiVO₄.

General information
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Scopus rating (2016): CiteScore 4.26 SJR 1.322 SNIP 1.369
Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 1.335 SNIP 1.403 CiteScore 4
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.315 SNIP 1.453 CiteScore 3.72
Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 1.299 SNIP 1.415 CiteScore 3.39
ISI indexed (2013): ISI indexed yes
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Scopus rating (2009): SJR 1.718 SNIP 1.631
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.692 SNIP 1.533
Web of Science (2008): Indexed yes
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Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.512 SNIP 1.346
Web of Science (2006): Indexed yes
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Scopus rating (2004): SJR 1.686 SNIP 1.831
Scopus rating (2003): SJR 1.868 SNIP 1.781
Scopus rating (2002): SJR 1.646 SNIP 1.531
Scopus rating (2001): SJR 1.859 SNIP 1.683
Scopus rating (2000): SJR 1.215 SNIP 1.545
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Impact of Diversity of Morphological Characteristics and Reynolds number on Local Hemodynamics in Basilar Aneurysms

Morphological and hemodynamic parameters have been suggested to affect the rupture of cerebral aneurysms, but detailed mechanisms of rupture are poorly understood. The purpose of our study is to determine criteria for predicting the risk of aneurysm rupture, which is critical for improved patient management. Existing aneurysm hemodynamics studies generally evaluate limited geometries or Reynolds numbers (Re), which are difficult to apply to a wide range of patient-specific cases. We focused on the association between hemodynamic characteristics and morphology. We assessed several two-dimensional (2D) and three-dimensional (3D) idealized and physiological geometries to characterize the hemodynamic landscape between flow patterns. The impact of morphology on velocity and wall shear stress (WSS) profiles were evaluated. We found that slight changes in aneurysm geometry or Re result in significant changes in the hemodynamic and WSS profiles. Our systematic mapping and non-dimensional analysis qualitatively identify hemodynamic conditions that may predispose aneurysms to rupture. This article is protected by copyright. All rights reserved.

General information
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BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.085 SNIP 1.428 CiteScore 3.03
Web of Science (2015): Indexed yes
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Scopus rating (2014): SJR 1.066 SNIP 1.337 CiteScore 2.86
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Scopus rating (2012): SJR 0.98 SNIP 1.437 CiteScore 2.46
ISI indexed (2012): ISI indexed yes
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Increasing the field-of-view of row–column-addressed ultrasound transducers: implementation of a diverging compound lens

The purpose of this work is to investigate compound lenses for row-column-addressed (RCA) ultrasound transducers for increasing the field-of-view (FOV) to a curvilinear volume region, while retaining a flat sole to avoid trapping air between the transducer sole and the patient, which would otherwise lead to unwanted reflections. The primary motivation behind this research is to develop a RCA ultrasound transducer for abdominal or cardiac imaging, where a curvilinear volume region is a necessity. RCA transducers provide 3-D ultrasound imaging with fewer channels than fully-addressed 2-D arrays (2N instead of N²), but they have inherently limited FOV. By increasing the RCA FOV, these transducers can be used for the same applications as fully-addressed transducers while retaining the same price range as conventional 2-D imaging due to the lower channel count. Analytical and finite element method (FEM) models were employed to evaluate design options. Composite materials were developed by loading polymers with inorganic powders to satisfy the corresponding speed of sound and specific acoustical impedance requirements. A Bi₂O₃ powder with a density of 8.9 g/cm³ was used to decrease the speed of sound of a room temperature vulcanizing (RTV) silicone, RTV615, from 1.03 mm/μs to 0.792 mm/μs. Using micro-balloons in RTV615 and a urethane, Hapflex 541, their speeds of sound were increased from 1.03 mm/μs to 1.50 mm/μs and from 1.52 mm/μs to 1.93 mm/μs, respectively. A diverging add-on lens was fabricated of a Bi₂O₃ loaded RTV615 and an unloaded Hapflex 541. The lens was tested using a RCA probe, and a FOV of 32.2° was measured from water tank tests, while the FEM model yielded 33.4°. A wire phantom with 0.15 mm diameter wires was imaged at 3 MHz down to a depth of 14 cm using a synthetic aperture imaging sequence with single element transmissions. The beamformed image showed that wires outside the array footprint were visible, demonstrating the increased FOV.

General information
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Organisations: Center for Fast Ultrasound Imaging, Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering, Sound Technology, Inc.
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Influence of Cetyltrimethylammonium Bromide on Gold Nanocrystal Formation Studied by in Situ Liquid Cell Scanning Transmission Electron Microscopy

The synthesis of monodisperse size- and shape-controlled Au nanocrystals is often achieved with cetyltrimethylammonium bromide (CTAB) surfactant; however, its role in the growth of such tailored nanostructures is not well understood. To elucidate the formation mechanism(s) and evolution of the morphology of Au nanocrystals in the early growth stage, we present an in situ liquid-cell scanning transmission electron microscopy (STEM) investigation using electron beam-induced radiolytic species as the reductant. The resulting particle shape at a low beam dose rate is shown to be strongly influenced by the surfactant; the Au nanocrystal growth rate is suppressed by increasing the CTAB concentration. At a low CTAB concentration, the nanoparticles (NPs) follow a reaction-limited growth mechanism, while at high a CTAB concentration the NPs follow a diffusion-limited mechanism, as described by the Lifshitz-Slyozov-Wagner (LSW) model. Moreover, we investigate the temporal evolution of specific NP geometries. The amount of Au reduced by the electron beam outside the irradiated area is quantified to better interpret the nanocrystal growth kinetics, as well as to further develop an understanding of electron beam interactions with nanomaterials toward improving the interpretation of in situ measurements.
Injectable iodine-125 labeled tissue marker for radioactive localization of non-palpable breast lesions

We have developed a $^{125}$I-radiolabeled injectable fiducial tissue marker with the potential to replace current methods used for surgical guidance of non-palpable breast tumors. Methods in routine clinical use today such as radioactive seed localization, radio-guided occult lesion localization and wire-guided localization suffers from limitations that this injectable fiducial tissue marker offers solutions to. The developed $^{125}$I-radiolabeled injectable fiducial tissue marker is based on highly viscous sucrose acetate isobutyrate. The marker was readily inserted in NMRI mice and proved to be spatially well-defined and stable over a seven day period with excellent CT contrast (>1500 HU), enabling fluoroscopic visualization of markers during placement. The radioactivity remains strongly associated with the marker during the implantation period, which limits exposure to healthy tissue. Biodistribution studies show that there is negligible radioactivity in all non-tumor tissues sampled, with the exception of the thyroid gland, where limited accumulation was observed (0.06% of injected dose after 7 days). Based on the excellent performance of the marker and the fact that it can be delivered through thin hypodermic needles (≥27G), the marker holds great promise for clinical application, since patient discomfort is reduced significantly compared to current methods. Statement of Significance. A new type of tissue marker for local administration to non-palpable breast tumors has been developed. The surgical guidance marker is based on derivatives of the biomaterial sucrose acetate isobutyrate and unlike currently used markers it is injectable in the tissue using thin needles, reducing the discomfort to the patients significantly. The marker confers CT contrast and has radioactive properties, meaning it also could find use in brachytherapy. The design of the iodine-125 labeled fiducial tissue marker enables control of dosimetry as well as a choice of iodine isotope used. The marker is anticipated to be clinical applicable due to its contrast performance in mice and its potential for enhanced flexibility in surgical procedures, compared to current methods.
Injection molded lab-on-a-disc platform for screening of genetically modified E. coli using liquid-liquid extraction and surface enhanced Raman scattering

We present the development of an automated centrifugal microfluidic platform with integrated sample pre-treatment (filtration and liquid-liquid extraction) and detection (SERS-based sensing). The platform consists of eight calibration and four assay modules, fabricated with polypropylene using injection molding and bonded with ultrasonic welding. The platform was used for detection of a secondary bacterial metabolite (p-coumaric acid) from bacterial supernatant. The obtained extraction efficiency was comparable to values obtained in batch experiments and the SERS-based sensing showed a good correlation with HPLC analysis.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Novo Nordisk Foundation Center for Biosustainability, Bacterial Cell Factory Optimization, Research Groups, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Politecnico di Torino
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Interaction between structurally different heteroexopolysaccharides and β-lactoglobulin studied by solution scattering and analytical ultracentrifugation

Despite a very large number of bacterial exopolysaccharides have been reported, detailed knowledge on their molecular structures and associative interactions with proteins is lacking. Small-angle X-ray scattering, dynamic light scattering and analytical ultracentrifugation (AUC) were used to characterize the interactions of six lactic acid bacterial heteroexopolysaccharides (HePS-1-HePS-6) with β-lactoglobulin (BLG). Compared to free HePSs, a large increase in the X-ray radius of gyration RG, maximum length L and hydrodynamic diameter dH of HePS-1-HePS-4 mixed with BLG revealed strong aggregation, the extent of which depended on the compact conformation and degree of branching of these HePSs. No significant effects were observed with HePS-5 and HePS-6. Turbidity and AUC analyses showed that both soluble and insoluble BLG-HePS complexes were formed. The findings provide new insights into the role of molecular structures in associative interactions between HePSs and BLG which has relevance for various industrial applications.

General information
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Organisations: Department of Biotechnology and Biomedicine, Enzyme and Protein Chemistry, Department of Micro- and Nanotechnology, Enzyme and Protein Chemistry, Department of Chemistry, X-ray Crystallography, Amphiphilic Polymers in Biological Sensing, Agriculture and Agri-Food Canada, University of Copenhagen
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Isoenergetic modification of whey protein structure by denaturation and crosslinking using transglutaminase

Transglutaminase (TG) catalyzes formation of covalent bonds between lysine and glutamine side chains and has applications in manipulation of food structure. Physical properties of a whey protein mixture (SPC) denatured either at elevated pH or by heat-treatment and followed by TG catalyzed crosslinking, have been characterised using dynamic light scattering, size exclusion chromatography, fluorescence spectroscopy and atomic force microscopy. The degree of enzymatic crosslinking appeared higher for pH- than for heat-denatured SPC. The hydrophobic surface properties depended on the treatment, thus heating caused the largest exposure of the hydrophobic core of SPC proteins, which was decreased by crosslinking. The particle size of the treated SPC samples increased upon crosslinking by TG. Moreover, the particle morphology depended on the type of denaturing treatment, thus heat-treated SPC contained fibrillar structures, while pH-denatured SPC remained globular as documented by using atomic force microscopy. Finally, the in vitro digestability of the different SPC samples was assessed under simulated gastric and intestinal conditions. Notably heat-treatment was found to lower the gastric digestion rate and enzymatic crosslinking reduced both the gastric and the intestinal rate of digestion. These characteristics of the various SPC samples provide a useful basis for design of isoenergetic model foods applicable in animal and human studies on how food structure affects satiety.

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Organisations: Department of Biotechnology and Biomedicine, Enzyme and Protein Chemistry, Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, University of Leeds, University of Copenhagen
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Laser ablation and injection moulding as techniques for producing micro channels compatible with Small Angle X-Ray Scattering

Microfluidic mixing is an important means for in-situ sample preparation and handling while Small Angle X-Ray Scattering (SAXS) is a proven tool for characterising (macro-)molecular structures. In combination those two techniques enable investigations of fast reactions with high time resolution (< 1 ms). The goal of combining a micro mixer with SAXS, however, puts constraints on the materials and production methods used in the device fabrication. The measurement channel of the mixer needs good X-ray transparency and a low scattering background. While both depend on the material used, the requirement for low scattering especially limits the techniques suitable for producing the mixer, as the fabrication process can induce molecular orientations and stresses that can adversely influence the scattering signal. Not only is it important to find a production method that results in a device with low background scattering, but it also has to be versatile enough to produce appropriate mixer designs. Here we discuss two methods – laser ablation of polycarbonate and injection moulding of Topas – which were found suitable for our needs, provided care is taken in aligning the mixing/reaction channel, where the actual measurements will be carried out. We find injection moulding to be the better of the two methods.
Liposome accumulation in irradiated tumors display important tumor and dose dependent differences

Radiation therapy may affect several important parameters in the tumor microenvironment and thereby influence the accumulation of liposomes by the enhanced permeability and retention (EPR)-effect. Here we investigate the effect of single dose radiation therapy on liposome tumor accumulation by PET/CT imaging using radiolabeled liposomes. Head and neck cancer xenografts (FaDu) and syngenic colorectal (CT26) cancer models were investigated. Radiotherapy displayed opposite effects in the two models. FaDu tumors displayed increased mean accumulation of liposomes for radiation doses up to 10 Gy, whereas CT26 tumors displayed a tendency for decreased accumulation. Tumor hypoxia was found negatively correlated to microregional distribution of liposomes. However, liposome distribution in relation to hypoxia was improved at lower radiation doses. The study reveals that the heterogeneity in liposome tumor accumulation between tumors and different radiation protocols are important factors that need to be taken into consideration to achieve optimal effect of liposome based radio-sensitizer therapy.
Low temperature bonding of heterogeneous materials using Al2O3 as an intermediate layer

Direct wafer bonding is a key enabling technology for many current and emerging photonic devices. Most prior work on direct wafer bonding has, however, focused on the Si platform for fabrication of silicon-on-insulator (SOI) and micro-electromechanical systems (MEMS). As a result, a universal bonding solution for heterogeneous material systems has not yet been developed. This has been a roadblock in the realization of novel devices which need the integration of new semiconductor platforms such as III-V on Si, Ge on Sapphire, LiNbO3 on GaAs etc. The large thermal expansion coefficient mismatch in the hetero-material systems limits the annealing to low temperatures to avoid stressed films. This work explores the use of Al2O3 as an intermediate layer for bonding heterogeneous materials. The key to achieve a stronger bond is to maximize the hydroxyl group density of the bonding interfaces. The use of Al2O3 helps achieve that,
since it has a high hydroxyl group density (around 18 OH/nm² at RT) which is approximately 4 times that of a Si surface. This work optimizes the bonding process using Al₂O₃ by studying the contribution of Al₂O₃ deposition parameters. An optimized process is presented and applied to bond GaAs on Sapphire and InP on SiO₂/Si.

Low temperature bonding of heterogeneous materials using Al₂O₃ as an intermediate layer
Integration of heterogeneous materials is crucial for many nanophotonic devices. The integration is often achieved by bonding using polymer adhesives or metals. A much better and cleaner option is direct wafer bonding, but the high annealing temperatures required make it a much less attractive option. Direct wafer bonding relies on a high density of hydroxyl groups on the surfaces, which may be difficult to achieve depending on the materials. Thus, it is a challenge to design a universal wafer bonding process. However, using an intermediate layer between the bonding surfaces reduces the dependence on the bonding materials, and thus, the bonding mechanism essentially remains the same. The authors present a systematic study on the use of Al₂O₃ as an intermediate layer for bonding of heterogeneous materials. The ability to achieve high hydroxyl group density and well-controlled films makes atomic layer deposited Al₂O₃ an excellent choice for the intermediate layer. The authors have optimized the bonding process to achieve a high interface energy of 1.7 J/m² for a low temperature annealing of 300 °C. The authors also demonstrate wafer bonding of InP to SiO₂ on Si and GaAs to sapphire using the Al₂O₃ interlayer. Published by the AVS.
Microfabricated Air-core Toroidal Inductor In Very High Frequency Power Converters

Miniaturization of power supplies is required for future intelligent electronic systems e.g. internet of things devices. Inductors play an essential role, and they are by far the most bulky and expensive components in power supplies. This paper presents a miniaturized microelectromechanical systems (MEMS) inductor and its performance in a very high frequency (VHF) power converter. The MEMS inductor is a silicon-embedded air-core toroidal inductor, and it is constructed with through-silicon vias, suspended copper windings, silicon fixtures, and a silicon support die. The air-core inductors outperform the silicon-core inductors with higher quality factor at higher frequency. This is verified by small-signal measurements. A 20-turn air-core inductor achieved an inductance of 44.6 nH and a quality factor of 13.3 at 33 MHz, while a silicon-core inductor with the same geometry has a quality factor of 9 at 20 MHz. A DC-DC class-E boost converter is designed and implemented using the fabricated MEMS air-core inductor and a high-performance 65 V gallium nitride field effect transistor. The VHF converter achieved a peak efficiency of 78 % at the input voltage of 6.5 VDC. The MEMS inductor can carry 1 A RMS AC current at 33 MHz and delivers 10.5 W to the output.

Microfluidic devices for sample preparation and rapid detection of foodborne pathogens

Rapid detection of foodborne pathogens at an early stage is imperative for preventing the outbreak of foodborne diseases, known as serious threats to human health. Conventional bacterial culturing methods for foodborne pathogen detection are time consuming, laborious, and with poor pathogen diagnosis competences. This has prompted researchers to call the current status of detection approaches into question and leverage new technologies for superior pathogen sensing outcomes. Novel strategies mainly rely on incorporating all the steps from sample preparation to detection in miniaturized devices for online monitoring of pathogens with high accuracy and sensitivity in a time-saving and cost effective manner. Lab on chip is a blooming area in diagnosis, which exploits different mechanical and biological techniques to detect very low concentrations of pathogens in food samples. This is achieved through streamlining the sample handling and concentrating procedures, which will subsequently reduce human errors and enhance the accuracy of the sensing methods. Integration of sample preparation techniques into these devices can effectively minimize the impact of complex food matrix on pathogen diagnosis and improve the limit of detections. Integration of pathogen capturing bio-receptors on...
microfluidic devices is a crucial step, which can facilitate recognition abilities in harsh chemical and physical conditions, offering a great commercial benefit to the food-manufacturing sector. This article reviews recent advances in current state-of-the-art of sample preparation and concentration from food matrices with focus on bacterial capturing methods and sensing technologies, along with their advantages and limitations when integrated into microfluidic devices for online rapid detection of pathogens in foods and food production line.

General information
State: Accepted/In press
Organisations: Department of Micro- and Nanotechnology, BioLabChip, National Food Institute, Research Group for Analytical and Predictive Microbiology, Technical University of Denmark
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BFI (2011): BFI-level 2
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ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
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Scopus rating (2010): SJR 2.938 SNIP 3.925
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.267 SNIP 3.153
Scopus rating (2006): SJR 1.715 SNIP 3.121
Scopus rating (2005): SJR 1.615 SNIP 2.919
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.073 SNIP 2.201
Scopus rating (2003): SJR 1.219 SNIP 2.097
Harvesting the energy generated by photosynthetic organisms through light-dependent reactions is a significant step towards a sustainable future energy supply. Thylakoid membranes are the site of photosynthesis, and thus particularly suited for developing photo-bioelectrochemical cells. Novel electrode materials and geometries could potentially improve the efficiency of energy harvesting using thylakoid membranes. For commercial applications, electrodes with large surface areas are needed. Photolithographic patterning of a photoresist, followed by pyrolysis, is a flexible and fast approach for the fabrication of carbon electrodes with tailored properties. In this work, electrode chips consisting of patterned carbon supported on quartz were designed and fabricated. The patterned electrode area is 1 cm², and the measurement chamber footprint is 0.5 cm², one order of magnitude larger than previously-tested electrodes for thylakoid membrane immobilization. The use of a transparent substrate allows back-side illumination, protecting the bioelectrochemical system from the environment and vice versa. Two different mediators, monomeric ([Ru(NH₃)₆]³⁺) and polymeric ([Os(2,2-bipyridine)₂-poly(N-vinylimidazole)₁₀Cl]²⁻/²⁻) are used for evaluating photocurrent generation from thylakoid membranes with different electrode geometries. Current densities up to 71 µA cm⁻² are measured upon illumination through the transparent electrode chip with solar simulated irradiance (1000 W m⁻²).

Model-Based Systems Engineering for Life-Sciences Instrumentation Development

Authors: Patou, F. (Intern), Dimaki, M. (Intern), Maier, A. (Intern), Svendsen, W. E. (Intern), Madsen, J. (Intern)
Morphology evolution of PS-b-PDMS block copolymer and its hierarchical directed self-assembly on block copolymer templates
Cylinder-forming polystyrene-block-polydimethylsiloxane (PS-b-PDMS, 27.2k-b-11.7k, SD39) block copolymer having a total molecular weight of 39 kg mol\(^{-1}\) was exploited to achieve in-plane morphologies of lines, dots and antidots. Brush-free self-assembly of the SD39 on silicon substrates was investigated using solvents that were PS or PDMS selective, neutral and non-solvents based on their Hansen solubility parameters. The different morphologies were achieved with annealing times ranging from 10 min to 1 h at room temperature. The SD39 patterns were used as an etch mask for transferring the pattern into the underlying substrate. Directed self-assembly and hierarchical directed self-assembly on block copolymer templates for confinement of dots was successfully demonstrated. The strategy for achieving multiple morphologies using one BCP by mere choice of the annealing solvents on unmodified substrates provides a simplified method for surface nanopatterning, templated growth of nanomaterials and nanofabrication.
**Nanofluidic device for extraction of elastic bio-entities**

The invention relates to a nanofluidic device for extraction of elastic bio-entities suspended in liquid. The device comprises a main passage and a plurality of nanoslits extending from a sidewall of the main passage. The main passage has a first height and each nanoslit has a second height so that the second height is lower than the first height. Further, each nanoslit comprises a plurality of nanopits, defining a third height which is larger than the second height, and each nanopit being at the bottom of a nanoslit. Each nanoslit has a width which increases from the sidewall of the main passage towards the nanopits.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
Authors: Marie, R. (Intern), Kristensen, A. (Intern), Mir, K. U. (Ekstern)
Publication date: 2018

**Publication information**

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Publication: Research - peer-review → Journal article – Annual report year: 2018

**Nanotextured Si surfaces derived from block-copolymer self-assembly with superhydrophobic, superhydrophilic, or superamphiphobic properties**

We demonstrate the use of wafer-scale nanolithography based on block-copolymer (BCP) self-assembly for the fabrication of surfaces with enhanced wetting properties. All classes of wetting behaviour derived from the same BCP nanolithography step are demonstrated. An in situ etch mask is defined by self-assembly of polystyrene (PS) and dimethylsiloxane (PDMS) domains to form a predominantly hexagonal array with pitch size (72 +/- 3) nm. The subsequent branched processing scheme, exclusively employing dry chemistry and reactive ion etching (RIE), allows the fabrication of nanoholes, nanopillars, or high aspect ratio nano-hoodoo features (overhang profile structures) with a diameter below 100 nm. The surfaces are finally functionalized with either hydrophobic surface chemistry by self-assembly from the precursor perfluorodecyltrichlorosilane (FDTS), or hydrophilic surface chemistry obtained by oxygen plasma treatment. The different texture and surface chemistry configurations are characterized with respect to their wetting properties with water, alkanes and organic oils. While, both nano-pillar and nano-hole surfaces feature excellent superhydrophobic properties with water contact angles (WCAs) exceeding 170 degrees and roll-off angles below 5 degrees, only the nano-pillar surfaces exhibit convincing superhydrophilicity with WCAs below 5 degrees. The repellency of low surface tension liquids known as amphiphobicity is demonstrated for the nano-hoodoo surfaces.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Center for Nanostructured Graphene
Authors: Telecka, A. (Intern), Li, T. (Intern), Ndoni, S. (Intern), Taboryski, R. J. (Intern)
Halloysite nanotubes (HNTs) are abundant naturally-occurring hollow aluminosilicate clay mineral fibers with a typical diameter < 100 nm and an aspect ratio of up to 200. Here we assessed the potential inhalation exposure to HNTs in an industrial research laboratory. Inside a fume hood, ten times 100 g of HNTs were poured at rate of 0.5 kg min⁻¹, which increased concentrations from the background level up to 2900 cm⁻³ and 6.4 μm² cm⁻³. Inside the fume hood, the respirable mass concentration was 143 μgm⁻³ including background particles. Outside the fume hood we did not measure elevated concentrations. We classified 1895 particles according to their length and aspect ratio. Five particles were in aspect ratio > 3 and in length > 2 μm. These particles were agglomerated and/or aggregated particles where the longest individual fiber was 2 μm in length. The occupational exposure limits for refractory mineral fibers vary from 0.1 to 2 fibers cm⁻³. Following standard protocols for fiber analysis, detection of 0.1 fibers cm⁻³ would require analysis on 4×10⁴ images when the filter loading is good. Thus, the fiber sampling and quantification procedures needs to be improved significantly if nanofibers < 100 nm in diameter are included in regulatory exposure assessment. Due to very limited toxicological information of HNTs we recommend avoiding inhalation exposure.
On-Particle Rolling Circle Amplification-Based Core-Satellite Magnetic Superstructures for MicroRNA Detection

Benefitting from the specially tailored properties of the building blocks as well as of the scaffolds, DNA-assembled core-satellite superstructures have gained increasing interest in drug delivery, imaging, and biosensing. The load of satellites plays a vital role in core-satellite superstructures, and it determines the signal intensity in response to a biological/physical stimulation/actuation. Herein, for the first time, we utilize on-particle rolling circle amplification (RCA) to prepare rapidly responsive core-satellite magnetic superstructures with a high load of magnetic nanoparticle (MNP) satellites. Combined with duplex-specific nuclease-assisted target recycling, the proposed magnetic superstructures hold great promise in sensitive and rapid microRNA detection. The long single-stranded DNA produced by RCA serving as the scaffold of the core-satellite superstructure can be hydrolyzed by duplex-specific nuclease in the presence of target microRNA, resulting in a release of MNPs that can be quantified in an optomagnetic sensor. The proposed biosensor has a simple mix-separate-measure strategy. For let-7b detection, the proposed biosensor offers a wide linear detection range of approximately 5 orders of magnitude with a detection sensitivity of 1 fM. Moreover, it has the capability to discriminate single-nucleotide mismatches and to detect let-7b in cell extracts and serum, thus showing considerable potential for clinical applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Uppsala University, BluSense Diagnostics
Authors: Tian, B. (Ekstern), Qiu, Z. (Ekstern), Ma, J. (Ekstern), Donolato, M. (Ekstern), Hansen, M. F. (Intern), Svedlindh, P. (Ekstern), Strömberg, M. (Ekstern)
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Scopus rating (2016): CiteScore 7.6 SJR 2.561 SNIP 1.536
On the interpretation of Mössbauer spectra of magnetic nanoparticles

Mössbauer spectra of magnetic nanoparticles are usually influenced by fluctuations of the direction of the magnetic hyperfine field. In samples of non-interacting particles, the superparamagnetic relaxation usually results in spectra consisting of a sum of a sextet and a doublet with a temperature dependent area ratio. This is in accordance with the exponential dependence of the superparamagnetic relaxation time on particle size and temperature in combination with the particle size distribution. An alternative interpretation of these features is a first order magnetic transition from a magnetically ordered state to a paramagnetic state. We point out that this interpretation seems not to be correct, because the doublet component has been found to transform to a magnetically split component when relatively small magnetic fields are applied, and therefore it cannot be due to a paramagnetic state. In other cases, spectra of magnetic nanoparticles consist of sextets with asymmetrically broadened lines without the presence of doublets. It has been suggested that such spectra can be explained by a multilevel model, according to which relaxation takes place between a large number of states. We point out that spectra with asymmetrically broadened lines at least in some cases rather should be explained by the influence of magnetic inter-particle interactions on the magnetic fluctuations.
On the use of liposome controls in studies investigating the clinical potential of extracellular vesicle-based drug delivery systems - A commentary

The field of extracellular vesicle (EV)-based drug delivery systems has evolved significantly through the recent years, and numerous studies suggest that these endogenous nanoparticles can function as efficient drug delivery vehicles in a variety of diseases. Many characteristics of these EV-based drug delivery vehicles suggest them to be superior at residing in the systemic circulation and possibly at mediating therapeutic effects compared to synthetic drug delivery vehicles, e.g. liposomes. In this Commentary, we discuss how some currently published head-to-head comparisons of EVs versus liposomes are weakened by the inadequate choice of liposomal formulation, and encourage researchers to implement better controls to show any potential superiority of EVs over other synthetic nanoparticles.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Aalborg University
Authors: Johnsen, K. B. (Ekstern), Gudbergsson, J. M. (Ekstern), Duroux, M. (Ekstern), Moos, T. (Ekstern), Andresen, T. L. (Intern), Simonsen, J. B. (Intern)
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Scopus rating (2017): SNIP 1.802 SJR 2.684
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.56 SJR 2.463 SNIP 1.85
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.738 SNIP 2.074 CiteScore 8.11
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.438 SNIP 2.092 CiteScore 6.86
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.441 SNIP 2.023 CiteScore 6.31
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.454 SNIP 2.075 CiteScore 5.84
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.763 SNIP 2.089 CiteScore 6.33
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.225 SNIP 2.307
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Optofluidic Sensor for Inline Hemolysis Detection on Whole Blood

Hemolysis is the rupture of red blood cells and constitutes the most common reason for unsuitable blood samples in the clinic. To detect hemolysis, one has to separate the hemoglobin in blood plasma from that in red blood cells. However, current methods entail centrifugation for cell-plasma separation, which is complex, time-consuming, and not easy to integrate into point-of-care (PoC) systems. Here, we demonstrate an optofluidic sensor composed of nanofilters on an optical waveguide, which enables evanescent-wave absorption measurement of hemoglobin in plasma with the capability of real-time inline detection on whole blood without extra sample preparation like centrifugation. Long-term testing with inline integration in a modified, commercial blood gas analyzer shows high reliability and repeatability of the measurements even with the presence of interference from bilirubin. We envision that the present work has large potential in improving diagnosis quality by enabling PoC hemolysis detection in blood gas analyzers and can also lend unique sensing capabilities to other applications dealing with complex turbid media.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Radiometer Medical ApS, Hebrew University of Jerusalem
Authors: Zhou, C. (Intern), Keshavarz Hedayati, M. (Intern), Zhu, X. (Intern), Nielsen, F. (Ekstern), Levy, U. (Ekstern), Kristensen, A. (Intern)
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Electronic versions:
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Ordered meso- and macroporous perovskite oxide catalysts for emerging applications

This feature article summarizes the recent progress in porous perovskite oxides as advanced catalysts for both energy conversion applications and various heterogeneous reactions. Recently, research has been focused on specifically designing porous perovskite materials so that large surface areas can be harnessed and surface properties can be improved. Numerous potential applications of porous perovskites have been investigated, including heterogeneous catalysis and air battery applications that rely on interactions and/or reactions of other components with porous perovskites. The main objective of this article is to examine the progress of recent research studies on porous perovskite nanomaterials, including the preparation methods and their applications in catalysis and batteries. The wide variety of the related knowledge on porous mixed oxides can provide guidance for researchers with interests ranging from the design of functionalized materials to the field of heterogeneous catalysis and electrochemical applications.

General information
State: Accepted/In press
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, University of Sydney, University of New South Wales, University of Kashan, Beijing University of Technology
Authors: Arandiyan, H. (Ekstern), Wang, Y. (Ekstern), Sun, H. (Intern), Rezaei, M. (Ekstern), Dai, H. (Ekstern)
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Scopus rating (2016): CiteScore 6.06 SJR 2.538 SNIP 1.16
Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 2.601 SNIP 1.295 CiteScore 6.7
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.692 SNIP 1.436 CiteScore 6.83
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.752 SNIP 1.372 CiteScore 6.73
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.118 SNIP 1.35 CiteScore 6.21
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.889 SNIP 1.323 CiteScore 5.96
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.781 SNIP 1.255
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Paper-based sensors for rapid detection of virulence factor produced by Pseudomonas aeruginosa

Pyocyanin is a toxin produced by Pseudomonas aeruginosa. Here we describe a novel paper-based electrochemical sensor for pyocyanin detection, manufactured with a simple and inexpensive approach based on electrode printing on paper. The resulting sensors constitute an effective electrochemical method to quantify pyocyanin in bacterial cultures without the conventional time consuming pretreatment of the samples. The electrochemical properties of the paper-based sensors were evaluated with ferri/ferrocyanide as a redox mediator, and showed reliable sensing performance. The paper-based sensors readily allow for the determination of pyocyanin in bacterial cultures with high reproducibility, achieving a limit of detection of 95 nM and a sensitivity of 4.30 μA/μM in standard culture media. Compared to the similar commercial ceramic based sensors, it is a 2.3-fold enhanced performance. The simple in-house fabrication of sensors for pyocyanin quantification allows researchers to understand in vitro adaptation of P. aeruginosa infections via rapid screenings of bacterial cultures that otherwise are expensive and time-consuming.
Pathomorphological Pattern of Mouse Liver After Intratracheal Instillation of Sanding Dust From Paint Containing Different Nanosized Titanium Dioxide Particles

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment, University of Copenhagen, University of Warmia and Mazury in Olsztyn
Authors: Szarek, J. (Ekstern), Mortensen, A. (Ekstern), Saber, A. (Ekstern), Jacobsen, N. (Ekstern), Levin, M. (Ekstern), Koponen, I. (Ekstern), Jensen, K. A. (Ekstern), Vogel, U. B. (Intern), Wallin, H. (Ekstern)
Number of pages: 1
Pages: 132
Photonic Crystal Slab Sensors in Microfluidics
This Ph.D. thesis discusses the design and application of so-called photonic crystal slab (PCS) sensors, with an emphasis on microfluidic integration. PCS sensors can measure the refractive index of fluids, which makes them universal in the sense that almost any change to a fluid will alter its refractive index. The underlying phenomenon is called guided-mode resonance (GMR), which responds to changes in the refractive index of fluids only within the first few hundred nanometers from the sensor surface. PCS sensors can be fabricated entirely out of polymers, and read out using instrumentation as simple as an LED and a photo diode. This work has thus far resulted in three manuscripts and one patent, which are attached.

The first manuscript, which has been submitted to Computer Physics Communications, describes an open-source algorithm, which integrates with many electromagnetics simulation tools to provide adaptive resolution. This algorithm can routinely make GMR simulations more than 100 times faster.

The second manuscript, submitted to Optics Express, describes the practical application of polymeric PCS sensors. As with any refractive index sensor, the devices are highly sensitive to temperature drift and fluctuations. We demonstrate a facile method for real-time compensation of these thermal disturbances.

The third manuscript, which has been published in Micromachines, concerns the integration of PCS sensors into a microfluidic H-filter. We show that by monitoring the refractive index (and thus concentration) gradient, the diffusion length of molecules in flow can be determined.

PCS sensors have been in development for the last few decades, and both readout systems and sensor substrates are commercially available. However, products on the market predominantly target high-end applications such as pharmaceutical development, where their high pricetags are justifiable. In order to lower the entry barrier of the technology, we patented what is currently being marketed as The NanoCuvette, a spectrophotometer cuvette with an embedded PCS sensor. Along with user-friendly software, this enables the use of an existing, unmodified spectrophotometer to make refractometric measurements, such as bulk concentration measurements on non-absorbing compounds. This effectively lowers the entry barrier for PCS sensors from tens of thousands of euros to tens of euros.

General information
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Organisations: Department of Micro- and Nanotechnology
Authors: Sørensen, K. T. (Intern)
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Plasmon-exciton polaritons in two-dimensional semiconductor/metal interfaces
The realization and control of polaritons is of paramount importance in the prospect of novel photonic devices. Here, we investigate the emergence of plasmon-exciton polaritons in hybrid structures consisting of a two-dimensional transition-metal dichalcogenide (TMDC) deposited onto a metal substrate or coating a metallic thin film. We determine the polaritonic spectrum and show that, in the former case, the addition of a top dielectric layer and, in the latter case, the thickness of the metal film can be used to tune and promote plasmon-exciton interactions well within the strong-coupling regime. Our results demonstrate that Rabi splittings exceeding 100 meV can readily be achieved in planar dielectric/TMDC/metal structures under ambient conditions. We thus believe that this Rapid Communication provides a simple and intuitive picture to tailor strong coupling in plexcitonics with potential applications for engineering compact photonic devices with tunable optical properties.

General information
State: Published
Plasmonic Metaparticles on a Blackbody Create Vivid Reflective Colors for Naked-Eye Environmental and Clinical Biodetection

Plasmonic dipoles are famous for their strong absorptivity rather than their reflectivity. Here, the as-yet unknown specular reflection and the Brewster effect of ultrafine plasmonic dipoles, metaparticles, are introduced and exploited as the basis of new design rules for advanced applications. A configuration of “Plasmonic metaparticles on a blackbody” is demonstrated and utilized for the design of a tailored perfect-colored absorber and for visual detection of environmental dielectrics that is not readily done by extinction plasmonics. Moreover, the Plasmonic Brewster Wavelength (PBW) effect is introduced as a new platform for the naked-eye and bulk biodetection of analytes. The technique operates based on slight changes of molecular polarizability which is not detectable via conventional plasmon resonance techniques. As a specific highlight, the clinical applicability of the PBW method is demonstrated while addressing the transduction plasmonic techniques’ challenge in detection of bulk refractive index changes of the healthy and diseased human serum exosomes. Finally, the sputtering-based fabrication method used here is simple, inexpensive, and scalable, and does not require the sophisticated patterning approach of lithography or precise alignment of light coupling for the biodetection.

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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 17.79
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 18.5
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 16.79
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 15.78
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Probe development of CMUT and PZT row-column-addressed 2-D arrays

This paper presents the characterization of two prototyped fully integrated 62 × 62 row-column-addressed (RCA) 2-D transducer array probes, which are based on capacitive micromachined ultrasonic transducer (CMUT) and on piezoelectric transducer (PZT) technology, respectively. Both transducers have integrated apodization to reduce ghost echoes and were designed with similar acoustical features i.e. 3 MHz center frequency, λ/2-pitch and 24.8 mm² × 24.8 mm² active footprint. The transducer arrays were assembled in a 3-D printed probe handle with electromagnetic shield and integrated electronics for driving the 128-channel coaxial cable to the scanner. The electronics were designed to allow all elements, both rows and columns, to be used interchangeably as either transmitters or receivers. The transducer characterization i.e. bandwidth, phase delay, surface pressure, sensitivity, insertion loss, and acoustical crosstalk, were based on several single element measurements, including pressure and pulse-echo, and were evaluated quantitatively and comparatively. The weighted center frequency was 3.0 MHz for both probes and the measured -6 dB fractional bandwidth was 109 ± 4% and 80 ± 3% for the CMUT and the PZT probe, respectively. The surface pressures of the CMUT and PZT were 0.55 ± 0.06 MPa and 1.68 ± 0.09 MPa, respectively, and the receive sensitivities of the rows (receiving elements) were 12.9 ± 0.7 μV/Pa and 13.7 ± 2.1 μV/Pa.

General information

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Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering, Center for Fast Ultrasound Imaging, Sound Technology, Inc., BK Ultrasound
Authors: Engholm, M. (Intern), Bouzari, H. (Intern), Christiansen, T. L. (Intern), Beers, C. (Ekstern), Bagge, J. P. (Ekstern), Moesner, L. N. (Ekstern), Diederichsen, S. E. (Intern), Stuart, M. B. (Intern), Jensen, J. A. (Intern), Thomsen, E. V. (Intern)
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Publication date: 2018
Main Research Area: Technical/natural sciences
Pulmonary exposure to carbonaceous nanomaterials and sperm quality

Background: Semen quality parameters are potentially affected by nanomaterials in several ways: Inhaled nanosized particles are potent inducers of pulmonary inflammation, leading to the release of inflammatory mediators. Small amounts of particles may translocate from the lungs into the lung capillaries, enter the systemic circulation and ultimately reach the testes. Both the inflammatory response and the particles may induce oxidative stress which can directly affect spermatogenesis. Furthermore, spermatogenesis may be indirectly affected by changes in the hormonal milieu as systemic inflammation is a potential modulator of endocrine function. The aim of this study was to investigate the effects of pulmonary exposure to carbonaceous nanomaterials on sperm quality parameters in an experimental mouse model.

Methods: Effects on sperm quality after pulmonary inflammation induced by carbonaceous nanomaterials were investigated by intratracheally instilling sexually mature male NMRI mice with four different carbonaceous nanomaterials dispersed in nanopure water: graphene oxide (18 μg/mouse/i.t.), Flammrus 101, Printex 90 and SRM1650b (0.1 mg/mouse/i.t. each) weekly for seven consecutive weeks. Pulmonary inflammation was determined by differential cell count in bronchoalveolar lavage fluid. Epididymal sperm concentration and motility were measured by computer-assisted sperm analysis. Epididymal sperm viability and morphological abnormalities were assessed manually using Hoechst 33,342/PI fluorescent and Spermac staining, respectively. Epididymal sperm were assessed with regard to sperm DNA integrity (damage). Daily sperm production was measured in the testis, and testosterone levels were measured in blood plasma by ELISA.

Results: Neutrophil numbers in the bronchoalveolar fluid showed sustained inflammatory response in the nanoparticle-exposed groups one week after the last instillation. No significant changes in epididymal sperm parameters, daily sperm production or plasma testosterone levels were found.

Conclusion: Despite the sustained pulmonary inflammatory response, an eight week exposure to graphene oxide, Flammrus 101, Printex 90 and the diesel particle SRM1650b in the present study did not appear to affect semen parameters, daily sperm production or testosterone concentration in male NMRI mice.

General information
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Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment, University of Copenhagen, SPZ Lab A/S
Authors: Skovmand, A. (Ekstern), Lauvas, A. J. (Ekstern), Christensen, P. (Ekstern), Vogel, U. B. (Intern), Hougaard, K. S. (Ekstern), Goericke-Pesch, S. (Ekstern)
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 9.4 SJR 2.755 SNIP 2.144
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.074 SNIP 2.023 CiteScore 8.84
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.411 SNIP 1.86 CiteScore 6.94
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.857 SNIP 2.552 CiteScore 8.5
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.221 SNIP 2.215 CiteScore 8.84
ISI indexed (2012): ISI indexed yes
Quality assessment of terahertz time-domain spectroscopy transmission and reflection modes for graphene conductivity mapping

We present a comparative study of electrical measurements of graphene using terahertz time-domain spectroscopy in transmission and reflection mode, and compare the measured sheet conductivity values to electrical van der Pauw measurements made independently in three different laboratories. Overall median conductivity variations of up to 15% were observed between laboratories, which are attributed mainly to the well-known temperature and humidity dependence of non-encapsulated graphene devices. We conclude that terahertz time-domain spectroscopy performed in either reflection mode or transmission modes are indeed very accurate methods for mapping electrical conductivity of graphene, and that both methods are interchangeable within measurement uncertainties. The conductivity obtained via terahertz time-domain spectroscopy were consistently in agreement with electrical van der Pauw measurements, while offering the additional advantages associated with contactless mapping, such as high throughput, no lithography requirement, and with the spatial mapping directly revealing the presence of any inhomogeneities or isolating defects. The confirmation of the accuracy of reflection-mode removes the requirement of a specialized THz-transparent substrate to accurately measure the conductivity.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, Department of Photonics Engineering, Ultrafast Infrared and Terahertz Science, das-Nano, Karlsruhe Institute of Technology KIT
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Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 3.48 SJR 1.532 SNIP 1.544
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.91 SNIP 1.674 CiteScore 3.78
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
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Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.337 SNIP 2.196 CiteScore 4.38
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.562 SNIP 2.108 CiteScore 3.85
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.58 SNIP 2.572 CiteScore 4.04
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.906 SNIP 2.428
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 3.039 SNIP 2.679
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 3.204 SNIP 2.423
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 3.284 SNIP 2.11
Web of Science (2007): Indexed yes
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 3.313 SNIP 2.336
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.819 SNIP 2.472
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.669 SNIP 2.217
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.745 SNIP 1.748
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.496 SNIP 1.42
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.98 SNIP 0.761
Quantification of MRI visibility and artifacts at 3T of liquid fiducial marker in a pancreas tissue-mimicking phantom

Purpose: X-ray-based position verification of the target volume in image-guided radiation therapy (IGRT) of patients with pancreatic ductal adenocarcinoma (PDAC) is currently performed on solid fiducial markers that are implanted under endoscopic ultrasonography. A new biodegradable liquid fiducial marker has recently been introduced. To assess its potential use for magnetic resonance imaging (MRI)-guided photon or proton radiotherapy of PDAC, the MRI visibility and artifacts of this marker were quantified and compared against solid gold markers.

Material and methods: Different spherical volumes (10 mu L, 25 mu L, 50 mu L, and 100 mu L) of a biodegradable liquid fiducial marker as well as seven differently sized and oriented solid gold (0.35 mm diameter; 5 mm and 10 mm length) and iron-gold alloy fiducial markers (0.28 mm diameter; 1 cm and 2 cm length) were implanted in a spherical gel phantom, mimicking the proton spin relaxation properties of healthy pancreatic tissue at 3 Tesla. MR relaxometry was performed to quantify the size and magnitude of the decrease in the effective transversal relaxation time T*(2) and relative proton density rho(H) as a measure of potential visibility and to quantify the size and magnitude of the increase in magnetic field inhomogeneity Delta B-0 as a measure of potential signal artifacts. The phantom was scanned in a 3.0 T PET/MR scanner with an eight-channel head coil.

Results: The solid fiducial markers showed a direct linear relationship between the potentially visible size and artifact size. The liquid fiducial marker showed a tendency toward a potentially visible size at smaller artifacts. Liquid markers from 25 to 100 mu L generated visible volumes comparable to the size of the solid markers. The magnitude of visibility was the highest for the liquid fiducial marker with volumes of 25-100 mu L showing no correlation with the magnitude of artifact. The solid markers showed a strong nonlinear correlation between magnitude of visibility and artifact, whereas the solid marker consisting of a gold-iron alloy induced the strongest artifacts.

Conclusion: The liquid fiducial marker causes signal voids on MRI due to its absence of water hydrogen atoms without strongly affecting the magnetic field in the surrounding tissue. The alteration of the static magnetic field was found to be the main effect leading to the visibility of the solid fiducial markers. Hence, especially when a low level of image distortion is required, MRI characteristics of the liquid marker surpass those of solid gold markers currently being used for IGRT of PDAC. (c) 2017 American Association of Physicists in Medicine
Quantitative optical mapping of two-dimensional materials

The pace of two-dimensional materials (2DM) research has been greatly accelerated by the ability to identify exfoliated thicknesses down to a monolayer from their optical contrast. Since this process requires time-consuming and error-prone manual assignment to avoid false-positives from image features with similar contrast, efforts towards fast and reliable automated assignments schemes is essential. We show that by modelling the expected 2DM contrast in digitally captured images, we can automatically identify candidate regions of 2DM. More importantly, we show a computationally-light machine vision strategy for eliminating false-positives from this set of 2DM candidates through the combined use of binary thresholding, opening and closing filters, and shape-analysis from edge detection. Calculation of data pyramids for arbitrarily high-resolution optical coverage maps of two-dimensional materials produced in this way allows the real-time presentation and processing of this image data in a zoomable interface, enabling large datasets to be explored and analysed with ease. The result is that a standard optical microscope with CCD camera can be used as an analysis tool able to accurately determine the coverage, residue/contamination concentration, and layer number for a wide range of presented 2DMs.
Reaction of Acetylenedicarboxylic Acid Made Easy: High-Pressure Route for Polymerization

A breakthrough has been achieved in improving the efficiency of solid-state polymerization of acetylenedicarboxylic acid (ADCA). Traditional solid-state polymerization of ADCA is marked by long exposure times of γ-radiation (>10 days) and very low yields (around 5.5%). We have been able to perform a reaction to an n = 8 oligomer, as confirmed by matrix-assisted laser desorption/ionization-time of flight, in less than 2 min by employing ~6 GPa of pressure. We have determined the crystal structure of ADCA on increasing pressure to (5.2 GPa) to provide insight into the process of polymerization with Pixel calculations supporting our evaluation of the polymerization process.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Strathclyde, Rutherford Appleton Laboratory

Reaction of Acetylenedicarboxylic Acid Made Easy: High-Pressure Route for Polymerization

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General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Strathclyde, Rutherford Appleton Laboratory
Recent Progress in Micro/Nanoreactors toward the Creation of Artificial Organelles

Artificial organelles created from a bottom up approach are a new type of engineered materials, which are not designed to be living but, instead, to mimic some specific functions inside cells. By doing so, artificial organelles are expected to become a powerful tool in biomedicine. They can act as nanoreactors to convert a prodrug into a drug inside the cells or as carriers encapsulating therapeutic enzymes to replace malfunctioning organelles in pathological conditions. For the design of artificial organelles, several requirements need to be fulfilled: a compartmentalized structure that can encapsulate the synthetic machinery to perform an enzymatic function, as well as a means to allow for communication between the interior of the artificial organelle and the external environment, so that substrates and products can diffuse in and out the carrier allowing for continuous enzymatic reactions. The most recent and exciting advances in architectures that fulfill the aforementioned requirements are featured in this review. Artificial organelles are classified depending on their constituting materials, being lipid and polymer-based systems the most prominent ones. Finally, special emphasis will be put on the intracellular response of these newly emerging systems.
Relating Magnetic Properties and High Hyperthermia Performance of Iron Oxide Nanoflowers

We investigated in depth the interrelations among structure, magnetic properties, relaxation dynamics and magnetic hyperthermia performance of magnetic nanoflowers. The nanoflowers are about 39 nm in size, and consist of densely packed iron oxide cores. They display a remanent magnetization, which we explain by the exchange coupling between the cores, but we observe indications for internal spin disorder. By polarized small angle neutron scattering we unambiguously confirm that on average the nanoflowers are preferentially magnetized along one direction. The extracted discrete relaxation time distribution of the colloidally dispersed particles indicates the presence of three distinct relaxation contributions. We can explain the two slower processes by Brownian and classical Néel relaxation, respectively. The additionally observed very fast relaxation contributions are attributed by us to the relaxation of the disordered spins within the nanoflowers. Finally, we show that the intrinsic loss power (ILP, magnetic hyperthermia performance) of the nanoflowers measured in colloidal dispersion at high frequency is comparatively large and independent of the viscosity of the surrounding medium. This concurs with our assumption that the observed relaxation in the high frequency range is primarily a result of internal spin relaxation, and probably connected to the disordered spins within the individual nanoflowers.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Department of Physics, Neutrons and X-rays for Materials Physics, Universidad de Cantabria, Technische Universität Braunschweig, Physikalisch-Technische Bundesanstalt, Uppsala University, University College London, Federal Institute for Materials Research and Testing, Chalmers University of Technology, University of Rostock, Micromod Partikeltechnologie GmbH, Institut Laue-Langevin, RISE Acreo
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Web of Science (2016): Indexed yes
Scopus rating (2017): SJR 2.135 SNIP 1.147
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Web of Science (2016): Indexed yes
Scopus rating (2016): CiteScore 4.48 SJR 1.964 SNIP 1.195
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Web of Science (2015): Indexed yes
Scopus rating (2015): SJR 1.886 SNIP 1.26 CiteScore 4.68
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Web of Science (2014): Indexed yes
Scopus rating (2014): SJR 2.032 SNIP 1.447 CiteScore 5.08
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Web of Science (2013): Indexed yes
Scopus rating (2013): SJR 2.143 SNIP 1.445 CiteScore 5.14
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Web of Science (2012): Indexed yes
Scopus rating (2012): SJR 2.529 SNIP 1.461 CiteScore 4.98
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Remote-loading of liposomes with manganese-52 and in vivo evaluation of the stabilities of 52Mn-DOTA and 64Cu-DOTA using radiolabelled liposomes and PET imaging

Liposomes are nanoparticles used in drug delivery that distribute over several days in humans and larger animals. Radiolabeling with long-lived positron emission tomography (PET) radionuclides, such as manganese-52 (52Mn, T½=5.6 days), allow the imaging of this biodistribution. We report optimized protocols for radiolabeling liposomes with 52Mn, through both remote-loading and surface labeling. For comparison, liposomes were also remote-loaded and surface labeled with copper-64 (64Cu, T½=12.7h) through conventional means. The chelator DOTA was used in all cases. The in vivo stability of radiometal chelates is widely debated but studies that mimic a realistic in vivo setting are lacking. Therefore, we employed these four radiolabeled liposome types as platforms to demonstrate a new concept for such in vivo evaluation, here of the chelates 52Mn-DOTA and 64Cu-DOTA. This was done by comparing "shielded" remote-loaded with "exposed" surface labeled variants in a CT26 tumor-bearing mouse model. Remote loading (90min at 55°C) and surface labeling (55°C for 2h) of 52Mn gave excellent radiolabeling efficiencies of 97-100% and 98-100% respectively, and the liposome biodistribution was imaged by PET for up to 8days. Liposomes with surface-conjugated 52Mn-DOTA exhibited a significantly shorter plasma half-life (T½=14.4h) when compared to the remote-loaded counterpart (T½=21.3h), whereas surface-conjugated 64Cu-DOTA cleared only slightly faster and non-significantly, when compared to remote-loaded (17.2±2.9h versus 20.3±1.2h). From our data, we conclude the successful remote-loading of liposomes with 52Mn, and furthermore that 52Mn-DOTA may be unstable in vivo whereas 64Cu-DOTA appears suitable for quantitative imaging.

General information
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Organisations: Center for Nuclear Technologies, The Hevesy Laboratory, Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Department of Chemistry, University of Copenhagen
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Retinoic Acid Signaling in Thymic Epithelial Cells Regulates Thymopoiesis

Despite the essential role of thymic epithelial cells (TEC) in T cell development, the signals regulating TEC differentiation and homeostasis remain incompletely understood. In this study, we show a key in vivo role for the vitamin A metabolite, retinoic acid (RA), in TEC homeostasis. In the absence of RA signaling in TEC, cortical TEC (cTEC) and CD80loMHC...
class II⁺ medullary TEC displayed subset-specific alterations in gene expression, which in cTEC included genes involved in epithelial proliferation, development, and differentiation. Mice whose TEC were unable to respond to RA showed increased cTEC proliferation, an accumulation of stem cell Ag-¹⁺ cTEC, and, in early life, a decrease in medullary TEC numbers. These alterations resulted in reduced thymic cellularity in early life, a reduction in CD4 single-positive and CD8 single-positive numbers in both young and adult mice, and enhanced peripheral CD8⁺ T cell survival upon TCR stimulation. Collectively, our results identify RA as a regulator of TEC homeostasis that is essential for TEC function and normal thymopoiesis.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Bio and Health Informatics, Integrative Systems Biology, Lund University, University of Copenhagen, University of Birmingham, University of Basel
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- BFI (2018): BFI-level 2
- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 2
- Scopus rating (2017): SJR 2.837 SNIP 1.112
- Web of Science (2017): Indexed Yes
- BFI (2016): BFI-level 2
- Scopus rating (2016): CiteScore 4.79 SJR 3.474 SNIP 1.176
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): SJR 3.571 SNIP 1.26 CiteScore 5.05
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): SJR 3.744 SNIP 1.271 CiteScore 5.03
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 2
- Scopus rating (2013): SJR 3.909 SNIP 1.35 CiteScore 5.61
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 2
- Scopus rating (2012): SJR 4.011 SNIP 1.362 CiteScore 5.82
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 2
- Scopus rating (2011): SJR 4.06 SNIP 1.347 CiteScore 5.67
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 2
- Scopus rating (2010): SJR 4.165 SNIP 1.306
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 2
- Scopus rating (2009): SJR 4.157 SNIP 1.338
- Web of Science (2009): Indexed yes
Revealing the Dimeric Crystal and Solution Structure of β-Lactoglobulin at pH 4 and Its pH and Salt Dependent Monomer–Dimer Equilibrium

The dimeric structure of bovine β-lactoglobulin A (BLGA) at pH 4.0 was solved to 2.0 Å resolution. Fitting the BLGA pH 4.0 structure to SAXS data at low ionic strength (goodness of fit R-factor = 3.6%) verified the dimeric state in solution. Analysis of the monomer–dimer equilibrium at varying pH and ionic strength by SAXS and scattering modeling showed that BLGA is dimeric at pH 3.0 and 4.0, shifting toward a monomer at pH 2.2, 2.6, and 7.0 yielding monomer/dimer ratios of 80/20%, 50/50%, and 25/75%, respectively. BLGA remained a dimer at pH 3.0 and 4.0 in 50–150 mM NaCl, whereas the electrostatic shielding raised the dimer content at pH 2.2, 2.6, and 7.0, i.e., below and above the pI. Overall, the findings provide new insights into the molecular characteristics of BLGA relevant for dairy product formulations and for various biotechnological and pharmaceutical applications.

General information
State: Accepted/In press
Organisations: Department of Biotechnology and Biomedicine, Enzyme and Protein Chemistry, Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Department of Chemistry, X-ray Crystallography, University of Copenhagen
Authors: Khan, S. (Intern), Ipsen, R. (Ekstern), Almdal, K. (Intern), Svensson, B. (Intern), Harris, P. (Intern)
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Publication information
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.339 SJR 1.95
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 5.74 SJR 1.98 SNIP 1.323
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Rotor-angle versus voltage instability in the third-order model for synchronous generators

We investigate the interplay of rotor-angle and voltage stability in electric power systems. To this end, we carry out a local stability analysis of the third-order model which entails the classical power-swing equations and the voltage dynamics. We provide necessary and sufficient stability conditions and investigate different routes to instability. For the special case of a two-bus system, we analytically derive a global stability map. Published by AIP Publishing.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Forschungszentrum Jülich GmbH, Karlsruhe Institute of Technology KIT
Authors: Sharafutdinov, K. (Ekstern), Gorjao, L. R. (Ekstern), Matthiae, M. (Intern), Faulwasser, T. (Ekstern), Witthaut, D. (Ekstern)
SERS-based detection methods for screening of genetically modified bacterial strains

The importance of metabolic engineering has been growing over the last decades, establishing the use of genetically modified microbial strains for overproduction of metabolites at industrial scale as an innovative, convenient and biosustainable method. Nowadays, application areas of microbial factories vary largely, including industrial production of valuable compounds for biofuels, polymer synthesis and food, cosmetic and pharmaceutical industry. The improvement of computational and biochemical tools has revolutionized the synthesis of novel modified microbial strains, opening up new possibilities for rapid genome modification and high-throughput development of large-size microbial libraries. However, there is still a need for fast, high-throughput and real-time screening techniques, in order to speed up the testing of newly produced strains.

In the frame of this PhD project, surface enhanced Raman scattering (SERS) has been identified as a fast and molecule-specific detection technique, increasingly applied to sensing in life sciences. Also due to its great potential for miniaturization and automation, SERS could represent a possible solution for specific, robust and high-throughput sensing in metabolic engineering.

As the main goal of this Ph.D. project, we explored the potential of SERS for quantitative and reproducible screening of genetically modified E. coli strains, based on the amount of specific secondary metabolites found in supernatant. However, due to the intrinsic sensitivity of SERS, and due to the matrix complexity of real supernatant samples, a pre-treatment step was needed to exclude salts and other unwanted compounds from detection. Liquid-liquid extraction (LLE) and supported liquid membrane (SLM) extraction were combined with SERS, enabling a robust and quantitative discrimination between different E. coli strains, validated with high-performance liquid chromatography (HPLC). Centrifugal microfluidics, based on the actuation of microfluidic discs by simply controlling a spinning motor, represents an appealing alternative to traditional microfluidics, placing special emphasis on parallelization, short time-to-response and ease of use of the developed devices. We developed a solvent-resistant lab-on-disc (LoD) device, integrating filtration, LLE and SERS-based sensing; besides achieving fast pre-treatment and sensing of supernatant samples on disc, the use of large-scale fabrication techniques (injection molding and ultrasonic welding) enabled the production of tens of microfluidic modules within two working days, demonstrating the scalability of the developed device.

Single-particle trajectories reveal two-state diffusion-kinetics of hOGG1 proteins on DNA

We reanalyze trajectories of hOGG1 repair proteins diffusing on DNA. A previous analysis of these trajectories with the popular mean-squared-displacement approach revealed only simple diffusion. Here, a new optimal estimator of diffusion coefficients reveals two-state kinetics of the protein. A simple, solvable model, in which the protein randomly switches between a loosely bound, highly mobile state and a tightly bound, less mobile state, is the simplest possible dynamic model consistent with the data. It yields accurate estimates of hOGG1’s (i) diffusivity in each state, uncorrupted by experimental errors arising from shot noise, motion blur and thermal fluctuations of the DNA; (ii) rates of switching between states and (iii) rate of detachment from the DNA. The protein spends roughly equal time in each state. It detaches only from the loosely bound state, with a rate that depends on pH and the salt concentration in solution, while its rates for switching between states are insensitive to both. The diffusivity in the loosely bound state depends primarily on pH and is three to ten times higher than in the tightly bound state. We propose and discuss some new experiments that...
take full advantage of the new tools of analysis presented here.

**General information**

State: Published  
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Massachusetts Institute of Technology  
Authors: Vestergaard, C. L. (Intern), Blainey, P. C. (Ekstern), Flyvbjerg, H. (Intern)  
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- BFI (2018): BFI-level 2  
- Web of Science (2018): Indexed yes  
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- Web of Science (2017): Indexed yes  
- BFI (2016): BFI-level 2  
- Scopus rating (2016): CiteScore 9.28 SJR 7.883 SNIP 2.744  
- Web of Science (2016): Indexed yes  
- BFI (2015): BFI-level 2  
- Scopus rating (2015): SJR 7.358 SNIP 2.631 CiteScore 9.48  
- Web of Science (2015): Indexed yes  
- BFI (2014): BFI-level 2  
- Scopus rating (2014): SJR 6.64 SNIP 2.552 CiteScore 8.74  
- Web of Science (2014): Indexed yes  
- BFI (2013): BFI-level 2  
- Scopus rating (2013): SJR 6.801 SNIP 2.284 CiteScore 8.46  
- ISI indexed (2013): ISI indexed yes  
- Web of Science (2013): Indexed yes  
- BFI (2012): BFI-level 2  
- Scopus rating (2012): SJR 6.329 SNIP 2.407 CiteScore 8.62  
- ISI indexed (2012): ISI indexed yes  
- Web of Science (2012): Indexed yes  
- BFI (2011): BFI-level 2  
- Scopus rating (2011): SJR 5.976 SNIP 2.19 CiteScore 7.86  
- ISI indexed (2011): ISI indexed yes  
- Web of Science (2011): Indexed yes  
- BFI (2010): BFI-level 2  
- Scopus rating (2010): SJR 5.381 SNIP 2.034  
- Web of Science (2010): Indexed yes  
- BFI (2009): BFI-level 2  
- Scopus rating (2009): SJR 5.669 SNIP 1.874  
- BFI (2008): BFI-level 2  
- Scopus rating (2008): SJR 4.912 SNIP 1.578  
- Web of Science (2008): Indexed yes  
- Scopus rating (2007): SJR 5.1 SNIP 1.807  
- Web of Science (2007): Indexed yes  
- Scopus rating (2006): SJR 4.776 SNIP 2.051  
- Web of Science (2006): Indexed yes  
- Scopus rating (2005): SJR 5.092 SNIP 2.147
Solving 2D/3D Heat Conduction Problems by Combining Topology Optimization and Anisotropic Mesh Adaptation

Topology optimization was recently combined with anisotropic mesh adaptation to solve 3D minimum compliance problems in a fast and robust way. This paper demonstrates that the methodology is also applicable to 2D/3D heat conduction problems. Nodal design variables are used and the objective function is chosen such that the problem is self-adjoint. There is no way around the book keeping associated with mesh adaptation, so the whole 5527 line MATLAB code is published (https://github.com/kristianE86/trullekrul). The design variables as well as the sensitivities have to be interpolated between meshes, but MATLAB does not support interpolation on simplex meshes and it is thus handled as part of the local operations in the mesh adaptation. This functionality is available for nodal as well as element-wise design variables, but we have found the former to be superior. Results are shown for various discretizations demonstrating that the objective function converges, but comparison to optimizations with fixed meshes indicate that the use of mesh adaptation results in worse objective functions, particularly in 3D. Out of the 5018 statements only 100 is used for the actual optimization loop, 100 for 2D/3D geometry/mesh setup and 50 for the forward problem. It is thus feasible to use the script as a platform for solving other problems or for investigating the details of the methodology itself.
Stability and Antimicrobial Activity of Nisin-Loaded Mesoporous Silica Nanoparticles: A Game-Changer in the War against Maleficent Microbes

Antimicrobial agents, such as nisin, are used extensively in the food industry. Here, we investigated various approaches to load nisin onto mesoporous silica nanoparticles (MSNs, 92 ± 10 nm in diameter), to enhance its stability and sustained release. The morphology, size, and surface charge of the as-prepared nanoparticles were analyzed using scanning transmission electron microscopy, dynamic light scattering, and ζ potential measurement. Nisin was either physically adsorbed or covalently attached to the variously functionalized MSNs, with high loading capacities (>600 mg of nisin g-1 of nanoparticles). The results of antibacterial activity analysis of nisin against Staphylococcus aureus showed that, despite the very low antibacterial activity of nisin covalently conjugated onto MSNs, the physical adsorption of nisin onto the unfunctionalized nanoparticles enhances its antimicrobial activities under various conditions, with no significant cytotoxicity effects on mouse fibroblast L929 cells. In conclusion, MSNs can be recommended as suitable carriers for nisin under various conditions.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, National Institute for Genetic Engineering and Biotechnology Iran, Norwegian University of Science and Technology
Authors: Behzadi, F. (Ekstern), Darouie, S. (Ekstern), Alavi, S. M. (Ekstern), Shariati, P. (Ekstern), Singh, G. (Ekstern), Dolatshahi-Pirouz, A. (Intern), Arpanaei, A. (Ekstern)
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   Web of Science (2018): Indexed yes
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   Scopus rating (2017): SNIP 1.343 SJR 1.269
   Web of Science (2017): Indexed yes
   BFI (2016): BFI-level 2
   Scopus rating (2016): CiteScore 3.45 SJR 1.305 SNIP 1.343
   Web of Science (2016): Indexed yes
   BFI (2015): BFI-level 2
   Scopus rating (2015): SJR 1.224 SNIP 1.245 CiteScore 3.23
   Web of Science (2015): Indexed yes
   BFI (2014): BFI-level 2
   Scopus rating (2014): SJR 1.267 SNIP 1.413 CiteScore 3.25
   Web of Science (2014): Indexed yes
   BFI (2013): BFI-level 2
   Scopus rating (2013): SJR 1.43 SNIP 1.47 CiteScore 3.44
   ISI indexed (2013): ISI indexed yes
   Web of Science (2013): Indexed yes
   BFI (2012): BFI-level 2
   Scopus rating (2012): SJR 1.408 SNIP 1.464 CiteScore 3.2
   ISI indexed (2012): ISI indexed yes
   Web of Science (2012): Indexed yes
   BFI (2011): BFI-level 2
   Scopus rating (2011): SJR 1.389 SNIP 1.441 CiteScore 3.1
   ISI indexed (2011): ISI indexed yes
   Web of Science (2011): Indexed yes
   BFI (2010): BFI-level 2
   Scopus rating (2010): SJR 1.42 SNIP 1.391
Structural studies of three-arm star block copolymers exposed to extreme stretch suggests persistent polymer tube

We present structural SANS-studies of a three-armed polystyrene star polymer with short deuterated segments at the end of each arm. We show that the form factor of the three-armed star molecules in the relaxed state agrees with that of the random phase approximation of Gaussian chains. Upon exposure to large extensional flow conditions, the star polymers change conformation resulting in a highly stretched structure that mimics a fully extended three-armed tube model. All three arms are parallel to the flow, one arm being either in positive or negative stretching direction, while the two other arms are oriented parallel, right next to each other in the direction opposite to the first arm.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Department of Chemical and Biochemical Engineering, The Danish Polymer Centre, Australian Nuclear Science and Technology Organisation
Authors: Garvey, C. J. (Ekstern), Almdal, K. (Intern), Dorokhin, A. (Intern), Huang, Q. (Intern), Hassager, O. (Intern)
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Scopus rating (2001): SJR 5.884 SNIP 3.375
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Scopus rating (2000): SJR 5.618 SNIP 3.135
Web of Science (2000): Indexed yes
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Surface-Enhanced Raman Spectroscopy Integrated Centrifugal Microfluidics Platform

This PhD thesis demonstrates (i) centrifugal microfluidics disc platform integrated with Au capped nanopillar (NP) substrates for surface-enhanced Raman spectroscopy (SERS) based sensing, and (ii) novel sample analysis concepts achieved by synergistical combination of sensing techniques and miniaturized fluid handling devices for facile quantitative and qualitative analysis of real-life sample matrices.

A nanofiltration approach based on a wicking (wetting) phenomenon of fluids on nanostructured surfaces was introduced. The method provides purification of complex suspensions by passing it through dense array of NP structures. Furthermore, the wicking assisted nanofiltration procedure was accomplished in centrifugal microfluidics platform and as a result additional sample purification was achieved through the centrifugation process. In this way, the Au coated NP substrate was utilized as nanofilter and SERS active surface at the same time.

To evaluate the efficiency of the nanofiltration technique, a well-known application case, detection of toxic melamine molecules in milk, was selected. According to the statistical SERS map analysis conducted on the purified sample region of the NP surface (2×4 mm²), the spectral response for melamine was 14 times higher as compared to the immersed and non-purified part of the chip. The quantitative study of melamine content with respect to the averaged peak intensity at 687 cm⁻¹ was in accordance with characteristic Langmuir adsorption curve behavior and the detection limit was estimated to be 10 parts per million (ppm).

The wicking based fluid sample transport was further investigated for simultaneous detection of multiple components in human urine solutions. Using the surface sensitivity of the SERS technique, affinity based chromatographic separation of urine compounds such as creatinine, uric acid and urea was achieved. Additionally, a unique and novel quantification procedure based on spectral profiles was presented.

Lastly, an alternative sensing approach was carried out using Au coated NP like structures on fused silica. By combining the advantages of electrochemical (EC) systems for quantitative analysis and the molecular specificity of SERS, a proof-of-concept study on detection of paracetamol in phosphate-buffered saline (PBS) was performed.

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Authors: Durucan, O. (Intern)
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Synthesis of Biomaterials for use in Drug Delivery to the Brain

The need for new treatments of brain diseases is growing with the increasing lifespan of western populations. Drug delivery to the central nervous system (CNS) is generally perceived as a tremendous challenge. Drug transport across the brain endothelium forming the blood-brain barrier (BBB) is a particularly great challenge because of the low intrinsic permeability of the barrier to most solutes and the presence of active efflux transporters.

Malignant glioma constitutes the most frequently diagnosed type of malignant brain cancer. The current benchmark for treatment of malignant glioma is a combination of surgical resection, radiotherapy and chemotherapy. Unfortunately, due to the distinct invasive nature of malignant glioma there is poor recovery prognosis, and a high probability of incurable recurrence, which is ascribed to the current insufficient treatment platform. Major progress within sophisticated tumor targeted multifunctional nanoparticles, can provide a wide range of unique opportunities for site-specific targeting of therapeutic agents to many areas within the vasculature. This potentially offers a new and improved platform for medical diagnostics, therapeutics or theranostics of glioma.

The objective of this PhD thesis was to expand the knowledge about nanoparticle delivery to the brain, by developing targeted hard and soft nanoparticles that could be sensitized towards glioma pathological conditions. The first study attempted to improve the understanding of TfR-mediated transcytosis of nanoparticles across the BBB. Specifically, we have studied the impact of the targeting ligand’s affinity, avidity and valency on the subsequent uptake of gold nanoparticles (AuNP) in brain. Following systematic investigations of the functionalized AuNPs both in vitro and in vivo, showed a very interesting potential of boosting the transcytosis of the BBB by tuning the avidity of the targeting moieties on the surface of the AuNPs.

The second and third study presents the development of two mechanisms to release the encapsulated drug inside the nanoparticles in order to create the desired efficacy. The two mechanisms utilizes the intrinsic bioreductive potential of cells and (over)expressed cancer specific enzymes to activate liposomes, respectively. In both studies it was demonstrated that the systems were potential tools for stimuli-responsive drug release targeting gliona cells.

Lastly, a more indirect measure to elicit an anti-cancer response is by targeting sub-types of immune cells to ‘teach’ them to eradicate tumor cells. Here we present a thorough mechanistic study, that by fine-tuning the liposomal charge; it was possible to show substantial specificity towards a specific cell-subtype of the immune system. Hence, this methodology could potentially offer a tool to specifically stimulate and activate differentiation of cell-subtypes of the immune system, making it a viable platform for e.g. cancer vaccines.

In conclusion, during this PhD we have managed to develop multiple strategies to address the pressing issue of brain drug delivery using multifunctional liposomal formulations. Multiple of the developed systems are still in further in vitro testing to clarify their therapeutic application.

Tailoring stress in pyrolytic carbon for fabrication of nanomechanical string resonators

In order to achieve high resonance frequencies and quality factors of pyrolytic carbon MEMS string resonators the resonator material needs to have a large tensile stress. In this study, the influence of pyrolysis temperature, dwell time and ramping rate on the residual stress in thin pyrolytic carbon films is investigated with the bending plate method. The results show that the pyrolysis temperature is the most important parameter for tailoring the residual stress, with a transition from tensile stress at temperature below 800ºC to compressive stress at temperatures above 800ºC. Two kinds of photoresist: positive (AZ5214E) and negative (SU-8) and different pyrolysis conditions are used to fabricate pyrolytic carbon string resonators at variable pyrolysis conditions. The best performance is obtained for devices with a length of 400 µm fabricated at a pyrolysis temperature of 700ºC, ramping rate of 30ºC/min and 10 minutes dwell time corresponding to the conditions for maximum tensile stress in pyrolytic carbon thin films. The optimized pyrolytic carbon string resonators had resonant frequencies above 300 kHz and quality factors (Q) in the order of 10⁴, which is suitable for their application as
Temperature Modulated Nanomechanical Thermal Analysis

The response of microcantilever deflection to complex heating profiles was used to study thermal events like glass transition and enthalpy relaxation on nanograms of the biopolymer Poly(lactic-co-glycolic acid) (PLGA). The use of two heating rates enables the separation of effects on the deflection response that depends on previous thermal history (non-reversing signal) and effects that depends only on the heating rate variation (reversing signal). As these effects may appear superposed in the total response, temperature modulation can increase the measurement sensitivity to some thermal events when signals are isolated. Initially, it was shown how the signal can be processed to extract reversing, total and non-reversing signals and how the temperature modulation affects the cantilever sensitivity to temperature. Then, this technique was used to study how the different aging times affects the non-reversing curve but has no effect on the reversing curve, enabling more precise extraction of glass transition (Tg) in aged samples. With non-reversing data at different aging times, we measured the aging rate by means of average relaxation time (τ) using the Cowie-Ferguson model, obtaining τ = 348 minutes for PLGA aged at 20 °C and at 50 % RH. Tg for PLGA at 50 % RH was measured 37.8 °C using the reversing signal with 0.32 °C of variation between aging times.
The power of synthetic biology for bioproduction, remediation and pollution control

The agenda of the UN’s Sustainable Development Goals (SDGs) [1] challenges the synthetic biology community—and the life sciences as a whole—to develop transformative technologies that help to protect, even expand our planet’s habitability. While modern tools for genome editing already benefit applications in health and agriculture, sustainability also asks for a dramatic transformation of our use of natural resources. The challenge is not just to limit and, wherever possible revert emissions of pollutants and greenhouse gases, but also to replace environmentally costly processes based on fossil fuels with bio-based sustainable alternatives. This task is not exclusively a scientific and technical one but will also require guidelines and regulations for the development and large-scale deployment of this new type of bio-based production. Some recent advances that can (or soon could) enable us to make progress in these areas—and several possible governance principles—need to be addressed.

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The Use of Nanomaterials and Microfluidics in Medical Diagnostics

In the last few decades, there has been an increasing demand for more sensitive, cheaper and faster diagnostic tests in healthcare. Nanotechnology has the potential to revolutionise medical diagnostics by allowing rapid testing potentially in the doctor's office, greater sensitivity down to single cell or molecule level, as well as screening of diseases at an earlier stage through identification of disease biomarkers at extremely low concentrations. Nanotechnology is considered a broad area of science that incorporates multiple scientific disciplines, and can be defined as the creation and manipulation of materials, systems, and devices at the nanometer scale. The development of nanomaterials and nano-devices can be classified into two general approaches. The top down approach deals exclusively with developing nanostructures through machining, templating and lithographic techniques and refers to the fabrication and development of microfluidic and nanofluidic devices. The bottom-up approach focuses on the synthesis of nanomaterials from a single atom or molecule and relies on self-assembly or self-organization to produce particles with uniform size and shape. These micro/nanofluidic devices and nanomaterials display extraordinary physical and chemical properties which have been exploited for a large number of different novel nanodiagnostic applications. In this chapter, a general overview of nanotechnology for medical diagnostic applications will be given. The chapter will firstly define nanotechnology followed by a brief summary of bottom-up approaches to developing nanomaterials and their use in medical diagnostics. Then a discussion on the top-down approach will focus on nano-devices, methods for fabrication and the applications of these devices in medical diagnostics. The chapter will go on to review the current applications of these nanomaterials. In the final part of the chapter, the future...
prospects and outlooks for nanotechnology in the field of molecular diagnostics will be discussed.

Three-dimensional iron sulfide-carbon interlocked graphene composites for high-performance sodium-ion storage

Three-dimensional (3D) carbon-wrapped iron sulfide interlocked graphene (Fe7S8@C-G) composites for high-performance sodium-ion storage are designed and produced through electrostatic interactions and subsequent sulfurization. The iron-based metal–organic frameworks (MOFs, MIL-88-Fe) interact with graphene oxide sheets to form 3D networks, and carbon-wrapped iron sulfide (Fe7S8@C) nanoparticles with high individual-particle conductivity are prepared following a sulfurization process, surrounded by interlocked graphene sheets to enhance the interparticle conductivity. The prepared Fe7S8@C-G composites exhibit not only improved individual-particle and interparticle conductivity to shorten electron/ion diffusion pathways, but also enhanced structural stability to prevent the aggregation of active materials and buffer large volume changes during sodiation/desodiation. As a sodium-ion storage material, the Fe7S8@C-G composites exhibit a reversible capacity of 449 mA h g⁻¹ at 500 mA g⁻¹ after 150 cycles and a retention capacity of 306 mA h g⁻¹ under a current density of 2000 mA g⁻¹. The crucial factors related to the structural changes and stability during cycles have been further investigated. These results demonstrate that the high-performance sodium-ion storage properties are mainly attributed to the uniquely designed three-dimensional configuration.
Using microcantilever sensors to measure poly(lactic-co-glycolic acid) plasticization by moisture uptake

Polymeric materials absorb water when exposed to humidity or in contact with aqueous solutions. The polymer and water molecules interact, changing the physicochemical parameters of the material; the most noticeable effect is a decreased glass transition temperature (Tg), known as plasticization. We used microcantilever sensors to measure the Tg versus moisture content in poly(lactic-co-glycolic acid) (PLGA), a biodegradable polymer used in implants and as a drug carrier. We demonstrate a concomitant measurement of the mass absorption and Tg using nanograms of material and an inexpensive setup. The standard deviation of Tg for this system was 0.025 °C, and the variation in Tg with respect to a 1% RH change was clearly resolved. The decrease in the Tg of PLGA was linear (R2 = 0.99) at a rate of 6.03 ± 0.57 °C per mass% of water absorbed. The initial dry Tg of PLGA was extrapolated to 41.24 ± 0.07 °C.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, University of São Paulo
Authors: Alves, G. M. A. (Ekstern), Bose-Goswami, S. (Intern), Mansano, R. D. (Ekstern), Boisen, A. (Intern)
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Scopus rating (2014): SJR 1.01 SNIP 1.984 CiteScore 2.46
BFI (2013): BFI-level 1
Vasomotor function in rat arteries after ex vivo and intragastric exposure to food-grade titanium dioxide and vegetable carbon particles

Background: Humans are continuously exposed to particles in the gastrointestinal tract. Exposure may occur directly through ingestion of particles via food or indirectly by removal of inhaled material from the airways by the mucociliary clearance system. We examined the effects of food-grade particle exposure on vasomotor function and systemic oxidative stress in an ex vivo study and intragastrically exposed rats.

Methods: In an ex vivo study, aorta rings from naive Sprague-Dawley rats were exposed for 30 min to food-grade TiO2 (E171), benchmark TiO2 (Aeroxide P25), food-grade vegetable carbon (E153) or benchmark carbon black (Printex 90). Subsequently, the vasomotor function was assessed in wire myographs. In an in vivo study, lean Zucker rats were exposed intragastrically once a week for 10 weeks to vehicle, E171 or E153. Doses were comparable to human daily intake. Vasomotor function in the coronary arteries and aorta was assessed using wire myographs. Tetrahydrobiopterin, ascorbate, malondialdehyde and asymmetric dimethylarginine were measured in blood as markers of oxidative stress and vascular function.

Results: Direct exposure of E171 to aorta rings ex vivo increased the acetylcholine-induced vasorelaxation and 5-hydroxytryptamine-induced vasocontraction. E153 only increased acetylcholine-induced vasorelaxation, and Printex 90 increased the 5-hydroxytryptamine-induced vasocontraction, whereas Aeroxide P25 did not affect the vasomotor function. In vivo exposure showed similar results as ex vivo exposure; increased acetylcholine-induced vasorelaxation in coronary artery segments of E153 and E171 exposed rats, whereas Aeroxide P25 did not affect the vasomotor function. Conclusions: Gastrointestinal tract exposure to E171 and E153 was associated with modest albeit statistically significant alterations in the vasocontraction and vasorelaxation responses. Direct particle exposure to aorta rings elicited a similar type of response. The vasomotor responses were not related to biomarkers of systemic oxidative stress.

General information

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Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Copenhagen
Authors: Jensen, D. M. (Ekstern), Christophersen, D. V. (Ekstern), Sheykhzade, M. (Ekstern), Skovsted, G. F. (Ekstern), Lykkesfeldt, J. (Ekstern), Munter, R. (Intern), Roursgaard, M. (Ekstern), Loft, S. (Ekstern), Møller, P. H. (Ekstern)
Wavelength tunable MEMS VCSELs for OCT imaging
MEMS VCSELs are one of the most promising swept source (SS) lasers for optical coherence tomography (OCT) and one of the best candidates for future integration with endoscopes, surgical probes and achieving an integrated OCT system. However, the current MEMS-based SS are processed on the III-V wafers, which are small, expensive and challenging to work with. Furthermore, the actuating part, i.e., the MEMS, is on the top of the structure which causes a strong dependence on packaging to decrease its sensitivity to the operating environment. This work addresses these design drawbacks and proposes a novel design framework. The proposed device uses a high contrast grating mirror on a Si MEMS stage as the bottom mirror, all of which is defined in an SOI wafer. The SOI wafer is then bonded to an InP III-V wafer with the desired active layers, thereby sealing the MEMS. Finally, the top mirror, a dielectric DBR (7 pairs of TiO2 - SiO2), is deposited on top. The new device is based on a silicon substrate with MEMS defined on a silicon membrane in an enclosed cavity. Thus the device is much more robust than the existing MEMS VCSELs. This design also enables either a two-way actuation on the MEMS or a smaller optical cavity (pull-away design), i.e., wider FSR (Free Spectral Range) to increase the wavelength sweep. Fabrication of the proposed device is outlined and the results of device characterization are reported.

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Organisations: Department of Photonics Engineering, Nanophotonic Devices, Nanophotonics Theory and Signal Processing, High-Speed Optical Communication, Centre of Excellence for Silicon Photonics for Optical Communications, Experimental Surface and Nanomaterials Physics, Department of Micro- and Nanotechnology, Silicon Microtechnology, OCTLIGHT ApS
Authors: Sahoo, H. K. (Intern), Ansbæk, T. (Ekstern), Ottaviano, L. (Intern), Semenova, E. (Intern), Hansen, O. (Intern), Yvind, K. (Intern)
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Width-Dependent Sheet Resistance of Nanometer-Wide Si Fins as Measured with Micro Four-Point Probe
This paper extends the applicability of the micro four-point probe technique from the sheet resistance measurements on large areas toward narrow (<20nm) semiconducting nanostructures with an elongated fin geometry. Using this technology, it is shown that the sheet resistance of boron-implanted and laser-annealed silicon fins with widths ranging from 500 down to 20nm rises as the width is reduced. Drift-diffusion simulations show that the observed increase can be partially explained by the carrier depletion induced by interface states at the fin sidewalls.

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Authors: Bogdanowicz, J. (Ekstern), Folkersma, S. (Ekstern), Sergeant, S. (Ekstern), Schulze, A. (Ekstern), Moussa, A. (Ekstern), Petersen, D. H. (Intern), Hansen, O. (Intern), Henrichsen, H. H. (Ekstern), Nielsen, P. F. (Ekstern), Vandervorst, W. (Ekstern)
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Mucin dispersions as a model for the oromucosal mucus layer in in vitro and ex vivo buccal permeability studies of small molecules

The mucus layer is believed to play a part in drug permeation across the oral mucosa. Human freeze-dried saliva (HFDS) and porcine gastric mucin (PGM) was evaluated as model for mucus layer per se or in conjunction with in vitro and ex vivo buccal permeability models. Four small molecules (nicotine, mannitol, propranolol, caffeine) showed decreased permeability across mucin dispersions, compared to controls, and a greater effect was seen with HFDS than with PGM. Permeability of propranolol and caffeine across filter-grown TR146 cells was decreased by the presence of mucin, whereas no effect was found on nicotine and mannitol. Incubation of porcine buccal mucosa with mucin dispersions for 24 h compromised the integrity of the tissue, whereas 30 min incubation did not affect tissue integrity. Tissue incubation with mucin dispersions did not decrease nicotine permeability. For the studied model drugs, it is concluded that mucin dispersions constitute a minor barrier for drug diffusion compared to the epithelium.
**Publication information**

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<th>Journal: European Journal of Pharmaceutics and Biopharmaceutics</th>
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Original language: English
A METHOD FOR PREPARING A SUBSTRATE BY APPLYING A SAMPLE TO BE ANALYSED
The invention relates to a method for preparing a substrate (105a) comprising a sample reception area (110) and a sensing area (111). The method comprises the steps of: 1) applying a sample on the sample reception area; 2) rotating the substrate around a predetermined axis; 3) during rotation, at least part of the liquid travels from the sample reception area to the sensing area due to capillary forces acting between the liquid and the substrate; and 4) removing the wave of particles and liquid formed at one end of the substrate. The sensing area is closer to the predetermined axis than the sample reception area. The sample comprises a liquid part and particles suspended therein.

ELECTROCHEMICAL DEVICE FOR DETECTION OF SELECTED QUORUM SENSING SIGNALS
For diagnostic purposes, and particularly point-of-care diagnostic purposes, there is a need for devices capable of detecting quorum sensing molecules such as AHL within a biological sample with high precision, and which furthermore are fast and simple to use. The present invention relates to an electrochemical device, comprising: 5 - at least one reference electrode (RE), - at least one counter electrode (CE), - two or more working electrodes (WEs), wherein each working electrode differ from the other working electrode(s) with respect to at least one of the following characteristics: surface area, 10 size, material, and coating, - a sample receiving area for receiving a biological sample, wherein the electrodes and the sample receiving area is fluidly connected - means for transferring the sample to the electrodes for measurement, and - means for displaying a result of the measurement.15
CHEMICAL VAPOUR DEPOSITION FROM A RADIATION-SENSITIVE PRECURSOR

The present invention relates in one aspect to a method of depositing a thin film on a substrate by chemical vapour deposition (CVD) from a radiation-sensitive precursor substance. The method comprises the steps of: (i) placing the substrate in a reaction chamber of a CVD system; (ii) heating the substrate, wherein heating includes the transmission of electromagnetic heating radiation from a controllable radiative heat source through the reaction chamber towards the substrate, wherein the radiative heat source is controlled to provide electromagnetic radiation as one or more heating pulses, each heating pulse followed by an idle period; (iii) during at least one of the idle periods, providing a pressure pulse of precursor substance inside the reaction chamber by feeding at least one precursor substance to the reaction chamber so as to establish a reaction partial pressure for thin film deposition from said pre-cursor substance onto the substrate and subsequently, after a dwell time, removing the precursor substance so as to reduce the partial pressure of the precursor substance in the reaction chamber to below a threshold; and (iv) repeating steps (ii) and (iii) until a desired thin film is formed. According to a further aspect, the invention relates to a chemical vapour deposition (CVD) system for depositing a thin film onto a substrate using precursor substances containing at least one radiation sensitive species.

Concentration of nanoparticles and/or microparticles in flow conditions by dielectrophoresis

A device for concentration of nanoparticles and/or microparticles in liquid flow conditions by dielectrophoresis is disclosed in this invention.

Concentration of nanoparticles and/or microparticles in flow conditions by dielectrophoresis

A device for concentration of nanoparticles and/or microparticles in liquid flow conditions by dielectrophoresis is disclosed in this invention.
Cuvette and method for measuring refractive index in a spectrophotometer

Embodiments of the present invention include a cuvette (100) for use in determining a refractive index of a sample matter in a spectrophotometer (600), the cuvette comprising a container (102) for holding the sample matter, the container (102) having an entry window (121) that allows input radiation to reach the sample matter, the container furthermore having an exit window (122) that allows a part of the input radiation to exit the container part, the entry window and the exit window defining a radiation path; and comprising a photonic crystal (101) rigidly attached to the container or integrally formed in the container and arranged in the radiation path, the photonic crystal having a grating part (111) causing a reflectance spectrum of the photonic crystal to exhibit a resonance. A spectrophotometer is also provided.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
Authors: Kristensen, A. (Intern), Sørensen, K. T. (Intern), Højlund-Nielsen, E. (Intern)
Publication date: 3 Aug 2017

Publication information
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Date: 03/08/2017
Priority date: 14/10/2016
Priority number: DKPA201670814
Original language: English
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Main Research Area: Technical/natural sciences
Source: espacenet
Source-ID: WO2017129196
Publication: Research › Patent – Annual report year: 2017

The effect of equiaxial stretching on the osteogenic differentiation and mechanical properties of human adipose stem cells

Although mechanical cues are known to affect stem cell fate and mechanobiology, the significance of such stimuli on the osteogenic differentiation of human adipose stem cells (hASCs) remains unclear. In this study, we investigated the effect of long-term mechanical stimulation on the attachment, osteogenic differentiation and mechanical properties of hASCs. Tailor-made, pneumatic cell stretching devices were used to expose hASCs to cyclic equiaxial stretching in osteogenic medium. Cell attachment and focal adhesions were visualised using immunocytochemical vinculin staining on days 3 and 6, and the proliferation and alkaline phosphatase activity, as a sign of early osteogenic differentiation, were analysed on days 0, 6 and 10. Furthermore, the mechanical properties of hASCs, in terms of apparent Young's modulus and normalised contractility, were obtained using a combination of atomic force microscopy based indentation and computational approaches. Our results indicated that cyclic equiaxial stretching delayed proliferation and promoted osteogenic differentiation of hASCs. Stretching also reduced cell size and intensified focal adhesions and actin cytoskeleton. Moreover, cell stiffening was observed during osteogenic differentiation and especially under mechanical stimulation. These results suggest that cyclic equiaxial stretching modifies cell morphology, focal adhesion formation and mechanical properties of hASCs. This could be exploited to enhance osteogenic differentiation.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, University of Tampere, Tampere University Hospital, National University of Ireland, Galway, Tampere University of Technology
Authors: Virjula, S. (Ekstern), Zhao, F. (Ekstern), Leivo, J. (Ekstern), Vanhatupa, S. (Ekstern), Kreutzer, J. (Ekstern), Vaughan, T. J. (Ekstern), Honkala, A. M. (Ekstern), Viehrig, M. (Intern), Mullen, C. A. (Ekstern), Kallio, P. (Ekstern), McNamara, L. M. (Ekstern), Miettinen, S. (Ekstern)
Number of pages: 11
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Publication date: 1 Aug 2017
Main Research Area: Technical/natural sciences

Publication information
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ISSN (Print): 1751-6161
Ratings:
BFI (2018): BFI-level 1
A method for manufacturing a hollow MEMS structure

The present invention relates to a method for manufacturing an at least partly hollow MEMS structure. In a first step one or more through-going openings is/are provided in core material. The one or more through-going openings is/are then covered by an etch-stop layer. After this step, a bottom electrically conducting layer, one or more electrically conducting vias and a top electrically conducting layer are created. The bottom layer is connected to the vias and vias are connected to the top layer. The vias are formed by filling at least one of the one or more through-going openings. The method further comprises the step of creating bottom and top conductors in the respective bottom and top layers. Finally, excess core material is removed in order to create the at least partly hollow MEMS structure which may include a MEMS inductor.
Escape routes, weak links, and desynchronization in fluctuation-driven networks

Shifting our electricity generation from fossil fuel to renewable energy sources introduces large fluctuations to the power system. Here, we demonstrate how increased fluctuations, reduced damping, and reduced intertia may undermine the dynamical robustness of power grid networks. Focusing on fundamental noise models, we derive analytic insights into which factors limit the dynamic robustness and how fluctuations may induce a system escape from an operating state. Moreover, we identify weak links in the grid that make it particularly vulnerable to fluctuations. These results thereby not only contribute to a theoretical understanding of how fluctuations act on distributed network dynamics, they may also help designing future renewable energy systems to be more robust.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Jacobs University Bremen, Technische Universitat Darmstadt, Technische Universitat Dresden, University of Cologne, Max Planck Institut fur Dynamik Und Selbstorganisation Gottingen, Research Centre Julich (FZJ)
Authors: Schäfer, B. (Ekstern), Matthiae, M. (Intern), Zhang, X. (Ekstern), Rohden, M. (Ekstern), Timme, M. (Ekstern), Witthaut, D. (Ekstern)
Number of pages: 5
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Main Research Area: Technical/natural sciences

Publication information
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Volume: 95
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ISSN (Print): 2470-0045
Ratings:
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Scopus rating (2017): SNIP 0.987 SJR 0.979
Web of Science (2017): Indexed Yes
Scopus rating (2016): CiteScore 1.95 SJR 1.271 SNIP 1.018
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 1.183 SNIP 1.043 CiteScore 1.89
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 1.244 SNIP 1.135 CiteScore 2.05
Web of Science (2014): Indexed yes
Scopus rating (2013): SJR 1.307 SNIP 1.214 CiteScore 2.28
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 1.414 SNIP 1.205 CiteScore 2.28
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 1.48 SNIP 1.211 CiteScore 2.28
ISI indexed (2011): ISI indexed yes
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Scopus rating (2010): SJR 1.692 SNIP 1.203
Web of Science (2010): Indexed yes
Scopus rating (2009): SJR 1.708 SNIP 1.246
Web of Science (2009): Indexed yes
Scopus rating (2008): SJR 1.972 SNIP 1.298
Web of Science (2008): Indexed yes
A method and a micro fluidic device comprising at least one micro fluidic structure for differential extraction of nuclear and extra-nuclear constituents of a single cell, said micro fluidic structure comprising a feeding channel for receiving a volume of a sample containing at least one cell, at least one trapping structure for capturing a single cell, and at least one output channel in fluid connection with the at least one trapping structure, wherein the at least one trapping structure extends from one side of the feeding channel substantially perpendicular to longitudinal axis of the feeding channel, the at least one trapping structure possessing an aperture at its end opposite to the fluid channel and in fluid communication with an output channel, said aperture being configured to provide a narrow section such that the nucleus of a cell captured in the trapping structure cannot pass through said narrow section into the output channel.
Micro-fabrication of three dimensional pyrolysed carbon microelectrodes
The present invention relates in one aspect to a method of producing a three-dimensional microscale patterned resist template for a pyrolysed carbon microelectrode structure by means of UV-lithography. Coating a planar substrate with an epoxy-based negative photoresist, such as an SU-8 photoresist; soft baking the photoresist layer; performing a full depth exposure with UV light through a first mask; performing a partial depth exposure with UV light through a second mask; wherein the full depth exposure and the partial depth exposure are aligned to ensure that the first and second latent images are connected to each other; post-exposure baking the photoresist layer; and developing the microscale patterned resist template as a free-standing structure of cross-linked resist with lateral hanging structures that are supported by vertical support structures at a free height above the substrate. The method is characterized by a soft baking temperature below 70 °C. Repetitive coating and partial depth exposure allows for the fabrication of multiple level laterally interconnected structures. Carbonization of the resist template provides truly three-dimensional carbon microelectrode structures.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Biomaterial Microsystems, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
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Publication date: 30 Mar 2017

Publication information
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Patent number: WO2017050808
Date: 30/03/2017
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Original language: English
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Main Research Area: Technical/natural sciences
Source: espacenet
Source-ID: WO2017050808
Publication: Research › Patent – Annual report year: 2017

Intracellular responsive dual delivery by endosomolytic polyplexes carrying DNA anchored porous silicon nanoparticles
Bioresponsive cytosolic nanobased multidelivery has been emerging as an enormously challenging novel concept due to the intrinsic protective barriers of the cells and hardly controllable performances of nanomaterials. Here, we present a new paradigm to advance nano-in-nano integration technology amenable to create multifunctional nanovehicles showing considerable promise to overcome restrictions of intracellular delivery, solve impediments of endosomal localization and aid effectual tracking of nanoparticles. A redox responsive intercalator chemistry comprised of cystine and 9-aminoacridine is designed as a cross-linker to cap carboxylated porous silicon nanoparticles with DNA. These intelligent nanocarriers are then encapsulated within novel one-pot electrostatically complexed nano-networks made of a zwitterionic amino acid (cysteine), an anionic bioadhesive polymer (poly(methyl vinyl ether-alt-maleic acid)) and a cationic endosomolytic polymer (polyethyleneimine). This combined nanocomposite is successfully tested for the co-delivery of hydrophobic (sorafenib) or hydrophilic (calcein) molecules loaded within the porous core, and an imaging agent covalently integrated into the polyplex shell by click chemistry. High loading capacity, low cyto- and hemo-toxicity, glutathione responsive on-command drug release, and superior cytosolic delivery are shown as achievable key features of the proposed formulation. Overall, formulating drug molecules, DNA and imaging agents, without any interference, in a physico-chemically optimized carrier may open a path towards broad applicability of these cost-effective multivalent nanocomposites for treating different diseases.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, University of Turku, University of Helsinki
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Number of pages: 12
Pages: 111-122
Publication date: 10 Mar 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Controlled Release
Volume: 249
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A method for fabricating a three-dimensional carbon structure

A method for fabricating a three-dimensional carbon structure (4) is disclosed. A mould (1) defining a three-dimensional shape is provided, and natural protein containing fibres are packed in the mould (1) at a predetermined packing density. The packed natural protein containing fibre structure (3) undergoes pyrolysis, either while still in the mould (1) or after
having been removed from the mould (1). Thereby a three-dimensional porous and electrically conducting carbon structure (4) having a three-dimensional shape defined by the three-dimensional shape of the mould (1) and a porosity defined by the packing density of the packed natural protein containing fibre structure (3) is obtained. The carbon structure (4) is well suited for use as a scaffold for tissue engineering, or for material for batteries, fuel cells, supercapacitors, sorbents for separation processes, gas storage, supports for many important catalysts, etc.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Bioanalytics, BioLabChip
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Publication date: 9 Mar 2017

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Patent number: WO2017036914
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Original language: English
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Main Research Area: Technical/natural sciences
Source: espacenet
Source-ID: WO2017036914
Publication: Research › Patent – Annual report year: 2017

**Fire retardant formulations**
The present invention relates to compositions where a substrate is liable to catch fire such as bituminous products, paints, carpets or the like. The invention relates to a composition comprising 40-95 weight % of a substrate to be rendered fire resistant such as bituminous material or paint, carpets which substrate is mixed with 5-60 weight % of a fire retardant component. The invention relates to a fire retardant component comprising or being constituted of attapulgite, and a salt being a source of a blowing or expanding agent, where the attapulgite and the salt are electrostatically connected by mixing and subjecting the mixture of the two components to agitation. Also, the invention relates to compositions comprising 40-95 weight % of a substrate to be rendered fire resistant mixed with 5-60 weight % of a fire retardant according to claim 1 or 2, which fire retardant component is mixed with the substrate or coated onto the substrate or applied as a separate layer to the substrate. The composition might additionally comprise between 0 -60 weight % of 20 other materials functioning as filler, plasticizer or the like.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Center for Nanostructured Graphene
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Publication date: 12 Jan 2017

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Patent number: WO2017005546
Date: 12/01/2017
Priority date: 09/07/2015
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Original language: English
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Main Research Area: Technical/natural sciences
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Source-ID: WO2017005546
Publication: Research › Patent – Annual report year: 2017

**3D Engineering PEG-Diacrylate hydrogels for mimicking human mechanical microenvironments**

**General information**
State: Published
3D Engineering PEG-Diacrylate hydrogels for mimicking human mechanical microenvironments

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Microsystems for Cell Processing, Sophion Bioscience A/S
Authors: Christensen, R. K. (Intern), Wilson, S. (Ekstern), Skafe-Pedersen, P. (Ekstern), Larsen, N. B. (Intern)
Publication date: 2017
Event: Poster session presented at Italian-Nordic Polymer Future Workshop, Pisa, Italy.
Main Research Area: Technical/natural sciences
Electronic versions:
Abstract_Pisa2017_09_RieKChristensen_.pdf
Publication: Research - peer-review » Poster – Annual report year: 2017

3-D Imaging using Row-Column-Addressed 2-D Arrays with a Diverging Lens: Phantom Study
A double-curved diverging lens over a flat row–column-addressed (RCA) 2-D array can extend its inherent rectilinear 3-D imaging field-of-view (FOV) to a curvilinear volume region, which is necessary for applications such as abdominal and cardiac imaging. A concave lens with radius of 12.7 mm was manufactured using RTV664 silicone. The diverging properties of the lens were evaluated based on measurements on several phantoms. The measured 6 dB FOV in contact with a material similar to human soft tissue was less than 15% different from the theoretical predictions, i.e., a curvilinear FOV of 32°×32°. A synthetic aperture imaging sequence with single element transmissions was designed for imaging down to 14 cm at a volume rate of 88 Hz. The performance was evaluated in terms of signal-to-noise ratio (SNR), FOV, and full-width-at-half-maximum (FWHM). The penetration depth in a tissue mimicking phantom with 0.5 dB/(cm MHz) attenuation was 13 cm. The results of this study confirm that the proposed lens approach is an effective method for increasing the FOV, when imaging with RCA 2-D arrays.

General information
State: Published
Organisations: Department of Electrical Engineering, Biomedical Engineering, Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Center for Fast Ultrasound Imaging, Sound Technology, Inc., BK Ultrasound
Number of pages: 4
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Main Research Area: Technical/natural sciences
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DOIs:
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Source: PublicationPreSubmission
Source-ID: 134786565
Publication: Research - peer-review » Article in proceedings – Annual report year: 2017

3D MEMS Air-core Inductor in a Very High Frequency Switched-Mode Power Converter
General information
State: Published
Organisations: DTU Danchip, Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Electrical Engineering, Electronics
Authors: Lê Thanh, H. (Intern), Nour, Y. (Intern), Ouyang, Z. (Intern), Knott, A. (Intern), Jensen, F. (Intern), Han, A. (Intern)
Number of pages: 1
Publication date: 2017
Main Research Area: Technical/natural sciences
Inductors, Power converters, Zero voltage switching, Gallium nitride FET, PwrSoC
Electronic versions:
Conf_MNE2017.pdf
Source: PublicationPreSubmission
Source-ID: 140683213
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Accuracy and Precision of Plane Wave Vector Flow Imaging for Laminar and Complex Flow In Vivo
In this study, a comparison between velocity fields for a plane wave 2-D vector flow imaging (VFI) method and a computational fluid dynamics (CFD) simulation is made. VFI estimates are obtained from the scan of a flow phantom, which mimics the complex flow conditions in the carotid artery. Furthermore, the precision of the VFI method is investigated under laminar and complex flow conditions in vivo. The carotid bifurcation of a healthy volunteer was scanned using both fast plane wave ultrasound and magnetic resonance imaging (MRI). The acquired MRI geometry of the bifurcation was used for fabricating an anthropomorphic flow phantom, which was also ultrasound scanned. The same geometry was used in a CFD simulation to calculate the velocity field. Results showed that similar flow patterns and vortices were estimated using CFD and VFI in the phantom. Velocity magnitudes were estimated with a mean difference within 15 %, however, it was 23 % in the external branch. For the in vivo scan, the precision in terms of mean standard deviation (SD) of estimates aligned to the cardiac cycle was highest in the center of the common carotid artery (SD 4.7° for angles) and lowest in the external branch and close to the vessel wall (SD 15.0° for angles).

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering, Center for Fast Ultrasound Imaging, Copenhagen University Hospital
Number of pages: 4
Publication date: 2017

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Publisher: IEEE
Main Research Area: Technical/natural sciences
Conference: 2017 IEEE International Ultrasonics Symposium (IUS), Washington, United States, 06/09/2017 - 06/09/2017
Electronic versions:
paper_1_.pdf
Source: PublicationPreSubmission
Source-ID: 134895857
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

A Flexible Web-Based Approach to Modeling Tandem Photocatalytic Devices
There have been several works modeling the optimal band gaps for tandem photocatalytic water splitting devices under different assumptions. Due to the many parameters involved, it is impossible for the authors to consider every conceivable situation. In this work, we have developed a web-based model (WBM) that allows users to input data such as photoabsorber diode parameters, catalytic losses, ionic losses, light concentration, etc. This program also adds a new parameter that allows one to balance the photon absorption distribution between both photoabsorbers in a tandem device (by thinning the top photoabsorber), thus allowing for a broader range of band gap combinations that can still provide highly efficient devices. While this does not change the overall maximum efficiency point, at certain band gap combinations balancing the photon absorption distribution between photoabsorbers can increase Solar to Hydrogen (STH) efficiency by up to 15% points. An additional feature of the WBM is that it allows users to upload data of a single photoelectrode, and then investigate the optimal matching photoabsorber band gap to maximize tandem device efficiency. This work analyzes some of the best previous experimental photoelectrodes, and quantitatively relates their performance to what would typically be expected via modeling programs.
A MATLAB Script for Solving 2D/3D Minimum Compliance Problems using Anisotropic Mesh Adaptation

We present a pure MATLAB implementation for solving 2D/3D compliance minimization problems using the density method. A filtered design variable with a minimum length is computed using a Helmholtz-type differential equation. The optimality criteria is used as optimizer and to avoid local minima we apply continuation of an exponent that controls the stiffness associated with intermediate design variables. We constrain the volume from above and use the implementation to show that optimizations with dynamic meshes can save significant amounts of computational time compared to fixed meshes without introducing mesh dependence for the mesh topology. This is despite the fact that the dynamic meshes cause oscillations of the objective function, particular for coarse meshes in 3D. The meshes are generated using anisotropic mesh adaptation based on local mesh modifications and we extent these modifications to preserve the information required for interpolating the design variables between meshes. We exploit symmetry boundaries in 3D, but not in 2D. Dirichlet boundary conditions are used to prevent non-zero filtered design variables on free boundaries. Mesh adaptation involves substantial book keeping, so the implementation totals some 5,000 lines of MATLAB code, but the functions associated with the forward analysis, geometry/mesh setup and optimization are concise and well documented, so the implementation can be used as a starting point for research on related topics.
A multifunctional nanocomplex for enhanced cell uptake, endosomal escape and improved cancer therapeutic effect

Aim: To evaluate the chemotherapeutic potential of a novel multifunctional nanocomposite encapsulating both porous silicon (PSi) and gold (Au) nanoparticles in a polymeric nanocomplex. Materials & methods: The nanocomposite was physicochemically characterized and evaluated in vitro for biocompatibility, cellular internalization, endosomolytic properties, cytoplasmatic drug delivery and chemotherapeutic efficacy. Results: The nanocomposites were successfully produced and exhibited adequate physicochemical properties and superior in vitro cyto- and hemocompatibilities. The encapsulation of PSi nanoparticles in the nanocomplexes significantly enhanced their cellular internalization and enabled their endosomal escape, resulting in the efficient cytoplasmic delivery of these nanosystems. Sorafenib-loaded nanocomposites showed a potent in vitro antiproliferative effect on MDA-MB-231 breast cancer cells. Conclusion: The multifunctional nanocomposite herein presented exhibits great potential as a chemotherapeutic nanoplatform.
A nanofiltration technique for analyte extraction from complex matrix and surface enhanced Raman spectroscopy based sensing

General information
State: Published
Organisations: Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Department of Micro- and Nanotechnology, Nanoprobes
Authors: Durucan, O. (Intern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern), Ilchenko, O. (Intern), Boisen, A. (Intern)
Number of pages: 1
Publication date: 2017
Main Research Area: Technical/natural sciences
Electronic versions: Onur_Durucan_MNE_Abstract.pdf

Relations
Activities:
A nanofiltration technique for analyte extraction from complex matrix and surface enhanced Raman spectroscopy based sensing
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

An assessment of the importance of exposure routes to the uptake and internal localisation of fluorescent nanoparticles in zebrafish (Danio rerio), using light sheet microscopy

A major challenge in nanotoxicology is finding suitable methods to determine the uptake and localisation of nanoparticles on a whole-organism level. Some uptake methods have been associated with artefacts induced by sample preparation, including staining for electron microscopy. This study used light sheet microscopy (LSM) to define the uptake and localisation of fluorescently labelled nanoparticles in living organisms with minimal sample preparation. Zebrafish (Danio rerio) were exposed to fluorescent gold nanoparticles (Au NPs) and fluorescent polystyrene NPs via aqueous or dietary exposure. The in vivo uptake and localisation of NPs was investigated using LSM at different time points (1, 3 and 7 days). A time-dependent increase in fluorescence was observed in the gut after dietary exposure to both Au NPs and polystyrene NPs. No fluorescence was observed within gut epithelia regardless of the NP exposure route indicating no or limited uptake via intestinal villi. Fish exposed to polystyrene NPs through the aqueous phase emitted fluorescence signals from the gills and intestine. Fluorescence was also detected in the head region of the fish after aqueous exposure to polystyrene NPs. This was not observed for Au NPs. Aqueous exposure to Au NPs resulted in increased relative swimming distance, while no effect was observed for other exposures. This study supports that the route of exposure is essential for the uptake and subsequent localisation of nanoparticles in zebrafish. Furthermore, it demonstrates that the localisation of NPs in whole living organisms can be visualised in real-time, using LSM.

General information
State: Published
Organisations: Department of Environmental Engineering, Environmental Chemistry, Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Gothenburg, Roskilde University
Authors: Skjolding, L. M. (Intern), Ašmonaitė, G. (Ekstern), Jølck, R. I. (Intern), Andresen, T. L. (Intern), Selck, H. (Ekstern), Baun, A. (Intern), Sturve, J. (Ekstern)
Pages: 351-359
Publication date: 2017
Main Research Area: Technical/natural sciences
Animal models for evaluation of oral delivery of biopharmaceuticals

Biopharmaceuticals are increasingly important for patients and the pharmaceutical industry due to their ability to treat and, in some cases, even cure chronic and potentially life-threatening diseases. Most biopharmaceuticals are administered by injection, but intensive focus on development of systems for oral delivery of biopharmaceuticals may result in new treatment modalities to increase the patient compliance and reduce product cost. In the preclinical development phase, use of experimental animal models is essential for evaluation of new formulation designs. In general, the limited oral bioavailability of biopharmaceuticals, of just a few percent, is expected, and therefore, the animal models and the experimental settings must be chosen with utmost care. More knowledge and focus on this topic is highly needed, despite experience from the numerous studies evaluating animal models for oral drug delivery of small molecule drugs. This review highlights and discusses pros and cons of the most currently used animal models and settings. Additionally, it also looks into the influence of anesthetics and sampling methods for evaluation of drug delivery systems for oral delivery of biopharmaceuticals primarily with examples on insulin.
An integrated lab-on-a-disc approach to detect inflammatory biomarkers from whole blood

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Magnetic Systems, Academia Sinica Taiwan, BluSense Diagnostics
Authors: Uddin, R. (Intern), Donolato, M. (Ekstern), Fock, J. (Intern), Hansen, M. F. (Intern), Hwu, E. (Ekstern), Boisen, A. (Intern)
Publication date: 2017
Main Research Area: Technical/natural sciences
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Source: PublicationPreSubmission
Source-ID: 140386200
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

An interaction of impacting droplets with superhydrophobic coatings

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Department of Mechanical Engineering, Fluid Mechanics
Authors: Okulova, N. (Intern), Okulov, V. (Intern), Taboryski, R. J. (Intern)
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Main Research Area: Technical/natural sciences
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Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Applying fluorescence correlation spectroscopy to investigate peptide-induced membrane disruption

There is considerable interest in understanding the interactions of antimicrobial peptides with phospholipid membranes. Fluorescence correlation spectroscopy (FCS) is a powerful experimental technique that can be used to gain insight into these interactions. Specifically, FCS can be used to quantify leakage of fluorescent molecules of different sizes from large unilamellar lipid vesicles, thereby providing a tool for estimating the size of peptide-induced membrane disruptions. If fluorescently labeled lipids are incorporated into the membranes of the vesicles, FCS can also be used to obtain information about whether leakage occurs due to localized membrane perturbations or global membrane destabilization. Here, we outline a detailed step-by-step protocol on how to optimally implement an FCS-based leakage assay. To make the protocol easily accessible to other researchers, it has been supplemented with a number of practical tips and tricks.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Center for Nanomedicine and Theranostics, Department of Chemistry
Authors: Kristensen, K. (Intern), Henriksen, J. R. (Intern), Andresen, T. L. (Intern)
Number of pages: 22
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Publication date: 2017

Host publication information
Title of host publication: Antimicrobial Peptides : Methods and Protocols
A pseudo-Voigt component model for high-resolution recovery of constituent spectra in Raman spectroscopy

Raman spectroscopy is a well-known analytical technique for identifying and analyzing chemical species. Since Raman scattering is a weak effect, surface-enhanced Raman spectroscopy (SERS) is often employed to amplify the signal. SERS signal surface mapping is a common method for detecting trace amounts of target molecules. Since the method produces large amounts of data and, in the case of very low concentrations, low signal-to-noise (SNR) ratio, ability to extract relevant spectral features is crucial. We propose a pseudo-Voigt model as a constrained source separation model, that is able to directly and reliably identify the Raman modes, with overall performance similar to the state of the art non-negative matrix factorization approach. However, the model provides better interpretation and is a step towards enabling the use of SERS in detection of trace amounts of molecules in real-life settings.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Alstrøm, T. S. (Intern), Schmidt, M. N. (Intern), Rindzevicius, T. (Intern), Boisen, A. (Intern), Larsen, J. (Intern)
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Main Research Area: Technical/natural sciences
Conference: 42nd IEEE International Conference on Acoustics, Speech and Signal Processing, New Orleans, United States, 05/03/2017 - 05/03/2017
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Artificial Organelles: Intracellular Sub-compartmentalized Microreactors to Conduct Enzymatic Cascade Reactions

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Technical University of Denmark
Authors: Gallardo, M. G. (Intern), Labay, C. P. (Intern), Trikalitis, V. (Ekstern), Kempen, P. (Intern), Larsen, J. (Intern), Andresen, T. L. (Intern), Hosta-Rigau, L. (Intern)
Number of pages: 1
Publication date: 2017
A statistical strategy to assess cleaning level of surfaces using fluorescence spectroscopy and Wilks' ratio

• A statistical strategy combining fluorescence spectroscopy, multivariate analysis and Wilks' ratio is proposed. • The method was tested both off-line and on-line having riboflavin as a (controlled) contaminant. • Wilks' ratio signals unusual recordings based on shifts in variance and covariance structure described in in-control data.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Surface Engineering, University of Copenhagen
Authors: Stoica, I. (Ekstern), Babamoradi, H. (Intern), van den Berg, F. (Ekstern)
Number of pages: 11
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Main Research Area: Technical/natural sciences

Publication information
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ISSN (Print): 0169-7439
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.222 SJR 0.672
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.6 SJR 0.652 SNIP 1.213
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.665 SNIP 1.258 CiteScore 2.68
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.88 SNIP 1.762 CiteScore 2.96
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.892 SNIP 1.43 CiteScore 2.67
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.87 SNIP 1.627 CiteScore 2.68
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.77 SNIP 1.323 CiteScore 2.27
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.761 SNIP 1.152
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.082 SNIP 1.314
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.96 SNIP 1.262
Web of Science (2008): Indexed yes
A two-dimensional Dirac fermion microscope

The electron microscope has been a powerful, highly versatile workhorse in the fields of material and surface science, micro and nanotechnology, biology and geology, for nearly 80 years. The advent of two-dimensional materials opens new possibilities for realizing an analogy to electron microscopy in the solid state. Here we provide a perspective view on how a two-dimensional (2D) Dirac fermion-based microscope can be realistically implemented and operated, using graphene as a vacuum chamber for ballistic electrons. We use semiclassical simulations to propose concrete architectures and design rules of 2D electron guns, deflectors, tunable lenses and various detectors. The simulations show how simple objects can be imaged with well-controlled and collimated in-plane beams consisting of relativistic charge carriers. Finally, we discuss the potential of such microscopes for investigating edges, terminations and defects, as well as interfaces, including external nanoscale structures such as adsorbed molecules, nanoparticles or quantum dots.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Nanocarbon, Theoretical Nanoelectronics, RWTH Aachen University
Authors: Bøggild, P. (Intern), Caridad, J. (Intern), Stampfer, C. (Ekstern), Calogero, G. (Intern), Papior, N. R. (Intern), Brandbyge, M. (Intern)
Number of pages: 1
Pages: 15783
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Nature Communications
Volume: 8
ISSN (Print): 2041-1723
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 2.912 SJR 6.582
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 11.8 SJR 6.414 SNIP 2.855
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 6.287 SNIP 2.86 CiteScore 11.23
Automated rolling circle amplification and optomagnetic product detection in an injection molded all-polymer chip – optimization of amplification temperature

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Stockholm University
Authors: Garbarino, F. (Intern), Minero, G. K. A. (Intern), Fock, J. (Intern), Rizzi, G. (Intern), Neumann, F. (Ekstern), Madaboosi, N. (Ekstern), Asalapuram, P. (Ekstern), Nilsson, M. (Ekstern), Hansen, M. F. (Intern)
Publication date: 2017
Main Research Area: Technical/natural sciences
Optomagnetic detection, Magnetic nanoparticles, Injection molding, Rolling circle amplification

Batch fabrication of nanopatterned graphene devices via nanoimprint lithography
Previous attempts to tune the electrical properties of large-scale graphene via nanopatterning have led to serious degradation of the key electrical parameters that make graphene a desirable material for electronic devices. We use thermal nanoimprint lithography to pattern wafer-scale graphene on a 4-in. wafer with prefabricated 25mm² devices. The nanopatterning process introduces a modest decrease in carrier mobility and only a minor change in residual doping. Due to the rapid fabrication time of approximately 90 min per wafer, this method has potential for large-scale industrial production. The chemiresistive gas sensing response towards NO₂ was assessed in humid synthetic air and dry air, with devices showing a response to 50 ppb of NO₂ only when nanopatterned.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, NIL Technology ApS, Technical University of Denmark
Authors: Mackenzie, D. (Intern), Smistrup, K. (Ekstern), Whelan, P. R. (Intern), Luo, B. (Intern), Shivayogimath, A. (Intern), Nielsen, T. (Ekstern), Petersen, D. H. (Intern), Messina, S. A. (Ekstern), Bøggild, P. (Intern)
Number of pages: 5
BCB polymer based row-column addressed CMUT

This paper presents an inexpensive, low temperature and rapid fabrication method for capacitive micromachined ultrasonic transducers (CMUT). The fabrication utilizes the bonding and dielectric properties of the photosensitive polymer Benzocyclobutene (BCB). A BCB based row-column addressed CMUT with integrated apodization has been fabricated and characterized with initial impedance measurement. Furthermore, two linear BCB CMUT arrays have been fabricated with different bottom electrode designs and characterized acoustically. All the fabricated arrays have a center frequency of 2.5 MHz when immersed into water and a pull-in voltage of 75 V. Stability tests have showed a stable coupling coefficient of approximately 0.1 during 10 hours of biased operation. Acoustic measurements, with a hydrophone positioned 1 cm from the CMUTs, have showed a peak-to-peak pressure of 14 kPa.

Bidirectional apical-basal traffic of the cation-independent mannose-6-phosphate receptor in brain endothelial cells

Brain capillary endothelium mediates the exchange of nutrients between blood and brain parenchyma. This barrier function of the brain capillaries also limits passage of pharmaceuticals from blood to brain, which hinders treatment of several neurological disorders. Receptor-mediated transport has been suggested as a potential pharmaceutical delivery route across the brain endothelium, e.g. reports have shown that the transferrin receptor (TfR) facilitates transcytosis of TfR antibodies, but it is not known whether this recycling receptor itself traffics from apical to basal membrane in the process. Here, we elucidate the endosomal trafficking of the retrograde transported cation-independent mannose-6-phosphate receptor (MPR300) in primary cultures of brain endothelial cells (BECs) of porcine and bovine origin. Receptor expression and localisation of MPR300 in the endolysosomal system and trafficking of internalised receptor are analysed. We also demonstrate that MPR300 can undergo bidirectional apical-basal trafficking in primary BECs in co-culture with astrocytes. This is, to our knowledge, the first detailed study of retrograde transported receptor trafficking in BECs, and the study demonstrates that MPR300 can be transported from the luminal to abluminal membrane and reverse. Such trafficking of MPR300 suggests that retrograde transported receptors in general may provide a mechanism for transport of pharmaceuticals into the brain.
Binding of Plasmodium falciparum to CD36 can be shielded by the glycocalyx

Background: Plasmodium falciparum-infected erythrocytes sequester in the microcirculation due to interaction between surface-expressed parasite proteins and endothelial receptors. Endothelial cells are covered in a carbohydrate-rich glycocalyx that shields against undesired leukocyte adhesion. It was investigated if the cellular glycocalyx affects the binding of P. falciparum-infected erythrocytes to CD36 in vitro.

Methods: Glycocalyx growth was followed in vitro by using azido sugars and cationized ferritin detecting O-glycoproteins and negatively charged proteoglycans, respectively. P. falciparum (clone FCR3/IT) was selected on Chinese hamster ovary (CHO) cells transfected with human CD36. Cytoadhesion to CHO CD36 at 1-4 days after seeding was quantified by using a static binding assay.

Results: The glycocalyx thickness of CHO cells increased during 4 days in culture as assessed by metabolic labelling of glycans with azido sugars and with electron microscopy studying the binding of cationized ferritin to cell surfaces. The functional importance of this process was addressed in binding assays by using CHO cells transfected with CD36. In parallel with the maturation of the glycocalyx, antibody-binding to CD36 was inhibited, despite stable expression of CD36. P. falciparum selected for CD36-binding recognized CD36 on CHO cells on the first day in culture, but the binding was lost after 2-4 days.

Conclusion: The endothelial glycocalyx affects parasite cytoadhesion in vitro, an effect that has previously been ignored. The previously reported loss of glycocalyx during experimental malaria may play an important role in the pathogenesis of malaria complications by allowing the close interaction between infected erythrocytes and endothelial receptors.
Biodistribution of Carbon Nanotubes in Animal Models

The many interesting physical and chemical properties of carbon nanotubes (CNT) make it one of the most commercially attractive materials in the era of nanotechnology. Here, we review the recent publications on in vivo biodistribution of pristine and functionalized forms of single-walled and multi-walled CNT. Pristine CNT remain in the lung for months or even years after pulmonary deposition. If cleared, the majority of CNT move to the gastrointestinal (GI) tract via the mucociliary escalator. However, there appears to be no uptake of CNT from the GI tract, with a possible exception of the smallest functionalized SWCNT. Importantly, a significant fraction of CNT translocate from the alveolar space to the near pulmonary region including lymph nodes, subpleura and pleura (<7% of the pulmonary deposited dose) and to distal organs including liver, spleen and bone marrow (~1%). These results clearly demonstrate the main sites of long-term CNT accumulation, which also includes pleura, a major site for fibre-induced pulmonary diseases. Studies on intravenous injection show that CNT in blood circulation are cleared relatively fast with a half-life of minutes or hours. The major target organs were the same as identified after pulmonary exposure with the exception of urine excretion of especially functionalized SWCNT and accumulation in lung tissue. Overall, there is evidence that CNT will primarily be distributed to the liver where they appear to be present at least one year after exposure.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment, University of Copenhagen
Number of pages: 14
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Publication information
Journal: Basic & Clinical Pharmacology & Toxicology
Volume: 121
ISSN (Print): 1742-7835
Ratings:
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.57
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.64
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Bioinspired Heparin Nanosponge Prepared by Photo-crosslinking for Controlled Release of Growth Factors

Growth factors have great therapeutic potential for various disease therapy and tissue engineering applications. However, their clinical efficacy is hampered by low bioavailability, rapid degradation in vivo and non-specific biodistribution. Nanoparticle based delivery systems are being evaluated to overcome these limitations. Herein, we have developed a thermosensitive heparin nanosponge (Hep-NS) by a one step photopolymerization reaction between diacrylated pluronic and thiolated heparin molecules. The amount of heparin in Hep-NS was precisely controlled by varying the heparin amount in the reaction feed. Hep-NS with varying amounts of heparin showed similar size and shape properties, though surface charge decreased with an increase in the amount of heparin conjugation. The anticoagulant activity of the Hep-NS decreased by 65% compared to free heparin, however the Hep-NS retained their growth factor binding ability. Four different growth factors, bFGF, VEGF, BMP-2, and HGF were successfully encapsulated into Hep-NS. In vitro studies showed sustained release of all the growth factors for almost 60 days and the rate of release was directly dependent on the amount of heparin in Hep-NS. The released growth factors retained their bioactivity as assessed by a cell proliferation assay. This heparin nanosponge is therefore a promising nanocarrier for the loading and controlled release of growth factors.
Biomimetic Approaches towards the Creation of Artificial Cells and Organelles for Future Healthcare Solutions

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Authors: Hosta-Rigau, L. (Intern), Gallardo, M. G. (Intern), Labay, C. P. (Intern)
Number of pages: 1
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Title of host publication: Book of Abstracts, Sustain 2017
Publisher: Technical University of Denmark (DTU)
Article number: H-4
Main Research Area: Technical/natural sciences
Conference: Sustain 2017, Kgs. Lyngby, Denmark, 06/12/2017 - 06/12/2017
Electronic versions:
SustainAbstracts2017c.compressed_86.pdf
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2017

Bioprinting technologies for disease modeling
There is a great need for the development of biomimetic human tissue models that allow elucidation of the pathophysiological conditions involved in disease initiation and progression. Conventional two-dimensional (2D) in vitro assays and animal models have been unable to fully recapitulate the critical characteristics of human physiology. Alternatively, three-dimensional (3D) tissue models are often developed in a low-throughput manner and lack crucial native-like architecture. The recent emergence of bioprinting technologies has enabled creating 3D tissue models that address the critical challenges of conventional in vitro assays through the development of custom bioinks and patient derived cells coupled with well-defined arrangements of biomaterials. Here, we provide an overview on the technological aspects of 3D bioprinting technique and discuss how the development of bioprinted tissue models have propelled our understanding of diseases’ characteristics (i.e. initiation and progression). The future perspectives on the use of bioprinted 3D tissue models for drug discovery application are also highlighted.
Blu-Ray-based micromechanical characterization platform for biopolymer degradation assessment

Degradable biopolymers are used as carrier materials in drug delivery devices. A complete understanding of their degradation behaviour is thus crucial in the design of new delivery systems. Here we combine a reliable method, based on spray coated micromechanical resonators and a disposable microfluidic chip, to characterize biopolymer degradation under the action of enzymes in controlled flow condition. The sensing platform is based on the mechanics and optics from a Blu-Ray player, which automatically localize individual sensors within the array, and sequentially measure and record the resonance frequency of up to twelve resonators within 4 min. Such fast and automated measuring technology, combined with the use of thin polymers layers in the degradation experiments, allows to reduce the experimental time needed for degradation studies from 6 weeks to 8 h. We first present a full characterization of sensor properties and then perform degradation studies of poly(lactic-co-glycolic acid) (PLGA) in steady flow for three different enzyme concentrations. The degradation has been performed in liquid environment. Before each resonator measurement, the measuring chamber has been automatically dried, since the resonator characteristics are much approved when measuring in air compared to liquid. The obtained degradation profiles are comparable to profiles obtained by conventional approaches, which have shown to require up to 6 weeks of experimental time frame.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Academia Sinica Taiwan, Technische Universität Wien
Authors: Casci Ceccacci, A. (Intern), Chen, C. (Ekstern), Hwu, E. (Ekstern), Morelli, L. (Intern), Bose-Goswami, S. (Intern), Bosco, F. (Intern), Schmid, S. (Ekstern), Boisen, A. (Intern)
Number of pages: 7
Pages: 1303–1309
Publication date: 2017
Main Research Area: Technical/natural sciences

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Journal: Sensors and Actuators B: Chemical
Volume: 241
ISSN (Print): 0925-4005
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.453 SJR 1.406
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 5.07 SJR 1.343 SNIP 1.464
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.225 SNIP 1.484 CiteScore 4.84
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.229 SNIP 1.658 CiteScore 4.37
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Boosting the Open Circuit Voltage of $\text{Cu}_2\text{ZnSnS}_4$ Solar Cells by a Lattice-Matched $\text{CeO}_2$ Layer and Theoretical Understanding of Interface Defects

General information

State: Published

Organisations: Department of Physics, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Department of Photonics Engineering, Optical Microsensors and Micromaterials, University of New South Wales, QuantumWise A/S

Authors: Crovetto, A. (Intern), Yan, C. (Ekstern), Palsgaard, M. L. N. (Intern), Iandolo, B. (Intern), Zhou, F. (Ekstern), Gunst, T. (Intern), Markussen, T. (Ekstern), Stride, J. (Ekstern), Schou, J. (Intern), Stokbro, K. (Ekstern), Brandbyge, M. (Intern), Hao, X. (Ekstern), Hansen, O. (Intern)

Publication date: 2017

Event: Abstract from 2017 MRS Spring Meeting & Exhibit, Phoenix, United States.

Main Research Area: Technical/natural sciences
Breakthrough in Current In Plane Metrology For Monitoring Large Scale MRAM Production

The current-in-plane tunneling technique (CIPT) has been a crucial tool in the development of magnetic tunnel junction stacks suitable for Magnetic Random Access Memories (MRAM) for more than a decade. The MRAM development has now reached the maturity to make the transition from R&D to large-scale production. This will require a metrology to precisely monitor the properties of the MTJ stacks over 300 mm wafers with high performance in terms of reproducibility and repeatability. Here, we present a major breakthrough in the CIPT metrology that can deliver a substantial improvement on the precision of the Resistance Area product (RA) and the Tunnel Magnetoresistance (TMR) measurements, compared to state of the art CIPT metrology tools dedicated to R&D. On two test wafers, the repeatability of RA and MR was improved up to 350% and the measurement reproducibility up to 1700%. We believe that CIPT metrology now constitutes a very strong candidate for monitoring MRAM production, since it can guarantee the high metrology performance needed for the advent of the MRAM era.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Capres A/S
Authors: Cagliani, A. (Intern), Østerberg, F. W. (Intern), Hansen, O. (Intern), Petersen, D. H. (Intern), Shiv, L. (Ekstern), Nielsen, P. F. (Ekstern)
Number of pages: 3
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Publication date: 2017

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Title of host publication: 2017 IEEE International Memory Workshop (IMW)
Publisher: IEEE
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Main Research Area: Technical/natural sciences
Conference: 2017 IEEE International Memory Workshop (IMW), Monterey, United States, 14/05/2017 - 14/05/2017
DOIs: 10.1109/IMW.2017.7939073
Source: FindIt
Source-ID: 2372666809
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

Breakthrough in current-in-plane tunneling measurement precision by application of multi-variable fitting algorithm

We present a breakthrough in micro-four-point probe (M4PP) metrology to substantially improve precision of transmission line (transfer length) type measurements by application of advanced electrode position correction. In particular, we demonstrate this methodology for the M4PP current-in-plane tunneling (CIPT) technique. The CIPT method has been a crucial tool in the development of magnetic tunnel junction (MTJ) stacks suitable for magnetic random-access memories for more than a decade. On two MTJ stacks, the measurement precision of resistance-area product and tunneling magnetoresistance was improved by up to a factor of 3.5 and the measurement reproducibility by up to a factor of 17, thanks to our improved position correction technique.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Capres A/S
Authors: Cagliani, A. (Intern), Østerberg, F. W. (Intern), Hansen, O. (Intern), Shiv, L. (Ekstern), Nielsen, P. F. (Ekstern), Petersen, D. H. (Intern)
Number of pages: 4
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Review of Scientific Instruments
Volume: 88
Issue number: 9
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ISSN (Print): 0034-6748
Ratings:
Burst pressure of phaseguide structures of different heights in all-polymer microfluidic channels: Paper

We present an experimental investigation of the burst/overflow pressure of water and a representative surfactant-containing buffer in microfluidic channels with phaseguide structures oriented at an angle of 90° to the channel length as a function of their height. The all-polymer chips were fabricated by injection moulding and sealed by ultrasonic welding. Channels with a height of 200 μm and widths of 1 mm or 3 mm were investigated for five values of between 8 μm and 82 μm. Phaseguide structures without branches and with branches at angles = 45°, 60° and 75° were studied. All phaseguide structures were found able to pin both liquids and the burst pressure was found to increase approximately linearly with the height of the phaseguide from about 100–350 Pa for water and from about 25–200 Pa for the buffer. The burst pressure was found not to depend on the channel width and it was only weakly influenced by the presence of a branch on the phaseguide. For phaseguides with a branch, the liquid was always found to burst at the branch location. The measured burst pressures were compared to those estimated using a simple theory. The knowledge obtained in this study enables simple tuning of liquid spreading and overflow in microfluidic channels by use of phaseguide structures with different heights and it also provides a set of systematic experimental data to be compared with simulations/theory.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems
Authors: Garbarino, F. (Intern), Kistrup, K. (Intern), Rizzi, G. (Intern), Hansen, M. F. (Intern)
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Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Micromechanics and Microengineering
Volume: 27
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Article number: 125015
ISSN (Print): 0960-1317
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.968 SJR 0.554
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.74 SJR 0.63 SNIP 1.067
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.687 SNIP 1.265 CiteScore 1.96
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.802 SNIP 1.316 CiteScore 1.84
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.737 SNIP 1.233 CiteScore 1.74
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.936 SNIP 1.491 CiteScore 1.92
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Butyrate-Loaded Chitosan/Hyaluronan Nanoparticles: A Suitable Tool for Sustained Inhibition of ROS Release by Activated Neutrophils

Tissue damage caused by excessive amounts of neutrophil-derived reactive oxygen species (ROS) occurs in many inflammatory diseases. Butyrate is a short-chain fatty acid (SCFA) with known anti-inflammatory properties, able to modulate several neutrophil functions. Evidence is provided here that butyrate inhibits neutrophil ROS release in a dose and time-dependent fashion. Given the short half-life of butyrate, chitosan/hyaluronan nanoparticles are next designed and developed as controlled release carriers able to provide cells with a long-lasting supply of this SCFA. Notably, while the inhibition of neutrophil ROS production by free butyrate declines over time, that of butyrate-loaded chitosan/hyaluronan nanoparticles (B-NPs) is sustained. Additional valuable features of these nanoparticles are inherent ROS scavenger activity, resistance to cell internalization, and mucoadhesiveness. B-NPs appear as promising tools to limit ROS-dependent tissue injury during inflammation. Particularly, by virtue of their mucoadhesiveness, B-NPs administered by enema can be effective in the treatment of inflammatory bowel diseases.
Cardiovascular health effects following exposure of human volunteers during fire extinction exercises

Background: Firefighters have increased risk of cardiovascular disease and of sudden death from coronary heart disease on duty while suppressing fires. This study investigated the effect of firefighting activities, using appropriate personal protective equipment (PPE), on biomarkers of cardiovascular effects in young conscripts training to become firefighters.

Methods: Healthy conscripts (n = 43) who participated in a rescue educational course for firefighting were enrolled in the study. The exposure period consisted of a three-day training course where the conscripts participated in various firefighting exercises in a constructed firehouse and flashover container. The subjects were instructed to extinguish fires of
either wood or wood with electrical cords and mattresses. The exposure to particulate matter (PM) was assessed at various locations and personal exposure was assessed by portable PM samplers and urinary excretion of 1-hydroxypyrene. Cardiovascular measurements included microvascular function and heart rate variability (HRV).

Results: The subjects were primarily exposed to PM in bystander positions, whereas self-contained breathing apparatus effectively abolished pulmonary exposure. Firefighting training was associated with elevated urinary excretion of 1-hydroxypyrene (105%, 95% CI: 52; 157%), increased body temperature, decreased microvascular function (-18%, 95% CI: -26; -9%) and altered HRV. There was no difference in cardiovascular measurements for the two types of fires.

Conclusion: Observations from this fire extinction training show that PM exposure mainly occurs in situations where firefighters removed the self-contained breathing apparatus. Altered cardiovascular disease endpoints after the firefighting exercise period were most likely due to complex effects from PM exposure, physical exhaustion and increased core body temperature.
Carrier-selective p- and n-contacts for efficient and stable photocatalytic water reduction

The successful realization of carrier-selective contacts for crystalline silicon (c-Si) based devices for photocatalytic hydrogen production has been demonstrated. The proposed TiO$_2$ protected carrier-selective contacts resemble a metal-oxide-semiconductor configuration, including a highly-doped nanocrystalline silicon (nc-Si) and a tunnel oxide, thereby forming a heterostructure with the c-Si substrate. By substituting conventional pn$^+$-junction Si by c-Si/SiO$_x$/nc-Si structure for both front and back contacts we demonstrate a 16% increase in photovoltage (an open circuit voltage of 584 mV under AM 1.5G conditions). TiO$_2$ protected carrier-selective photoelectrodes showed excellent long-term durability in acidic aqueous solution having stable photocurrent output for more than 40 days, implying that the proposed carrier-selective contact is a promising configuration to substitute for the conventional pn-junction based c-Si photocathodes.

General information
State: Published
Organisations: Department of Physics, Experimental Surface and Nanomaterials Physics, Department of Micro- and Nanotechnology, Silicon Microtechnology, Center for Electron Nanoscopy
Authors: Bae, D. (Intern), Pedersen, T. (Intern), Seger, B. (Intern), Iandolo, B. (Intern), Hansen, O. (Intern), Vesborg, P. C. K. (Intern), Chorkendorff, I. (Intern)
Pages: 59-64
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Main Research Area: Technical/natural sciences

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Journal: Catalysis Today
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ISSN (Print): 0920-5861
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.329 SJR 1.347
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.26 SJR 1.322 SNIP 1.369
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.335 SNIP 1.403 CiteScore 4
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.315 SNIP 1.453 CiteScore 3.72
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.299 SNIP 1.415 CiteScore 3.39
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.469 SNIP 1.422 CiteScore 3.38
ISI indexed (2012): ISI indexed yes
Challenges in the integration of silicon SERS substrates into a polypropylene injection moulded microfluidic chip

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Serioli, L. (Intern), Morelli, L. (Intern), Matteucci, M. (Intern), Zor, K. (Intern), Boisen, A. (Intern)
Publication date: 2017
Main Research Area: Technical/natural sciences Integration, SERS, Microfluidics
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Characterization of fine particles using optomagnetic measurements
The remanent magnetic moment and the hydrodynamic size are important parameters for the synthesis and applications of magnetic nanoparticles (MNPs). We present the theoretical basis for the determination of the remanent magnetic moment and the hydrodynamic size of MNPs with a narrow size distribution using optomagnetic measurements. In these, the 2nd harmonic variation of the intensity of light transmitted through an MNP suspension is measured as a function of an applied axial oscillating magnetic field. We first show how the measurements of the optomagnetic signal magnitude at a
low frequency vs. magnetic field amplitude can be used to determine the MNP moment. Subsequently, we use linear response theory to describe the dynamic non-equilibrium response of the MNP suspension at low magnetic field amplitudes and derive a link between optomagnetic measurements and magnetic AC susceptibility measurements. We demonstrate the presented methodology on two samples of commercially available multi-core MNPs. The results compare well with those obtained by dynamic light scattering, AC susceptibility and vibrating sample magnetometry measurements on the same samples when the different weighting of the particle size in the techniques is taken into account. The optomagnetic technique is simple, fast and does not require prior knowledge of the concentration of MNPs and it thus has the potential to be used as a routine tool for quality control of MNPs.
Chemical Engineering in the "BIO" world

Modern Chemical Engineering was born around the end of the 19th century in Great Britain, Germany, and the USA, the most industrialized countries at that time. Milton C. Whitaker, in 1914, affirmed that the difference between Chemistry and Chemical Engineering lies in the capability of chemical engineers to transfer laboratory findings to the industrial level. Since then, Chemical Engineering underwent huge transformations determining the detachment from the original Chemistry nest. The beginning of the sixties of the 20th century saw the development of a new branch of Chemical Engineering baptized Biomedical Engineering by Peppas and Langer and that now we can name Biological Engineering. Interestingly, although Biological Engineering focused on completely different topics from Chemical Engineering ones, it resorted to the same theoretical tools such as, for instance, mass, energy and momentum balances. Thus, the birth of Biological Engineering may be considered as a Darwinian evolution of Chemical Engineering similar to that experienced by mammals which, returning to water, used legs and arms to swim. From 1960 on, Biological Engineering underwent a considerable evolution as witnessed by the great variety of topics covered such as hemodialysis, release of synthetic drugs, artificial organs and, more recently, delivery of small interfering RNAs (siRNA). This review, based on the activities developed in the frame of our PRIN 2010-11 (2010PLMH2) project, tries to recount origins and evolution of Chemical Engineering illustrating several examples of recent and successful applications in the biological field. This, in turn, may stimulate the discussion about the Chemical Engineering students curriculum studiorum update.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Pages: 158-178
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Main Research Area: Technical/natural sciences
Ciprofloxacin-loaded sodium alginate/poly (lactic-co-glycolic acid) electrospun fibrous mats for wound healing

Wound dressings should ideally be able to maintain high humidity, remove excess wound exudate, permit thermal insulation, provide certain mechanical strength, and in some cases deliver antibiotics to prevent infections. Until now, none of the existing wound dressing products can meet all these requirements. To design a wound dressing with as many of the aforementioned features as possible, in this study, we attempted to prepare ciprofloxacin (CIP), an antibiotic, loaded electrospun hydrophobic poly (lactic-co-glycolic acid) (PLGA) fibrous mats modified with hydrophilic sodium alginate (ALG) microparticles. The results showed that ALG could improve the wettability, water absorption capacity, and enhance the release rate of ciprofloxacin from the PLGA fibrous mats. In addition, the addition of ALG reduced the stiffness of PLGA fibrous mats for better protection of the injured area as indicated by the Young's Modulus. Moreover, the burst release of CIP resulted from the addition of ALG seemed to provide an improved antibacterial effect to the PLGA mats. This study demonstrated the potential of combining hydrophilic and hydrophobic polymers to design the desired wound dressings via the electrospinning process.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, University of Copenhagen, University of Southern Denmark
Authors: Liu, X. (Ekstern), Nielsen, L. H. (Intern), Klodzinska, S. N. (Ekstern), Nielsen, H. M. (Ekstern), Qu, H. (Ekstern), Christensen, L. P. (Ekstern), Rantanen, J. (Ekstern), Yang, M. (Ekstern)
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Publication information

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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.49 SJR 1.411 SNIP 1.416
Web of Science (2016): Indexed yes
Circulating Glucagon 1-61 Regulates Blood Glucose by Increasing Insulin Secretion and Hepatic Glucose Production

Glucagon is secreted from pancreatic α cells, and hypersecretion (hyperglucagonemia) contributes to diabetic hyperglycemia. Molecular heterogeneity in hyperglucagonemia is poorly investigated. By screening human plasma using high-resolution-proteomics, we identified several glucagon variants, among which proglucagon 1-61 (PG 1-61) appears to be the most abundant form. PG 1-61 is secreted in subjects with obesity, both before and after gastric bypass surgery, with protein and fat as the main drivers for secretion before surgery, but glucose after. Studies in hepatocytes and in β cells demonstrated that PG 1-61 dose-dependently increases levels of cAMP, through the glucagon receptor, and increases insulin secretion and protein levels of enzymes regulating glycogenolysis and gluconeogenesis. In rats, PG 1-61 increases blood glucose and plasma insulin and decreases plasma levels of amino acids in vivo. We conclude that glucagon variants, such as PG 1-61, may contribute to glucose regulation by stimulating hepatic glucose production and insulin secretion.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Center for Nanomedicine and Theranostics, University of Copenhagen, Max Planck Institute of Biochemistry
It has been theoretically suggested and experimentally demonstrated that fast and low-cost sequencing of DNA, RNA, and peptide molecules might be achieved by passing such molecules between electrodes embedded in a nanochannel. The experimental realization of this scheme faces major challenges, however. In realistic liquid environments, typical currents in tunneling devices are of the order of picoamps. This corresponds to only six electrons per microsecond, and this number affects the integration time required to do current measurements in real experiments. This limits the speed of sequencing, though current fluctuations due to Brownian motion of the molecule average out during the required integration time. Moreover, data acquisition equipment introduces noise, and electronic filters create correlations in time-series data. We discuss how these effects must be included in the analysis of, e.g., the assignment of specific nucleobases to current signals. As the signals from different molecules overlap, unambiguous classification is impossible with a single measurement. We argue that the assignment of molecules to a signal is a standard pattern classification problem and calculation of the error rates is straightforward. The ideas presented here can be extended to other sequencing approaches of current interest.
Coating Nanoparticles with Plant-Produced Transferrin-Hydrophobin Fusion Protein Enhances Their Uptake in Cancer Cells

The encapsulation of drugs to nanoparticles may offer a solution for targeted delivery. Here, we set out to engineer a self-assembling targeting ligand by combining the functional properties of human transferrin and fungal hydrophobins in a single fusion protein. We showed that human transferrin can be expressed in Nicotiana benthamiana plants as a fusion with Trichoderma reesei hydrophobins HFBI, HFBII, or HFBIV. Transferrin-HFBIIV was further expressed in tobacco BY-2 suspension cells. Both partners of the fusion protein retained their functionality; the hydrophobin moiety enabled migration to a surfactant phase in an aqueous two-phase system, and the transferrin moiety was able to reversibly bind iron. Coating porous silicon nanoparticles with the fusion protein resulted in uptake of the nanoparticles in human cancer cells. This study provides a proof-of-concept for the functionalization of hydrophobin coatings with transferrin as a targeting ligand.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, VTT - Technical Research Centre of Finland, University of Turku, Agriculture and Agri-Food Canada, University of Helsinki
Authors: Reuter, L. J. (Ekstern), Shahbazi, M. (Intern), Makila, E. M. (Ekstern), Salonen, J. J. (Ekstern), Saberianfar, R. (Ekstern), Menassa, R. (Ekstern), Santos, H. A. (Ekstern), Joensuu, J. J. (Ekstern), Ritala, A. (Ekstern)
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BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.984 SJR 1.801
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.63 SJR 1.802 SNIP 1.065
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.664 SNIP 1.065 CiteScore 4.64
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Colloidal Flower-Shaped Iron Oxide Nanoparticles: Synthesis Strategies and Coatings

The assembly of magnetic cores into regular structures may notably influence the properties displayed by a magnetic colloid. In this work, key synthesis parameters driving the self-assembly process capable of organizing colloidal magnetic cores into highly regular and reproducible multi-core nanoparticles are determined. In addition, a self-consistent picture that explains the collective magnetic properties exhibited by these complex assemblies is achieved through structural, colloidal, and magnetic means. For this purpose, different strategies to obtain flower-shaped iron oxide assemblies in the size range 25–100 nm are examined. The routes are based on the partial oxidation of Fe(OH)$_2$, polyol-mediated synthesis or the reduction of iron acetylacetonate. The nanoparticles are functionalized either with dextran, citric acid, or alternatively embedded in polystyrene and their long-term stability is assessed. The core size is measured, calculated, and modeled using both structural and magnetic means while the Debye model and multi-core extended model are used to study interparticle interactions. This is the first step toward standardized protocols of synthesis and characterization of flower-shaped nanoparticles.

General information

State: Published
Organisations: Department of Physics, Neutrons and X-rays for Materials Physics, Department of Micro- and Nanotechnology, Magnetic Systems, Universidad Complutense, Micromod Partikeltechnologie GmbH, nanoPET Pharma GmbH, SP Technical Research Institute of Sweden, UCL Healthcare Biomagnetics Laboratory, Physikalisch-Technische
Comammox Nitrospira are abundant ammonia oxidizers in diverse groundwater-fed rapid sand filter communities

The recent discovery of completely nitrifying Nitrospira demands a re-examination of nitrifying environments to evaluate their contribution to nitrogen cycling. To approach this challenge, tools are needed to detect and quantify comammox Nitrospira. We present primers for the simultaneous quantification and diversity assessment of both comammox Nitrospira clades. The primers cover a wide range of comammox diversity, spanning all available high quality sequences. We applied these primers to 12 groundwater-fed rapid sand filters, and found comammox Nitrospira to be abundant in all filters. Clade B comammox comprise the majority (∼75%) of comammox abundance in all filters. Nitrosomonadaceae were present in all filters, although at low abundance (mean=1.8%). Ordination suggests that temperature impacts the structure of nitrifying communities, and in particular that increasing temperature favours Nitrospira. The nitrogen content of the filter material, sulfate concentration and surface ammonium loading rates shape the structure of the comammox guild in the filters. This work provides an assay for simultaneous detection and diversity assessment of clades A and B comammox Nitrospira, expands our current knowledge of comammox Nitrospira diversity and demonstrates a key role for comammox Nitrospira in nitrification in groundwater-fed biofilters.

General information
State: Accepted/In press
Organisations: Department of Environmental Engineering, Water Technologies, Department of Micro- and Nanotechnology, Surface Engineering, Department of Applied Mathematics and Computer Science, Technical University of Denmark
Authors: Fowler, S. J. (Ekstern), Palomo, A. (Intern), Dechesne, A. (Intern), Mines, P. D. (Intern), Smets, B. F. (Intern)
Number of pages: 14
Publication date: 2017
Main Research Area: Technical/natural sciences

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Ratings:
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.31 SJR 2.209
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 5.02 SJR 2.377 SNIP 1.383
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.02 SNIP 1.571 CiteScore 5.61
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.862 SNIP 1.599 CiteScore 5.6
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.273 SNIP 1.823 CiteScore 6.37
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.165 SNIP 1.639 CiteScore 5.94
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.368 SNIP 1.7 CiteScore 6.1
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.775 SNIP 1.551
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.502 SNIP 1.378
Combined Colorimetric and Gravimetric CMUT Sensor for Detection of Phenylacetone

The detection of phenylacetone is of interest as it is a common precursor for the synthesis of (meth)amphetaamine. Resonant gravimetric sensors can be used to detect the mass and hereby the concentration of a gas while colorimetric arrays typically have an exceptional selectivity to the target analyte if the right colorimetric dyes are chosen. We present a sensor system consisting of a Capacitive Micromachined Ultrasonic Transducer (CMUT) and a colorimetric array for detection of phenylacetone. The CMUT is used as a resonant gravimetric gas sensor where the resonance frequency shift due to mass loading of the plate. A single Local Oxidation of Silicon (LOCOS) step was used to define the cavities which were sealed with a Si3N4 plate with a thickness of 100nm, resulting in a resonance frequency of 38.8MHz and a theoretical mass sensitivity of 28.3 zg/Hz·μ2. The CMUTs were functionalized with the same dyes used to fabricate colorimetric arrays. While both the CMUTs and the colorimetric arrays showed selectivity to phenylacetone, the best selectivity was achieved by the colorimetric array. Furthermore, the mass of the phenylacetone was found as a function of time. Thus, the combination of the colorimetric array and the CMUT results in a good selectivity and a quantitative value for the mass.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-Applied Sensors, Surface Engineering, Colloids and Biological Interfaces
Authors: Mølgaard, M. J. G. (Intern), Laustsen, M. (Intern), Thygesen, I. L. (Intern), Jakobsen, M. H. (Intern), Andresen, T. L. (Intern), Thomsen, E. V. (Intern)
Number of pages: 4
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Electronic versions: Untitled_2.pdf
DOIs: 10.1109/ULTSYM.2017.8091676
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017
Comparison of optomagnetic and AC susceptibility readouts in a magnetic nanoparticle agglutination assay for detection of C-reactive protein

There is an increasing need to develop biosensor methods that are highly sensitive and that can be combined with low-cost consumables. The use of magnetic nanoparticles (MNPs) is attractive because their detection is compatible with low-cost disposables and because application of a magnetic field can be used to accelerate assay kinetics. We present the first study and comparison of the performance of magnetic susceptibility measurements and a newly proposed optomagnetic method. For the comparison we use the C-reactive protein (CRP) induced agglutination of identical samples of 100 nm MNPs conjugated with CRP antibodies. Both methods detect agglutination as a shift to lower frequencies in measurements of the dynamics in response to an applied oscillating magnetic field. The magnetic susceptibility method probes the magnetic response whereas the optomagnetic technique probes the modulation of laser light transmitted through the sample. The two techniques provided highly correlated results upon agglutination when they measure the decrease of the signal from the individual MNPs (turn-off detection strategy), whereas the techniques provided different results, strongly depending on the read-out frequency, when detecting the signal due to MNP agglomerates (turn-on detection strategy). These observations are considered to be caused by differences in the volumedependence of the magnetic and optical signals from agglomerates. The highest signal from agglomerates was found in the optomagnetic signal at low frequencies.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Uppsala University
Authors: Fock, J. (Intern), Parmvi, M. (Intern), Strömberg, M. (Ekstern), Svedlindh, P. (Ekstern), Donolato, M. (Intern), Hansen, M. F. (Intern)
Number of pages: 19
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Main Research Area: Technical/natural sciences

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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.65 SJR 2.373
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 7.22 SJR 2.095 SNIP 1.619
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.044 SNIP 1.671 CiteScore 7.07
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.057 SNIP 1.716 CiteScore 6.57
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.029 SNIP 1.726 CiteScore 6.34
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.397 SNIP 1.592 CiteScore 5.7
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.126 SNIP 1.704 CiteScore 5.85
ISI indexed (2011): ISI indexed yes
Complete sequence-based pathway analysis by differential on-chip DNA and RNA extraction from a single cell

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Philips Research Laboratories, Philips Biocell, Fasteris SA, XGenomes
Authors: van Strijp, D. (Ekstern), Vulders, R. C. M. (Ekstern), Larsen, N. (Ekstern), Schira, J. (Ekstern), Baerlocher, L. (Ekstern), van Driel, M. A. (Ekstern), Jensen, M. P. (Intern), Hansen, T. S. (Ekstern), Kristensen, A. (Intern), Mir, K. U. (Ekstern), Olesen, T. (Ekstern), Verhaegh, W. F. J. (Ekstern), Marie, R. (Intern), van der Zaag, P. J. (Ekstern)
Number of pages: 9
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Journal: Scientific Reports
Volume: 7
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ISSN (Print): 2045-2322
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.245 SJR 1.533
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.63 SJR 1.692 SNIP 1.354
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Compression of glycolide-h$_4$ to 6GPa

This study details the structural characterization of glycolide-h$_4$ as a function of pressure to 6GPa using neutron powder diffraction on the PEARL instrument at ISIS Neutron and Muon source. Glycolide-h$_4$, rather than its deuterated isotopologue, was used in this study due to the difficulty of deuteration. The low background afforded by zirconia-toughened alumina anvils nevertheless enabled the collection of data suitable for structural analysis to be obtained to a pressure of 5GPa. Glycolide-h$_4$ undergoes a reconstructive phase transition at 0.15GPa to a previously identified form (II), which is stable to 6GPa.
Conducting pyrolysed carbon scaffolds for cell replacement therapy and energy applications

Combining a conductive material with a transparent material allows creating a device with integrated functions that takes advantage of both properties. Such an optoelectrical device can function as substrate for the attachment of biological samples, as actuator for specific functions of the biological samples and as sensor to monitor the triggered responses. Carbon is a widely used electrode material due to its numerous advantages (electrochemical properties, price, stability, biocompatibility and versatility for fabrication). Additionally, glass-like carbon fabricated through the pyrolysis of SU-8 has been shown to enhance stem cell differentiation into dopaminergic neurons. Due to these properties, carbon was chosen as the conductive material for the development of optoelectrical devices.

Quartz is transparent in the UV and visible range. It is thermally resistant up to 1600°C, chemically inert, hard, durable and non-porous. These properties make it ideal as the transparent component in the development of optoelectrical devices.

The aim of this work is to contribute to the development of optoelectrical devices for applications in two different fields: 1) the treatment of Parkinson’s disease and 2) energy harvesting from photosynthetic organisms. During the duration of this PhD project, the optoelectrical devices designed in the group have moved from an idea to the proof-of-concept stage. The experimental work performed as part of this thesis combined cleanroom fabrication, pyrolysis, characterisation of the fabricated structures, and biological applications. The work aimed at Parkinson’s disease has focused on the differentiation of stem cells into dopaminergic neurons and analysing the ability to release dopamine of the neurons generated by culturing on carbon electrodes. The work aimed at applications in biophotovoltaics has explored energy harvesting from thylakoid membranes as photosynthetic systems residing on patterned carbon electrodes for generating electrical power.

General information
Considerations on the Construction of a Powder Bed Fusion Platform for Additive Manufacturing

As the demand for moulds and other tools becomes increasingly specific and complex, an additive manufacturing approach to production is making its way to the industry through laser based consolidation of metal powder particles by a method known as powder bed fusion. This paper concerns a variety of design choices facilitating the development of an experimental powder bed fusion machine tool, capable of manufacturing metal parts with strength matching that of conventional manufactured parts and a complexity surpassing that of subtractive processes. To understand the different mechanisms acting within such an experimental machine tool, a fully open and customizable rig is constructed. Emphasizing modularity in the rig, allows alternation of lasers, scanner systems, optical elements, powder deposition, layer height, temperature, atmosphere, and powder type. Through a custom-made software platform, control of the process is achieved, which extends into a graphical user interface, easing adjustment of process parameters and the job file generation.

General information
State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Department of Micro- and Nanotechnology
Authors: Andersen, S. A. (Intern), Nielsen, K. (Intern), Pedersen, D. B. (Intern), Nielsen, J. S. (Intern)
Pages: 3-10
Publication date: 2017
Conference: Nordic Laser Materials Processing Conference (NOLAMP16), Aalborg, Denmark, 22/08/2017 - 22/08/2017
Main Research Area: Technical/natural sciences
Convenient one-step synthesis of 5-carboxy-seminaphthofluorescins

The one-step synthesis and characterization of a series of regioisomerically pure 5-carboxy-seminaphthofluorescins (5-carboxy-SNAFLs) is reported. The optical properties were determined in aqueous buffer at around biological pH, and highly pH sensitive, large Stokes-shift fluorophores with emission in the deep-red to near-infrared region were identified.

General information

State: Published
Organisations: Department of Chemistry, Center for Nanomedicine and Theranostics, X-ray Crystallography, Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Organic Chemistry, Lund University
Authors: Hammershøj, P. (Intern), Thyhaug, E. (Ekstern), Harris, P. (Intern), Ek, P. K. (Intern), Andresen, T. L. (Intern), Clausen, M. H. (Intern)
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Main Research Area: Technical/natural sciences

Publication information

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Volume: 58
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.571 SJR 0.683
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.13 SJR 0.754 SNIP 0.637
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.748 SNIP 0.739 CiteScore 2.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.796 SNIP 0.791 CiteScore 2.41
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.908 SNIP 0.793 CiteScore 2.4
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.094 SNIP 0.84 CiteScore 2.45
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.217 SNIP 0.93 CiteScore 2.76
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.245 SNIP 0.912
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.296 SNIP 0.935
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.346 SNIP 0.882
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.448 SNIP 0.942
Web of Science (2007): Indexed yes
Nanoporous networks of covalent organic polymers (COPs) are successfully grafted on the surfaces of activated carbons, through a series of surface modification techniques, including acyl chloride formation by thionyl chloride. Hybrid composites of activated carbon functionalized with COPs exhibit a core-shell formation of COP material grafted to the outer layers of activated carbon. This general method brings features of both COPs and porous carbons together for target-specific environmental remediation applications, which was corroborated with successful adsorption tests for organic dyes and metals.
Creating infinite contrast in fluorescence microscopy by using lanthanide centered emission

The popularity of fluorescence microscopy arises from the inherent mode of action, where the fluorescence emission from probes is used to visualize selected features on a presumed dark background. However, the background is rarely truly dark, and image processing and analysis is needed to enhance the fluorescent signal that is ascribed to the selected feature. The image acquisition is facilitated by using considerable illumination, bright probes at a relatively high concentration in order to make the fluorescent signal significantly more intense than the background signal. Here, we present two methods for completely removing the background signal in spectrally resolved fluorescence microscopy. The methodology is applicable for all probes with narrow and well-defined emission bands (Full width half-maximum < 20 nm). Here, we use two lanthanide based probes exploiting the narrow emission lines of europium(III) and terbium(III) ions. We used a model system with zeolites doped with lanthanides immobilized in a polymer stained with several fluorescent dyes regularly used in bioimaging. After smoothing the spectral data recorded in each pixel, they are differentiated. Method I is based on the direct sum of the gradient, while method II resolves the fluorescent signal by subtracting a background calculated via the gradient. Both methods improve signal-to-background ratio significantly and we suggest that spectral imaging of lanthanide-centered emission can be used as a tool to obtain absolute contrast in bioimaging.
Cryo scanning electron microscopy of Plasmodium falciparum-infected erythrocytes

Plasmodium falciparum invades erythrocytes as an essential part of their life cycle. While living inside erythrocytes, the parasite remodels the cell's intracellular organization as well as its outer surface. Late trophozoite-stage parasites and schizonts introduce numerous small protrusions on the erythrocyte surface, called knobs. Current methods for studying these knobs include atomic force microscopy and electron microscopy. Standard electron microscopy methods rely on chemical fixation and dehydration modifying cell size. Here, a novel method is presented using rapid freezing and scanning electron microscopy under cryogenic conditions allowing for high resolution and magnification of erythrocytes. This novel technique can be used for precise estimates of knob density and for studies on cytoadhesion.
Curvilinear 3-D Imaging Using Row–Column-Addressed 2-D Arrays with a Diverging Lens: Feasibility Study

Constructing a double-curved row–column-addressed (RCA) 2-D array or applying a diverging lens over the flat RCA 2-D array can extend the imaging field-of-view (FOV) to a curvilinear volume without increasing the aperture size, which is necessary for applications such as abdominal and cardiac imaging. Extended FOV and low channel count of double-curved RCA 2-D arrays make 3-D imaging possible with equipment in the price range of conventional 2-D imaging. This study proposes a delay-and-sum beamformation scheme specific to double-curved RCA 2-D arrays and validates its focusing ability based on simulations. A synthetic aperture imaging sequence with single element transmissions is designed for imaging down to 14 cm at a volume rate of 88 Hz. Using a diverging lens with f-number of -1 circumscribing the underlying RCA array, the imaging quality of a double-curved λ/2-pitch 3 MHz 62+62 RCA 2-D array is investigated as a function of depth within a curvilinear FOV of 60°×60°. The simulated double-curved 2-D array exhibits the same full-width-at-halfmaximum values for a point scatterer within its curvilinear FOV at a fixed radial distance compared with a flat 2-D array within its rectilinear FOV. The results of this study demonstrate that the proposed beamforming approach is accurate for achieving correct time-of-flight calculations, and hence avoids geometrical distortions.

**General information**

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- BFI (2018): BFI-level 2
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- Web of Science (2015): Indexed yes
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- Scopus rating (2014): SJR 1.088 SNIP 1.627 CiteScore 2.18
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- Web of Science (2012): Indexed yes
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- Scopus rating (2011): SJR 0.733 SNIP 1.325 CiteScore 1.95
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 2
- Scopus rating (2010): SJR 0.928 SNIP 1.562
- Web of Science (2010): Indexed yes
Data Analysis in Experimental Biomedical Research

This thesis covers two non-related topics in experimental biomedical research: data analysis in thrombin generation experiments (collaboration with Novo Nordisk A/S), and analysis of images and physiological signals in the context of neurovascular signalling and blood flow regulation in the brain (collaboration with University of Copenhagen).

The ongoing progress in experimental methods of thrombin generation allowed to introduce ready-to-use commercial assays for thrombin measurement. On the other hand, commercial assays use “black box” data analysis which makes it nearly impossible for researchers to critically assess and compare obtained results. We reverse engineered the data analysis performed by CAT, a de facto standard assay in the field. This revealed a number of possibilities to improve its methods of data analysis. We found that experimental calibration data is described well with textbook Michaelis-Menten kinetics of the basic enzymatic reaction. We also found that a simple phenomenological model inspired by a cascade of basic enzymatic reactions describes thrombin generation data. Finally, we proved that CAT greatly overestimates several key physiological parameters that describe thrombin generation. Our work is a step towards standardization in the field of thrombin generation based on transparent and well-motivated flexible methods of data analysis.

One of the recent surprising discoveries about pericytes was their active role in the regulation of the blood flow. However, this discovery was critically acclaimed in literature, so their true regulatory function has only started to emerge. We were able to bridge the two opposing points of view and found that pericytes are likely to be the local centers of capillary blood flow regulation. In addition, we investigated the role of octapeptide angiotensin two (ANGII) in the mechanism of hypertension on neurovascular signaling and regulation in the brain. We found that values of resting and increase in cerebral blood flow dropped upon administration of ANGII in a concentration-dependent manner, in agreement with previous findings. We also observed local constrictions of vessels in up to second order, which proves that ANGII changes their contractile tone by directly affecting smooth muscle cells as well as a subset of capillary pericytes. Here we developed tools for noise-robust extraction of vessel diameter traces from experimental two-photon microscopy images that could serve the broad community of biologists and neuroscientists. More importantly, we demonstrated on a number of examples how both careful data management and rigorous statistical analysis are crucial for deriving solid conclusions
about the behavior of complex biological systems.

Defective ZnCo$_2$O$_4$ with Zn vacancies: Synthesis, property and electrochemical application

Through the liquid-phase co-precipitation and alkaline-tailored method, the defective ZnCo$_2$O$_4$ with Zn vacancies (Zn$_{0.95}$Co$_2$O$_4$) has been synthesized, which is similar to the crystal phase, morphology, and particle size of the pure ZnCo$_2$O$_4$ before etched, except the enlarged BET specific surface. For the first time, the Zn$_{0.95}$Co$_2$O$_4$ has been evaluated as an anode material for lithium-ion batteries. The Zn vacancies in defective ZnCo$_2$O$_4$ may decrease the probability of the reversible by-reaction between Zn and Li-Zn alloy by the cyclic voltammogram measurement. Compared to the traditional ZnCo$_2$O$_4$, the Zn vacancies in defective ZnCo$_2$O$_4$ can provide larger interface, activate more reaction sites and expand faster transport paths for both of Li-ions and electronics insertion/extraction, so the electrochemical performance of defective ZnCo$_2$O$_4$ has been enhanced highly. The discharge capacity retains at 652.2 mAh g$^{-1}$ under 0.4 A g$^{-1}$ after 200 cycles. When the rate returns to 0.4 A g$^{-1}$, the average discharge capacity could be recovered to 748.9 mAh g$^{-1}$ under the multiple-step high rates after many cycles.
Tumor immune escape is today recognized as an important cancer hallmark and is therefore a major focus area in cancer therapy. Monocytes and dendritic cells (DCs), which are central to creating a robust anti-tumor immune response and establishing an anti-tumorogenic microenvironment, are directly targeted by the tumor escape mechanisms to develop immunosuppressive phenotypes. Providing activated monocytes and DCs to the tumor tissue is therefore an attractive way to break the tumor-derived immune suppression and reinstate cancer immune surveillance. To activate monocytes and DCs with high efficiency, we have investigated an immunotherapeutic Toll-Like Receptor (TLR) agonist delivery system comprising liposomes targeted to the dendritic cell immunoreceptor (DCIR). We formulated the immune stimulating TLR7 agonist TMX-202 in the liposomes and examined the targeting of the liposomes as well as their immune activating potential in blood-derived monocytes, myeloid DCs (mDCs), and plasmacytoid DCs (pDCs). Monocytes and mDCs were targeted with high specificity over lymphocytes, and exhibited potent TLR7-specific secretion of the anti-cancer cytokines IL-12p70, IFN-α 2a, and IFN-γ. This delivery system could be a way to improve cancer treatment either in the form of a
vaccine with co-formulated antigen or as an immunotherapeutic vector to boost monocyte and DC activity in combination with other treatment protocols such as chemotherapy or radiotherapy. Cancer immunotherapy is a powerful new tool in the oncologist's therapeutic arsenal, with our increased knowledge of anti-tumor immunity providing many new targets for intervention. Monocytes and dendritic cells (DCs) are attractive targets for enhancing the anti-tumor immune response, but systemic delivery of immunomodulators has proven to be associated with a high risk of fatal adverse events due to the systemic activation of the immune system. We address this important obstacle by targeting the delivery of an immunomodulator, a Toll-like receptor agonist, to DCs and monocytes in the bloodstream. We thus focus the activation, potentially avoiding the above-mentioned adverse effects, and demonstrate greatly increased ability of the agonist to induce secretion of anti-cancer cytokines.
Denaturation strategies for detection of double stranded PCR products on GMR magnetic biosensor array

Microarrays and other surface-based nucleic acid detection schemes rely on the hybridization of the target to surface-bound detection probes. We present the first comparison of two strategies to detect DNA using a giant magnetoresistive (GMR) biosensor platform starting from an initially double-stranded DNA target. The target strand of interest is biotinylated and detected by the GMR sensor by linking streptavidin magnetic nanoparticles (MNPs) to the sensor surface. The sensor platform has a dynamic detection range from 40 pM to 40 nM with highly reproducible results and is used to monitor real-time binding signals. The first strategy, using off-chip heat denaturation followed by sequential on-chip incubation of the nucleic acids and MNPs, produces a signal that stabilizes quickly but the signal magnitude is reduced due to competitive rehybridization of the target in solution. The second strategy, using magnetic capture of the double-stranded product followed by denaturing, produces a higher signal but the signal increase is limited by diffusion of the MNPs. Our results show that both strategies give highly reproducible results but that the signal obtained using magnetic capture is higher and insensitive to rehybridization.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Fluidic Array Systems and Technology, Stanford University, Danish Cancer Society
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BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 7.22 SJR 2.095 SNIP 1.619
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Scopus rating (2015): SJR 2.044 SNIP 1.671 CiteScore 7.07
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Web of Science (2012): Indexed yes
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Scopus rating (2011): SJR 2.126 SNIP 1.704 CiteScore 5.85
ISI indexed (2011): ISI indexed yes
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Design and development of electrochemical polymer-based lab-on-a-disc devices for biological applications

The need for reliable, fast, easy to use, portable and cost effective analytical tools has led to several novel approaches in the development of miniaturized microfluidic platforms integrated with electrochemical sensors. This thesis presents the design and development of an electrochemical detection based centrifugal microfluidic platforms towards applications in bioprocess monitoring, medical diagnostics, food and environmental analysis, etc. Stencil based electrode fabrication approach was developed and optimized to pattern reliable and reproducible electrodes on a polymeric substrate. Also, a fast, easy to use and simplified approach was established for interfacing the electrodes integrated with the polymeric Lab-on-a-disc (LoD) devices. On-disc filtration and supported liquid membrane (SLM) extraction was adapted on LoD devices for sample pre-treatment (e.g., filtration, extraction, enrichment). The applicability of the developed microfluidic systems was demonstrated by monitoring a biological process, namely quantifying the amount of the bacterial metabolite p-Coumaric acid (pHCA) produced by genetically modified E. coli cells. The first generation LoD device (with integrated filtration) was used to quantify pHCA at the end of bacterial culture (24 hours) when the cell density is the highest. We demonstrated the efficiency of the centrifugal filtration, which enabled cell-free electrochemical detection eliminating the effect of high cell density on electrochemical quantification of pHCA. The second generation LoD device (with integrated SLM extraction) was more advanced and facilitated extraction, enrichment, as well as electrochemical detection of pHCA from the complex sample matrix, i.e., E. coli supernatant at different time points during the cell culture. Realizing the need for more advanced sensors that can be integrated with microfluidic devices, we developed dual functionality sensors facilitating surface-enhanced Raman spectroscopy (SERS) based sensing as well as electrochemical detection. Moreover, to eliminate the need for bulky peripheral instrumentation connected through slip rings for on-disc electrochemical measurements, we present a miniaturized smartphone controlled wireless potentiostat, which can be integrated on a rotating microfluidic platform.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Sanger, K. (Intern), Boisen, A. (Intern), Zor, K. (Intern), Heiskanen, A. (Intern)
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Detection of melamine in milk using nanopillar filters and Raman spectroscopy

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Durucan, O. (Intern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern), Matteucci, M. (Intern), Boisen, A. (Intern)
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SustainAbstracts2017c.compressed_66.pdf
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2017

Detection of p-coumaric acid from cell supernatant using surface enhanced Raman scattering
A standard protocol for analysis of microbial factories requires the screening of several populations in order to find the best performing ones. Standard analytical methods usually include high performance liquid chromatography (HPLC), thin layer chromatography (TLC) or spectrophotometry, which are expensive and time-consuming processes. Surface Enhanced Raman Spectroscopy (SERS), instead, is a highly sensitive spectroscopic technique for specific, fast and real-time sensing of biological samples. Here we demonstrate the use of SERS to discriminate between two different bacterial populations based on detection of p-coumaric acid (pHCA) in cell supernatant. SERS active substrates, based on leaning gold-capped silicon nanopillars, were used for detection. They were successfully used to detect culture medium spiked with pHCA, and the effect of medium dilution was studied. For analysis of biological production of pHCA, triplicate cultures of E. coli strains expressing a pHCA-forming enzyme (P) as well as of a non-producing strain (C) were grown. Then, supernatant samples were collected and their pHCA content was measured using SERS and HPLC for comparison. The intensity of the pHCA Raman mode at 1169 cm\(^{-1}\) (CH-rocking motion) showed different trends for P and C strains, similar to the results obtained using the HPLC method. Results illustrate that SERS can be used for quick and semiquantitative discrimination of pHCA concentrations in cell supernatant medium.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Novo Nordisk Foundation Center for Biosustainability, Bacterial Cell Factory Optimization, Research Groups, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Morelli, L. (Intern), Jendresen, C. B. (Intern), Zor, K. (Intern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern), Nielsen, A. T. (Intern), Boisen, A. (Intern)
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Surface enhanced Raman spectroscopy, P-coumaric acid, E. coli, Microbial factories, Fast analysis
Detection of Surface-Linked Polychlorinated Biphenyls using Surface-Enhanced Raman Scattering Spectroscopy

We present an improved procedure for analytical detection of toxic polychlorinated biphenyls (PCB) using surface-enhanced Raman scattering (SERS) spectroscopy. A gold-capped silicon nanopillar substrate was utilized to concentrate PCB molecules within an area of high electromagnetic fields through formation of microsized nanopillar clusters, and consequently, so-called “hot spots” can be formed. In order to improve PCB detection limit, 3,3′,4,4′-tetrachlorobiphenyl (PCB77) compounds were chemically modified with a –SCH3 (PCB77-SCH3) group. Experimental and numerical analysis of vibrational modes showed only minor differences between standard PCB77 and PCB77-SCH3. Consequently, we observe significantly increased SERS signals for –SCH3 modified PCB77 while retaining most vibrational modes that characterize standard PCB77. Results point towards more efficient path for detecting different PCB congener from real-life samples. We interpret the result as PCB77-SCH3 link to gold surface via sulfur atoms that facilitates accumulation of the modified PCB molecules on the metal surface. For similar SERS experimental conditions most spectral characteristics of PCB77 are identifiable down to concentrations of ~10^{-5} M while PCB77-SCH3 spectral fingerprint is retained in ~10^{-8} M range.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Hansa Fine Chemicals GmbH, Universidad Industrial de Santander
Authors: Rindzevicius, T. (Intern), Barten, J. (Ekstern), Vorobiev, M. (Ekstern), Schmidt, M. S. (Intern), Castillo, J. J. (Ekstern), Boisen, A. (Intern)
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BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.88
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.1
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.68
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
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ISI indexed (2012): ISI indexed yes
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Determination of the activation energy of Martensite formation in steel during heating from 77 K

General information
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Organisations: Department of Mechanical Engineering, Materials and Surface Engineering, Department of Micro- and Nanotechnology, Magnetic Systems
Authors: Villa, M. (Intern), Hansen, M. F. (Intern), Somers, M. A. J. (Intern)
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Electronic versions:

Development of an Immunosensor for PfHRP 2 as a Biomarker for Malaria Detection

Plasmodium falciparum histidine-rich protein 2 (PfHRP 2) was selected in this work as the biomarker for the detection and diagnosis of malaria. An enzyme-linked immunosorbent assay (ELISA) was first developed to evaluate the immunoreagent's suitability for the sensor's development. A gold-based sensor with an integrated counter and an Ag/AgCl reference electrode was first selected and characterised and then used to develop the immunosensor for PfHRP 2, which enables a low cost, easy to use, and sensitive biosensor for malaria diagnosis. The sensor was applied to immobilise the anti-PfHRP 2 monoclonal antibody as the capture receptor. A sandwich ELISA assay format was constructed using horseradish peroxidase (HRP) as the enzyme label, and the electrochemical signal was generated using a 3, 3', 5, 5' tetramethyl-benzidine dihydrochloride (TMB)/H₂O₂ system. The performance of the assay and the sensor were optimised and characterised, achieving a PfHRP 2 limit of detection (LOD) of 2.14 ng mL⁻¹ in buffer samples and 2.95 ng mL⁻¹ in 100% spiked serum samples. The assay signal was then amplified using gold nanoparticles conjugated detection antibody-enzyme and a detection limit of 36 pg mL⁻¹ was achieved in buffer samples and 40 pg mL⁻¹ in serum samples. This sensor format is ideal for malaria detection and on-site analysis as a point-of-care device (POC) in resource-limited settings where the implementation of malaria diagnostics is essential in control and elimination efforts.

General information
State: Published
Organisations: BioLabChip, Department of Micro- and Nanotechnology, Cranfield University
Development of a plastic membrane containing micro-hole(s) for a potential bio-sensing application

In this work, a poly (methyl methacrylate) membrane containing micro-holes (MHs) as a prototype of a simple sensing platform of a lab-on-a-chip device has been developed for potential analysis of clinical fluidic samples. A four probe electrochemical impedance spectroscopy (EIS) setup, with two electrodes placed on each side of the membrane, was adopted for monitoring the MH impedance (Fig. 1a). The setup was used to investigate if EIS is suitable to sense the trapping of an analyte inside the MHs. Latex micro-beads with a diameter of 10 μm were used to test clogging of the MHs. Additionally, finite element model simulations were performed using Comsol Multiphysics software to theoretically evaluate the sensitivity field of the EIS measurement along the MHs. (C) 2017 The Authors. Published by Elsevier Ltd.

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Organisations: Department of Micro- and Nanotechnology, Bioanalytics, Malmö University
Authors: Krikstolaityte, V. (Intern), Ruzgas, T. (Ekstern), Heiskanen, A. (Intern), Canali, C. (Intern), Arnebrant, T. (Ekstern), Emnéus, J. (Intern)
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Development of a Video-Microscopic Tool To Evaluate the Precipitation Kinetics of Poorly Water Soluble Drugs: A Case Study with Tadalafil and HPMC

Many drug candidates today have a low aqueous solubility and, hence, may show a low oral bioavailability, presenting a major formulation and drug delivery challenge. One way to increase the bioavailability of these drugs is to use a supersaturating drug delivery strategy. The aim of this study was to develop a video-microscopic method, to evaluate the effect of a precipitation inhibitor on supersaturated solutions of the poorly soluble drug tadalafil, using a novel video-microscopic small scale setup. Based on preliminary studies, a degree of supersaturation of 29 was chosen for the supersaturation studies with tadalafil in FaSSIF. Different amounts of hydroxypropyl methyl cellulose (HPMC) were predissolved in FaSSIF to give four different concentrations, and the supersaturated system was then created using a solvent shift method. Precipitation of tadalafil from the supersaturated solutions was monitored by video-microscopy as a function of time. Single-particle analysis was possible using commercially available software; however, to investigate the entire population of precipitating particles (i.e., their number and area covered in the field of view), an image analysis algorithm was developed (multiparticle analysis). The induction time for precipitation of tadalafil in FaSSIF was significantly prolonged by adding 0.01% (w/v) HPMC to FaSSIF, and the maximum inhibition was reached at 0.1% (w/v) HPMC, after which additional HPMC did not further increase the induction time. The single-particle and multiparticle analyses yielded the same ranking of the HPMC concentrations, regarding the inhibitory effect on precipitation. The developed small scale method to assess the effect of precipitation inhibitors can speed up the process of choosing the right precipitation inhibitor and the concentration to be used.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, University of Copenhagen, Philips Biocell
Authors: Christfort, J. F. (Ekstern), Plum, J. (Ekstern), Madsen, C. M. (Ekstern), Nielsen, L. H. (Intern), Sandau, M. (Ekstern), Andersen, K. (Ekstern), Müllertz, A. (Ekstern), Rades, T. (Ekstern)
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Scopus rating (2015): SJR 1.605 SNIP 1.221 CiteScore 4.88
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Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 1.903 SNIP 1.324 CiteScore 5.26
ISI indexed (2013): ISI indexed yes
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Scopus rating (2012): SJR 2.152 SNIP 1.474 CiteScore 5.41
ISI indexed (2012): ISI indexed yes
Differences in inflammation and acute phase response but similar genotoxicity in mice following pulmonary exposure to graphene oxide and reduced graphene oxide

We investigated toxicity of 2-3 layered >1 μm sized graphene oxide (GO) and reduced graphene oxide (rGO) in mice following single intratracheal exposure with respect to pulmonary inflammation, acute phase response (biomarker for risk of cardiovascular disease) and genotoxicity. In addition, we assessed exposure levels of particulate matter emitted during production of graphene in a clean room and in a normal industrial environment using chemical vapour deposition. Toxicity was evaluated at day 1, 3, 28 and 90 days (18, 54 and 162 μg/mouse), except for GO exposed mice at day 28 and 90 where only the lowest dose was evaluated. GO induced a strong acute inflammatory response together with a pulmonary (Serum-Amyloid A, Saa3) and hepatic (Saa1) acute phase response. rGO induced less acute, but a constant and prolonged inflammation up to day 90. Lung histopathology showed particle agglomerates at day 90 without signs of fibrosis. In addition, DNA damage in BAL cells was observed across time points and doses for both GO and rGO. In conclusion, pulmonary exposure to GO and rGO induced inflammation, acute phase response and genotoxicity but no fibrosis.

General information

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Organisations: Department of Micro- and Nanotechnology, Nanocarbon, National Research Center for Working Environment, Roskilde University, National Institute of Occupational Health, Graphenea S.A.
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Diffusion of dopants in nanostructured black silicon for application in solar cells

General information
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Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Technical University of Denmark
Authors: Stilling-Andersen, A. R. (Intern), Solodovnikova, O. (Ekstern), Davidsen, R. S. (Intern), Iandolo, B. (Intern)
Number of pages: 1
Publication date: 2017

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Publisher: Technical University of Denmark (DTU)
Article number: M-15
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Digital resonant laser printing: manipulating optical meta-elements on demand

General information
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Organisations: Department of Micro- and Nanotechnology, Optofluidics
Authors: Zhu, X. (Intern), Keshavarz Hedayati, M. (Intern), Raza, S. (Intern), Levy, U. (Intern), Mortensen, N. A. (Intern), Kristensen, A. (Intern)
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Electronic versions:
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Direct Amplitude-Phase Near-Field Observation of Higher-Order Anapole States
Anapole states associated with the resonant suppression of electric-dipole scattering exhibit minimized extinction and maximized storage of electromagnetic energy inside a particle. Using numerical simulations, optical extinction spectroscopy, and amplitude-phase near-field mapping of silicon dielectric disks, we demonstrate high-order anapole states in the near-infrared wavelength range (900-1700 nm). We develop the procedure for unambiguously identifying anapole states by monitoring the normal component of the electric near-field and experimentally detect the first two anapole states as verified by far-field extinction spectroscopy and confirmed with the numerical simulations. We demonstrate that higher-order anapole states possess stronger energy concentration and narrower resonances, a remarkable feature that is advantageous for their applications in metasurfaces and nanophotonics components, such as nonlinear higher-harmonic generators and nanoscale lasers.

General information
State: Published
Organisations: Department of Photonics Engineering, Plasmonics and Metamaterials, DTU Danchip, Department of Micro- and Nanotechnology, Laser Zentrum Hannover E.V., University of Southern Denmark
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Main Research Area: Technical/natural sciences

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Scopus rating (2015): CiteScore 14.76
Web of Science (2015): Indexed yes
Direct bonding of ALD Al₂O₃ to silicon nitride thin films

Direct bonding is an advanced joining technique for bonding of silicon based surfaces at low temperature without any specific surface pretreatment. The main purpose of this work is to develop new techniques to enhance the fabrication process for nanofluidic systems for in situ transmission electron microscopy (TEM) by improving low temperature annealing bonding strength when using atomic layer deposition of aluminum oxide. We have investigated and characterized bonding of Al₂O₃-Si₃N₄ (low stress silicon rich nitride) and Al₂O₃-SiN₄ (stoichiometric nitride) thin films annealed from room temperature up to 600 degrees C without pretreatment prior to the pre bonding. We find that bonding of Al₂O₃-Si₃N₄ and Al₂O₃-SiN₄ is favorable in a temperature range from room temperature to 600 °C. We report bonding strength of 1300±150 mJ/m² comparable to and in some case even higher than that of other materials Al₂O₃ can be bonded to. Preliminary tests demonstrating a well-defined nanochannel system with 100 nm high channels successfully bonded and tests against leaks using optical fluorescence technique and transmission electron microscopy (TEM) characterization of liquid samples are also reported. Moreover, the current bonding method can be also used for further MEMS applications.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Optofluidics, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, Technical University of Denmark
Authors: Laganà, S. (Intern), Mikkelsen, E. K. (Ekstern), Marie, R. (Intern), Hansen, O. (Intern), Mølhave, K. (Intern)
Number of pages: 4
Pages: 71-74
Direct Hysteresis Heating of Catalytically Active Ni–Co Nanoparticles as Steam Reforming Catalyst

We demonstrated a proof-of-concept catalytic steam reforming flow reactor system heated only by supported magnetic nickel–cobalt nanoparticles in an oscillating magnetic field. The heat transfer was facilitated by the hysteresis heating in the nickel–cobalt nanoparticles alone. This produced a sufficient power input to equilibrate the reaction at above 780 °C with more than 98% conversion of methane. The high conversion of methane indicated that Co-rich nanoparticles with a high Curie temperature provide sufficient heat to enable the endothermic reaction, with the catalytic activity facilitated by the Ni content in the nanoparticles. The magnetic hysteresis losses obtained from temperature-dependent hysteresis measurements were found to correlate well with the heat generation in the system. The direct heating of the catalytic system provides a fast heat transfer and thereby overcomes the heat-transfer limitation of the industrial-scale steam reformer. This could consequently enable a more compact steam reformer design.
Direct PCR - A rapid method for multiplexed detection of different serotypes of Salmonella in enriched pork meat samples

Salmonellosis, an infectious disease caused by Salmonella spp., is one of the most common foodborne diseases. Isolation and identification of Salmonella by conventional bacterial culture method is time consuming. In response to the demand for rapid on line or at site detection of pathogens, in this study, we developed a multiplex Direct PCR method for rapid detection of different Salmonella serotypes directly from pork meat samples without any DNA purification steps. An inhibitor-resistant Phusion Pfu DNA polymerase was used to overcome PCR inhibition. Four pairs of primers including a pair of newly designed primers targeting Salmonella spp. at subtype level were incorporated in the multiplex Direct PCR. To maximize the efficiency of the Direct PCR, the ratio between sample and dilution buffer was optimized. The sensitivity and specificity of the multiplex Direct PCR were tested using naturally contaminated pork meat samples for detecting and subtyping of Salmonella spp. Conventional bacterial culture methods were used as reference to evaluate the performance of the multiplex Direct PCR. Relative accuracy, sensitivity and specificity of 98.8%; 97.6% and 100%, respectively, were achieved by the method. Application of the multiplex Direct PCR to detect Salmonella in pork meat at slaughter reduces the time of detection from 5 to 6 days by conventional bacterial culture and serotyping methods to 14 h (including 12 h enrichment time). Furthermore, the method poses a possibility of miniaturization and integration into a point-of-need Lab-on-a-chip system for rapid online pathogen detection.
Disorder-induced localised gating in graphene

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Theoretical Nanotechnology
Authors: Aktor, T. (Intern), Jauho, A. (Intern), Power, S. (Intern)
Publication date: 2017
Main Research Area: Technical/natural sciences

Dispersive Molecular Imprinting of Proteins for the Production of Plastic Antibodies

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NanoChemistry
Authors: Ashley, J. (Intern), Feng, X. (Intern), Halder, A. (Intern), Zhou, T. (Intern), Sun, Y. (Intern)
Number of pages: 1
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Publisher: Technical University of Denmark (DTU)
Main Research Area: Technical/natural sciences
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Drop shape analysis for determination of dynamic contact angles by double sided elliptical fitting method

Contact angle measurements are a fast and simple way to measure surface properties and is therefore widely used to measure surface energy and quantify wetting of a solid surface by a liquid substance. In common praxis contact angle measurements are done with sessile drops on a horizontal surface fitted to a drop profile derived from the Young-Laplace equation. When measuring the wetting behaviour by tilting experiments this is not possible since it involves moving drops that are not in equilibrium. Here we present a fitting technique capable of determining the contact angle of asymmetric drops with very high accuracy even with blurry or noisy images. We do this by splitting the trace of a drop into a left and right part at the apex and then fit each side to an ellipse.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering
Authors: Andersen, N. K. (Intern), Taboryski, R. J. (Intern)
Number of pages: 6
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Main Research Area: Technical/natural sciences

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Journal: Measurement Science and Technology
Dry Etch Black Silicon with Low Surface Damage: Effect of Low Capacitively Coupled Plasma Power

Black silicon fabricated by reactive ion etch (RIE) is promising for integration into silicon solar cells thanks to its excellent light trapping ability. However, intensive ion bombardment during the RIE induces surface damage, which results in enhanced surface recombination velocity. Here, we present a RIE optimization leading to reduced surface damage while retaining excellent light trapping and low reflectivity. In particular, we demonstrate that the reduction of the capacitively coupled power during reactive ion etching preserves a reflectance below 1% and improves the effective minority carrier lifetime thanks to reduced ion energy. Surface passivation using atomic layer deposition of Al₂O₃ improves the effective lifetime to 7.5 ms and 0.8 ms for black silicon n- and p-type wafers, respectively.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Anhalt University of Applied Sciences, Fraunhofer Center for Silicon Photovoltaics CSP
Authors: Iandolo, B. (Intern), Plakhotnyuk, M. (Intern), Gaudig, M. (Ekstern), Davidsen, R. S. (Intern), Lausch, D. (Ekstern), Hansen, O. (Intern)
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Dual kinetic and mechanistic profiling of rolling circle amplification using real-time optomagnetic studies

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Stockholm University
Authors: Minero, G. K. A. (Intern), Rizzi, G. (Intern), Neumann, F. (Ekstern), Madaboosi, N. (Ekstern), Asalapuram, P. (Ekstern), Fock, J. (Intern), Nilsson, M. (Ekstern), Hansen, M. F. (Intern)
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Main Research Area: Technical/natural sciences
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Effective lifetime of minority carriers in black silicon nano-textured by cones and pyramids

We calculated the dependence of effective lifetime of minority carriers in black silicon nano-textured by cones and pyramids on the diameter of the cone base, the side of the pyramid base, the height of cone and pyramid. The numerical calculation shows that n-type polished plate of single crystal silicon and n-type plate of black silicon have a high minority carrier lifetime both in the bulk and on the silicon surface, indicating a high purity of both the bulk of silicon and its surface. However, the measured experimentally effective lifetime of minority carriers in the n-type black silicon is 1.55 ms and is determined by the surface lifetime. The measured effective lifetime of minority charge carriers in the p-type polished silicon is 1.24 ms. The minority carrier lifetime in the bulk of the polished p-type silicon is lower than the surface one.
Effect of carbon on interstitial ordering and magnetic properties of \( \varepsilon \)-Fe\(_{2}(N,C)_{1-z} \)

Hexagonal \( \varepsilon \)-iron nitride and \( \varepsilon \)-iron carbonitride phases are formed on nitriding and nitrocarburizing of iron and steel surfaces and can exist in broad compositional ranges. Long-range nitrogen ordering and magnetic properties for \( \varepsilon \)-iron nitrides and their dependence on composition have been the focus of several studies. So far, limited attention has been paid to the carbonitrides. In the current work, the effects of substitution of nitrogen by carbon on the interstitial ordering and magnetic properties in Fe\(_2(C,N)_{1-z}\) are explored using neutron diffraction, Mössbauer spectroscopy and vibrating sample magnetometry. Neutron diffraction patterns showed 001 and 301 superstructure reflections, confirming a previously proposed structural model in space group P31m (compared to P6\(_3\)22 for the pure nitrides). On partial substitution of nitrogen by carbon in \( \varepsilon \)-iron nitride the Curie temperature, the saturation magnetization and the hyperfine fields of the iron atoms are increased, while isomer shifts are decreased. The effects on the a and c lattice parameters indicate a change in interstitial ordering, which is related to more favorable interactions between a nitrogen and carbon atom than among nitrogen atoms. This interaction leads to additional interstitial (short-range) ordering and a decrease in the c lattice parameter, while the a lattice parameter is largely unaffected.
Effect of nanostructures orientation on electroosmotic flow in a microfluidic channel

Electroosmotic flow (EOF) is an electric-field-induced fluid flow that has numerous micro-/nanofluidic applications, ranging from pumping to chemical and biomedical analyses. Nanoscale networks/structures are often integrated in microchannels for a broad range of applications, such as electrophoretic separation of biomolecules, high reaction efficiency catalytic microreactors, and enhancement of heat transfer and sensing. Their introduction has been known to reduce EOF.

Hitherto, a proper study on the effect of nanostructures orientation on EOF in a microfluidic channel is yet to be carried out. In this investigation, we present a novel fabrication method for nanostructure designs that possess maximum orientation difference, i.e., parallel versus perpendicular indented nanolines, to examine the effect of nanostructures orientation on EOF. It consists of four phases: fabrication of silicon master, creation of mold insert via electroplating, injection molding with cyclic olefin copolymer, and thermal bonding and integration of practical inlet/outlet ports. The effect
of nanostructures orientation on EOF was studied experimentally by current monitoring method. The experimental results show that nanolines which are perpendicular to the microchannel reduce the EOF velocity significantly (approximately 20%). This flow velocity reduction is due to the distortion of local electric field by the perpendicular nanolines at the nanostructured surface as demonstrated by finite element simulation. In contrast, nanolines which are parallel to the microchannel have no effect on EOF, as it can be deduced that the parallel nanolines do not distort the local electric field. The outcomes of this investigation contribute to the precise control of EOF in lab-on-chip devices, and fundamental understanding of EOF in devices which utilize nanostructured surfaces for chemical and biological analyses.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Nanyang Technological University, Park Systems Ltd
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.87 SJR 1.339 SNIP 0.945
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.257 SNIP 1.035 CiteScore 3.07
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.497 SNIP 1.269 CiteScore 3.09
Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 1.602 SNIP 1.231 CiteScore 2.74
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Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
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ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.899 SNIP 1.451 CiteScore 3.86
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.844 SNIP 1.252
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.809 SNIP 1.27
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.857 SNIP 1.32
Effect of repeat unit structure and molecular mass of lactic acid bacteria hetero-exopolysaccharides on binding to milk proteins

Interactions of exopolysaccharides and proteins are of great importance in food science, but complicated to analyze and quantify at the molecular level. A surface plasmon resonance procedure was established to characterize binding of seven structure-determined, branched hetero-exopolysaccharides (HePSs) of 0.14–4.9 MDa from lactic acid bacteria to different milk proteins (β-casein, κ-casein, native and heat-treated β-lactoglobulin) at pH 4.0–5.0. Maximum binding capacity (RUmax) and apparent affinity (KA,app) were HePS- and protein-dependent and varied for example 10- and 600-fold, respectively, in the complexation with native β-lactoglobulin at pH 4.0. Highest RUmax and KA,app were obtained with heat-treated β-lactoglobulin and β-casein, respectively. Overall, RUmax and KA,app decreased 6- and 20-fold, respectively, with increasing pH from 4.0 to 5.0. KA,app was influenced by ionic strength and temperature, indicating that polar interactions stabilize HePS–protein complexes. HePS size as well as oligosaccharide repeat structure, conferring chain flexibility and hydrogen bonding potential, influence the KA,app.
Efficient electro-optic modulation in low-loss graphene-plasmonic slot waveguides

Surface plasmon polaritons enable light concentration within subwavelength regions, opening thereby new avenues for miniaturizing the device and strengthening light-matter interactions. Here we realize efficient electro-optic modulation in low-loss plasmonic waveguides with the aid of graphene, and the devices are fully integrated in the silicon-on-insulator platform. By advantageously exploiting low-loss plasmonic slot-waveguide modes, which weakly leak into a substrate while featuring strong fields within the two-layer-graphene covered slots in metals, we successfully achieve a tunability of 0.13 dB μm⁻¹ for our fabricated graphene-plasmonic waveguide devices with extremely low insertion loss, which outperforms previously reported graphene-plasmonic devices. Our results highlight the potential of graphene plasmonic...
leaky-mode hybrid waveguides to realize active ultra-compact devices for optoelectronic applications.

Electret Stability Related to the Crystallinity in Polypropylene
Through mixing isotactic-polypropylene (i-PP) and atactic-polypropylene (a-PP), we have demonstrated the importance of the crystallinity in polypropylene as an electret material. Samples with crystallinities between 7% and 47% were used. A high degree of crystallinity in polypropylene, used as an electret, gives a better charge stability with respect to temperature and humidity changes. The semicrystalline i-PP significantly outperforms a-PP regarding charge stability. a-PP is an amorphous polymer. By mixing a-PP and i-PP, the degree of crystallinity can be controlled, while all other sample preparation processes and characteristics can be identical. This is important since the performance of an electret material
is sensitive to its previous process history. Activation energies used for predicting the thermal potential decay are
determined from thermally stimulated current and isothermal potential decay experiments. Activation energies from 0.98
eV to 1.41 eV were determined. From these values, a very good agreement was achieved between the experimental
potential decay at room temperature for more than 290 days, and a theoretical estimation of the potential decay.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors
Authors: Thyssen, A. (Intern), Almdal, K. (Intern), Thomsen, E. V. (Intern)
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Main Research Area: Technical/natural sciences

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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.46 SJR 0.553 SNIP 1.53
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.551 SNIP 1.778 CiteScore 2.34
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.553 SNIP 1.701 CiteScore 2.03
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.682 SNIP 2.096 CiteScore 2.26
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.844 SNIP 1.912 CiteScore 2.17
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.601 SNIP 1.804 CiteScore 1.72
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.891 SNIP 1.942
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.916 SNIP 1.607
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.02 SNIP 1.831
Scopus rating (2007): SJR 0.869 SNIP 1.606
Scopus rating (2006): SJR 0.706 SNIP 1.844
Scopus rating (2005): SJR 0.701 SNIP 1.638
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.714 SNIP 1.51
Scopus rating (2003): SJR 0.754 SNIP 1.417
Scopus rating (2002): SJR 1.013 SNIP 1.037
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.799 SNIP 1.15
Scopus rating (2000): SJR 0.306 SNIP 0.89
We present a conceptually simple method for treating electron-phonon scattering and phonon limited mobilities. By combining Green’s function based transport calculations and molecular dynamics, we obtain a temperature dependent transmission from which we evaluate the mobility. We validate our approach by comparing to mobilities and conductivities obtained by the Boltzmann transport equation for different bulk and one-dimensional systems. For bulk silicon and gold we compare against experimental values. We discuss limitations and advantages of each of the computational approaches.
Electron trajectories and magnetotransport in nanopatterned graphene under commensurability conditions

Commensurability oscillations in the magnetotransport of periodically patterned systems, emerging from the interplay of cyclotron orbit and pattern periodicity, are a benchmark of mesoscopic physics in electron gas systems. Exploiting similar effects in two-dimensional materials would allow exceptional control of electron behavior, but it is hindered by the requirement to maintain ballistic transport over large length scales. Recent experiments have overcome this obstacle and observed distinct magnetoresistance commensurability peaks for perforated graphene sheets (antidot lattices).

Interpreting the exact mechanisms behind these peaks is of key importance, particularly in graphene, where a range of regimes are accessible by varying the electron density. In this work, a fully atomistic, device-based simulation of magnetoresistance experiments allows us to analyze both the resistance peaks and the current flow at commensurability conditions. Magnetoresistance spectra are found in excellent agreement with experiment, but we show that a semiclassical analysis, in terms of simple skipping or pinned orbits, is insufficient to fully describe the corresponding electron trajectories. Instead, a generalized mechanism in terms of states bound to individual antidots, or to groups of antidots, is required. Commensurability features are shown to arise when scattering between such states is enhanced.

The emergence and suppression of commensurability peaks is explored for different antidot sizes, magnetic field strengths, and electron densities. The insights gained from our study will guide the design and optimization of future experiments with nanostructured graphene.
**Electroosmotic flow in microchannel with black silicon nanostructures**

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Nanyang Technological University
Authors: Lim, A. E. (Ekstern), Lim, C. Y. (Ekstern), Lam, Y. C. (Ekstern), Taboryski, R. J. (Intern)
Publication date: 2017

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Source: PublicationPreSubmission
Source-ID: 136857115
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**Electrospinning of Xanthan Polysaccharide**
Electrospun pure xanthan polysaccharide nanofibers are prepared using formic acid as a solvent. Morphological studies by scanning electron microscopy show that uniform fibers with average diameters ranging from 128 ± 36.7 to 240 ± 80.7 nm are formed depending on the polysaccharide concentration (0.5 to 2.5 wt/vol%). The correlation between the concentration and the rheological properties of xanthan solutions, with the morphology of the nanofibers is investigated. At the polysaccharide concentrations where nanofiber formation is observed, an increase of the elastic modulus and first normal stress differences is observed. The typical "weak gel-like" and thixotropic properties known for aqueous xanthan solutions, are not observed for the xanthan solutions in formic acid. The Fourier transform infrared spectroscopic and circular dichroism studies verify that an esterification reaction takes place, where formic acid reacts with the pyruvic acid groups of xanthan. Hence, formate groups neutralize the pyruvic charges which in turn stabilize the helical conformation of xanthan. The results obtained from size-exclusion chromatography reveal a small difference in the molecular weight of the polysaccharide when dissolved in distilled water or in formic acid.

**General information**
State: Published
Organisations: National Food Institute, Research Group for Nano-Bio Science, Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Self-Organized Nanoporous Materials
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BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.945 SJR 0.755
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.01 SJR 0.905 SNIP 0.972
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.847 SNIP 1.072 CiteScore 2.88
Electrospun Polymer Fiber Lasers for Applications in Vapor Sensing

A sensing approach based on laser emission from polymer fiber networks is presented. Poly(methyl methacrylate) (PMMA) fibers doped with a laser dye are fabricated by electrospinning. They form random loop resonators, which show laser emission upon optical pumping. The shift of the spectral position of the narrow lasing modes upon uptake of alcohol vapors (model vapors are methanol and ethanol) serves as sensor signal. Thus, the high sensitivity related to the spectral line shifts of cavity-based transducers can be combined with the fiber's large surface to volume ratio. The resulting optical sensors feature excellent sensing performance due to the large overlap (more than 80%) of light field and transducer. The shift of the laser modes results from the swelling of the polymer when exposed to solvent vapors. Due to distinctly different diffusion coefficients in polymers, the uptake dynamics reflected in the transient shift of the lasing peaks can be used to discriminate ethanol and methanol vapor in mixtures of them. The sensing mechanism is expected to be applicable to other solvent vapors that cause polymer swelling.
Elements of Eoarchean life trapped in mineral Inclusions

Metasedimentary rocks from Isua, West Greenland (over 3,700 million years old) contain 13C-depleted carbonaceous compounds, with isotopic ratios that are compatible with a biogenic origin. Metamorphic garnet crystals in these rocks contain trails of carbonaceous inclusions that are contiguous with carbon-rich sedimentary beds in the host rock, where carbon is fully graphitized. Previous studies have not been able to document other elements of life (mainly hydrogen, oxygen, nitrogen and phosphorus) structurally bound to this carbonaceous material. Here we study carbonaceous inclusions armoured within garnet porphyroblasts, by in situ infrared absorption on approximately 10-21 m³ domains within these inclusions. We show that the absorption spectra are consistent with carbon bonded to nitrogen and oxygen, and probably also to phosphate. The levels of C-H or O-H bonds were found to be low. These results are consistent with biogenic organic material isolated for billions of years and thermally matured at temperatures of around 500 °C. They therefore provide spatial characterization for potentially the oldest biogenic carbon relics in Earth's geological record. The preservation of Eoarchean organic residues within sedimentary material corroborates earlier claims for the biogenic origins of carbon in Isua metasediments.
Emerging Biofabrication Strategies for Engineering Complex Tissue Constructs

The demand for organ transplantation and repair, coupled with a shortage of available donors, poses an urgent clinical need for the development of innovative treatment strategies for long-term repair and regeneration of injured or diseased tissues and organs. Bioengineering organs, by growing patient-derived cells in biomaterial scaffolds in the presence of pertinent physicochemical signals, provides a promising solution to meet this demand. However, recapitulating the structural and cytoarchitectural complexities of native tissues in vitro remains a significant challenge to be addressed. Through tremendous efforts over the past decade, several innovative biofabrication strategies have been developed to overcome these challenges. This review highlights recent work on emerging three-dimensional bioprinting and textile techniques, compares the advantages and shortcomings of these approaches, outlines the use of common biomaterials and advanced hybrid scaffolds, and describes several design considerations including the structural, physical, biological, and economical parameters that are crucial for the fabrication of functional, complex, engineered tissues. Finally, the applications of these biofabrication strategies in neural, skin, connective, and muscle tissue engineering are explored.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Technical University of Denmark, University of Victoria BC, Arizona State University
Energy Based Clutter Filtering for Vector Flow Imaging

To obtain accurate blood flow velocity estimates it is important to remove the clutter signal originating from tissue. Conventionally, the clutter signal has been separated from the blood signal based on the difference of their spectral frequencies. However, this approach is not enough for obtaining vector flow measurements, since the spectra overlaps at high beam-to-flow angles. In this work a distinct approach is proposed, where the energy of the velocity spectrum is used to differentiate among the two signals. The energy based method is applied by limiting the amplitude of the velocity spectrum function to a predetermined threshold. The effect of the clutter filtering is evaluated on a plane wave (PW) scan sequence in combination with transverse oscillation (TO) and directional beamforming (DB) for velocity estimation. The performance of the filter is assessed by comparison of the velocity estimates of the proposed filter against a conventional moving average clutter filter. The effect of tissue motion is investigated using a Field II simulation of a straight vessel with moving wall, while the direct effect of the filter on the velocity estimates is evaluated on a CFD model of a carotid bifurcation with a fixed vessel wall. The results show that the proposed filter outperformed the moving average during moving vessel wall conditions, where standard deviations from the velocity magnitudes and angles were kept consistently below 6% and 6° compared to 63% and 48° on the moving average filter. The results on the CFD showed that on non-moving conditions the velocity estimates had minor statistical differences with errors on the magnitude of -7.95±10.1% and angles of 0.15±6.65° for the proposed filter compared to -5.83±9.08% and -0.12±4.48°.

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Source: PublicationPreSubmission
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Engineering the Surface/Interface Structures of Titanium Dioxide Micro and Nano Architectures towards Environmental and Electrochemical Applications

Titanium dioxide (TiO₂) materials have been intensively studied in the past years because of many varied applications. This mini review article focuses on TiO₂ micro and nano architectures with the prevalent crystal structures (anatase, rutile, brookite, and TiO₂(B)), and summarizes the major advances in the surface and interface engineering and applications in environmental and electrochemical applications. We analyze the advantages of surface/interface engineered TiO₂ micro and nano structures, and present the principles and growth mechanisms of TiO₂ nanostructures via different strategies, with an emphasis on rational control of the surface and interface structures. We further discuss the applications of TiO₂ micro and nano architectures in photocatalysis, lithium/sodium ion batteries, and Li-S batteries. Throughout the discussion, the relationship between the device performance and the surface/interface structures of TiO₂ micro and nano structures will be highlighted. Then, we discuss the phase transitions of TiO₂ nanostructures and possible strategies of improving the phase stability. The review concludes with a perspective on the current challenges and future research directions.

General information
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Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Hebei University of Science and Technology, Boston College
Authors: Wang, X. (Ekstern), Zhao, Y. (Ekstern), Mølhave, K. (Intern), Sun, H. (Intern)
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Nanomaterials
Volume: 7
Issue number: 11
Enhanced efficacy of sublingual immunotherapy by liposome-mediated delivery of allergen

Immunotherapy by sublingual administration of allergens provides high patient compliance and has emerged as an alternative to subcutaneous immunotherapy for the treatment of IgE-associated allergic diseases. However, sublingual immunotherapy (SLIT) can cause adverse events. Development of allergen delivery systems enabling more efficient delivery and hence lower allergen load might reduce the adverse events. In the present study, we have investigated neutral and cationic liposomes as delivery systems of ovalbumin (OVA), as a model allergen, in an OVA-induced allergic airway inflammation model. We investigated the liposome carriers' ability to improve tolerance induction of antigens compared to the corresponding dose of free OVA. Mice were treated sublingually over 2 weeks with free or liposome encapsulated OVA followed by intraperitoneal injections and intranasal challenge. Mice sublingually treated with OVA-liposomes showed a significant reduction of airway eosinophilia and splenocyte proliferation in comparison to free OVA. A similar nonsignificant pattern was seen for OVA-specific IgE antibodies. In addition, reduced levels of interferon-gamma and interleukin-5 were observed in spleen cell culture supernatants from OVA-liposome-treated mice compared to the sham-treated group. In conclusion, in vivo efficacy data showed that prophylactic SLIT with OVA-liposomes is significantly more effective in preventing allergic inflammation than the corresponding dose of free OVA.
Enhanced field emission of ZnO nanoneedle arrays via solution etching at room temperature

ZnO nanoneedle arrays (ZnO nns) were synthesized by a facile two-step solution-phase method based on the etching of pre-synthesized ZnO nanowire arrays (ZnO nws) with flat ends at room temperature. Field emission measurement results showed that the turn-on electronic fields of ZnO nns and nws were 2.7 and 5.3 V μm⁻¹ at a current density of 10 μA cm⁻², and the field enhancement factors were 4939.3 for ZnO nns and 1423.6 for ZnO nws. The enhanced field emission properties in ZnO nns were ascribed to the sharp tip geometry.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, CITIC Dicastal Wheel Manufacturing Co., Ltd, Pakistan Institute of Nuclear Science and Technology
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Number of pages: 4
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Scopus rating (2017): SNIP 0.887 SJR 0.782
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.51 SJR 0.754 SNIP 0.939
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.767 SNIP 0.993 CiteScore 2.5
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.877 SNIP 1.28 CiteScore 2.64
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Enhanced high-frequency microwave absorption of Fe₃O₄ architectures based on porous nanoflake
Hierarchical Fe₃O₄ architectures assembled with porous nanoplates (p-Fe₃O₄) were synthesized. Due to the strong shape anisotropy of the nanoplates, the p-Fe₃O₄ exhibits increased microwave resonance towards high frequency range. The improved microwave absorption properties of the p-Fe₃O₄, including dielectric loss and magnetic loss, are attributed to the enhanced electric polarization and interfacial polarization induced by oxygen vacancies and high surface area.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Hebei University of Science and Technology, Northeastern University at Qinhuangdao, Chinese Academy of Sciences
Authors: Wang, X. (Ekstern), Liu, Y. (Ekstern), Han, H. (Ekstern), Mølhave, K. (Intern), Sun, H. (Intern)
Number of pages: 5
Pages: 16013-16017
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Enrichment of megabase-sized DNA molecules for single-molecule optical mapping and next-generation sequencing

Next-generation sequencing (NGS) has caused a revolution, yet left a gap: long-range genetic information from native, non-amplified DNA fragments is unavailable. It might be obtained by optical mapping of megabase-sized DNA molecules. Frequently only a specific genomic region is of interest, so here we introduce a method for selection and enrichment of megabase-sized DNA molecules intended for single-molecule optical mapping: DNA from a human cell line is digested by the NotI rare-cutting enzyme and size-selected by pulsed-field gel electrophoresis. For demonstration, more than 600 sub-megabase- to megabase-sized DNA molecules were recovered from the gel and analysed by denaturation-renaturation optical mapping. Size-selected molecules from the same gel were sequenced by NGS. The optically mapped molecules and the NGS reads showed enrichment from regions defined by NotI restriction sites. We demonstrate that the unannotated genome can be characterized in a locus-specific manner via molecules partially overlapping with the annotated genome. The method is a promising tool for investigation of structural variants in enriched human genomic regions for both research and diagnostic purposes. Our enrichment method could potentially work with other genomes or target specified regions by applying other genomic editing tools, such as the CRISPR/Cas9 system.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Optofluidics, Polymer Micro & Nano Engineering, University of Copenhagen, NIL Technology ApS
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BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.63 SJR 1.692 SNIP 1.354
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.034 SNIP 1.597 CiteScore 5.3
Web of Science (2015): Indexed yes
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Scopus rating (2013): SJR 1.998 SNIP 1.57 CiteScore 4.06
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Web of Science (2013): Indexed yes
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Enzyme sensitive liposomes in chemotherapy and potention of immunotherapy

Cancer is one of the leading causes of death in the world, and improved treatment approaches are urgently needed. One of the major treatment regimes used in the clinic today is chemotherapy. However, chemotherapeutic drugs are often hampered by poor circulation and low specificity, leading to low efficacy and induction of severe adverse effects. Interestingly, the pharmacokinetics and biodistribution of drugs can be substantially altered by encapsulation in liposomal drug delivery vehicles. The first chapter of this thesis gives a brief introduction to cancer followed by a discussion of the applicability of liposomes as drug delivery vehicles in cancer therapy.

The second chapter describes the development of a liposome system with an inbuilt release mechanism triggered by secretory phospholipase A2 (sPLA2). This enzyme is expressed at elevated levels in many human cancers, and as such represents a potential cancer specific trigger mechanism. The presented study validates the concept of sPLA2 induced release. However, in vivo evaluation reveals severe toxicity, potentially related to off-target activation of the trigger mechanism.

In the third chapter, a matrix metalloproteinase (MMP) sensitive liposome system is evaluated. Here cationic liposomes are engineered with an MMP cleavable PEG construct, aimed at shedding the PEG layer upon encounter with cancer expressed MMP enzymes, leading to exposure of the cationic charge and enhanced uptake in cancer cells. It is demonstrated that although exposure of cationic charge leads to enhanced uptake, it does not necessarily lead to enhanced bioavailability of the drug, underlining the importance of a release mechanism.

The fourth chapter explores the impact of the immune system on the efficacy of liposomal oxaliplatin. The chapter starts with an introduction to the cancer-immunity cycle and to how treatment approaches can aid this interplay. Subsequently it demonstrates that the presence of a functional immune system is important in the efficacy of liposomal oxaliplatin, and that this efficacy can be substantially enhanced by combination with the immune modulatory agent R848.

In the fifth and last chapter it is concluded that the potential of liposomes in cancer drug delivery is highly dependent on the intrinsic parameters of the liposome, the phenotype of the cancer and the potential effects on off-target tissues. Furthermore, it is underlined that effective cancer therapy requires approaches that target several different aspects of the cancer, and that in the case of liposomal oxaliplatin this can be partially achieved by combination with an effective immune modulatory agent. Finally it is speculated that further improvement of the presented treatment strategy might be obtained by targeting additional aspects of the cancer-immunity interplay not already addressed.

Evaluation of a Bioabsorbable Self-Expandable Vein Stent-Base Made of Poly(l-lactide) In Vitro and In Vivo

Purpose This study was designed to evaluate performance and tissue response to a self-expandable bioabsorbable vein stent-base cut from a tube with enhanced stiffness and strength in vitro and in vivo.

Methods A diamond-shaped stent-base was cut from a sequential biaxially strained poly(l-lactide) (PLLA) tube for optimized performance. The performance of the stent-base was evaluated in a finite element analysis model, and validation was attempted in vitro through a cyclic flat-plate compression and radial force measurement. The performance of the stent-base was tested in vivo using 3 sheep with 2 implants each for 2 and 3½ weeks, respectively.

Results In vitro the stent-base showed an elliptical deformation but no fractures. In vivo the stent-base showed adequate radial force and no migration. All implanted stent-bases showed multiple fractures not only at the predicted stress zones but at all connecting points. Fragments of the caudal stent-base stayed in the vein wall indicating sufficient tissue coverage to avoid embolization of the fractured stent pieces, whereas fragments from the cranial device remaining were few. Neointima formation was confirmed histologically at 2 and 3½ weeks.

Conclusion A bioabsorbable self-expandable stent-base made from PLLA for large veins seems feasible, but over time, the PLLA used in this study appears too stiff and lacks the sufficient flexibility to move with the vena cava, causing multiple
Exact theory of optical tweezers and its application to absolute calibration

Optical tweezers have become a powerful tool for basic and applied research in cell biology. Here, we describe an experimentally verified theory for the trapping forces generated by optical tweezers based on first principles that allows absolute calibration. For pedagogical reasons, the steps that led to the development of the theory over the past 15 years are outlined. The results are applicable to a broad range of microsphere radii, from the Rayleigh regime to the ray optics one, for different polarizations and trapping heights, including all commonly employed parameter domains. Protocols for implementing absolute calibration are given, explaining how to measure all required experimental parameters, and including a link to an applet for stiffness calculations.

Exchange-biased AMR bridges for magnetic field sensing and biosensing

We introduce magnetic field sensor bridges that are formed by combinations of stripes of an exchange-pinned magnetic stack displaying anisotropic magnetoresistance. We present a systematic overview on how the stripe geometries can be combined to form sensor bridges with a scalable signal and how these can be tailored towards detection of external magnetic fields and of magnetic beads over or tethered to the sensor surface. Particular attention is given to the case where the beads are magnetized by the sensor self-field due to the bias current passed through the sensor, which is interesting for magnetic bead sensing and where the static and dynamic magnetic bead response can be monitored in the 2nd harmonic sensor response to an oscillating bias current. The recent literature on applications of these sensors for detection of magnetic fields and of the dynamic and static response of magnetic beads in suspension and attached to the sensor surface is reviewed as well as the use of the sensors for magnetic biosensing in volume- and surface-based formats. We illustrate that the sensors can be flexibly designed and applied for a number of sensing applications with sensitive detection of magnetic fields down to the nT range.
Experimental study on heat transfer augmentation of graphene based ferrofluids in presence of magnetic field

The effect of a permanent magnetic field on the heat transfer characteristics of hybrid graphene-magnetite nanofluids (hybrid nanofluid) under forced laminar flow was experimentally investigated. For this purpose, a reduced graphene oxide-Fe3O4 was synthesized by using two-dimensional (2D) graphene oxide, iron salts and tannic acid as the reductant and stabilizer. Graphene sheets acted as the supporting materials to enhance the stability and thermal properties of magnetite nanoparticles. The thermo-physical and magnetic properties of this hybrid nanofluid have been widely characterized and it shows that the thermal conductivity increased up to 11%. The hybrid nanofluid behaves as a Newtonian fluid with liquid like behavior with superparamagnetic properties as was evident from its magnetic saturation value at 45.9 emu/g. Moreover, the experimental heat-transfer results indicated that the heat transfer enhancement of the hybrid nanofluid compared to the control fluid (distilled water) was negligible when no magnetic field was applied. Additionally, the convective heat transfer was significantly improved under the influence of a magnetic field with a maximum enhancement of 82% in terms of the convective heat transfer properties of the hybrid nanofluid.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Sharif University of Technology, University of Malaya, Tarbiat Modares University
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Main Research Area: Technical/natural sciences

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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.78 SJR 1.438 SNIP 1.851
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.683 SNIP 1.884 CiteScore 3.32
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.539 SNIP 2.187 CiteScore 3.16
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.466 SNIP 2.469 CiteScore 3.31
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.492 SNIP 2.422 CiteScore 2.7
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.338 SNIP 2.186 CiteScore 2.83
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.385 SNIP 2.012
BFI (2009): BFI-level 2
**Extraction And SERS Based Detection Of Bacterial Metabolites In Mixture On A Centrifugal Microfluidic Device**

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Politecnico di Torino
Authors: Morelli, L. (Intern), Serioli, L. (Intern), Centorbi, F. A. (Ekstern), Matteucci, M. (Intern), Demarchi, D. (Ekstern), Zor, K. (Intern), Boisen, A. (Intern)
Publication date: 2017
Event: Abstract from 21st International Conference on Miniaturized Systems for Chemistry and Life Sciences, Savannah, United States.
Main Research Area: Technical/natural sciences
Surface enhanced Raman scattering (SERS), Centrifugal microfluidics, liquid-liquid extraction (LLE), p-coumaric acid, Cinnamic acid

**Fabrication and characterization of Au dimer antennas on glass pillars with enhanced plasmonic response**

We report on the fabrication and dark-field spectroscopy characterization of Au dimer nanoantennas placed on top of SiO2 nanopillars. The reported process enables the fabrication of nanopillar dimers with gaps down to 15 nm and heights up to 1 μm. A clear dependence of the plasmonic resonance position on the dimer gap is observed for smaller pillar heights, showing the high uniformity and reproducibility of the process. It is shown how increasing the height of nanopillars significantly affects the recorded elastic scattering spectra from Au nanoantennas. The results are compared to finite-difference time-domain (FDTD) and finite-element method (FEM) simulations. Additionally, measured spectra are accompanied by dark-field microscopy images of the dimers, showing the pronounced change in color. Placing nanoantennas on nanopillars with a height comparable to the in-plane dimer dimensions results in an enhancement of the scattering response, which can be understood through reduced interaction of the near-fields with the substrate. When increasing the pillar height further, scattering by the pillars themselves manifests itself as a strong tail at lower wavelengths. Additionally, strong directional scattering is expected as a result of the interface between the nanoantennas and nanopillars, which is taken into account in simulations. For pillars of height close to the plasmonic resonance wavelength, the scattering spectra become more complex due to additional scattering peaks as a result of larger geometrical nonuniformities.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Technische Universität Wien
Fabrication, characterization and evaluation of bacterial cellulose-based capsule shells for oral drug delivery

Bacterial cellulose (BC) was investigated for the first time for the preparation of capsule shells for immediate and sustained release of drugs. The prepared capsule shells were characterized using X-ray diffraction, scanning electron microscopy and Fourier transform infrared spectroscopy. The BC capsule shells were studied for drug release using an USP type-I dissolution apparatus. Irrespective of the drying method and the thickness of the BC sheet, the capsule shells displayed an immediate drug release profile. Moreover, the addition of release-retardant cellulosic polymers sustained the drug release having first-order kinetics for hydroxypropylmethylcellulose and carboxymethyl cellulose sodium with R² values of 0.9995 and 0.9954, respectively. Furthermore, these capsules shells remained buoyant in 0.1 N HCl (pH 1.2) solution up to 12 h. This study showed that BC is a promising alternative to gelatin capsules with both immediate and sustained drug release properties depending upon the compositions of the encapsulated materials.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, COMSATS Institute of Information Technology, University of Helsinki, University of Turku
Authors: Ullah, H. (Ekstern), Badshah, M. (Ekstern), Mäkilä, E. (Ekstern), Salonen, J. (Ekstern), Shahbazi, M. (Intern), Santos, H. A. (Ekstern), Khan, T. (Ekstern)
Number of pages: 10
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Main Research Area: Technical/natural sciences
Fabrication of 3D electrodes for subretinal photovoltaic stimulation

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Experimental Surface and Nanomaterials Physics, Aarhus University Hospital
Authors: Davidsen, R. S. (Intern), Keller, S. S. (Intern), Bek, T. (Ekstern), Hansen, O. (Intern)
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Fabrication of completely free-standing pyrolytic carbon string resonator

General information
State: Published
Organisations: Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Department of Micro- and Nanotechnology, Nanoprobes
Authors: Nguyen, Q. L. (Intern), Larsen, P. E. (Intern), Boisen, A. (Intern), Keller, S. S. (Intern)
Number of pages: 1
Publication date: 2017
Main Research Area: Technical/natural sciences

Fabrication of completely free-standing pyrolytic carbon string resonators

General information
State: Published
Organisations: Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Department of Micro- and Nanotechnology, Nanoprobes
Authors: Nguyen, Q. L. (Intern), Larsen, P. E. (Intern), Boisen, A. (Intern), Keller, S. S. (Intern)
Number of pages: 1
Publication date: 2017
Main Research Area: Technical/natural sciences

Fabrication of Large Area Broadband and Omnidirectional Antireflective Transparent Foils by Roll-to-Roll Extrusion Coating

This study investigates the fabrication and performance of broadband and omnidirectional antireflective polymer foils, in the visible spectrum (400–800 nm), consisting of subwavelength inverted moth-eye structures. The foils are fabricated by a high throughput roll-to-roll extrusion coating process allowing structuring on both sides at a rate of 60 m min−1, with web width 45 cm. The highest average transmittance obtained in the visible spectrum is (98 ± 1) %; compared with (92 ± 1) % for the unstructured foil. The antireflective foil shows no significant difference in transmittance between normal incidence and incidence up to at least 60°. The foil performance is also investigated for different depths (Dp) and shapes of structures. The transmittance initially increases with Dp and reaches a maximum at Dp = 120 nm. For process parameters yielding greater depths, other shape factors also play a critical role in the foil's antireflective properties.

General information
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Organisations: Department of Mechanical Engineering, Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Department of Photonics Engineering, Optical Microsensors and Micromaterials, Danish Fundamental Metrology, Heliac ApS
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Fabrication of three-dimensional carbon microelectrodes for electrochemical sensing

Carbon microelectrodes have a wide range of applications because of their unique material properties and biocompatibility. The aim of the research work carried out in this thesis was to develop three-dimensional (3D) carbon microelectrodes for electrochemical applications. Three different fabrication processes were established for fabrication of 3D carbon microelectrodes using UV photolithography followed by pyrolysis. UV exposure at three different wavelengths 365 nm, 313 nm and 405 nm was optimized to fabricate suspended 3D epoxy polymer templates. The polymer template was pyrolysed at high temperature to obtain the corresponding carbon microelectrodes. The fabricated microelectrodes
are characterized for their physical, electrical and electrochemical properties. The pyrolysis process was optimized for low electrical resistance and high mechanical stability. To explore the application of carbon microelectrodes four different model systems (Glucose sensing, Yeast analysis, Dopamine detection in human stem cell and bone cell monitoring) were tested. In all the model systems 3D carbon microelectrodes showed a 2-3 folds higher sensing signal when compared to 2D carbon electrodes.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology
Authors: Hemanth, S. (Intern), Keller, S. S. (Intern), Caviglia, C. (Intern)
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**Fast Plane Wave 2-D Vector Flow Imaging Using Transverse Oscillation and Directional Beamforming**
Several techniques can estimate the 2-D velocity vector in ultrasound. Directional beamforming (DB) estimates blood flow velocities with a higher precision and accuracy than transverse oscillation (TO), but at the cost of a high beamforming load when estimating the flow angle. In this paper, it is proposed to use TO to estimate an initial flow angle, which is then refined in a DB step. Velocity magnitude is estimated along the flow direction using cross-correlation. It is shown that the suggested TO-DB method can improve the performance of velocity estimates compared to TO, and with a beamforming load, which is 4.6 times larger than for TO and seven times smaller than for conventional DB. Steered plane wave transmissions are employed for high frame rate imaging, and parabolic flow with a peak velocity of 0.5 m/s is simulated in straight vessels at beamto-flow angles from 45 to 90. The TO-DB method estimates the angle with a bias and standard deviation (SD) less than 2, and the SD of the velocity magnitude is less than 2%. When using only TO, the SD of the angle ranges from 2 to 17 and for the velocity magnitude up to 7%. Bias of the velocity magnitude is within 2% for TO and slightly larger but within 4% for TO-DB. The same trends are observed in measurements although with a slightly larger bias. Simulations of realistic flow in a carotid bifurcation model provide visualization of complex flow, and the spread of velocity magnitude estimates is 7.1 cm/s for TO-DB, while it is 11.8 cm/s using only TO. However, velocities for TO-DB are underestimated at peak systole as indicated by a regression value of 0.97 for TO and 0.85 for TO-DB. An in vivo scanning of the carotid bifurcation is used for vector velocity estimations using TO and TO-DB. The SD of the velocity profile over a cardiac cycle is 4.2% for TO and 3.2% for TO-DB.

**General information**
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Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering, Department of Information Technology, Center for Fast Ultrasound Imaging, Copenhagen University Hospital
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BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.814 SNIP 1.494 CiteScore 2.43
Web of Science (2015): Indexed yes
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Scopus rating (2014): SJR 1.088 SNIP 1.627 CiteScore 2.18
Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 0.872 SNIP 1.496 CiteScore 2.18
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
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BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.733 SNIP 1.325 CiteScore 1.95
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
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Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.296 SNIP 1.775
Web of Science (2009): Indexed yes
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Scopus rating (2008): SJR 1.324 SNIP 1.567
Web of Science (2008): Indexed yes
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Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.197 SNIP 2.162
Web of Science (2006): Indexed yes
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Web of Science (2005): Indexed yes
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Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.437 SNIP 1.742
Web of Science (2003): Indexed yes
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Web of Science (2002): Indexed yes
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Scopus rating (1999): SJR 0.808 SNIP 1.386
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Publication: Research - peer-review › Journal article – Annual report year: 2017
Fast Plane Wave Imaging
This PhD project investigates and further develops methods for ultrasound plane wave imaging and blood flow estimation with the objective of overcoming some of the major limitations in conventional ultrasound systems, which are related to low frame rates and only estimation of velocities along the ultrasound beam. The first part of the contribution investigates the compromise between frame rate and plane wave image quality including the influence of grating lobes from a λ-pitch transducer. A method for optimizing the image quality is suggested, and it is shown that the frame rate can be increased by a factor of three without loss of image quality for a particular λ/2-pitch transducer, when compared to a λ-pitch transducer. The second part presents a method for high frame rate 2-D vector flow imaging. The method was validated in simulations and measurements, and it is shown that angles can be estimated with a bias and standard deviation less than 2°, and the velocity magnitude can be estimated with a bias and standard deviation less than 4% over a large range of beam-to-flow angles. The vector flow method was also investigated under laminar and complex flow conditions in the carotid arteries in ten healthy volunteers. Complex flow patterns were measured in an anthropomorphic flow phantom and showed good agreement with the velocity field simulated using computational fluid dynamics. The last part of the contribution investigates two clinical applications. Plane wave imaging was used for slow velocity flow estimation in the human placenta, which made it possible to map the vessel resistance in several fetal arteries. Finally, vector flow imaging was used for volume flow estimation in patients undergoing dialysis. The sources of error related to the volume flow estimation were investigated, making it possible to compensate for the errors. The developed techniques for plane wave imaging using high frame rates and/or estimation of 2-D vector flow may give the clinicians new tools for assessing the health of blood vessels and aid while examining patients with cardiovascular and organ diseases.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering
Authors: Jensen, J. (Intern), Jensen, J. A. (Intern), Stuart, M. B. (Intern)
Number of pages: 210
Publication date: 2017

Fe₃O₄@polyaniline yolk-shell micro/nanospheres as bifunctional materials for lithium storage and electromagnetic wave absorption
Unique Fe₃O₄/polyaniline (PANI) composite with yolk-shell micro/nanostructure (FPys) has been successfully synthesized by a facile silica-assisted in-situ polymerization and subsequent etching strategy. The structural and compositional studies of the FPys composites are performed by employing X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS). The yolk-shell morphology of the products is confirmed by scanning electron microscopy (SEM) and transmission electron microscopy (TEM) observations. When evaluated as anode material for lithium-ion batteries, the as-prepared FPys electrodes deliver superior capacity, better cycling stability and rate capability than those of bare Fe₃O₄ micro/nanospheres and Fe₃O₄/PANI core-shell (FPcs) electrodes. Moreover, FPys also exhibits excellent electromagnetic wave absorption performance when comparing to the synthesized Fe₃O₄-based electromagnetic wave absorbers, in which strong reflection loss and extensive response bandwidth can be achieved simultaneously. The excellent bifunctional properties of FPys material are associated with the specially designed hierarchical micro/nanostructures. The current strategy that application directed structural design can be applied to the synthesis of other multifunctional materials.

General information
State: Published
Organisations: Department of Chemistry, NanoChemistry, Organic Chemistry, Department of Micro- and Nanotechnology, Molecular Windows, Hebei University of Science and Technology, Central South University
Authors: Wang, X. (Ekstern), Zhang, M. (Intern), Zhao, J. (Intern), Huang, G. (Ekstern), Sun, H. (Intern)
Pages: 1054-1063
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 1.093 SNIP 1.328
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.37 SJR 0.958 SNIP 1.221
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.89 SNIP 1.268 CiteScore 3.13
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.948 SNIP 1.453 CiteScore 2.96
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.96 SNIP 1.475 CiteScore 2.78
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.913 SNIP 1.362 CiteScore 2.26
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.908 SNIP 1.386 CiteScore 2.27
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.922 SNIP 1.126
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.84 SNIP 1.024
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.89 SNIP 1.084
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.791 SNIP 0.935
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.861 SNIP 1.046
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.689 SNIP 0.938
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.984 SNIP 1.123
Scopus rating (2003): SJR 1.017 SNIP 1.036
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.954 SNIP 0.97
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.874 SNIP 0.804
Scopus rating (2000): SJR 1.065 SNIP 0.783
Stacked van der Waals (vdW) heterostructures where semiconducting two-dimensional (2D) materials are contacted by overlaid graphene electrodes enable atomically thin, flexible electronics. We use first-principles quantum transport simulations of graphene-contacted MoS2 devices to show how the transistor effect critically depends on the stacking configuration relative to the gate electrode. We can trace this behavior to the stacking-dependent response of the contact region to the capacitive electric field induced by the gate. The contact resistance is a central parameter and our observation establishes an important design rule for ultrathin devices based on 2D atomic crystals.
Finding the Needle in the Haystack—the Use of Microfluidic Droplet Technology to Identify Vitamin-Secreting Lactic Acid Bacteria

Efficient screening technologies aim to reduce both the time and the cost required for identifying rare mutants possessing a phenotype of interest in a mutagenized population. In this study, we combined a mild mutagenesis strategy with high-throughput screening based on microfluidic droplet technology to identify Lactococcus lactis variants secreting vitamin B2 (riboflavin). Initially, we used a roseoflavin-resistant mutant of L. lactis strain MG1363, JC017, which secreted low levels of riboflavin. By using fluorescence-activated droplet sorting, several mutants that secreted riboflavin more efficiently than JC017 were readily isolated from the mutagenesis library. The screening was highly efficient, and candidates with as few as 1.6 mutations per million base pairs (Mbp) were isolated. The genetic characterization revealed that riboflavin production was triggered by mutations inhibiting purine biosynthesis, which is surprising since the purine nucleotide GTP is a riboflavin precursor. Purine starvation in the mutants induced overexpression of the riboflavin biosynthesis cluster ribABGH. When the purine starvation was relieved by purine supplementation in the growth medium, the outcome was an immediate downregulation of the riboflavin biosynthesis cluster and a reduction in riboflavin production. Finally, by applying the new isolates in milk fermentation, the riboflavin content of milk (0.99 mg/liter) was improved to 2.81 mg/liter, compared with 0.66 mg/liter and 1.51 mg/liter by using the wild-type strain and the original roseoflavin-resistant mutant JC017, respectively. The results obtained demonstrate how powerful classical mutagenesis can be when combined with droplet-based microfluidic screening technology for obtaining microorganisms with useful attributes.

IMPORTANCE The food industry prefers to use classical approaches, e.g., random mutagenesis followed by screening, to improve microorganisms used in food production, as the use of recombinant DNA technologies is still not widely accepted. Although modern automated screening platforms are widely accessible, screening remains as a bottleneck in strain development, especially when a mild mutagenesis approach is applied to reduce the chance of accumulating unintended mutations, which may cause unwanted phenotypic changes. Here, we incorporate a droplet-based high-throughput screening method into the strain development process and readily capture L. lactis variants with more efficient vitamin secretion from low-error-rate mutagenesis libraries. This study shows that useful mutants showing strong phenotypes but without extensive mutations can be identified with efficient screening technologies. It is therefore possible to avoid accumulating detrimental mutations while enriching beneficial ones through iterative mutagenesis screening. Due to the low mutation rates, the genetic determinants are also readily identified.

General information
State: Published
Organisations: National Food Institute, Research Group for Microbial Biotechnology and Biorefining, Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology
Authors: Chen, J. (Intern), Vestergaard, M. (Intern), Jensen, T. G. (Intern), Shen, J. (Intern), Dufva, M. (Intern), Solem, C. (Intern), Jensen, P. R. (Intern)
Number of pages: 12
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: mBio (Print)
First-principles electron transport with phonon coupling: Large scale at low cost

Phonon-assisted tunneling plays a crucial role for electronic device performance and even more so with future size down-scaling. We show how one can include this effect in large-scale first-principles calculations using a single "special thermal displacement" (STD) of the atomic coordinates at almost the same cost as elastic transport calculations, by extending the recent method of Zacharias et al. [Phys. Rev. B 94, 075125 (2016)] to the important case of Landauer conductance. We apply the method to ultrascaled silicon devices and demonstrate the importance of phonon-assisted band-to-band and source-to-drain tunneling. In a diode the phonons lead to a rectification ratio suppression in good agreement with experiments, while in an ultrathin body transistor the phonons increase off currents by four orders of magnitude, and the subthreshold swing by a factor of 4, in agreement with perturbation theory.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Center for Nanostructured Graphene, QuantumWise A/S
Authors: Gunst, T. (Intern), Markussen, T. (Ekstern), Palsgaard, M. L. N. (Ekstern), Stokbro, K. (Ekstern), Brandbyge, M. (Intern)
Number of pages: 6
Publication date: 2017
Main Research Area: Technical/natural sciences

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BFI (2017): BFI-level 2
Scopus rating (2017): SJR 1.604 SNIP 1.04
Graphene has an extremely high carrier mobility partly due to its planar mirror symmetry inhibiting scattering by the highly occupied acoustic flexural phonons. Electrostatic gating of a graphene device can break the planar mirror symmetry, yielding a coupling mechanism to the flexural phonons. We examine the effect of the gate-induced one-phonon scattering on the mobility for several gate geometries and dielectric environments using first-principles calculations based on density
functional theory and the Boltzmann equation. We demonstrate that this scattering mechanism can be a mobility-limiting factor, and show how the carrier density and temperature scaling of the mobility depends on the electrostatic environment. Our findings may explain the high deformation potential for in-plane acoustic phonons extracted from experiments and, furthermore, suggest a direct relation between device symmetry and resulting mobility.

**General information**

State: Published  
Organisations: Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Center for Nanostructured Graphene, Theoretical Nanotechnology  
Authors: Gunst, T. (Intern), Kaasbjerg, K. (Intern), Brandbyge, M. (Intern)  
Number of pages: 6  
Publication date: 2017  
Main Research Area: Technical/natural sciences

**Publication information**

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Issue number: 4  
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ISSN (Print): 0031-9007  
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BFI (2018): BFI-level 2  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 2  
Scopus rating (2017): SNIP 2.464 SJR 3.622  
Web of Science (2017): Indexed yes  
BFI (2016): BFI-level 2  
Scopus rating (2016): CiteScore 6.33 SJR 4.196 SNIP 2.61  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 2  
Scopus rating (2015): SJR 4.656 SNIP 2.538 CiteScore 5.76  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 2  
Scopus rating (2014): SJR 5.232 SNIP 2.71 CiteScore 6.62  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 2  
Scopus rating (2013): SJR 5.675 SNIP 2.781 CiteScore 7.46  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 2  
Scopus rating (2012): SJR 6.292 SNIP 2.867 CiteScore 7.19  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 2  
Scopus rating (2011): SJR 6.314 SNIP 2.905 CiteScore 7.02  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 2  
Scopus rating (2010): SJR 6.45 SNIP 2.757  
Web of Science (2010): Indexed yes  
BFI (2009): BFI-level 2  
Scopus rating (2009): SJR 6.325 SNIP 2.947  
Web of Science (2009): Indexed yes  
BFI (2008): BFI-level 2  
Scopus rating (2008): SJR 6.194 SNIP 2.837  
Web of Science (2008): Indexed yes  
Scopus rating (2007): SJR 5.95 SNIP 2.738
Formation of graphene-like 2D spinel MnCo$_2$O$_4$ and its lithium storage properties

Two-dimensional (2D) materials fulfill the requirements for fast lithium storage due to the large exposed surface area and the open shortened path for Li insertion/extraction. Novel graphene-like 2D spinel MnCo$_2$O$_4$ powders have been synthesized, which inherit the morphology and structure of special metalorganic precursors (MeO$_2$C$_2$H$_4$) (Me = Co and Mn). When tested in an electrochemical system, it delivers high initial discharge capacities of 1157.3 mAh g$^{-1}$ at 0.2 Ag$^{-1}$ and 1006.3 mAh g$^{-1}$ at 0.4 Ag$^{-1}$, and also exhibits advanced capacity retention and superior rate performance (~780.0 mAh g$^{-1}$ at 0.2 Ag$^{-1}$ and ~550.0 mAh g$^{-1}$ at 0.4 Ag$^{-1}$ after 200 cycles). Remarkably, the 2D layered structure is retained perfectly after 200 cycles at 0.4 Ag$^{-1}$. Hence, the type of unique self-assembly metal-organic precursors could provide a flexible and general way to synthesize 2D layered metal oxides as templates for high-performance lithium-ion batteries.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Central South University
Authors: Huang, G. (Ekstern), Guo, X. (Ekstern), Cao, X. (Ekstern), Tian, Q. (Ekstern), Sun, H. (Intern)
Number of pages: 8
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 1.02 SNIP 1.403
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.05 SJR 0.954 SNIP 1.332
Freestanding and flexible graphene papers as bioelectrochemical cathode for selective and efficient CO₂ conversion

During microbial electrosynthesis (MES) driven CO₂ reduction, cathode plays a vital role by donating electrons to microbe. Here, we exploited the advantage of reduced graphene oxide (RGO) paper as novel cathode material to enhance electron transfer between the cathode and microbe, which in turn facilitated CO₂ reduction. The acetate production rate of Sporomusa ovata-driven MES reactors was 168.5 ± 22.4 mmol m⁻² d⁻¹ with RGO paper cathodes poised at −690 mV versus standard hydrogen electrode. This rate was approximately 8 fold faster than for carbon paper electrodes of the
same dimension. The current density with RGO paper cathodes of 2580 ± 540 mA m⁻² was increased 7 fold compared to carbon paper cathodes. This also corresponded to a better cathodic current response on their cyclic voltammetric curves. The coulombic efficiency for the electrons conversion into acetate was 90.7 ± 9.3% with RGO paper cathodes and 83.8 ± 4.2% with carbon paper cathodes, respectively. Furthermore, more intensive cell attachment was observed on RGO paper electrodes than on carbon paper electrodes with confocal laser scanning microscopy and scanning electron microscopy. These results highlight the potential of RGO paper as a promising cathode for MES from CO₂.

General information
State: Published
Organisations: Novo Nordisk Foundation Center for Biosustainability, Research Groups, Department of Chemistry, NanoChemistry, Department of Micro- and Nanotechnology, Nanocarbon, Organic Chemistry
Authors: Aryal, N. (Intern), Halder, A. (Intern), Zhang, M. (Intern), Whelan, P. R. (Intern), Tremblay, P. (Intern), Chi, Q. (Intern), Zhang, T. (Intern)
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Main Research Area: Technical/natural sciences

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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.245 SJR 1.533
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.63 SJR 1.692 SNIP 1.354
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.034 SNIP 1.597 CiteScore 5.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.163 SNIP 1.554 CiteScore 4.75
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.998 SNIP 1.57 CiteScore 4.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.531 SNIP 0.962 CiteScore 2.44
ISI indexed (2012): ISI indexed yes
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From 2D fluidic array screening to 3D bacterial capturing structures in a point of care system for sepsis diagnosis
A combined 2D microfluidic-microarray high throughput approach is reported to identify universal bacterial capturing ligands that can be tethered on the surface of 3D sponges fabricated by different methods for concentrating of bacterial targets in diagnosis devices. The developed platform allows for the first time the simultaneous monitoring of various ligands’ affinities to different bacteria species in a dynamic condition in vitro. Moreover, it has been feasible to recognize
the effect of steric hindrance on the function of capturing motifs through immobilizing spacer molecules with different lengths between the solid surface and ligands. 3D sponges and micropillars are modified with the most potent capturing molecule to assess their bacterial capturing in real blood samples. Next, the 3D structures are placed into a chip with an immense potential to recognize bacteria through imaging and fluorescence intensity concept.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, Colloids and Biological Interfaces, National Food Institute, Research Group for Analytical and Predictive Microbiology
Authors: Shahbazi, M. (Intern), Kant, K. (Intern), Kaplinsky, J. J. (Intern), Aaydha Chidambara, V. (Intern), Bang, D. D. (Intern), Wolff, A. (Intern)
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microorganisms, biomedical imaging, bioMEMS, bio-optics, blood, lab-on-a-chip, microfluidics, fluorescence intensity, 2D fluidic array screening, 3D bacterial capturing structures, point of care system, sepsis diagnosis, 2D microfluidic-microarray high throughput approach, bacterial capturing ligands, 3D sponges, diagnosis devices, steric hindrance, capturing motifs, spacer molecule immobilization, micropillars, real blood samples, imaging, Microorganisms, Surface treatment, Three-dimensional displays, Surface morphology, Substrates, Two dimensional displays, Peptides, Patient diagnostic methods and instrumentation, Micromechanical and nanomechanical devices and systems, Applied fluid mechanics, Microfluidics and nanofluidics, Optical and laser radiation (medical uses), Optical and laser radiation (biomedical imaging/measurement), MEMS and NEMS device technology
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Source-ID: 2354166636
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From concept to in vivo testing: Microcontainers for oral drug delivery
This work explores the potential of polymeric micrometer sized devices (microcontainers) as oral drug delivery systems (DDS). Arrays of detachable microcontainers (D-MCs) were fabricated on a sacrificial layer to improve the handling and facilitate the collection of individual D-MCs. A model drug, ketoprofen, was loaded into the microcontainers using supercritical CO2 impregnation, followed by deposition of an enteric coating to protect the drug from the harsh gastric environment and to provide a fast release in the intestine. In vitro, in vivo and ex vivo studies were performed to assess the viability of the D-MCs as oral DDS. D-MCs improved the relative oral bioavailability by 180% within 4h, and increased the absorption rate by 2.4 times compared to the control. This work represents a significant step forward in the translation of these devices from laboratory to clinic.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Department of Applied Mathematics and Computer Science , Cognitive Systems, Department of Physics, Neutrons and X-rays for Materials Physics, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, University of Copenhagen
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.802 SJR 2.684
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.56 SJR 2.463 SNIP 1.85
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.738 SNIP 2.074 CiteScore 8.11
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.438 SNIP 2.092 CiteScore 6.86
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.441 SNIP 2.023 CiteScore 6.31
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.454 SNIP 2.075 CiteScore 5.84
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.763 SNIP 2.089 CiteScore 6.33
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.225 SNIP 2.307
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.922 SNIP 2.033
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.272 SNIP 1.895
Scopus rating (2007): SJR 2.168 SNIP 1.81
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.788 SNIP 1.779
Scopus rating (2005): SJR 1.57 SNIP 1.826
Scopus rating (2004): SJR 1.485 SNIP 1.775
Scopus rating (2003): SJR 1.61 SNIP 1.687
Scopus rating (2002): SJR 1.442 SNIP 1.539
Scopus rating (2001): SJR 1.26 SNIP 1.363
Scopus rating (2000): SJR 0.956 SNIP 1.391
Scopus rating (1999): SJR 1.036 SNIP 1.294
Original language: English
Enteric coating, Microtechnology, Oral drug delivery, Supercritical impregnation
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Relations
Projects:
From concept to in vivo testing: Microcontainers for oral drug delivery
Source: FindIt
Source-ID: 2392221100
Publication: Research - peer-review › Journal article – Annual report year: 2017
Numerous heavy metal removal practices for stormwater runoff have been studied and applied; however, there is still room for improvement. Among these practices, adsorption has proven to be the most efficient way of removing heavy metals. Commonly used adsorbents have an innate sorption capacity in relation to high concentrations of heavy metal ions, but if they are to be used for stormwater runoff, high affinity with rapid sorption kinetics for low concentrations of heavy metals is necessary. Therefore, in this study, new types of functional nanostructured polymer sorbents for effective heavy metal removal from stormwater are suggested.

First, comparison studies of several existing polymer sorbents were conducted, to find decisive functional groups for removing heavy metals from the solution. To enhance the sorption kinetics and affinity of polymer sorbents in the presence of competing ions, sulphur functional groups and polar functional groups in the polymer networks were found to be imperative. Based on this result, new types of covalently connected polymer sorbents were devised and characterised. One of the novel polymer sorbents, disulphide-linked polymer (COP-63), was selected for perusing heavy metal sorption behaviour. Although COP-63 has a moderate surface area, it demonstrated cadmium removal efficiency equivalent to highly porous activated carbon (AC), while it also exhibited 16 times faster sorption kinetics compared to AC, owing to high affinity towards disulphide and thiol functionality. The chemisorption mechanism of sorbents was confirmed by sorption kinetics, the effects of pH and metal complexation. The metal ions copper, cadmium and zinc showed high binding affinity towards the polymer sorbent, even in the presence of competing cations in the form of calcium.

To retrofit polymer sorbents for a real stormwater filter, controlling the size of sorbents by formulating composites was applied. The first composites were obtained by grafting polymer onto granular-AC through acyl chlorination (DiS-AC), and the formulation of composites was confirmed by various characterisation techniques. DiS-AC demonstrated 89 L/g sorption affinity for cadmium, which is notably higher than conventional sorbents’ sorption affinity. Furthermore, within an hour, half of the trace amounts of cadmium ions were removed by the DiS-AC, even in a batch test. Other composites were obtained by embedding the polymer particles on the surface of an alginate bead (DiS-algi). Moreover, the sorption capacity of DiS-algi was 22.3 mg/g, and within 6 minutes, half of the cadmium had been removed with 31 L/mg of Langmuir sorption affinity, outperforming an AC filter.

Moreover, DiS-algi was used to build the reactive filtration column for simulating a real stormwater treatment filter. A breakthrough test of the reactive column showed the complete uptake of cadmium from a contaminated flow, lasting two hours until reaching the breakthrough point. The maximum sorption capacity of the reactive column was 877 µg/g. Furthermore, regeneration tests of the column verified its reusability.

Based on the results of this PhD, novel polymer and composites sorbents are proposed for distinct uses. The devised functional nanostructured polymers confirmed their potential for efficient heavy metal removal, and the simulation of a real-life stormwater filter was successful. Therefore, the novel polymer sorbents herein proved to be viable materials for stormwater runoff filtration systems.
Generation of micro-droplet arrays by dip-coating of biphilic surfaces; the dependence of entrained droplet volume on withdrawal velocity

Droplet array chips were realized using an alignment-free fabrication process in silicon. The chips were textured with a homogeneous nano-scale surface roughness but were partially covered with a self-assembled monolayer of perfluorodecyltrichlorosilane (FDTS), resulting in a super-biphilic surface. When submerged in water and withdrawn again, microliter sized droplets are formed due to pinning of water on the hydrophilic spots. The entrained droplet volumes were investigated under variation of spot size and withdrawal velocity. Two regimes of droplet formation were revealed: at low speeds, the droplet volume achieved finite values even for vanishing speeds, while at higher speeds the volume was governed by fluid inertia. A simple 2D boundary layer model describes the behavior at high speeds well. Entrained droplet volume could be altered, post-fabrication, by more than a factor of 15, which opens up for more applications of the dip-coating technique due to the significant increase in versatility of the micro-droplet array platform.
Gold nanomaterials for the selective capturing and SERS diagnosis of toxins in aqueous and biological fluids

A highly sensitive nanosensing method for the combined selective capture and SERS detection of Microcystin-LR (MC-LR) in blood plasma has been developed. The new method utilizes gold coated magnetic nanoparticles that are functionalized with anti MC-LR antibody Fab’ fragments for the selective capture of MC-LR from aqueous media and blood plasma. Using an oriented immobilization approach, the Fab’ fragments are covalently attached to gold surface to form a monolayer with high capture efficiency towards the toxin. After the selective capture, the purified MC-LR molecules were released from the extractor nanoparticles within 5min by manipulating the pH environment of the nanoparticles. The regenerated extractor nanoparticles maintained their capture efficiency and, therefore, were re-used to capture of MC-LR from successive samples. The released purified toxin was screened within 10min on gold coated silicon nanopillars and a new paper-based SERS substrate by handheld Raman spectrometer. The SERS enhancement factors of the nanopillars and the new paper-based substrate were $2.5 \times 10^6$ and $3 \times 10^5$ respectively. The lower limit of quantification (LOQ) of MC-LR by SERS on the nanopillar substrate was 10fM ($R^2=0.9975$) which is well below the clinically required detection limit of the toxin. The SERS determination of MC-LR was cross validated against ELISA. By using antibody fragments that are specific to the target biomolecule, the new methodology can be extended to the rapid extraction and detection of other toxins and proteins.
Grain boundary-induced variability of charge transport in hydrogenated polycrystalline graphene

Chemical functionalization has proven to be a promising means of tailoring the unique properties of graphene. For example, hydrogenation can yield a variety of interesting effects, including a metal-insulator transition or the formation of localized magnetic moments. Meanwhile, graphene grown by chemical vapor deposition is the most suitable for large-scale production, but the resulting material tends to be polycrystalline. Up to now there has been relatively little focus on how chemical functionalization, and hydrogenation in particular, impacts the properties of polycrystalline graphene. In this work, we use numerical simulations to study the electrical properties of hydrogenated polycrystalline graphene. We find a strong correlation between the spatial distribution of the hydrogen adsorbates and the charge transport properties. Charge transport is weakly sensitive to hydrogenation when adsorbates are confined to the grain boundaries, while a uniform distribution of hydrogen degrades the electronic mobility. This difference stems from the formation of the hydrogen-induced resonant impurity states, which are inhibited when the honeycomb symmetry is locally broken by the grain boundaries. These findings suggest a tunability of electrical transport of polycrystalline graphene through selective hydrogen functionalization, and also have implications for hydrogen-induced magnetization and spin lifetime of this material.

General information
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Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Barcelona Institute of Science and Technology
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Graphene antidot lattice transport measurements
We investigate graphene devices patterned with a narrow band of holes perpendicular to the current flow, a few-row graphene antidot lattice (FR-GAL). Theoretical reports suggest that a FR-GAL can have a bandgap with a relatively small reduction of the transmission compared to what is typical for antidot arrays devices. Graphene devices were fabricated using 100 keV electron beam lithography (EBL) for nanopatterning as well as for defining electrical contacts. Patterns with hole diameter and neck widths of order 30 nm were produced, which is the highest reported pattern density of antidot lattices in graphene reported defined by EBL. Electrical measurements showed that devices with one and five rows exhibited field effect mobility of ~100 cm²/Vs, while a larger number of rows, around 40, led to a significant reduction of field effect mobility (<5 cm²/Vs). The carrier mobility was measured as a function of temperature, with the low-temperature behaviour being well described by variable range hopping, indicating the transport to be dominated by disorder.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene
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Graphene based coatings for corrosion protection

Graphene directed architecture of fine engineered nanostructures with electrochemical applications

Thanks to its high performance as a conducting or/and chemically active support material, graphene has offered unique opportunities for developing novel nanostructured materials to meet various demands. The assembly of graphene with other nanoscale building blocks such as metals, metal oxides, and polymers has led to the possibility to create new electroactive and multifunctional nanostructures, which can serve as promising material platforms for electrochemical purposes. However, the precise control and fine-tuning of material structures and properties are still challenging and in demand. In this review, we aim to highlight some recent efforts devoted to rational design, assembly and fine engineering of electrochemically active nanostructures using graphene or/and its derivatives as soft templates for controlled synthesis and directed growth. We organize the contents according to the chemically classified nanostructures, including metallic nanostructures, self-assembled organic and supramolecular structures, and fine engineered metal oxides. In these cases, graphene templates either sacrificed during templating synthesis or retained as support for final products. We also discuss remained challenges and future perspective in the graphene-templating design and synthesis of various materials. Overall, this review could offer crucial insights into the nanoscale engineering of new nanostructures using graphene as a soft template and their potential applications in electrochemical science and technology. We hope this review would also stimulate new ideas and approaches for relevant ongoing research.
Graphene Oxide-Directed Tunable Assembly of MoS$_2$ Ultrathin Nanosheets for Electrocatalytic Hydrogen Evolution

Three dimensional (3D) hierarchical architectures based on molybdenum disulfide (MoS$_2$) and reduced graphene oxide (rGO) are synthesized through a mixed solvothermal method. By simply increasing the amount of graphene oxide (GO) during the synthesis, the 3D assembly of MoS$_2$ can be tuned from nanoflowers to cross-linked nanosheets firmly attached to GO. The structural and compositional analysis show that MoS$_2$ nanostructures in the hybrids are constituted by...
ultrathin nanosheets with single or a few layers, and the GO precursor is reduced as rGO simultaneously. Due to the synergetic effects of rGO nanosheets and controllable assembly in MoS$_2$ ultrathin nanostructures, the resulting nanohybrids show optimized electrocatalytic hydrogen evolution properties in 0.5 M H$_2$SO$_4$ solution. This work provides a facile method to increase the efficiency of hydrogen production for MoS$_2$ based materials and their analogues via a tunable bottom-up assembly strategy.

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Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Boston College
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Graphene-Paper Based Electrochemical Sensors
Graphene paper as a new form of graphene-supported nanomaterials has received worldwide attention since its first report in 2007. Due to their high flexibility, lightweight and good electrical conductivity, graphene papers have demonstrated the promising potential for crucial applications in electrochemical sensors and energy technologies among others. In this chapter, we present some examples to overview recent advances in the research and development of two-dimensional (2D) graphene papers as new materials for electrochemical sensors. The chapter covers the design, fabrication, functionalization and application evaluations of graphene papers. We first summarize the mainstream methods for fabrication of graphene papers/membranes, with the focus on chemical vapour deposition techniques and solution-processing assembly approaches. A large portion of this chapter is then devoted to the highlights of specific functionalization of graphene papers with polymer and nanoscale functional building blocks for electrochemical-sensing purposes. In terms of electrochemical-sensing applications, the emphasis is on enzyme-graphene and nanoparticle-graphene paper-based systems for the detection of glucose. We finally conclude this chapter with brief remarks and outlook.

General information
State: Published
Organisations: Department of Chemistry, NanoChemistry, Department of Micro- and Nanotechnology, Organic Chemistry
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Hand-Held Femtogram Detection of Hazardous Picric Acid with 2 Hydrophobic Ag Nanopillar SERS Substrates and Mechanism of 3 Elasto-Capillarity

Picric acid (PA) is a severe environmental and security risk due to its unstable, toxic, and explosive properties. It is also challenging to detect in trace amounts and in situ because of its highly acidic and anionic character. Here, we assess sensing of PA under nonlaboratory conditions using surface-enhanced Raman scattering (SERS) silver nanopillar substrates and hand-held Raman spectroscopy equipment. The advancing elasto-capillarity effects are explained by molecular dynamics simulations. We obtain a SERS PA detection limit on the order of 20 ppt, corresponding attomole amounts, which together with the simple analysis methodology demonstrates that the presented approach is highly competitive for ultrasensitive analysis in the field.

Heat transfer and entropy generation analysis of hybrid graphene/Fe3O4 ferro-nanofluid flow under the influence of a magnetic field

The heat transfer characteristics and entropy generation rate of hybrid graphene-magnetite nanofluids under forced laminar flow that subjected to the permanent magnetic fields were investigated. For this purpose, a nanoscale reduced graphene oxide-Fe3O4 hybrid was synthesized by using graphene oxide, iron salts and tannic acid as the reductant and stabilizer. The thermophysical and magnetic properties of the hybrid nanofluid have been widely characterized and thermal conductivity has shown an enhancement of 11%. The experimental results indicated that the heat transfer enhancement of hybrid magnetite nanofluid compared to the case of distilled was negligible when no magnetic field was applied. Additionally, the heat transfer characteristics have been improved significantly under magnetic field. The outcome of the analysis shows that the total entropy generation rate was reduced up to 41% compared to distilled water. It appears that these magnetic hybrid nanofluids can function as good alternative fluids in the magnetic thermal engineering systems.
Hierarchical nanoflowers assembled with Au nanoparticles decorated ZnO nanosheets toward enhanced photocatalytic properties

Hierarchical nanoflowers assembled with Au nanoparticles (NPs) decorated ZnO nanosheets (Au-ZnO nanosheet flowers, AZNSFs) were successful synthesized. The AZNSFs showed more efficient activity to photodegradation of RhB than that of pure ZnO nanosheet flowers and commercial ZnO nanopowders. The improved photocatalytic properties of the AZNSFs nano hybrids are attributed to the large specific surface area induced by the 3D hierarchical architectures, stable structure and the charge separation due to the electronic interaction between Au NPs and ZnO nanosheets.
High-performance lithium storage based on the synergy of atomic-thickness nanosheets of TiO$_2$(B) and ultrafine Co$_3$O$_4$ nanoparticles
Lithium ion batteries (LIBs) are critical constituents of modern day vehicular and telecommunication technologies. Transition metal oxides and their composites have been extensively studied as potential electrode materials for LIBs. However, inefficient lithiation, poor electrical conductivity, and drastic volume change during cycling result in low reversible capacity and rapid capacity fading, and thus hinder the practical applications of those electrodes. In this work, we report a facile synthesis of a novel hierarchical composites, which consist of ultrafine Co$_3$O$_4$ nanoparticles uniformly dispersed on TiO$_2$(B) nanosheets with atomic thickness (Co$_3$O$_4$ NPs@TiO$_2$(B) NSs). When tested as anode material for LIBs, the Co$_3$O$_4$ NPs@TiO$_2$(B) NSs sample with optimized composition shows a reversible capacity of ∼677.3 mAhg$^{-1}$ after 80 cycles at a current density of 100 mAg$^{-1}$. A capacity of 386.2 mAhg$^{-1}$ is still achieved at 1000 mAg$^{-1}$. The synergistic effect of ultrafine Co$_3$O$_4$ nanoparticles and atomic-thickness TiO$_2$(B) nanosheets is responsible for the enhanced electrochemical performance.

**General information**

State: Published  
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Tsinghua University, University of Cambridge  
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Scopus rating (2015): SJR 1.9 SNIP 1.667 CiteScore 6.34  
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Scopus rating (2014): SJR 1.964 SNIP 2.042 CiteScore 6.3  
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Web of Science (2009): Indexed yes  
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High temperature SU-8 pyrolysis for fabrication of carbon electrodes

In this work, we present the investigation of the pyrolysis parameters at high temperature (1100 °C) for the fabrication of two-dimensional pyrolytic carbon electrodes. The electrodes were fabricated by pyrolysis of lithographically patterned negative epoxy based photoresist SU-8. A central composite experimental design was used to identify the influence of dwell time at the highest pyrolysis temperature and heating rate on electrical, electrochemical and structural properties of the pyrolytic carbon: Van der Pauw sheet resistance measurements, cyclic voltammetry, electrochemical impedance spectroscopy and Raman spectroscopy were used to characterize the pyrolytic carbon. The results show that the temperature increase from 900 °C to 1100 °C improves the electrical and electrochemical properties. At 1100 °C, longer dwell time leads to lower resistivity, while the variation of the pyrolysis parameters has small influence on electrochemical performance.
High-Throughput Fabrication of Nanocone Substrates through Polymer Injection Moulding For SERS Analysis in Microfluidic Systems

Metal-coated nanostructured surfaces have shown promise as substrates for surface-enhanced Raman spectroscopy (SERS) as they allow chemical trace detection with high sensitivity and rapid response. This sensitivity and specificity makes SERS especially interesting for environmental and biological analysis. Metal-capped silicon nanopillars, fabricated through a maskless ion etch, are state-of-the-art for on-chip SERS substrates. A dense cluster of high aspect ratio polymer nanocones was achieved by using high-throughput polymer injection moulding over a large area replicating a silicon nanopillar structure. Gold-capped polymer nanocones display similar SERS sensitivity as silicon nanopillars, while being easily integrable into a microfluidic chips.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Spectro Inlets ApS
Authors: Viehrig, M. (Intern), Matteucci, M. (Intern), Thilsted, A. H. (Ekstern), Schmidt, M. S. (Intern), Boisen, A. (Intern)
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High throughput soft embossing process for micro-patterning of PEDOT thin films

The patterning of conductive polymers is a major challenge in the implementation of these materials in several research and industrial applications, spanning from photovoltaics to biosensors. Within this context, we have developed a reliable technique to pattern a thin layer of the conductive polymer poly(3,4-ethylenedioxythiophene) (PEDOT) by means of a low cost and high throughput soft embossing process. We were able to reproduce a functional conductive pattern with a minimum dimension of 1 μm and to fabricate electrically decoupled electrodes. Moreover, the conductivity of the PEDOT films has been characterized, finding that a post-processing treatment with Ethylene Glycol allows an increase in conductivity and a decrease in water solubility of the PEDOT film. Finally, cyclic voltammetry demonstrates that the post-treatment also ensures the electrochemical activity of the film. Our technology offers a facile solution for the patterning of organic conductors with resolution in the micro scale, and can be the basis for the realization and development of polymeric microdevices with electrical and electrochemical functionalities.
Hot-pressed geopolymer
This research explores the use of simultaneous heating and pressing techniques in order to enhance the mechanical properties of fly ash (FA) based geopolymer under relatively low temperature conditions to ensure minimum-porosity. Four effective parameters of pressing force, alkali activator/FA, duration of hot-pressing and sodium concentration are studied. Together with detailed experimental studies, our results reveal that the most dominant factor is the induced pressure. The main results indicated that the highest compressive strength of the geopolymer (134 MPa) could be obtained by employing the hot pressing, temperature and duration of 41.4 MPa, 350 °C and 20 min, respectively. The microstructure of the hot-pressed specimens showed more developed geopolymer matrix compared with conventional ones leading to higher compressive strength in much shortest time. The improved mechanical properties are generally attributed to the dense structure of the material and higher geopolymer gel production during the hot pressing process. However, further reaction of partially reacted particles improves the mechanical properties over time.

General information
State: Published
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How nonlocal damping reduces plasmon-enhanced fluorescence in ultranarrow gaps [arXiv]

Nonclassical modifications of plasmon-assisted fluorescence enhancement are theoretically explored by placing dipole emitters at the narrow gaps encountered in canonical plasmonic architectures, namely dimers and trimers of different metallic nanoparticles. Through detailed simulations, in comparison with appropriate analytical modelling, it is shown that, within classical electrodynamics, and for the largely reduced separations explored, fluorescence enhancement factors of the order of 10^6 can be achieved. This remarkable prediction is mainly governed by the dramatic increase in excitation rate triggered by the corresponding field enhancement inside the gaps. Nevertheless, once nonclassical corrections are included, the amplification factors decrease by up to two orders of magnitude and a saturation regime for narrower gaps is reached, as shown by simulations based on the generalized nonlocal optical response theory. A simple strategy to introduce nonlocal corrections to the analytic solutions, which reproduce the trends of the simulations excellently, is also proposed. It is therefore demonstrated that the nonlocal optical response of the metal imposes more realistic, finite upper bounds to the enhancement feasible with ultrasmall plasmonic cavities, thus providing a theoretical description closer to state of the art experiments. [Phys. Rev. B 96, 085413 (2017) doi:10.1103/PhysRevB.96.085413].
How the relative permittivity of solar cell materials influences solar cell performance

The relative permittivity of the materials constituting heterojunction solar cells is usually not considered as a design parameter when searching for novel combinations of heterojunction materials. In this work, we investigate the validity of such an approach. Specifically, we show the effect of the materials permittivity on the physics and performance of the solar cell by means of numerical simulation supported by analytical relations. We demonstrate that, depending on the specific solar cell configuration and materials properties, there are scenarios where the relative permittivity has a major influence on the achievable conversion efficiency, and scenarios where its influence can be safely ignored. In particular, we argue that high-permittivity materials should always be the preferred choice as heterojunction partners of the absorber layer when prototyping new materials combinations. When the heterojunction partner has a high permittivity, solar cells are consistently more robust against several non-idealities that are especially likely to occur in early-stage development, when the device is not yet optimized.

General information
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Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Technical University of Denmark
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Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.99 SNIP 2.85 CiteScore 4.44
ISI indexed (2013): ISI indexed yes
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BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.605 SNIP 2.517 CiteScore 3.65
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Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
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Web of Science (2011): Indexed yes
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Scopus rating (2009): SJR 1.265 SNIP 2.158
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Scopus rating (2008): SJR 1.684 SNIP 1.994
Web of Science (2008): Indexed yes
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Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.594 SNIP 2.229
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.233 SNIP 1.601
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.523 SNIP 1.702
Scopus rating (2003): SJR 1.152 SNIP 1.423
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.331 SNIP 1.561
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.292 SNIP 1.277
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How to foster a High-Tech entrepreneurial mind-set – A multidisciplinary engineering course for Bachelor students

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How to measure load-dependent kinetics of individual motor molecules without a force clamp

Single-molecule force spectroscopy techniques, including optical trapping, magnetic trapping, and atomic force microscopy, have provided unprecedented opportunities to understand biological processes at the smallest biological length scales. For example, they have been used to elucidate the molecular basis of muscle contraction and intracellular cargo transport along cytoskeletal filamentous proteins. Optical trapping is among the most sophisticated single-molecule techniques. With exceptionally high spatial and temporal resolutions, it has been extensively utilized to understand biological functions at the single molecule level, such as conformational changes and force-generation of individual motor proteins or force-dependent kinetics in molecular interactions. Here, we describe a new method, “Harmonic Force Spectroscopy (HFS).” With a conventional dual-beam optical trap and a simple harmonic oscillation of the sample stage, HFS can measure the load-dependent kinetics of transient molecular interactions, such as a human β-cardiac myosin II interacting with an actin filament. We demonstrate that the ADP release rate of an individual human β-cardiac myosin II molecule depends exponentially on the applied load, which provides a clue to understanding the molecular mechanism behind the force–velocity curve of a contracting cardiac muscle. The experimental protocol and the data analysis are simple, fast, and efficient. This chapter provides a practical guide to the method: basic concepts, experimental setup, step-by-step experimental protocol, theory, data analysis, and results.

General information
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Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, University of California at San Francisco, Stanford University School of Medicine
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Source-ID: 127555006
Publication: Research - peer-review › Book chapter – Annual report year: 2017

How to Measure Load-Dependent Kinetics of Individual Motor Molecules Without a Force-Clamp
Molecular motors are responsible for numerous cellular processes from cargo transport to heart contraction. Their interactions with other cellular components are often transient and exhibit kinetics that depend on load. Here, we measure such interactions using a new method, Harmonic Force Spectroscopy. In this method, harmonic oscillation of the sample stage of a laser trap immediately, automatically and randomly applies sinusoidally varying loads to a single motor
molecule interacting with a single track along which it moves. The experimental protocol and the data analysis are simple, fast and efficient. The protocol accumulates statistics fast enough to deliver single-molecule results from single-molecule experiments. We demonstrate the method's performance by measuring the force-dependent kinetics of individual human beta-cardiac myosin molecules interacting with an actin filament at physiological ATP concentration. We show that a molecule's ADP release rate depends exponentially on the applied load. This points to Kramer's Brownian diffusion model of chemical reactions as explanation why muscle contracts with a velocity inversely proportional to external load.

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General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, University of California at San Francisco, Stanford University School of Medicine
Authors: Sung, J. (Ekstern), Mortensen, K. (Intern), Spudich, J. A. (Ekstern), Flyvbjerg, H. (Intern)
Number of pages: 1
Publication date: 2017
Event: Abstract from 30th Marian Smoluchowski Symposium on Statistical Physics, Krakow, Poland.
Main Research Area: Technical/natural sciences
Source: PublicationPreSubmission
Source-ID: 136954268
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

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How to measure separation and angles between inter-molecular fluorescent markers
Structure and function of an individual biomolecule can be explored with minimum two fluorescent markers of different colors. Since the light of such markers can be spectrally separated and imaged simultaneously, the markers can be colocalized. Here, we describe the method used for such two-color colocalization microscopy. Then we extend it to fluorescent markers with fixed orientations and in intramolecular proximity. Our benchmarking of this extension produced two extra results: (a) we established short double-labeled DNA molecules as probes of 3D orientation of anything to which one can attach them firmly; (b) we established how to map with super-resolution between color-separated channels, which should be useful for all dual-color colocalization measurements with either fixed or freely rotating fluorescent molecules. Throughout, we use only simple means: from each color-separated microscope image in a time-lapse movie, we simultaneously determine both the relative (x,y)-separation of the fluorophores and their individual orientations in space, both with accuracy and precision. The relative positions and orientations of two domains of the same molecule are thus time-resolved. Using short double-stranded DNA (dsDNA) molecules internally labeled with two fixed fluorophores, we (i) demonstrate the accuracy and precision of our localization- and mapping-methods, using the known structure of dsDNA as benchmark; (ii) resolve 10 base pair differences in fluorophore separations; (iii) determine the unique 3D orientation of each DNA molecule.

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General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals
Authors: Flyvbjerg, H. (Intern)
Publication date: 2017
Event: Abstract from APS March Meeting 2017, New Orleans, United States.
Main Research Area: Technical/natural sciences
Source: PublicationPreSubmission
Source-ID: 136954138
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

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How to measure separations and angles between intra-molecular fluorescent markers

definition of a single biomolecule can be explored with minimum two fluorescent markers of different colors. Since the light of such markers can be spectrally separated and imaged simultaneously, the markers can be colocalized. Here, we describe the method used for such two-color colocalization microscopy. Then we extend it to fluorescent markers with fixed orientations and in intramolecular proximity. Our benchmarking of this extension produced two extra results: (a) we established short double-labeled DNA molecules as probes of 3D orientation of anything to which one can attach them firmly; (b) we established how to map with super-resolution between color-separated channels, which should be useful for all dual-color colocalization measurements with either fixed or freely rotating fluorescent molecules. Throughout, we use only simple means: from each color-separated microscope image in a time-lapse movie, we simultaneously determine both the relative (x,y)-separation of the fluorophores and their individual orientations in space, both with accuracy and precision. The relative positions and orientations of two domains of the same molecule are thus time-resolved. Using short double-stranded DNA (dsDNA) molecules internally labeled with two fixed fluorophores, we (i) demonstrate the accuracy and precision of our localization- and mapping-methods, using the known structure of dsDNA as benchmark; (ii) resolve 10 base pair differences in fluorophore separations; (iii) determine the unique 3D orientation of each DNA molecule.

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General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Stanford University, Stanford University School of Medicine
Authors: Flyvbjerg, H. (Intern), Mortensen, K. (Intern), Sung, J. (Ekstern), Spudich, J. A. (Ekstern)
Publication date: 2017

Host publication information
Title of host publication: Bulletin of the American Physical Society
Volume: Volume 62, Number 4
Main Research Area: Technical/natural sciences
Conference: APS March Meeting 2017, New Orleans, United States, 13/03/2017 - 13/03/2017
Electronic versions:
Untitled.pdf
Source: PublicationPreSubmission
Source-ID: 140693255
Hydrodynamic model approach to the formation of plasmonic wakes in graphene

Using the hydrodynamic model in the electrostatic approximation, we describe the formation of graphene surface plasmons when a nearby charge is in motion either perpendicular or parallel to a graphene sheet. In the first case, the electron-energy loss (EEL) spectrum of the electron is computed, showing that the resonances in the spectrum are linked to the frequency of the graphene surface plasmons. In the second case, we discuss the formation of plasmonic wakes due to the dragging of the surface plasmons induced by the motion of the charge. This effect is similar to Coulomb drag between two electron gases at a distance from each other. We derive simple expressions for the electrostatic potential induced by the moving charge on graphene. We show that there is a transition from a Mach-type wake at high speeds to a Kelvin-type wake at low ones and identify the Froude number for plasmonic wakes. We show that the Froude number can be controlled externally by tuning both the Fermi energy in graphene and the dielectric function of the environment, a situation with no parallel in ship wakes. Using EEL, we propose a source of graphene plasmons, based on a graphene drum built in a metallic waveguide and activated by an electron beam created by the tip of an electronic microscope. We also introduce the notion of a plasmonic billiard.
Identification of Gene Transcription Start Sites and Enhancers Responding to Pulmonary Carbon Nanotube Exposure in Vivo

Increased use of nanomaterials in industry, medicine, and consumer products has raised concerns over their toxicity. To ensure safe use of nanomaterials, understanding their biological effects at the molecular level is crucial. In particular, the regulatory mechanisms responsible for the cascade of genes activated by nanomaterial exposure are not well-characterized. To this end, we profiled the genome-wide usage of gene transcription start sites and linked active enhancer regions in lungs of C57BL/6 mice 24 h after intratracheal instillation of a single dose of the multiwalled carbon nanotube (MWCNT) Mitsui-7. Our results revealed a massive gene regulatory response, where expression of key inflammatory genes (e.g., Csf3, Il24, and Fgf23) was increased >100-fold 24 h after Mitsui-7 exposure. Many of the Mitsui-7-responsive transcription start sites were alternative transcription start sites for known genes, and the number of alternative transcription start sites used in a given gene was correlated with overall Mitsui-7 response. Strikingly, genes that were up-regulated after Mitsui-7 exposure only through their main annotated transcription start site were linked to inflammatory and defense responses, while genes up-regulated only through alternative transcription start sites were functionally heterogeneous and not inflammation-associated. Furthermore, we identified almost 12 000 active enhancers, many of which were Mitsui-7-responsive, and we identified similarly responding putative target genes. Overall, our study provides the location and activity of Mitsui-7-induced enhancers and transcription start sites, providing a useful resource for targeted experiments elucidating the biological effects of nanomaterials and the identification of biomarkers for early detection of MWCNT-induced inflammation.
Immobilisation of barley aleurone layers enables parallelisation of assays and analysis of transient gene expression in single cells

The barley aleurone layer is an established model system for studying phytohormone signalling, enzyme secretion and programmed cell death during seed germination. Most analyses performed on the aleurone layer are end-point assays based on cell extracts, meaning each sample is only analysed at a single time point. By immobilising barley aleurone layer tissue on polydimethylsiloxane pillars in the lid of a multiwell plate, continuous monitoring of living tissue is enabled using multiple non-destructive assays in parallel. Cell viability and menadione reducing capacity were monitored in the same aleurone layer samples over time, in the presence or absence of plant hormones and other effectors. The system is also amenable to transient gene expression by particle bombardment, with simultaneous monitoring of cell death. In conclusion, the easy to handle and efficient experimental setup developed here enables continuous monitoring of tissue samples, parallelisation of assays and single cell analysis, with potential for time course studies using any plant tissue that can be immobilised, for example leaves or epidermal peels.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Department of Systems Biology, Bioanalytics, Fluidic Array Systems and Technology, Aarhus University
Impact of physiological shear stress on cell association/uptake with a novel multicompartment carrier

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Authors: York-Durán, M. J. (Intern), Ek, P. K. (Intern), Gallardo, M. G. (Intern), Hosta-Rigau, L. (Intern)
Number of pages: 1
Publication date: 2017

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Title of host publication: Book of Abstracts, Sustain 2017
Publisher: Technical University of Denmark (DTU)
Article number: H-11
Main Research Area: Technical/natural sciences
Conference: Sustain 2017, Kgs. Lyngby, Denmark, 06/12/2017 - 06/12/2017
Electronic versions:
SustainAbstracts2017c.compressed_93.pdf
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2017

Improved detection of chemical substances from colorimetric sensor data using probabilistic machine learning

We present a data-driven machine learning approach to detect drug- and explosives-precursors using colorimetric sensor technology for air-sampling. The sensing technology has been developed in the context of the CRIM-TRACK project. At present a fully- integrated portable prototype for air sampling with disposable sensing chips and automated data acquisition has been developed. The prototype allows for fast, user-friendly sampling, which has made it possible to produce large datasets of colorimetric data for different target analytes in laboratory and simulated real-world application scenarios. To make use of the highly multi-variate data produced from the colorimetric chip a number of machine learning techniques are employed to provide reliable classification of target analytes from confounders found in the air streams. We demonstrate that a data-driven machine learning method using dimensionality reduction in combination with a probabilistic classifier makes it possible to produce informative features and a high detection rate of analytes. Furthermore, the probabilistic machine learning approach provides a means of automatically identifying unreliable measurements that could produce false predictions. The robustness of the colorimetric sensor has been evaluated in a series of experiments focusing on the amphetamine pre-cursor phenylacetone as well as the improvised explosives pre-cursor hydrogen peroxide. The analysis demonstrates that the system is able to detect analytes in clean air and mixed with substances that occur naturally in real-world sampling scenarios. The technology under development in CRIM-TRACK has the potential as an effective tool to control trafficking of illegal drugs, explosive detection, or in other law enforcement applications.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, Copenhagen Center for Health Technology, Department of Micro- and Nanotechnology, Surface Engineering, Cranfield University, Securetec Detektions-Systeme AG, Pro Design Electronic GmbH, Gammadata Instrument AB
Number of pages: 8
Publication date: 2017

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Publisher: SPIE - International Society for Optical Engineering
Article number: 1018307
ISBN (Print): 9781510608672
Series: Proceedings of S P I E - International Society for Optical Engineering
Volume: 10183
ISSN: 0277-786X
Main Research Area: Technical/natural sciences
Conference: Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XVIII, Anaheim, United States, 09/04/2017 - 09/04/2017
Artificial nose, Colorimetric sensor array, Machine learning
Electronic versions:
1018307_1_.pdf
DOIs:
Improved Focusing Method for 3-D Imaging using Row–Column-Addressed 2-D Arrays

A row–column-addressed (RCA) 2-D array can be interpreted as two orthogonal 1-D arrays. By transmitting with row elements and receiving the echoes through column elements or vice versa, a rectilinear volume in front of the array can be beamformed. Since the transmit and receive 1-D arrays are orthogonal to each other, only one-way focusing is possible in each transmit or receive plane. For applications, where the scatterers are sparse, e.g., in micro-bubble tracking, this study suggests to multiply the envelope data received by the row elements when transmitting with columns as well as the data received by the column elements when transmitting with rows, to improve the focusing. In this way, at each point a two-way focused profile in both transmit and receive directions can be produced. This paper investigates the performance of the new focusing scheme based on simulations and phantom measurements with a PZT λ/2-pitch 3 MHz 62+62 RCA 2-D transducer probe. A synthetic aperture imaging sequence with single element transmissions at a time, is designed for imaging down to 14 cm at a volume rate of 44 Hz.

Improved Targeting of Cancers with Nanotherapeutics

Targeted cancer nanotherapeutics offers numerous opportunities for the selective uptake of toxic chemotherapies within tumors and cancer cells. The unique properties of nanoparticles, such as their small size, large surface-to-volume ratios, and the ability to achieve multivalency of targeting ligands on their surface, provide superior advantages for nanoparticle-based drug delivery to a variety of cancers. This review highlights various key concepts in the design of targeted nanotherapeutics for cancer therapy, and discusses physicochemical parameters affecting nanoparticle targeting, along with recent developments for cancer-targeted nanomedicines.
Improvements on non-equilibrium and transport Green function techniques: The next-generation TRANSIESTA

We present novel methods implemented within the non-equilibrium Green function code (NEGF) TRANSIESTA based on density functional theory (DFT). Our flexible, next-generation DFT–NEGF code handles devices with one or multiple electrodes ($N_e \geq 1$) with individual chemical potentials and electronic temperatures. We describe its novel methods for electrostatic gating, contour optimizations, and assertion of charge conservation, as well as the newly implemented algorithms for optimized and scalable matrix inversion, performance-critical pivoting, and hybrid parallelization. Additionally, a generic NEGF “post-processing” code (TBTRANS/PHTRANS) for electron and phonon transport is presented with several novelties such as Hamiltonian interpolations, $N_e \geq 1$ electrode capability, bond-currents, generalized interface for user-defined tight-binding transport, transmission projection using eigenstates of a projected Hamiltonian, and fast inversion algorithms for large-scale simulations easily exceeding 106 atoms on workstation computers. The new features of both codes are demonstrated and bench-marked for relevant test systems.
Publication information
Journal: Computer Physics Communications
Volume: 212
ISSN (Print): 0010-4655
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.999 SJR 1.729
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.04 SJR 1.914 SNIP 2.094
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.788 SNIP 1.935 CiteScore 3.79
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.344 SNIP 1.649 CiteScore 2.86
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.455 SNIP 1.692 CiteScore 3.17
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.11 SNIP 2.162 CiteScore 3.46
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.75 SNIP 1.951 CiteScore 3.22
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.466 SNIP 1.379
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.228 SNIP 1.266
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.228 SNIP 1.172
Scopus rating (2007): SJR 1.005 SNIP 1.065
Scopus rating (2006): SJR 1.048 SNIP 1.145
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.792 SNIP 1.118
Scopus rating (2004): SJR 1.036 SNIP 1.122
Scopus rating (2003): SJR 1.075 SNIP 1.02
Scopus rating (2002): SJR 0.821 SNIP 0.896
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.668 SNIP 0.872
Scopus rating (2000): SJR 0.797 SNIP 0.905
Scopus rating (1999): SJR 1.235 SNIP 1.033
Original language: English
Incorporation of Human-Platelet-Derived Growth Factor-BB Encapsulated Poly(lactic-co-glycolic acid) Microspheres into 3D CORAGRAF Enhances Osteogenic Differentiation of Mesenchymal Stromal Cells

Tissue engineering aims to generate or facilitate regrowth or healing of damaged tissues by applying a combination of biomaterials, cells, and bioactive signaling molecules. In this regard, growth factors clearly play important roles in regulating cellular fate. However, uncontrolled release of growth factors has been demonstrated to produce severe side effects on the surrounding tissues. In this study, poly(lactic-co-glycolic acid) (PLGA) microspheres (MS) incorporated three-dimensional (3D) CORAGRAF scaffolds were engineered to achieve controlled release of platelet-derived growth factor-BB (PDGF-BB) for the differentiation of stem cells within the 3D polymer network. Fourier transform infrared spectroscopy, energy-dispersive X-ray spectroscopy, scanning electron microscopy, and microtomography were applied to characterize the fabricated scaffolds. In vitro study revealed that the CORAGRAF-PLGA-PDGF-BB scaffold system enhanced the release of PDGF-BB for the regulation of cell behavior. Stromal cell attachment, viability, release of osteogenic differentiation markers such as osteocalcin, and upregulation of osteogenic gene expression exhibited positive response. Overall, the developed scaffold system was noted to support rapid cell expansion and differentiation of stromal cells into osteogenic cells in vitro for bone tissue engineering applications.
Indoor measurement of angle resolved light absorption by antireflective glass in solar panels

In this work, we present measurements of angle resolved light absorption of antireflective (AR) glass of PV samples, performed indoors using a collimated high radiance broadband light source. This indoor method proved to be viable and offered a significant simplification compared to outdoor measurements with trackers. The experimental results showed optical responses that are stable and suitable for indoor characterization of solar cells. We find the characteristic optical response of six different antireflective glasses, and based on such measurements, we perform PVsyst simulations and present the monthly DC energy production estimates across four distinct latitudinal locations with six different glass types. The results indicated that the AR glasses present different optical effects at the angles intervals between 0 – 45° and 60 – 90° and that the Diffuse AR glass can improve monthly yields by as much as 2% relatively to a bare cell.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Photovoltaic Materials and Systems, Organic Energy Materials, Department of Micro- and Nanotechnology, Silicon Microtechnology, Experimental Surface and Nanomaterials Physics
Number of pages: 4
Publication date: 2017

Host publication information
Title of host publication: Proceedings of the 33rd European Photovoltaic Solar Energy Conference and Exhibition
Main Research Area: Technical/natural sciences
Antireflective glass, Angle of Incidence, Incidence Angle Modifier, Simulation
Electronic versions:
Poster

Relations
Projects:
Indoor measurement of angle resolved light absorption by antireflective glass in solar panels
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017
Indoor Measurement of Angle Resolved Light Absorption by Black Silicon

Angle resolved optical spectroscopy of photovoltaic (PV) samples gives crucial information on PV panels under realistic working conditions. Here, we introduce measurements of angle resolved light absorption by PV cells, performed indoors using a collimated high radiance broadband light source. Our indoor method offers a significant simplification as compared to measurements by solar trackers. As a proof-of-concept demonstration, we show characterization of black silicon solar cells. The experimental results showed stable and reliable optical responses that makes our setup suitable for indoor, angle resolved characterization of solar cells.

General information
State: Published
Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Department of Micro- and Nanotechnology, Silicon Microtechnology, Experimental Surface and Nanomaterials Physics, Photovoltaic Materials and Systems, Organic Energy Materials
Number of pages: 3
Publication date: 2017

Host publication information
Title of host publication: Proceedings of the international 2017 IEEE Photovoltaic Specialists Conference
Publisher: IEEE
Main Research Area: Technical/natural sciences
Electronic versions:
Indoor_Measurement_of_Angle_Resolved_Absorption_of_Black_Silicon_CommentsAddressed_BI_Mek_PP_Final_1_.pdf
Source: PublicationPreSubmission
Source-ID: 139805541
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

In-situ doped junctionless polysilicon nanowires field effect transistors for low-cost biosensors
Silicon nanowire (SiNW) field effect transistor based biosensors have already been proven to be a promising tool to detect biomolecules. However, the most commonly used fabrication techniques involve expensive Silicon-On-Insulator (SOI) wafers, E-beam lithography and ion-implantation steps. In the work presented here, a top down approach to fabricate SiNW junctionless field effect biosensors using novel in-situ doped polysilicon is demonstrated. The p-type polysilicon is grown with an optimum boron concentration that gives a good metal-silicon electrical contact while maintaining the doping level at a low enough level to provide a good sensitivity for the biosensor. The silicon nanowires are patterned using standard photolithography and a wet etch method. The metal contacts are made from magnetron sputtered TiW and e-beam evaporation of gold. The passivation of electrodes has been done by sputtered Si3N4 which is patterned by a lift-off process. The characterization of the critical fabrication steps is done by Secondary Ion Mass Spectroscopy (SIMS) and by statistical analysis of the measurements made on the width of the SiNWs. The electrical characterization of the SiNW in air is done by sweeping the back gate voltage while keeping the source drain potential to a constant value and surface characterization is done by applying liquid gate in phosphate buffered saline (PBS) solution. The fabricated SiNWs sensors functionalized with (3-aminopropyl)triethoxysilane (APTES) have demonstrated good sensitivity in detecting different pH buffer solutions.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems, Technical University of Denmark
Pages: 88-95
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Sensing and Bio-Sensing Research
Volume: 13
ISSN (Print): 2214-1804
Ratings:
Scopus rating (2017): SNIP 0.807 SJR 0.604
Scopus rating (2016): CiteScore 1.49 SJR 0.372 SNIP 0.623
Scopus rating (2015): SJR 0.285 SNIP 0.868 CiteScore 1.31
In Situ Production of Graphene-Fiber Hybrid Structures

We report a scalable method to obtain a new material where large graphene sheets form webs linking carbon fibers. Film-fiber hybrid nonwoven mats are formed during fiber processing and converted to carbon structures after a simple thermal treatment. This contrasts with multistep methods that attempt to mix previously prepared graphene and fibers, or require complicated and costly processes for deposition of graphene over carbon fibers. The developed graphene-fiber hybrid structures have seamless connections between graphene and fibers, and in fact the graphene "veils" extend directly from one fiber into another forming a continuous surface. The graphene-fiber hybrid structures are produced in situ from aqueous poly(vinyl alcohol) solutions. The solutions were subjected to centrifugal spinning to produce fine nanofiber mats. The addition of salt to the polymer solution stimulated a capillarity effect that promoted the formation of thin veils, which become graphene sheets upon dehydration by sulfuric acid vapor followed by carbonization (at relatively low temperatures, below 800 °C). These veils extend over several micrometers within the pores of the fiber network, and consist of crystalline graphene layers that cross-link the fibers to form a highly interconnected hybrid network. The surface area and pore diameter of the hybrid structures were measured to be 521 m²g⁻¹ and 10 nm, respectively. The resulting structure shows high electrical conductivity, 550 S/m, and promising shielding of electromagnetic interference, making it an attractive system for a broad range of electronic applications.
Integrin Targeting and Toxicological Assessment of Peptide-Conjugated Liposome Delivery Systems to Activated Endothelial Cells

Utilisation of functionalized liposomes as the means of targeted delivery of therapeutics may enhance specific transport of biologically active drugs to target tissues, while avoiding or reducing undesired side effects. In the present investigation, peptide-conjugated cationic liposomes were constructed with the aim of targeting integrins (i.e. vitronectin and/or fibronectin receptors) on activated endothelial cells. The peptide-conjugated liposomes induced only cytotoxicity at the highest concentration in non-activated or activated endothelial cells, as well as in co-culture of endothelial cells and macrophages. There was unaltered secretion of cytokines following exposure of peptide-conjugated liposomes to endothelial cells, indicating that the materials were not inflammogenic. Liposomes with a peptide targeting the fibronectin receptor (integrin α5β1) were more effective in targeting of activated endothelial cells, as compared to a liposome with a peptide that targeted both the fibronectin and vitronectin receptors, as well as liposomes with a control peptide. The liposome targeted to the fibronectin receptor also displayed uptake in endothelial cells in co-culture with activated macrophages. Therefore, this study demonstrates the feasibility of constructing a peptide-conjugated cationic liposome, which displays targeting to activated endothelial cells at concentrations that are not cytotoxic or inflammogenic to the cells.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Copenhagen
Authors: Kermanizadeh, A. (Forskerdatabase), Villadsen, K. (Forskerdatabase), Østrem, R. G. (Intern), Jensen, K. J. (Forskerdatabase), Møller, P. (Ekstern), Loft, S. (Ekstern)
Pages: 380-389
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Basic & Clinical Pharmacology & Toxicology
Volume: 120
Issue number: 4
ISSN (Print): 1742-7835
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.57
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.64
Knowledge on molecular structure of exopolysaccharides (EPSs) and their roles in the associative interactions with proteins is essential to understand the relationship between their structure, physical and rheological properties. Despite their importance, no detailed molecular characterization of bacterial EPSs and their associative interactions with proteins have been reported up to now. By combining X-ray solutionscattering (SAXS), dynamic light scattering (DLS) and analytical ultracentrifugation (AUC) in conjunction with scattering modeling, we have characterized four different heteroexopolysaccharides (HePS-1–HePS-4) from lactic acid bacteria (LAB) and their interactions with β-lactoglobulin. We have previously shown that these HePSs exhibited a compact conformation in solution. Here, SAXS data for HePSs (HePS-1–HePS-4) complexes with β-lactoglobulin showed that β-lactoglobulin aggregated strongly with these HePSs. β-lactoglobulin exists as a dimer at pH 4 in the absence of HePSs. When mixed with HePSs, SAXS analysis showed that β-lactoglobulin formed large aggregates. DLS also showed formation of large aggregates of β-lactoglobulin with HePSs, thus validating SAXS data. Turbidity and AUC data indicated that both soluble and insoluble BLG–HePSs complexes were formed. This study provides new insights into the role of molecular structures in associative interactions between HePSs and BLG which has relevance for various industrial applications.
Interactions of the Calcite {10.4} Surface with Organic Compounds: Structure and Behaviour at Mineral – Organic Interfaces

The structure and the strength of organic compound adsorption on mineral surfaces are of interest for a number of industrial and environmental applications, oil recovery, CO₂ storage and contamination remediation. Biomineralised calcite plays an essential role in the function of many organisms that control crystal growth with organic macromolecules. Carbonate rocks, composed almost exclusively of calcite, host drinking water aquifers and oil reservoirs. In this study, we examined the ordering behaviour of several organic compounds and the thickness of the adsorbed layers formed on calcite {10.4} surfaces. We used X-ray reflectivity (XRR) to study calcite {10.4} surfaces that were prepared in three alcohols: methanol, isopropanol and pentanol and one carboxylic acid: octanoic acid. All molecules adsorbed in self-assembled layers, where thickness depended on the density and the length of the molecule. For methanol and isopropanol, molecular dynamic simulations (MD) provided complementary information, which allowed us to develop a surface model. Branching in isopropanol induced slightly less ordering because of the additional degree of freedom. Pentanol and octanoic acid adsorbed as single monolayers. The results of this work indicate that adhered organic compounds from the surrounding environment can affect the surface behaviour, depending on properties of the organic compound.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Theoretical Biophysics, University of Copenhagen
Authors: Hakim, S. S. (Ekstern), Olsson, M. H. M. (Ekstern), Sørensen, H. O. (Ekstern), Bovet, N. (Ekstern), Bohr, J. (Intern), Feidenhansl, R. (Ekstern), Stipp, S. L. S. (Ekstern)
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Scientific Reports
Volume: 7
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ISSN (Print): 2045-2322
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.245 SJR 1.533
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.63 SJR 1.692 SNIP 1.354
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.034 SNIP 1.597 CiteScore 5.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.163 SNIP 1.554 CiteScore 4.75
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.998 SNIP 1.57 CiteScore 4.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.531 SNIP 0.962 CiteScore 2.44
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
ISI indexed (2011): ISI indexed no
Original language: English
Environmental chemistry, Biogeochemistry
Electronic versions:
s41598_017_06977_4.pdf
DOIs:
Interface band gap narrowing behind open circuit voltage losses in Cu$_2$ZnSnS$_4$ solar cells

We present evidence that bandgap narrowing at the heterointerface may be a major cause of the large open circuit voltage deficit of Cu$_2$ZnSnS$_4$/CdS solar cells. Bandgap narrowing is caused by surface states that extend the Cu$_2$ZnSnS$_4$ valence band into the forbidden gap. Those surface states are consistently found in Cu$_2$ZnSnS$_4$, but not in Cu$_2$ZnSnSe$_4$, by first-principles calculations. They do not simply arise from defects at surfaces but are an intrinsic feature of Cu$_2$ZnSnS$_4$ surfaces. By including those states in a device model, the outcome of previously published temperature-dependent open circuit voltage measurements on Cu$_2$ZnSnS$_4$ solar cells can be reproduced quantitatively without necessarily assuming a cliff-like conduction band offset with the CdS buffer layer. Our first-principles calculations indicate that Zn-based alternative buffer layers are advantageous due to the ability of Zn to passivate those surface states. Focusing future research on Zn-based buffers is expected to significantly improve the open circuit voltage and efficiency of pure-sulfide Cu$_2$ZnSnS$_4$ solar cells.
Intracellular Microreactors as Artificial Organelles to Conduct Multiple Enzymatic Reactions Simultaneously

The creation of artificial organelles is a new paradigm in medical therapy that aims to substitute for missing cellular function by replenishing a specific cellular task. Artificial organelles tackle the challenge of mimicking metabolism, which is the set of chemical reactions that occur within a cell, mainly catalyzed by enzymes. So far, the few reported carriers able to conduct enzymatic reactions intracellularly are based on single-compartment carriers. However, cell organelles outperform by conducting multiple reactions simultaneously within confined sub-compartments. Here, the field of artificial organelles is advanced by reporting the assembly of a microreactor consisting of polymer capsules entrapping gold nanoclusters (AuNCs) and liposomes as sub-compartments. The fluorescence properties of AuNCs are employed to monitor the microreactors uptake by macrophages. Encapsulation is demonstrated and functionality of microreactors with trypsin (TRP) and horseradish peroxidase (HRP)-loaded liposomes is preserved. Multiple enzymatic reactions taking place simultaneously is demonstrated by exposing macrophages with the internalized microreactors to bis-(benzyloxycarbonyl-Ile-Pro-Arg)-Rho-110 and Amplex Red substrates, which are specific for TRP and HRP, respectively. Conversion of the substrates into the respective fluorescent products is observed. This report on the first microreactor conducting multiple enzymatic reactions simultaneously inside a cell is a considerable step in the field of artificial organelles.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Technical University of Denmark
Investigating dye performance and crosstalk in fluorescence enabled bioimaging using a model system

Detailed imaging of biological structures, often smaller than the diffraction limit, is possible in fluorescence microscopy due to the molecular size and photophysical properties of fluorescent probes. Advances in hardware and multiple providers of high-end bioimaging makes comparing images between studies and between research groups very difficult. Therefore, we suggest a model system to benchmark instrumentation, methods and staining procedures. The system we introduce is based on doped zeolites in stained polyvinyl alcohol (PVA) films: a highly accessible model system which has the properties needed to act as a benchmark in bioimaging experiments. Rather than comparing molecular probes and imaging methods in complicated biological systems, we demonstrate that the model system can emulate this complexity and can be used to probe the effect of concentration, brightness, and cross-talk of fluorophores on the detected fluorescence signal. The described model system comprises of lanthanide (III) ion doped Linde Type A zeolites dispersed in a PVA film stained with fluorophores. We tested: F18, MitoTracker Red and ATTO647N. This model system allowed comparing performance of the fluorophores in experimental conditions. Importantly, we here report considerable cross-talk of the dyes when exchanging excitation and emission settings. Additionally, bleaching was quantified. The proposed model makes it possible to test and benchmark staining procedures before these dyes are applied to more complex biological systems.
Investigation of Cu$_2$ZnSnS$_4$ nanoparticles for thin-film solar cell applications

We study the effect of the annealing atmosphere on grain growth of ligand-free and ligand-coated Cu$_2$ZnSnS$_4$ (CZTS) nanoparticle-based thin films by thermal analysis. We use thermogravimetric analysis (TGA) coupled with mass spectrometry (MS) to simultaneously monitor mass changes and evolved gases of both nanoparticle powders and inks. The investigation focuses on annealing in air, nitrogen and forming gas (5% H$_2$ in Ar), i.e., oxidizing, inert, and reducing atmospheres. We find that the oleylamine capping ligands thermally decompose into smaller organic fragments starting below its boiling point, with a slightly higher decomposition rate in reducing atmosphere. With nanoparticle inks, very modest grain growth is observed, with no differences between the atmospheres. Conversely, with nanoparticle powders, micron-sized grains appear all over for the ligand-free sample and some micron-sized grains are seen with inert atmosphere for the ligand-coated powder. The starting material is thus very important for grain growth.

General information
State: Published
Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Energy Conversion and Storage, Mixed Conductors, Department of Micro- and Nanotechnology, Silicon Microtechnology, Experimental Surface and Nanomaterials Physics, Nanyang Technological University
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Web of Science (2018): Indexed yes
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Scopus rating (2017): SNIP 0.864 SJR 0.617
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.83 SJR 0.639 SNIP 0.881
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.68 SNIP 0.923 CiteScore 1.84
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.725 SNIP 1.075 CiteScore 1.94
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.814 SNIP 1.195 CiteScore 2
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.897 SNIP 1.153 CiteScore 1.86
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.995 SNIP 1.323 CiteScore 2.13
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.132 SNIP 1.224
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.127 SNIP 1.213
Investigation of sizing - from glass fibre surface to composite interface

Composites are far from a new invention, and have through time taken many shapes. From a simple hay clay house to advanced nano particle containing composites for advanced material applications. Since the industrialisation in the late 1800’s the use of fibre reinforced composites have increased significantly. The usage span wide, from furniture and car components to construction materials. Even though, the concept of composites is well known and widely applied, the fundamental principles of the interaction of the constituents, in the composites are still not fully understood. This thesis is a part of Danish Center for Composite Structures and Materials for wind turbine blades who work towards improving composites. Since wind turbine blades are the basis of the DCCSM it is the materials used here that are the focus, explicitly glass fibres and epoxy matrix. Glass fibre composites greatly dominate the fibre reinforced composite industry due to the combination of their relatively high stiffness and low production cost. During manufacturing the glass fibres are applied a coating, called sizing, for protection of the fibres and for compatibility with the polymer matrix. The sizing is located at the interface between glass fibre and polymer matrix. Despite the importance of this interface, in regards to the stress transfer, which is responsible for the reinforcing effect of fibres, very little research address how the interface is affected and how it can be controlled. This thesis covers an analysis of the sizing from the glass fibre surface to the interface in composites.

Through soxhlet extraction with acetone it was possible to remove a part of the sizing from the glass fibres for analysis. By burning off the sizing at 565 ºC a higher mass loss was obtained than from the extraction, indicating that a part of the sizing might be covalently bonded to the glass fibre surface. The investigation of the sizing extract by ATR-FTIR and TGA-MS revealed the presence of a DGEBA film former as one of the components of the sizing. Glass plates were successfully coated with the organosilanes APTMS and GPTMS in order to mimic the surface of the glass fibres. The non-planar surface of glass fibres yields difficulties in some analysis e.g. determination of contact angle. The plates displayed a clear difference in contact angle after being coated towards a more polar surface.

An investigation of the adhesion between fibre and matrix analysed by microbond testing and the determination of the IFSS was conducted varying the amine:epoxide group ratio in the matrix and the testing temperature. IFSS was found to be affected by both parameters. A maximum IFSS was observed around the stoichiometric ratio of amine:epoxide group (1:1). The presence of amine or epoxide groups in the sizing will affect the ratio at the interface and in all probability also the IFSS with a decrease in IFSS as the result. Furthermore, the testing temperature influenced the IFSS. The highest values were obtained at room temperature. Above the glass transition temperature the dependency of the amine:epoxide group ratio changed to become linear. Two different microbond setups were used for the determination of the IFSS and a difference was detected. It was explained by the difference in loading procedure; one had constant strain rate and the other constant load rate. Additionally the duration of the microbond test might also influence the determination of the IFSS. The influence on the mechanical properties stiffness, strength and J-integral by changes in the chemistry of the interface was investigated. The stiffness of single glass fibres increased after the removal of sizing by extraction but also when the sizing was removed by burning. This could partly be explained by the sizing being less dense than the glass fibres. For the burned glass fibres compactment of the glass structure also yields an increase in stiffness. The fibre strength was less
affected by the extraction of sizing but burning drastically decreased the strength. The enlargement of surface flaws after the removal of the protective sizing is given as the cause of the decrease in strength. Coating of fibres after extraction of the original sizing by the organosilane GPTMS resulted only in insignificant changes of stiffness and strength of single glass fibres. However the effect on the adhesion measured by the J-integral was remarkable. Small scale specimens were successfully used for the DCB testing and the determination of the J-integral. The GPTMS modified fibres displayed significant higher interface adhesion in comparison to the fibres with the original sizing. From this it had been proved that the original sizing is far from the optimal when it comes to facilitating a strong adhesion between glass fibre and matrix.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Composites and Materials Mechanics, Department of Wind Energy
Authors: Petersen, H. N. (Intern), Almdal, K. (Intern), Brøndsted, P. (Intern), Kusano, Y. (Intern), Sørensen, B. F. (Intern)
Number of pages: 84
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IR spectroscopy with pyrolytic carbon string resonator as a tool for particle detection

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Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Nguyen, Q. L. (Intern), Larsen, P. E. (Intern), Schmid, S. (Intern), Boisen, A. (Intern), Keller, S. S. (Intern)
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Event: Poster session presented at 14th International Workshop on Nanomechanical Sensors, Keauhou Bay , United States.
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IR spectroscopy with pyrolytic carbon string resonator as a tool for particle detection

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Vienna University of Technology
Authors: Nguyen, Q. L. (Intern), Larsen, P. E. (Intern), Schmid, S. (Ekstern), Boisen, A. (Intern), Keller, S. S. (Intern)
Publication date: 2017
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Electronic versions:
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Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Label-free monitoring of diffusion in microfluidics
Label-free, real-time detection of concentration gradients is demonstrated in a microfluidic H-filter, using an integrated photonic crystal slab sensor to monitor sample refractive index with spatial resolution. The recorded diffusion profiles
reveal root-mean-square diffusion lengths for non-fluorescing and non-absorbing molecules, both small (glucose, 180 Da) and large (bovine serum albumin, 67 kDa).

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Organisations: Department of Micro- and Nanotechnology, Optofluidics
Authors: Sørensen, K. T. (Intern), Kristensen, A. (Intern)
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Main Research Area: Technical/natural sciences

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Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 1.83 SJR 0.395 SNIP 0.791
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 0.463 SNIP 0.925 CiteScore 1.78
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 0.625 SNIP 1.341 CiteScore 2.1
Scopus rating (2013): SJR 0.479 SNIP 1.107 CiteScore 1.73
ISI indexed (2013): ISI indexed no
Scopus rating (2012): SJR 0.472 SNIP 1.285 CiteScore 1.28
ISI indexed (2012): ISI indexed no
Scopus rating (2011): SJR 0.222 SNIP 0.882
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Source: FindIt
Source-ID: 2393187966
Publication: Research - peer-review › Journal article – Annual report year: 2017

Lab-on-a-disc platform for screening of genetically modified E. coli cells via cell-free electrochemical detection of p-Coumaric acid
We present a robust easy to use lab-on-a-disc (LoD) device with integrated sample pre-treatment and electrochemical detection system for cell-free detection of a secondary metabolite, p-Coumaric acid (pHCA), produced by genetically modified E. coli. In the LoD device, which incorporates eight filtration and electrochemical detection units, the sample filtration was performed by rotating the disc using a programmable closed-loop stepper motor. The electrodes, patterned on plastic substrate, were connected through a printed circuit board to the slip ring using a robust magnetic clamping system that enables easy assembly and robust electrical connections. pHCA was quantified in a linear range from 0.125 up to 2 mM using square wave voltammetry. The platform was successfully used for the quantification of pHCA produced by two genetically modified E. coli strains after 24 h of cell culture. The data obtained from the electrochemical measurements showed good correlation with high performance liquid chromatographic analysis. The developed LoD system offers fast and easy detection of pHCA, enabling screening of genetically modified organisms based on the quantity of produced secondary metabolites.
Large-scale Fabrication of 2D Materials by Chemical Vapor Deposition

The family of 2D materials comprises a vast range of few-atom thick materials held together by van der Waals interactions that have a diverse set of material properties. While these materials are interesting in their own right, the most exciting aspect of their research is the ability to combine this vast range of materials - without the lattice mismatch constraints of conventional 3D materials - into atomically engineered, artificial 3D crystals that pave the way for new physics, and subsequently, for new applications. 2D materials are expected to disrupt a number of industries in the future, such as electronics, displays, energy, and catalysis. The key bottleneck for commercial implementation is in large-scale synthesis and subsequent fabrication of high quality devices. Chemical vapor deposition is considered to be the most economically feasible synthesis method to this end. In the case of graphene, for which synthesis and transfer methods have been established, the key bottleneck is in cost reduction and device integration without significant degradation of material properties. In the case of the other 2D materials, the key bottleneck is in the absence of reliable and scalable methods for synthesis.

This thesis aims to address some of the challenges associated with materials fabrication in order to lay the groundwork for commercial implementation of 2D materials. To improve graphene implementation in electronic applications, copper catalyst foils were engineered to reduce surface roughness, wrinkles, and polycrystallinity in the resulting graphene layer; in the process, monocristalline copper foils with a post-process surface roughness below 10 nm - an order of magnitude lower than current commercial foils - were achieved. A new transfer technique was also developed as a route towards vertical integration of device fabrication process steps.

To realize large-scale and economical graphene production, significant reductions in graphene production cost were achieved through efficient space utilization in a commercial chemical vapor deposition reactor, allowing for a 30x improvement in throughput. A large-scale, non-destructive transfer process for DIY-application of graphene films onto arbitrary substrates was also developed through the use of commercially available polymer films and solvents. Finally, a novel in-situ process monitoring tool was developed to complement large-scale graphene production, which was used here to troubleshoot and optimize processes to enable reproducible and high quality graphene synthesis.

To address the challenge of synthesizing the vast library of 2D materials, a universal platform for 2D materials synthesis via CVD-like conditions was invented, and was used to synthesize more than 26 different compounds - some well-known and others never-before isolated - to demonstrate its universality. The discovery of this general growth method calls for a perspective shift from the conventional 2D materials growth model inherited from graphene synthesis on copper, and provides an instructional guide for rapidly synthesizing prospective new 2D materials, paving the way for accelerated progress in the field in coming years.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon
Authors: Shivayogimath, A. (Intern), Bøggild, P. (Intern), Booth, T. (Intern)
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Main Research Area: Technical/natural sciences

Relations
Projects:
Large-scale Fabrication of 2D Materials by Chemical Vapor Deposition
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Source-ID: 142649154
Publication: Research › Ph.D. thesis – Annual report year: 2018

Large-scale, Lithography-free Production of Transparent Nanostructured Surface for Dual-functional Electrochemical and SERS Sensing
In this work, we present a dual-functional sensor that can perform surface-enhanced Raman spectroscopy (SERS) based identification and electrochemical (EC) quantification of analytes in liquid samples. A lithography-free reactive ion etching process was utilized to obtain nanostructures of high aspect ratios distributed homogeneously on a 4-inch fused silica wafer. The sensor was made up of three-electrode array, obtained by subsequent e-beam evaporation of Au on nanostructures in selected areas through a shadow mask. The SERS performance was evaluated through surface-averaged enhancement factor (EF), which was ~6.2 x 10^5, and spatial uniformity of EF, which was ~13% in terms of relative standard deviation. Excellent electrochemical performance and reproducibility were revealed by recording cyclic voltammograms. On nanostructured electrodes, paracetamol (PAR) showed an improved quasi-reversible behavior with decrease in peak potential separation (ΔEp ~90mV) and higher peak currents (Ip/p ~1), comparing to planar electrodes (ΔEp ~560mV). The oxidation potential of PAR was also lowered by ~80 mV on nanostructured electrodes. To illustrate dual-functional sensing, quantitative evaluation of PAR ranging from 30 µM to 3 mM was realized through EC detection, and presence of PAR was verified by its SERS fingerprint.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Bioanalytics
Authors: Sanger, K. (Intern), Durucan, O. (Intern), Wu, K. (Intern), Thilsted, A. H. (Intern), Heiskanen, A. R. (Intern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern), Zor, K. (Intern), Boisen, A. (Intern)
Pages: 1869–1875
Publication date: 2017
Main Research Area: Technical/natural sciences

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Scopus rating (2017): SNIP 1.241 SJR 1.895
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10.1021/acssensors.7b00783
Source: FindIt
Source-ID: 2393629846
Publication: Research - peer-review › Journal article – Annual report year: 2017

Liquid fiducial marker applicability in proton therapy of locally advanced lung cancer
Background and purpose: We investigated the clinical applicability of a novel liquid fiducial marker (LFM) for image-guided pencil beam scanned (PBS) proton therapy (PBSPPT) of locally advanced lung cancer (LALC). Materials and methods: The relative proton stopping power (RSP) of the LFM was calculated and measured. Dose perturbations of the LFM and three solid markers, in a phantom, were measured. PBSPPT treatment planning on computer tomography scans of five patients with LALC with the LFM implanted was performed with 1-3 fields. Results: The RSP was experimentally determined to be 1.164 for the LFM. Phantom measurements revealed a maximum relative deviation in dose of 4.8% for the LFM in the spread-out Bragg Peak, compared to 12-67% for the solid markers. Using the experimentally determined RSP, the maximum proton range error introduced by the LFM is about 1. mm. If the marker was displaced at PBSPPT, the maximum dosimetric error was limited to 2 percentage points for 3-field plans. Conclusion: The dose perturbations introduced by the LFM were considerably smaller than the solid markers investigated. The RSP of the fiducial marker should be corrected in the treatment planning system to avoid errors. The investigated LFM introduced clinically acceptable dose perturbations for image-guided PBSPPT of LALC.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Rigshospitalet, Paul Scherrer Institut, Bispebjerg University Hospital
Loading of Drug-Polymer Matrices in Microreservoirs for Oral Drug Delivery

For major advances in microfabricated drug delivery systems (DDS), fabrication methods with high throughput using biocompatible polymers are required. Once these DDS are fabricated, loading of drug poses a significant challenge. Here, hot punching is presented as an innovative method for drug loading in microfabricated DDS. The microfabricated DDS are microcontainers fabricated in photosresist SU-8 and biopolymer poly-ε-caprolactone (PCL). Furosemide (F) drug is embedded in poly-ε-caprolactone (PCL) polymer matrix. This F-PCL drug polymer matrix is loaded in SU-8 and PLLA microcontainers using hot punching with >99% yield. Thus, it is illustrated that hot punching allows high-throughput, parallel loading of 3D polymer microcontainers with drug-polymer matrices in a single process step.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Petersen, R. S. (Intern), Keller, S. S. (Intern), Boisen, A. (Intern)
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Web of Science (2018): Indexed yes
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Scopus rating (2017): SNIP 0.945 SJR 0.755
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.01 SJR 0.905 SNIP 0.972
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.847 SNIP 1.072 CiteScore 2.88
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.009 SNIP 1.294 CiteScore 2.81
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.956 SNIP 1.24 CiteScore 2.66
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.963 SNIP 1.181 CiteScore 2.34
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.972 SNIP 1.058 CiteScore 2.18
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.922 SNIP 0.916
Web of Science (2010): Indexed yes
Low surface damage dry etched black silicon

Black silicon (bSi) is promising for integration into silicon solar cell fabrication flow due to its excellent light trapping and low reflectance, and a continuously improving passivation. However, intensive ion bombardment during the reactive ion etching used to fabricate bSi induces surface damage that causes significant recombination. Here, we present a process optimization strategy for bSi, where surface damage is reduced and surface passivation is improved while excellent light trapping and low reflectance are maintained. We demonstrate that reduction of the capacitively coupled plasma power, during reactive ion etching at non-cryogenic temperature (-20°C), preserves the reflectivity below 1% and improves the effective minority carrier lifetime due to reduced ion energy. We investigate the effect of the etching process on the surface morphology, light trapping, reflectance, transmittance, and effective lifetime of bSi. Additional surface passivation using atomic layer deposition of Al₂O₃ significantly improves the effective lifetime. For n-type wafers, the lifetime reaches 12 ms for polished and 7.5 ms for bSi surfaces. For p-type wafers, the lifetime reaches 800 ls for both polished and bSi surfaces.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, DTU Danchip, Nanoprobes, Department of Energy Conversion and Storage, Anhalt University of Applied Sciences, Fraunhofer Center for Silicon Photovoltaics CSP
Authors: Plakhotnyuk, M. M. (Intern), Gaudig, M. (Ekstern), Davidsen, R. S. (Intern), Michael-Lindhard, J. (Intern), Hirsch, J. (Ekstern), Lausch, D. (Ekstern), Schmidt, M. S. (Intern), Stamate, E. (Intern), Hansen, O. (Intern)
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.953 SJR 0.739
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.72 SJR 0.906 SNIP 0.977
Macroscale SERS Uniformity and Reproducibility Using Densely Clustered Nanopillars

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Wu, K. (Intern), Schmidt, M. S. (Intern), Rindzevicius, T. (Intern), Thilsted, A. H. (Intern), Boisen, A. (Intern)
Publication date: 2017
Event: Abstract from The Fourth International Conference on Frontiers of Plasmonics, Hefei, China.
Main Research Area: Technical/natural sciences
Electronic versions:
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Source: PublicationPreSubmission
Source-ID: 136956766
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Magnetic Bead-Based Biosensing on an Automated & Integrated Lab-on-a-Disc Platform
The PhD thesis presents the development and utilization of magnetic bead-based agglutination assays for the detection of biomarkers in biofluids as well as discovery of a biomarker relevant to the mechanism of action of a type-2 diabetes (T2D) drug while integrating the assays on an automated centrifugal microfluidic platform with incorporated readout units. The assays were developed through surface functionalization of micro or nano-sized magnetic beads with specific antibodies or aptamers to specifically bind with the biomarker of interest resulting in the formation of the biomarker-bridged magnetic bead clusters and hence called 'agglutination' assay. The concentration of the analyte or biomarker was quantified based on the size of the clusters. The model biomarkers studied in this project were thrombin – a blood coagulation protein; C-reactive protein – an acute phase protein-biomarker for inflammatory diseases; and mononuclear white blood cell count – a biomarker for the prognosis of different medical conditions. Furthermore, the concept of the agglutination assay was utilized for a biomarker discovery application by investigating the mechanism of action of a T2D drug - metformin through the analysis and quantification of the aggregation and disaggregation phenomena of the magnetic beads in response to the presence of the drug.

The assays were either partially or fully integrated on disc-shaped polymeric microfluidic substrates i.e. microfluidic discs for incorporating the advantages of centrifugal microfluidics e.g. eliminating the need for external fluidic connectors or pumps, and facilitating simple, compact and low-cost instrumentation along with effective multiplexing of microfluidic units.
All the discs were fabricated in-house using multiple layers of polymeric substrates. Two specific valving mechanisms namely centrifugo-pneumatic and event-triggered valving were incorporated into the microfluidic platform in order to facilitate the integration of the assay from sample-to-answer.
The readouts were performed by two different optical methods: Blu-ray based optomagnetic readout and optical imaging method. The readout instruments were customized and incorporated with the automated centrifugation microfluidic platform to produce an integrated and automated biosensing platform with a potential for operating in an out-of-lab setting which can pave the way for future development of a point-of-care diagnostic tool.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Uddin, R. (Intern), Boisen, A. (Intern), Burger, R. (Intern), Donolato, M. (Intern)
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Publication: Research › Ph.D. thesis – Annual report year: 2018

Magnetic Properties of Large-Scale Nanostructured Graphene Systems
The on-going progress in two-dimensional (2D) materials and nanostructure fabrication motivates the study of altered and combined materials. Graphene—the most studied material of the 2D family—displays unique electronic and spintronic properties. Exceptionally high electron mobilities, that surpass those in conventional materials such as silicon, make graphene a very interesting material for high-speed electronics. Simultaneously, long spin-diffusion lengths and spin-life...
times makes graphene an eligible spin-transport channel. In this thesis, we explore fundamental features of nanostructured graphene systems using large-scale modeling techniques.

Graphene perforations, or antidots, have received substantial interest in the prospect of opening large band gaps in the otherwise gapless graphene. Motivated by recent improvements of fabrication processes, such as forming graphene antidots and layer-by-layer stacking, we consider a hybrid bilayer graphene system: Graphene on graphene antidot lattice (GOAL). These systems can be engineered to select attractive features from either bilayer and monolayer graphene. For a certain set of optimized geometries, we obtain linearly dispersing bands with a high corresponding mobility, resembling that of monolayer graphene. Nevertheless, these linearly dispersive GOALs can be made gapped by breaking layer symmetry, using e.g. perpendicular electric fields.

In the area of graphene spintronics, the formation of magnetic moments is predicted as the result of breaking the graphene sublattice symmetry. We take advantage of this, and explore the fundamental features of zigzag-edged triangular graphene antidots (zz-TGAs). Their specific edge configurations give rise to highly desirable spin-filtering and spin-splitting transport features. The mechanisms behind these functionalities are studied in detail in lattices, devices, and finally in disordered systems of experimentally feasible scale.

We demonstrate that superlattices of triangular antidots exhibit large bands gaps, induced by sublattice symmetry breaking. Spin-polarized TGAs are shown to become half-metallic near the Fermi level, giving rise to perfectly spin-polarized densities of states. By studying the transport properties of devices with embedded zz-TGAs, we highlight an interesting spatial spin-splitting feature analogous to the spin Hall effect. Unlike the conventional spin Hall effect, this feature is obtained without spin-orbit interactions or topologically protected transport channels. Motivated by spin Hall effect measurements, we calculate transverse resistance signals in zz-TGA devices and show that these can provide a general diagnostic tool to detect the presence of zigzag edge magnetism. The extraordinary features of zz-TGAs at small scales motivate our study of their underlying mechanisms in larger, more realistically sized TGAs. Half-metallic, semiconducting and highly anisotropic transport behaviors can be induced in these systems. Furthermore, these properties are extremely robust in the face of substantial disorder, in stark contrast to what is seen for many other antidot-based devices. Ultimately, these properties may prove useful in spintronic devices, graphene-based transistors and integrated electronic circuits where a particular transport direction is preferred.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology
Authors: Gregersen, S. S. (Ekstern), Jauho, A. (Intern), Power, S. (Intern)
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Magnetoelastic Vibrational Energy Harvester with Enhance Robustness

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Technical University of Denmark
Authors: Alcala, L. R. (Intern), Passer, T. (Ekstern), Thomsen, E. V. (Intern)
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Source-ID: 140504243
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Magnetoresistive sensors for measurements of DNA hybridization kinetics - effect of TINA modifications

We present the use of magnetoresistive sensors integrated in a microfluidic system for real-time studies of the hybridization kinetics of DNA labeled with magnetic nanoparticles to an array of surface-tethered probes. The nanoparticles were magnetized by the magnetic field from the sensor current. A local negative reference ensured that only the specific binding signal was measured. Analysis of the real-time hybridization using a two-compartment model yielded both the association and dissociation constants $k_{on}$ and $k_{off}$. The effect of probe modifications with ortho-Twisted Intercalating Nucleic Acid (TINA) was studied. Such modifications have been demonstrated to increase the melting temperature of DNA hybrids in solution and are also relevant for surface-based DNA sensing. Kinetic data for DNA probes with no TINA modification or with TINA modifications at the 5' end (1 × TINA) or at both the 5' and 3' ends (2 × TINA) were compared. TINA modifications were found to provide a relative decrease of $k_{off}$ by a factor of 6-20 at temperatures from 57.5°C to 60°C. The values of $k_{on}$ were generally in the range between 0.5-2 × 105 M$^{-1}$ s$^{-1}$ and showed lower values for the unmodified probe than for the TINA modified probes. The observations correlated well with measured melting temperatures of the DNA hybrids.

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Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Fluidic Array Systems and Technology
Authors: Rizzi, G. (Intern), Dufva, M. (Intern), Hansen, M. F. (Intern)
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BFI (2016): BFI-level 1
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BFI (2015): BFI-level 1
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Scopus rating (2014): SJR 2.163 SNIP 1.554 CiteScore 4.75
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.998 SNIP 1.57 CiteScore 4.06
ISI indexed (2013): ISI indexed yes
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Mapping the electrical properties of large-area graphene

The significant progress in terms of fabricating large-area graphene films for transparent electrodes, barriers, electronics, telecommunication and other applications has not yet been accompanied by efficient methods for characterizing the electrical properties of large-area graphene. While in the early prototyping as well as research and development phases, electrical test devices created by conventional lithography have provided adequate insights, this approach is becoming increasingly problematic due to complications such as irreversible damage to the original graphene film, contamination, and a high measurement effort per device. In this topical review, we provide a comprehensive overview of the issues that need to be addressed by any large-area characterisation method for electrical key performance indicators, with emphasis on electrical uniformity and on how this can be used to provide a more accurate analysis of the graphene film. We review and compare three different, but complementary approaches that rely either on fixed contacts (dry laser lithography), movable contacts (micro four point probes) and non-contact (terahertz time-domain spectroscopy) between the probe and the graphene film, all of which have been optimized for maximal throughput and accuracy, and minimal damage to the graphene film. Of these three, the main emphasis is on THz time-domain spectroscopy, which is non-destructive, highly accurate and allows both conductivity, carrier density and carrier mobility to be mapped across arbitrarily large areas at rates that by far exceed any other known method. We also detail how the THz conductivity spectra give insights on the scattering mechanisms, and through that, the microstructure of graphene films subject to different growth and transfer processes. The perspectives for upscaling to realistic production environments are discussed.

General information

State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Nanocarbon, Department of Photonics Engineering, Ultrafast Infrared and Terahertz Science, Graphenea S.A., National Physical Laboratory
Authors: Bøggild, P. (Intern), Mackenzie, D. (Intern), Whelan, P. R. (Intern), Petersen, D. H. (Intern), Buron, J. C. D. (Intern), Zurutuza, A. (Ekstern), Gallop, J. (Ekstern), Hao, L. (Ekstern), Jepsen, P. U. (Intern)
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Scopus rating (2017): SNIP 1.072 SJR 2.813
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.26 SJR 2.314 SNIP 0.915
Web of Science (2016): Indexed yes
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Martensite formation in Fe-C alloys at cryogenic temperatures

Magnetometry was applied to quantify the fraction of austenite retained in Fe-C alloys subjected to various treatments. These treatments consisted of: (i) water quenching; (ii) water quenching followed by immersion in boiling nitrogen and again in water; (iii) as for (ii) but re-heating from 77 K at a rate of 0.0083 K s$^{-1}$; (iv) as for (iii) but (re-)heating at 0.167 K s$^{-1}$ interrupted by an isothermal step. Data was coupled with hardness measurements and demonstrates that the re-heating conditions from 77 K significantly influence the fraction of austenite retained at the end of the thermal cycle.

General information
State: Published
Organisations: Department of Mechanical Engineering, Materials and Surface Engineering, Department of Micro- and Nanotechnology, Magnetic Systems
Authors: Villa, M. (Intern), Hansen, M. F. (Intern), Somers, M. A. J. (Intern)
Pages: 129–132
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BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.855 SJR 1.923
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.71 SJR 1.884 SNIP 1.737
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.259 SNIP 1.841 CiteScore 3.54
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.65 SNIP 2.035 CiteScore 3.55
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.323 SNIP 1.946 CiteScore 3.19
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.292 SNIP 1.996 CiteScore 3.01
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.314 SNIP 2.082 CiteScore 3.21
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.427 SNIP 2.117
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.569 SNIP 1.999
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.607 SNIP 2.108
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.216 SNIP 2.157
Measuring and Tailoring the Structure of Two-Dimensional Materials by Transmission Electron Microscopy

As the critical dimensions of electronic devices decrease in size, the nanoscale structure becomes important for the electronic properties. Two-dimensional (2D) materials, with a thickness down to one atom, are very affected by disorder. Any type of disorder in graphene, including lattice disorder, roughness, and stress, contributes to charge carrier scattering and limits the carrier mobility. The current de-facto standard for making high quality graphene devices is by hexagonal boron nitride (hBN) encapsulation, which plays the role of a dielectric providing perfect protection from the environment and flattening the graphene. However, such encapsulated samples are commonly placed on silicon oxide substrates which are non-planar surfaces that induce roughness. Another source of carrier scattering, edge roughness, is detrimental for the carrier mobility of nanostructured graphene devices. The minimisation of these sources of scattering is, therefore, important for industrial applications as well as fundamental scientific purposes.

Transmission electron microscopy (TEM) is an excellent tool for structural characterisation of 2D materials because of its sub-angstrom resolution, and potential for adding stimuli like heat, electrical biasing, and studying the interaction with gas molecules. In this project, TEM has been used to measure the structure and also to physically pattern graphene on the nanoscale.

First, the design, fabrication and characterisation of TEM sample carriers for simultaneous in-situ heating and electrical biasing of 2D materials is presented. Chips with platinum heaters on a free-standing silicon nitride membrane were fabricated. The chips were capable of heating to 350 °C consistently for at least 24 hours, and displayed a maximum temperature of 749 °C. The best performing chips were found to be those with larger silicon nitride membranes, and the failure mechanism was related to the stability of the membranes. Patterning graphene with low edge roughness is necessary to avoid charge carrier mobility degradation in graphene devices. Crystallographic etching of graphene by oxygen is a viable route towards low edge roughness patterning and was investigated in an environmental TEM. The edge roughness was found to be dependent on the oxygen pressure, where lower pressures lead to hexagonally shaped holes in graphene with armchair-oriented edges, while higher pressures lead to irregularly shaped holes. Furthermore, the etch rate was found to increase with pressure, electron beam current density, and temperature. The high resolution of the TEM also allowed to study the discrete nature of the etching process at low pressures, where the instantaneous etch rates can be described by the Poisson distribution.

Finally, the roughness of suspended graphene, suspended graphene/hBN heterostructures, and hBN/graphene/hBN heterostructures were investigated by an electron diffraction technique in the TEM. This method enables to measure the roughness of suspended graphene at a higher resolution than scanning probe techniques, which suffer from noise at the low levels of roughness investigated here, and also measure the roughness of graphene embedded in hBN. The root mean square roughness of suspended bare graphene was measured to a value of 114 pm, and decreased to a value of 21 pm and 12 pm for hBN supported graphene and hBN encapsulated graphene, respectively. Simulations support the notion that hBN encapsulated graphene should display lower roughness than hBN supported graphene due to a localisation of flexural phonons in the hBN layers.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon
Authors: Thomsen, J. D. (Intern), Bøggild, P. (Intern), Booth, T. (Intern)
Poly(l-lactide) (PLLA) is a bioabsorbable polymer with high stiffness and strength compared to the other commercially available bioabsorbable polymers. The properties of PLLA can be improved by straining, causing deformation-mediated molecular orientation. PLLA tubes were biaxially strained above their Tg for improvement of their strength, in a two-step process (sequential straining). Mechanical properties and crystal morphology were investigated as a function of processing strain rate and temperature. DSC revealed that a low processing strain rate allows molecular chain relaxation in the direction of strain and the crystallization is suppressed. Faster strain rates on the other hand suppress chain relaxation, and results in crystalline tubes. The mechanical properties are influenced by both processing strain rate and temperature. Low strain rates allow chain relaxation resulting in the lowest strength and stiffness, whereas a larger stiffness and strength is achieved by increasing strain rate and temperature. Isotropic mechanical properties are only observed at high processing strain rates.
Mechanical Resonators for Material Characterization: Sensor Development and Applications

The goals of this PhD project were to provide new approaches and developing new systems for material characterization, based on micro and nanomechanical sensors.

Common issues that have shown to hinder large-scale integration of sensing techniques based on a micromechanical sensor are the readout and sample handling. To address the first point, a semi-automatic characterization platform based on the optics and the mechanics of a commercial Blu-Ray pickup head unit was developed. Microbridges were chosen instead of microcantilevers to provide more robustness to the sensor. By embedding the sensor in a single-use microfluidic cartridge, the experimental condition was improved. The sample handling, as well as the environmental condition of the phenomena under test, are better controlled. As proof of concept to test the capabilities of the system, we studied the biopolymer degradation of Poly Lactic-co-Glycolic Acid (PLGA), which is of high relevance in the biomedical research field. A second version of the system is currently under development, and it aims to increase the throughput of the system allowing to read out multiple microbridge arrays.

For material characterization, spectroscopy analysis is often considered a benchmark technology. Conventional infrared spectroscopy approaches commonly require milligram amount of sample. Considering the frame of reference given by the overall aim of the project, mechanical sensors can be exploited to provide a unique tool for performing spectroscopy on a limited amount of sample. In this project, a nanomechanical photothermal sensor has been designed, developed and
exploited to perform thin film Infrared Spectroscopy. Contrary to what has been previously shown, this work has focused on a membrane sensor providing a robust experimental approach which better suit sample quantification and preparation. The purpose of the studies presented here is to show the real potential of photothermal spectroscopy based on a nanomechanical sensor and to provide a method to maximise the signal to noise ratio (SNR) from a single acquisition. The methodology presented showed that it is possible obtaining a high SNR of 300 on a 20nm thick polymer layer showing a substantial improvement compared to the benchmark technique, attenuated total reflectance spectroscopy (ATR-FTIR). This high sensitivity allowed us to observe the chemical modification occurring during the gelification of a submicron thick layer of poly-vinyl-pyrrolidone (PVP) corresponding to picogram quantity of material.

Mechanochemistry Induced Using Force Exerted by a Functionalized Microscope Tip
Atomic-scale mechanochemistry is realized from force exerted by a C60-functionalized scanning tunneling microscope tip. Two conformers of tin phthalocyanine can be prepared on coinage-metal surfaces. A transition between these conformers is induced on Cu(111) and Ag(100). Density-functional calculations reveal details of this reaction. Because of the large energy barrier of the reaction and the strong interaction of SnPc with Cu(111), the process cannot be achieved by electrical means.
Membrane Curvature and Lipid Composition Synergize To Regulate N-Ras Anchor Recruitment

Proteins anchored to membranes through covalently linked fatty acids and/or isoprenoid groups play crucial roles in all forms of life. Sorting and trafficking of lipidated proteins has traditionally been discussed in the context of partitioning to membrane domains of different lipid composition. We recently showed that membrane shape/curvature can in itself mediate the recruitment of lipidated proteins. However, exactly how membrane curvature and composition synergize remains largely unexplored. Here we investigated how three critical structural parameters of lipids, namely acyl chain saturation, headgroup size, and acyl chain length, modulate the capacity of membrane curvature to recruit lipidated proteins. As a model system we used the lipidated minimal membrane anchor of the GTPase, N-Ras (tN-Ras). Our data revealed complex synergistic effects, whereby tN-Ras binding was higher on planar DOPC than POPC membranes, but inversely higher on curved POPC than DOPC membranes. This variation in the binding to both planar and curved membranes leads to a net increase in the recruitment by membrane curvature of tN-Ras when reducing the acyl chain saturation state. Additionally, we found increased recruitment by membrane curvature of tN-Ras when substituting PC for PE, and when decreasing acyl chain length from 14 to 12 carbons (DMPC versus DLPC). However, these variations in recruitment ability had different origins, with the headgroup size primarily influencing tN-Ras binding to planar membranes whereas the change in acyl chain length primarily affected binding to curved membranes. Molecular field theory calculations recapitulated these findings and revealed lateral pressure as an underlying biophysical mechanism dictating how curvature and composition synergize to modulate recruitment of lipidated proteins. Our findings suggest that the
different compositions of cellular compartments could modulate the potency of membrane curvature to recruit lipidated proteins and thereby synergistically regulate the trafficking and sorting of lipidated proteins.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Copenhagen, University of South Carolina
Authors: Larsen, J. B. (Intern), Kennard, C. (Ekstern), Pedersen, S. L. (Ekstern), Jensen, K. J. (Ekstern), Uline, M. J. (Ekstern), Hatzakis, N. S. (Ekstern), Stamou, D. (Ekstern)
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- Scopus rating (2017): SNIP 0.979 SJR 1.949
- Web of Science (2017): Indexed Yes
- BFI (2016): BFI-level 1
- Scopus rating (2016): CiteScore 3.06 SJR 1.988 SNIP 1.005
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 1
- Scopus rating (2015): SJR 2.13 SNIP 1.134 CiteScore 3.3
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 1
- Scopus rating (2014): SJR 2.21 SNIP 1.15 CiteScore 3.33
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 1
- Scopus rating (2013): SJR 2.245 SNIP 1.156 CiteScore 3.64
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 1
- Scopus rating (2012): SJR 2.361 SNIP 1.143 CiteScore 3.57
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 1
- Scopus rating (2011): SJR 2.357 SNIP 1.202 CiteScore 3.75
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 1
- Scopus rating (2010): SJR 2.695 SNIP 1.303
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 1
- Scopus rating (2009): SJR 3.016 SNIP 1.357
- Web of Science (2009): Indexed yes
- BFI (2008): BFI-level 2
- Web of Science (2008): Indexed yes
- Scopus rating (2007): SJR 3.161 SNIP 1.413
- Web of Science (2007): Indexed yes
- Scopus rating (2006): SJR 2.857 SNIP 1.419
Metal-Organic Framework Derived FeP/C Interlocked Graphene Hybrid Composite for Hydrogen Evolution Reaction

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Organisations: Department of Chemistry, NanoChemistry, Department of Micro- and Nanotechnology, Molecular Windows, Organic Chemistry
Authors: Huang, W. (Intern), Sun, H. (Intern), Mølhave, K. (Intern), Zhang, J. (Intern)
Number of pages: 1
Publication date: 2017

Microcontainers as an oral delivery system for spray dried cubosomes containing ovalbumin
The purpose of this study was to prepare cubosomes encapsulating the model antigen ovalbumin (OVA) via spray drying, and to characterise such cubosomes with a view for their potential application in oral vaccine delivery. Furthermore the cubosome formulation was loaded into polymeric microcontainers intended as an oral drug delivery system. The cubosomes consisted of commercial glyceryl monooleate, Dimodan®, containing OVA and were surrounded with a dextran shell prepared by spray drying. Cryo-TEM was used to confirm that cubosomes were formed after hydration of the spray dried precursor powder. The precursor powder had a mean particle size of 1.3±0.1μm, whereas the mean diameter of the dispersed cubosomes was 282±7nm (PDI: 0.18) measured by dynamic light scattering. 8.5±0.3% (w/w) of OVA was present in the cubosome powder and OVA was found released slowly over the first 70h, followed by a more rapid release. Total release of 47.9±2.8% of loaded OVA occurred over 96h in a buffer at pH 6.8. When the powder was filled into microcontainers, and the opening covered with the pH sensitive polymer Eudragit S100, the pH sensitive 'lid' was intact at gastric pH, but release of OVA from the cubosomes and microcontainers occurred at pH 6.8, releasing 44.1±5.6% of the OVA in 96h. Small-angle X-ray scattering (SAXS) revealed that the 'dry' particles possessed an internal ordered lipid structure (lamellar and inverse micellar phase) by virtue of a small amount of residual water, and after hydration in buffer at pH 6.8, the particles formed the hexagonal inverse cubic phases, thereby indicating that cubosomes were formed when released from microcontainers.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, University of Copenhagen, Monash University
MICROCONTAINERS FOR INTESTINAL DRUG DELIVERY: in vivo and ex vivo study

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Nanoprobes, Københavns Universitet, University of Copenhagen
Authors: Mazzoni, C. (Intern), Tentor, F. (Intern), Andersen, S. S. S. (Forskerdatabase), Nielsen, L. H. (Intern), Keller, S. S. (Intern), Müllertz, A. (Ekstern), Marizza, P. (Intern), Boisen, A. (Intern)
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Publication date: 2017
Event: Abstract from Non-Invasive Delivery of Macromolecules Conference, San Diego, United States.
Main Research Area: Technical/natural sciences
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Microcontainers for Oral Vaccine Delivery

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Nielsen, L. H. (Intern), von Halling Laier, C. (Intern), Boisen, A. (Intern)
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Micro-fabricated all optical pressure sensors
Optical pressure sensors can operate in certain harsh application areas where the electrical pressure sensors cannot. However, the sensitivity is often not as good for the optical sensors. This work presents an all optical pressure sensor, which is fabricated by micro fabrication techniques, where the sensitivity can be tuned in the fabrication process. The developed sensor design, simplifies the fabrication process leading to a lower fabrication cost, which can make the all optical pressure sensors more competitive towards their electrical counterpart. The sensor has shown promising results and a linear pressure response has been measured with a sensitivity of 0.6nm/bar.

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Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, CEKO Sensors
Authors: Havreland, A. S. (Intern), Petersen, S. D. (Intern), Østergaard, C. (Intern), Reck-Nielsen, K. (Intern), Thomsen, E. V. (Intern)
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Publication date: 2017
Main Research Area: Technical/natural sciences
Microfabricated Nanofluidic cells for in situ liquid TEM

Over the last decade, transmission electron microscopy (TEM) has been revolutionized not only by the introduction of new and very sophisticated hardware for improved resolution, such as aberration correctors and monochromators, but also by the improvement of new methods that have provided more than structural information of materials. In this regard, in situ liquid cell electron microscopy (EM) is one of the new emerging methods that gained a lot of attention by making possible to observe processes and samples in liquid environments within the chamber of an electron microscope.

The main focus of this PhD project is to improve the technologies behind liquid cell TEM by developing a novel and robust liquid cell device able to increase the control over the liquid layer thickness, essential for good imaging conditions. A new type of nanofluidic cell has been created with an architecture based on wafer bonding of Atomic layer deposited (ALD) Al₂O₃ on Si₃N₄ membranes. With the improved liquid layer thickness control, we use the devices to measure the electron mean free path in water which is a fundamental aspect of TEM studies, and present the high-resolution TEM capabilities of the nanofluidic cell. Furthermore, the first findings on nanoparticle (NP) growth in this particular nanochannel system are presented that also opens up for new types of liquid cell studies with laminar flow.

These results demonstrate the capability of the novel nanofluidic cell to provide ultra-thin liquid layers, allowing quantitative and high-precision acquisition of liquid thickness maps, high resolution observations and meaningful information about synthesis of NPs from metal precursor solutions in confined space.

Finally, a new concept device based on a Si₃N₄ membrane for plunge freezing fixation, which enables ultra-fast cooling rates, is presented.
Microfabrication of gratings for X-ray Imaging

General information
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Organisations: DTU Danchip, Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Physics, Neutrons and X-rays for Materials Physics, Technical University of Denmark
Authors: Silvestre, C. (Intern), Christiansen, E. D. (Ekstern), Zeng, Y. (Ekstern), Kehres, J. (Intern), Jansen, H. (Intern), Hansen, O. (Intern)
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Microfabrication of X-Ray grating for Talbot Interferometry

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State: Published
Organisations: DTU Danchip, Department of Micro- and Nanotechnology, Silicon Microtechnology
Authors: Silvestre, C. (Intern), Chang, B. (Intern), Jansen, H. (Intern), Hansen, O. (Intern)
Publication date: 2017
Main Research Area: Technical/natural sciences
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Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Microwave synthesis of metal nanocatalysts for the electrochemical oxidation of small biomolecules

Electrochemical oxidation of small biomolecules provides an approach to generate clean energy from a sustainable resource. It serves as a principle for anode reactions in fuel cells to convert energy stored in chemical bonds into electrical power. Efficient and robust nanocatalysts are essential to reduce the reaction barrier and accelerate the reaction kinetics. First the general aspects of electrochemical oxidation of small biomolecules are outlined and the green synthesis of metal particles by microwave synthesis is compared to conventional heating synthesis. Then recent progress in microwave-assisted nanocrystals used for electrochemical oxidation of small biomolecules is reviewed for alcohols, acids, and glucose. The challenges and future perspectives for the microwave synthesis as well as electrochemical oxidation of small biomolecules are discussed.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Department of Chemistry, NanoChemistry, Organic Chemistry, Technical University of Denmark
Authors: Jensen, K. S. S. (Ekstern), Sun, H. (Intern), Werchmeister, R. M. L. (Intern), Mølhave, K. (Intern), Zhang, J. (Intern)
Pages: 124-132
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Modulating antibody affinity towards the transferrin receptor to increase brain uptake of anti-transferrin receptor antibody targeted gold nanoparticles

Drug delivery to the brain is hampered by the presence of the blood-brain barrier (BBB) that under physiological conditions precludes entrance of most substances contained in the systemic circulation. Thus, this barrier must be overcome to deliver medicines into the brain parenchyma. The transferrin receptor is exclusively expressed on capillaries of the brain, which makes it an interesting target for transport of drugs towards the brain. However, the current evidence on the receptor movement in brain capillaries does not suggest transcytosis, and delivering medicines or nanoparticles using antibodies towards this receptor has largely been without success. We investigated the impact of antibody affinity on the transport of gold nanoparticles into the brain parenchyma. PEGylated gold nanoparticles were conjugated to either a high or low affinity antibodies towards the transferrin receptor, an isotype IgG control, or no antibodies, and injected into mice. Brain capillary depletion, ICP-MS, and various microscopy techniques were employed to analyse the resulting tissue. For the transferrin receptor-targeted groups, gold nanoparticles could be detected along vessel structures as revealed by silver enhancement and light microscopy. Electron microscopy showed that the particles had been efficiently endocytosed into the endothelial cells of the BBB. A small fraction of particles could also be detected in the brain parenchyma, which was underscored by measuring the gold content in brain parenchyma after capillary depletion. Furthermore, the uptake of gold nanoparticles into both the brain capillaries and brain parenchyma were significantly affected by the affinity of the attached antibodies.
Molecularly imprinted polymers for sample preparation and biosensing in food analysis: Progress and perspectives

Molecularly imprinted polymers (MIPs) are biomimetics which can selectively bind to analytes of interest. One of the most interesting areas where MIPs have shown the biggest potential is food analysis. MIPs have found use as sorbents in sample preparation attributed to the high selectivity and high loading capacity. MIPs have been intensively employed in classical solid-phase extraction and solid-phase microextraction. More recently, MIPs have been combined with magnetic bead extraction, which greatly simplifies sample handling procedures. Studies have consistently shown that MIPs can effectively minimize complex food matrix effects, and improve recoveries and detection limits. In addition to sample preparation, MIPs have also been viewed as promising alternatives to bio-receptors due to the inherent molecular recognition abilities and the high stability in harsh chemical and physical conditions. MIPs have been utilized as receptors in biosensing platforms such as electrochemical, optical and mass biosensors to detect various analytes in food. In this review, we will discuss the current state-of-the-art of MIP synthesis and applications in the context of food analysis. We will highlight the imprinting methods which are applicable for imprinting food templates, summarize the recent progress in using MIPs for preparing and analysing food samples, and discuss the current limitations in the commercialisation of MIPs technology. Finally, future perspectives will be given.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, National Food Institute, Research Group for Analytical and Predictive Microbiology
Authors: Ashley, J. (Intern), Shahbazi, M. (Intern), Kant, K. (Intern), Aaydha Chidambara, V. (Intern), Wolff, A. (Intern), Bang, D. D. (Intern), Sun, Y. (Intern)
Number of pages: 10
Pages: 606-615
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
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Volume: 91
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  Web of Science (2017): Indexed yes
  BFI (2016): BFI-level 1
  Scopus rating (2016): CiteScore 7.22 SJR 2.095 SNIP 1.619
  Web of Science (2016): Indexed yes
  BFI (2015): BFI-level 1
  Scopus rating (2015): SJR 2.044 SNIP 1.671 CiteScore 7.07
  Web of Science (2015): Indexed yes
  BFI (2014): BFI-level 1
  Scopus rating (2014): SJR 2.057 SNIP 1.716 CiteScore 6.57
  Web of Science (2014): Indexed yes
  BFI (2013): BFI-level 1
  Scopus rating (2013): SJR 2.029 SNIP 1.726 CiteScore 6.34
  ISI indexed (2013): ISI indexed yes
  Web of Science (2013): Indexed yes
  BFI (2012): BFI-level 1
  Scopus rating (2012): SJR 2.397 SNIP 1.592 CiteScore 5.7
  ISI indexed (2012): ISI indexed yes
  Web of Science (2012): Indexed yes
  BFI (2011): BFI-level 1
  Scopus rating (2011): SJR 2.126 SNIP 1.704 CiteScore 5.85
  ISI indexed (2011): ISI indexed yes
  Web of Science (2011): Indexed yes
  BFI (2010): BFI-level 2
  Scopus rating (2010): SJR 2.143 SNIP 1.609
Molecular weight-dependent degradation and drug release of surface-eroding poly(ethylene carbonate)

Poly(ethylene carbonate) (PEC) is a unique biomaterial showing significant potential for controlled drug delivery applications. The current study investigated the impact of the molecular weight on the biological performance of drug-loaded PEC films.

Following the preparation and thorough physicochemical characterization of diverse PEC (molecular weights: 85, 110, 133, 174 and 196 kDa), the degradation and drug release behavior of rifampicin- and bovine serum albumin-loaded PEC films was investigated in vitro (in the presence and absence of cholesterol esterase), in cell culture (RAW264.7 macrophages) and in vivo (subcutaneous implantation in rats). All investigated samples degraded by means of surface erosion (mass loss, but constant molecular weight), which was accompanied by a predictable, erosion-controlled drug release pattern. Accordingly, the obtained in vitro degradation half-lives correlated well with the observed in vitro half-times of drug delivery ($R^2 = 0.96$). Here, the PEC of the highest molecular weight resulted in the fastest degradation/drug release. When incubated with macrophages or implanted in animals, the degradation rate of PEC films superimposed the results of in vitro incubations with cholesterol esterase. Interestingly, SEM analysis indicated a distinct surface erosion process for enzyme-, macrophage- and in vivo-treated polymer films in a molecular weight-dependent manner.

Overall, the molecular weight of surface-eroding PEC was identified as an essential parameter to control the spatial and temporal on-demand degradation and drug release from the employed delivery system.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, University of Copenhagen, Philippus-Universitat Marburg
Authors: Bohr, A. (Ekstern), Wang, Y. (Ekstern), Harmankaya, N. (Ekstern), Water, J. J. (Ekstern), Baldursdottir, S. G. (Ekstern), Almdal, K. (Intern), Beck-Broichsitter, M. (Ekstern)
Pages: 140-148
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Main Research Area: Technical/natural sciences

Publication information

Journal: European Journal of Pharmaceutics and Biopharmaceutics
Volume: 115
ISSN (Print): 0939-6411
Ratings:
BFI (2018): BFI-level 2
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Multicompartment Artificial Organelles Conducting Enzymatic Cascade Reactions Inside Cells

Cell organelles are subcellular structures entrapping a set of enzymes to achieve a specific functionality. The incorporation of artificial organelles into cells is a novel medical paradigm which might contribute to the treatment of various cell disorders by replacing malfunctioning organelles. In particular, artificial organelles are expected to be a powerful solution in the context of enzyme replacement therapy since enzymatic malfunction is the primary cause of organelle dysfunction. Although several attempts have been made to encapsulate enzymes within a carrier vehicle, only few intracellularly active artificial organelles have been reported to date and they all consist of single-compartment carriers. However, it is noted that biological organelles consist of multicompartment architectures where enzymatic reactions are executed within distinct subcompartments. Compartmentalization allows for multiple processes to take place in close vicinity and in a parallel manner without the risk of interference or degradation. Here, we report on a subcompartmentalized and intracellularly active carrier, a crucial step for advancing artificial organelles. In particular, we develop and characterize a novel capsosome system, which consists of multiple liposomes and fluorescent gold nanoclusters embedded within a polymer.
carrier capsule. We subsequently demonstrate that encapsulated enzymes preserve their activity intracellularly, allowing for controlled enzymatic cascade reaction within a host cell.

**General information**

**State:** Published  
**Organisations:** Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Technical University of Denmark  
**Authors:** Gallardo, M. G. (Intern), Labay, C. P. (Intern), Trikalitis, V. (Ekstern), Kempen, P. (Intern), Larsen, J. (Intern), Andresen, T. L. (Intern), Hosta-Rigau, L. (Intern)  
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**Journal:** ACS Applied Materials and Interfaces  
**Volume:** 9  
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**Ratings:**  
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- Web of Science (2018): Indexed yes  
- BFI (2017): BFI-level 1  
- Scopus rating (2017): SJR 2.784 SNIP 1.543  
- Web of Science (2017): Indexed yes  
- BFI (2016): BFI-level 1  
- Scopus rating (2016): CiteScore 7.6 SJR 2.561 SNIP 1.536  
- Web of Science (2016): Indexed yes  
- BFI (2015): BFI-level 1  
- Scopus rating (2015): SJR 2.262 SNIP 1.555 CiteScore 7.38  
- Web of Science (2015): Indexed yes  
- BFI (2014): BFI-level 1  
- Scopus rating (2014): SJR 2.125 SNIP 1.636 CiteScore 6.88  
- Web of Science (2014): Indexed yes  
- BFI (2013): BFI-level 1  
- Scopus rating (2013): SJR 1.992 SNIP 1.548 CiteScore 6.05  
- ISI indexed (2013): ISI indexed yes  
- Web of Science (2013): Indexed yes  
- BFI (2012): BFI-level 1  
- Scopus rating (2012): SJR 2.199 SNIP 1.327 CiteScore 4.94  
- ISI indexed (2012): ISI indexed yes  
- Web of Science (2012): Indexed yes  
- BFI (2011): BFI-level 1  
- Scopus rating (2011): SJR 2.046 SNIP 1.404 CiteScore 4.41  
- ISI indexed (2011): ISI indexed no  
- Web of Science (2011): Indexed yes  
- Scopus rating (2010): SJR 1.597 SNIP 0.944  
- Web of Science (2010): Indexed yes  
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**Capsosomes, Enzymatic cascade reactions, Fluorescent gold nanoclusters, Intracellular microreactors, Liposomes**  
**DOIs:**  
10.1021/acsmi.6b16275  
**Source:** FindIt  
**Source-ID:** 2351497665  
**Publication:** Research - peer-review › Journal article – Annual report year: 2017
Multistaged Nanovaccines Based on Porous Silicon@Acetalated Dextran@Cancer Cell Membrane for Cancer Immunotherapy

A novel porous silicon (Psi)-based nanovaccines for cancer immunotherapy was developed by nanoprecipitation in glass capillary microfluidics. One of these systems, thermally oxidized Psi (TOPSi)@AcDEX (Acetalated dextran), was then encapsulated with vesicles derived from cancer cells, in order to combine the advantages derived from the antigenic composition of tumor lysate with the adjuvant properties of the PSI nanoparticles chosen. The other system explored, TOPSi@SpAcDEX, characterized by a positive surface charge, was surface functionalized with a model antigen (Trp2). The adjuvant nanoparticles presented high monodispersity due to the efficient mixing produced in the microfluidic device and were shown to be highly cytocompatible over two human immortalized cell lines, KG1 and BDCM. Moreover, the nanoparticles induced the expression of co-stimulatory signals both in the immortal cell lines and in peripheral blood monocytes. Finally, TOPSi@AcDEX@CCM greatly enhanced the secretion of IFN-γ in PBMC, and did not induce the secretion of IL-4, thereby orienting the polarization of the newly primed T-cells toward a Th1 cell-mediated response. Overall, the developed nanovaccines showed promising adjuvant properties and the possibility of encapsulating the nanosystems with materials derived from the patient’s tumor opens new prospects in the field of personalized cancer medicine.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, University of Helsinki, Harvard University, Åbo Akademi University, University of Turku
Authors: Fontana, F. (Ekstern), Shahbazi, M. A. (Intern), Liu, D. (Ekstern), Zhang, H. (Ekstern), Mäkilä, E. (Ekstern), Salonen, J. (Ekstern), Hirvonen, J. T. (Ekstern), Santos, H. A. (Ekstern)
Number of pages: 9
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Main Research Area: Technical/natural sciences

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Article number: 1603239
ISSN (Print): 0935-9648
Ratings:
BFI (2018): BFI-level 3
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 17.79
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 18.5
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 16.79
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 15.78
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 14.41
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 12.28
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Web of Science (2010): Indexed yes
Multi-walled carbon nanotube-induced genotoxic, inflammatory and pro-fibrotic responses in mice: Investigating the mechanisms of pulmonary carcinogenesis

The International Agency for Research on Cancer has classified one type of multi-walled carbon nanotubes (MWCNTs) as possibly carcinogenic to humans. However, the underlying mechanisms of MWCNT-induced carcinogenicity are not known. In this study, the genotoxic, mutagenic, inflammatory, and fibrotic potential of MWCNTs were investigated. Muta™Mouse adult females were exposed to 36±6 or 109±18μg/mouse of Mitsui-7, or 26±2 or 78±5μg/mouse of NM-401, once a week for four consecutive weeks via intratracheal instillations, alongside vehicle-treated controls. Samples were collected 90 days following the first exposure for measurement of DNA strand breaks, lacZ mutant frequency, p53 expression, cell proliferation, lung inflammation, histopathology, and changes in global gene expression. Both MWCNT types persisted in lung tissues 90 days post-exposure, and induced lung inflammation and fibrosis to similar extents. However, there was no evidence of DNA damage as measured by the comet assay following Mitsui-7 exposure, or increases in lacZ mutant frequency, for either MWCNTs. Increased p53 expression was observed in the fibrotic foci induced by both MWCNTs. Gene expression analysis revealed perturbations of a number of biological processes associated with cancer including cell death, cell proliferation, free radical scavenging, and others in both groups, with the largest response in NM-401-treated mice. The results suggest that if the two MWCNT types were capable of inducing DNA damage, strong adaptive responses mounted against the damage, resulting in efficient and timely elimination of damaged cells through cell death, may have prevented accumulation of DNA damage and mutations at the post-exposure time point investigated in the study. Thus, MWCNT-induced carcinogenesis may involve ongoing low levels of DNA damage in an environment of persisting fibres, chronic inflammation and tissue irritation, and parallel increases or decreases in the expression of genes involved in several pro-carcinogenic pathways.

General information
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Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment, Health Canada
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Main Research Area: Technical/natural sciences

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Journal: Mutation research
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ISSN (Print): 0027-5107
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BFI (2016): BFI-level 1
Web of Science (2016): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 0.111
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.71 SJR 0.561 SNIP 0.745
Multi-walled carbon nanotube-physicochemical properties predict the systemic acute phase response following pulmonary exposure in mice

Pulmonary exposure to multi-walled carbon nanotubes (MWCNTs) has been linked to an increased risk of developing cardiovascular disease in addition to the well-documented physicochemical-dependent adverse lung effects. A proposed mechanism is through a strong and sustained pulmonary secretion of acute phase proteins to the blood. We identified physicochemical determinants of MWCNT-induced systemic acute phase response by analyzing effects of pulmonary exposure to 14 commercial, well-characterized MWCNTs in female C57BL/6J mice pulmonary exposed to 0, 6, 18 or 54 lag MWCNT/mouse. Plasma levels of acute phase response proteins serum amyloid A1/2 (SAA1/2) and SAA3 were determined on day 1, 28 or 92. Expression levels of hepatic Saal and pulmonary Saa3 mRNA levels were assessed to determine the origin of the acute phase response proteins. Pulmonary Saa3 mRNA expression levels were greater and lasted longer than hepatic Saal mRNA expression. Plasma SAA1/2 and SAA3 protein levels were related to time and physicochemical properties using adjusted, multiple regression analyses. SAA3 and SAA1/2 plasma protein levels were increased after exposure to almost all of the MWCNTs on day 1, whereas limited changes were observed on day 28 and 92. SAA1/2 and SAA3 protein levels did not correlate and only SAA3 protein levels correlated with neutrophil influx. The multiple regression analyses revealed a protective effect of MWCNT length on SAA1/2 protein level on day 1, such that a longer length resulted in lowered SAA1/2 plasma levels. Increased SAA3 protein levels were positively related to dose and
content of Mn, Mg and Co on day 1, whereas oxidation and diameter of the MWCNTs were protective on day 28 and 92, respectively. The results of this study reveal very differently controlled pulmonary and hepatic acute phase responses after MWCNT exposure. As the responses were influenced by the physicochemical properties of the MWCNTs, this study provides the first step towards designing MWCNT that induce less SAA.

General information
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Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 1.164 SNIP 1.111
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.11 SJR 1.236 SNIP 1.101
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.427 SNIP 1.136 CiteScore 3.32
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.559 SNIP 1.148 CiteScore 3.54
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.772 SNIP 1.153 CiteScore 3.94
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.982 SNIP 1.156 CiteScore 4.15
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.425 SNIP 1.233 CiteScore 4.58
ISI indexed (2011): ISI indexed no
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 2.705 SNIP 1.178
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 2.614 SNIP 1.046
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 2.506 SNIP 1.006
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.379 SNIP 0.537
Na-assisted grain growth in CZTS nanoparticle thin films for solar cell applications

We have studied the effect of Na in Cu2ZnSnS4 nanoparticle thin films [1]. The as-synthesized CZTS nanoparticles were inherently ligand-free [2], which allows us to use of polar solvents, such as water and ethanol. Another advantage of these particles is that the user- and environmentally-friendly NaCl salt can be directly dissolved in controllable amounts. This further circumvents the need for later incorporation of dopants, or a ligand-exchange step to functionalize the surface of the nanoparticles. In addition, the homogeneous distribution of Na in the ink allows uniform grain growth within the deposited absorber layer. By including Na in the nanoparticle ink, micron-sized grains throughout the whole absorber are achieved after annealing in a sulfur atmosphere at 600°C. The absorber layer appeared to be of full density, and no closed porosity could be detected. In addition, the photoluminescence signal increased by a factor of 200 after Na-inclusion. Without Na, the grains were very difficult to sinter, the film was porous, and the photoluminescence was low. A concentration of Na/(Cu+Zn+Sn)=30% was necessary for the densification of the absorber, which is significantly higher than that used in other Na-doped CZTS systems. The annealed films were found to be of the desired Cu-poor and Zn-rich composition. We also found that a sulfidation temperature above 550°C was required. At 550°C, NaCl-crystals appeared on the surface of the thin films, suggesting an incomplete transformation of Na into the liquid phase Na2Sx-additive during sintering. At this temperature, grain growth was only detected in close proximity to the NaCl regions. It was also observed that the NaCl crystals could be easily removed by a quick water rinse, but that this treatment reduced the photoluminescence signal. This is relevant as it is customary to leave the absorber layer in a water-based solution after annealing before buffer layer deposition.

General information
State: Published
Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Physics, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, Department of Micro- and Nanotechnology, Nanyang Technological University
Authors: Engberg, S. L. J. (Intern), Crovetto, A. (Intern), Hansen, O. (Intern), Lam, Y. M. (Ekstern), Schou, J. (Intern)
Number of pages: 1
Publication date: 2017
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Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Nanomechanical Infrared Spectroscopy with Vibrating Filters for Pharmaceutical Analysis

Standard infrared spectroscopy techniques are well-developed and widely used. However, they typically require milligrams of sample and can involve time-consuming sample preparation. A promising alternative is represented by nanomechanical infrared spectroscopy (NAM-IR) based on the photothermal response of a nanomechanical resonator, which enables the chemical analysis of picograms of analyte directly from a liquid solution in only a few minutes. Herein, we present NAM-IR using perforated membranes (filters). The method was tested with the pharmaceutical compound indomethacin to successfully perform a chemical and morphological analysis on roughly 100 pg of sample. With an absolute estimated sensitivity of 109±15 fg, the presented method is suitable for ultrasensitive vibrational spectroscopy.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Silicon Microtechnology, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Technical University of Denmark, University of Copenhagen, Technische Universität Wien
Authors: Kurek, M. (Intern), Carnoy, M. (Ekstern), Larsen, P. E. (Intern), Nielsen, L. H. (Intern), Hansen, O. (Intern), Rades, T. (Ekstern), Schmid, S. (Ekstern), Boisen, A. (Intern)
Pages: 3901-3905
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 2.165 SJR 6.155
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 10.8 SJR 5.954 SNIP 2.146
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 5.888 SNIP 2.225 CiteScore 11.13
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 5.811 SNIP 2.307 CiteScore 10.84
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 5.702 SNIP 2.198 CiteScore 10.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 6.407 SNIP 2.329 CiteScore 10.55
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 6.063 SNIP 2.361 CiteScore 10.75
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 5.921 SNIP 2.303
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 5.571 SNIP 2.246
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 5.589 SNIP 2.153
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 4.528 SNIP 1.888
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 4.868 SNIP 2.165
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 4.797 SNIP 2.279
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 4.247 SNIP 2.198
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 3.559 SNIP 2.117
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 4.012 SNIP 2.142
Scopus rating (2001): SJR 3.788 SNIP 2.069
Scopus rating (2000): SJR 3.447 SNIP 2.1
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 3.529 SNIP 2.046
Original language: English
IR spectroscopy, crystallization, nanomechanics, nanoparticles
Nanopatterning of graphene guided by block copolymer self-assembly
Motivated by the unique and superior properties of graphene, including transistors, integrated circuits, displays, sensors, nanocomposite materials and optical applications, we have pioneered advances in the emerging field of nanopatterned graphene. This PhD project is a part of Center for Nanostructured Graphene (CNG) activities. As compared to pristine graphene, nanopatterned graphene creates a band gap suitable for transistor logic applications, enables functionalization of graphene edges, creates novel magnetic and optical properties, and could be utilized in ultrathin, high-flow filtration applications.

The main purpose of this PhD project is to explore and develop block copolymer self-assembly for generating highly ordered nanostructure graphene with as small as possible neck width and period sizes, which can be utilized in many important applications such as sensors, transistors and optoelectronic devices. Here, we use a novel block copolymer (BCP) self-assembly method for nanolithography. This procedure significantly simplifies the traditional BCP lithography process, showing a wide substrate tolerance and allowing for efficient pattern transfer. Afterward we fabricated uniform suspended nanomesh graphene with the pore size of 24 nm and neck width of 14 nm by using this BC lithography process, combing local photocatalysis. We also achieve large-area fabrication of nanoscale graphene disk and nanomesh arrays, which support plasmon resonances in the near-infrared regime. In the end of this thesis, we functionalize graphene chemically in the presence of the nanoporous mask. These bottom-up BC lithography methods allow the fabrication of arbitrary geometries, with rational control over the graphene nanostructure's placement, orientation, size, and lateral extent, which paves ways for numerous applications.
Nanoreinforced Hydrogels for Tissue Engineering: Biomaterials that are Compatible with Load-Bearing and Electroactive Tissues

Given their highly porous nature and excellent water retention, hydrogel-based biomaterials can mimic critical properties of the native cellular environment. However, their potential to emulate the electromechanical milieu of native tissues or conform well with the curved topology of human organs needs to be further explored to address a broad range of physiological demands of the body. In this regard, the incorporation of nanomaterials within hydrogels has shown great promise, as a simple one-step approach, to generate multifunctional scaffolds with previously unattainable biological, mechanical, and electrical properties. Here, recent advances in the fabrication and application of nanocomposite hydrogels in tissue engineering applications are described, with specific attention toward skeletal and electroactive tissues, such as cardiac, nerve, bone, cartilage, and skeletal muscle. Additionally, some potential uses of nanoreinforced hydrogels within the emerging disciplines of cyborgics, bionics, and soft biorobotics are highlighted.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Technical University of Denmark, Aalborg University, University of Malaya, National Institute for Genetic Engineering and Biotechnology Iran, Arizona State University
Authors: Mehrali, M. (Intern), Thakur, A. (Ekstern), Pennisi, C. P. (Ekstern), Talebian, S. (Ekstern), Arpanaei, A. (Ekstern), Nikkhah, M. (Ekstern), Dolatshahi-Pirouz, A. (Intern)
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 17.79
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 18.5
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 16.79
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Nanoscale Plasmonic V-Groove Waveguides for the Interrogation of Single Fluorescent Bacterial Cells

We experimentally demonstrate the interrogation of an individual Escherichia coli cell using a nanoscale plasmonic V-groove waveguide. Several different configurations were studied. The first involved the excitation of the cell in a liquid environment because it flows on top of the waveguide nanocoupler, while the obtained fluorescence is coupled into the waveguide and collected at the other nanocoupler. The other two configurations involved the positioning of the bacterium within the nanoscale waveguide and its excitation in a dry environment either directly from the top or through waveguide modes. This is achieved by taking advantage of the waveguide properties not only for light guiding but also as a mechanical tool for trapping the bacteria within the V-grooves. The obtained results are supported by a set of numerical simulations, shedding more light on the mechanism of excitation. This demonstration paves the way for the construction of an efficient bioplasmonic chip for diverse cell-based sensing applications.
Nanostructured graphene for spintronics

Zigzag edges of the honeycomb structure of graphene exhibit magnetic polarization, making them attractive as building blocks for spintronic devices. Here, we show that devices with zigzag-edged triangular antidots perform essential spintronic functionalities, such as spatial spin splitting or spin filtering of unpolarized incoming currents. Near-perfect performance can be obtained with optimized structures. The device performance is robust against substantial disorder. The gate-voltage dependence of transverse resistance is qualitatively different for spin-polarized and spin-unpolarized devices, and can be used as a diagnostic tool. Importantly, the suggested devices are feasible within current technologies.
Nanostructures graphene plasmons work close to near-infrared window

Due to strong mode-confinement, long propagation-distance, and unique tunability, graphene plasmons have been widely explored in the mid-infrared and terahertz windows. However, it remains a big challenge to push graphene plasmons to shorter wavelengths in order to integrate graphene plasmon concepts with existing mature technologies in the near-infrared region. We investigate localized graphene plasmons supported by graphene nanodisks and experimentally demonstrated graphene plasmon working at 2 μm with the aid of a fully scalable block copolymer self-assembly method. Our results show a promising way to promote graphene plasmons for both fundamental studies and potential applications in the near-infrared window.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Self-Organized Nanoporous Materials, Center for Nanostructured Graphene, Department of Photonics Engineering, Structured Electromagnetic Materials
Authors: Wang, Z. (Intern), Li, T. (Intern), Almdal, K. (Intern), Xiao, S. (Intern), Mortensen, N. A. (Intern), Ndoni, S. (Intern)
Number of pages: 1
Publication date: 2017
Main Research Area: Technical/natural sciences
Electronic versions:
Grapheneconf2017_Wang_Zhongli.pdf
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Source-ID: 131068219
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Nanotechnology: Building and Observing at the Nanometer Scale

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Nanocarbon, University of New South Wales
Authors: Booth, T. (Intern), Baker, M. A. B. (Ekstern)
Number of pages: 11
Pages: 633-643
Publication date: 2017

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Chapter: 32
Main Research Area: Technical/natural sciences
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Source: FindIt
Source-ID: 2393398645
Publication: Research - peer-review › Book chapter – Annual report year: 2018

New approaches for first-principles modelling of inelastic transport in nanoscale semiconductor devices with thousands of atoms

We present two different methods which both enable large-scale first-principles device simulations including electron-phonon coupling (EPC). The methods are based on Density Functional Theory and Nonequilibrium Greens Functions (DFT-NEGF) calculations of electron transport. The inelastic current is in both methods calculated in a post-processing step to a self consistent DFT calculation. The first method is based on first order perturbation theory in the EPC self-energy within the Lowest Order Expansion (LOE) approximation. The method requires calculation of the first-principles EPC in the device region and it includes the effect of each phonon mode on the current perturbatively. This approach is made practical by calculating the EPC of the device region using a smaller periodic reference system. In addition, the
phonon modes are assembled into a small number of energy intervals in which phonon modes are described collectively. The second method involves calculating the electron transmission for a single configuration where the atoms are displaced according to the phonon temperature of the system. Thus, this method has a computational cost equivalent to conventional elastic transport calculations. Both methods have been implemented in the Atomistix ToolKit (ATK) and we apply the methods for calculating the inelastic current in a silicon n-i-n junction and for calculation of phonon limited mobilities of silicon nanowires.

New Evidence for the Mechanism of Action of a Type-2 Diabetes Drug Using a Magnetic Bead-Based Automated Biosensing Platform

The mechanism of action (MOA) of the first line type-2 diabetes drug metformin remains unclear despite its widespread usage. However, recent evidence suggests that the mitochondrial copper (Cu)-binding action of metformin may contribute toward the drug's MOA. Here, we present a novel biosensing platform for investigating the MOA of metformin using a magnetic microbead-based agglutination assay which has allowed us to demonstrate for the first time the interaction between Cu and metformin at clinically relevant low micromolar concentrations of the drug, thus suggesting a potential pathway of metformin's blood-glucose lowering action. In this assay, cysteine-functionalized magnetic beads were agglutinated in the presence of Cu due to cysteine's Cu-chelation property. Addition of clinically relevant doses of metformin resulted in disaggregation of Cu-bridged bead-clusters, whereas the effect of adding a closely related but blood-glucose neutral drug propanediimidamide (PDI) showed completely different responses to the clusters. The entire assay was integrated in an automated microfluidics platform with an advanced optical imaging unit by which we investigated these aggregation-disaggregation phenomena in a reliable, automated, and user-friendly fashion with total assay time of 17 min requiring a sample (metformin/PDI) volume of 30 μL. The marked difference of Cu-binding action between the blood-glucose lowering drug metformin and its inactive analogue PDI thus suggests that metformin's distinctive Cu-binding properties may be required for its effect on glucose homeostasis. The novel automated platform demonstrating this novel investigation thus holds the potential to be utilized for investigating significant and sensitive molecular interactions via magnetic bead-based agglutination assay.
Not all that glitters is gold - Electron microscopy study on uptake of gold nanoparticles in Daphnia magna and related artefacts

Increasing use of engineered nanoparticles has led to extensive research into their potential hazards to the environment and human health. Cellular uptake from the gut is sparsely investigated and microscopy techniques applied for uptake studies can result in misinterpretations. Various microscopy techniques are used to investigate internalization of 10nm gold nanoparticles in Daphnia magna gut lumen and gut epithelial cells upon 24h exposure and outline potential artefacts, i.e. high contract precipitates from sample preparation related to these techniques. Light sheet microscopy confirmed accumulation of gold nanoparticles in the gut lumen. Scanning transmission electron microscopy and elemental analysis revealed gold nanoparticles attached to the microvilli of gut cells. Interestingly, the peritrophic membrane appeared to act as a semipermeable barrier between the lumen and the gut epithelium, permitting only single particles through. Structures resembling nanoparticles were also observed inside gut cells. As elemental analysis could not verify these to be gold they were likely artifacts from the preparation, such as osmium and iron. Importantly, gold nanoparticles were in fact found inside holocrine cells with disrupted membranes. Thus, false positive observations of nanoparticle internalization may result from either preparation artefacts or by mistaking disrupted cells for intact. These findings emphasize the importance of cell integrity and combining elemental analysis with the localization of internalized nanoparticles using transmission electron microscopy.

General information
State: Published
Organisations: Center for Electron Nanoscopy, Department of Environmental Engineering, Environmental Chemistry, Department of Micro- and Nanotechnology, Molecular Windows, Roskilde University
Authors: Jensen, L. H. S. (Intern), Skjolding, L. M. (Intern), Thit, A. (Ekstern), Sørensen, S. N. (Intern), Købler, C. (Intern), Molhave, K. (Intern), Baun, A. (Intern)
Pages: 1503-1509
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Environmental Toxicology and Chemistry
Volume: 36
Issue number: 6
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Aquatic invertebrates, Freshwater toxicology, Nanoparticles, Nanotoxicology

Numerical Optimization in Microfluidics
Numerical modelling can illuminate the working mechanism and limitations of microfluidic devices. Such insights are useful in their own right, but one can take advantage of numerical modelling in a systematic way using numerical optimization. In this chapter we will discuss when and how numerical optimization is best used.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Nanoprobes
Authors: Jensen, K. E. (Intern)
Number of pages: 14
Pages: 95-108
Publication date: 2017

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Title of host publication: Complex Fluid-Flows in Microfluidics
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ISBN (Electronic): 978-3-319-59593-1
Chapter: 5
Main Research Area: Technical/natural sciences
DOIs: 10.1007/978-3-319-59593-1_5

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Source: FindIt
Source-ID: 2372109739
Publication: Research - peer-review › Book chapter – Annual report year: 2017

Nutlin-3a and Cytokine Co-loaded Spermine-Modified Acetalated Dextran Nanoparticles for Cancer Chemo-Immunotherapy
The combination of chemo- and immunotherapy represents one promising strategy to overcome the existent challenges in the present-day anticancer therapy. Here, spermine-modified acetalated dextran nanoparticles (Sp-AcDEX NPs), co-loaded with the non-genotoxic molecule Nutlin-3a (Nut3a), and the cytokine granulocyte-macrophage colony-stimulating factor (GM-CSF), are developed to induce cancer cell death and create a specific antitumor immune response. These polymeric NPs release Nut3a in a pH dependent fashion and induce endosomal escape. Due to Nut3a, the loaded NPs exert specific toxicity toward wild-type p53 cancer cells while avoiding toxicity in immune cells. Furthermore, the NPs show intrinsic immune adjuvancy on monocyte derived-dendritic cells, upregulating the expression of cell surface CD83 and CD86 costimulatory markers. Finally, it is examined that by inducing MCF-7 breast cancer cell death and acting as immune adjuvants, the NPs can downregulate the expression of IL-10 and upregulate IL-1β, leading to proliferation of CD3+ and cytotoxic CD8+ T cells. Overall, the study suggests that Sp-AcDEX NPs loaded with Nut3a and GM-CSF is a promising system for chemo-immunotherapy, capable of inducing tumor cell death and stimulating immune response.

General information
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Organisations: Department of Micro- and Nanotechnology, BioLabChip, University of Helsinki, University of Porto
Number of pages: 14
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Main Research Area: Technical/natural sciences
On the ‘centre of gravity’ method for measuring the composition of magnetite/maghemite mixtures, or the stoichiometry of magnetite-maghemite solid solutions, via 57Fe Mössbauer spectroscopy

We evaluate the application of 57Fe Mössbauer spectroscopy to the determination of the composition of magnetite (Fe3O4)/maghemite (γ-Fe2O3) mixtures and the stoichiometry of magnetite-maghemite solid solutions. In particular, we consider a recently proposed model-independent method which does not rely on a priori assumptions regarding the nature of the sample, other than that it is free of other Fe-containing phases. In it a single parameter, δ̅RT, the ‘centre of gravity’, or area weighted mean isomer shift at room temperature, T = 295 ± 5 K-is extracted by curve-fitting a sample’s Mössbauer spectrum, and is correlated to the sample’s composition or stoichiometry. We present data on high-purity magnetite and maghemite powders, and mixtures thereof, as well as comparison literature data from nanoparticulate mixtures and solid solutions, to show that a linear correlation exists between δRT and the numerical proportion of Fe atoms in the magnetite environment: α = Fe3+/Fe3+ = (δ̅RT − δo)/m, where δo = 0.3206 ± 0.0022 mm s⁻¹ and m = 0.2135 ± 0.0076 mm s⁻¹. We also present equations to relate α to the weight percentage w of magnetite in mixed phases, and the magnetite stoichiometry x = Fe2+/Fe3+ in solid solutions. The analytical method is generally applicable, but is most accurate when the absorption profiles are sharp; in some samples this may require spectra to be recorded at reduced temperatures. We consider such cases and provide equations to relate δ(7) to the corresponding α value.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Department of Physics, Neutrons and X-rays for Materials Physics, University College London, Universidad de Cantabria
Number of pages: 16
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
On the properties of poly(isoprene-b-ferrocenylmethyl methacrylate) block copolymers

By combining poly(1,4-isoprene) (PI) with poly(ferrocenylmethyl methacrylate) (PFMMA) in a diblock copolymer structure by means of anionic polymerization we obtained narrowly dispersed PI-b-PFMMA copolymers with molecular weight ranging from 13000 to 62000 g/mol. The products were stable up to 228 °C, according to thermal gravimetry, which allowed us to further investigate their viscoelastic and X-ray scattering properties at elevated temperature by rheology and SAXS, respectively. For PI-b-PFMMA with total molecular weight 13400 g/mol a phase transition at 105 °C was identified leading to the segmental mixing at $T > 105$ °C and microphase separation at $T <105$ °C. The microphase separated morphology acquired hexagonally packed cylinder (HEX) microstructure in bulk. The explanation of the ordered HEX morphology was derived from a quantification of the thermodynamic immiscibility between PI and PFMMA segments via random phase approximation theory yielding generally accepted dependency of the Flory-Huggins interaction parameter ($\chi$) on temperature.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, University of Copenhagen
Authors: Chernyy, S. (Intern), Kirkensgaard, J. J. K. (Ekstern), Bakke, A. (Ekstern), Mortensen, K. (Ekstern), Almdal, K. (Intern)
Pages: 129-136
Publication date: 2017
Main Research Area: Technical/natural sciences

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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.163 SJR 1.097
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.77 SJR 1.207 SNIP 1.253
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.144 SNIP 1.277 CiteScore 3.72
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.326 SNIP 1.613 CiteScore 3.85
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.414 SNIP 1.649 CiteScore 4.07
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.589 SNIP 1.777 CiteScore 3.74
ISI indexed (2012): ISI indexed yes
Optical and hydrodynamic stretching of single cells from blood

Mechanical properties, like deformability or elasticity, of cells can in some cases be indicative of the health of the organism they originate from. In this work, we explore the potential of deformability and other mechanical parameters of individual red blood cells (RBCs) from humans as a marker for the state of health of the human source, patient or donor. In particular, we have investigated the use of different experimental strategies implemented in injection molded plastic microfluidic devices. One strategy is to optically stretch the red blood cells in an optical two-beam trap, also known as an optical stretcher, in a microfluidic chip in which optical fibers have been placed during a post-processing step. Another strategy is to exert hydrodynamic shear forces on the cells by forcing the cells through a narrow constriction. The latter method has the advantage of a considerably higher throughput but does so far not allow for subsequent investigations of single "interesting" cells. The paper is a progress report with preliminary results based on the different strategies, we have pursued.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Physics, Quantum Physics and Information Technology, Technical University of Denmark, Copenhagen University Hospital
Authors: Thirstrup, H. (Ekstern), Rungling, T. B. (Ekstern), Khalil Al-Hamdani, M. Z. (Ekstern), Pathanchalinathan, R. (Ekstern), Dziegiel, M. H. (Ekstern), Kristensen, A. (Intern), Marie, R. (Intern), Berg-Sørensen, K. (Intern)
Number of pages: 3

DOI: 10.1016/j.polymer.2017.11.036
Source: Findit
Source-ID: 239390283
Publication: Research - peer-review › Journal article – Annual report year: 2017
Optical and photocatalytic properties of indium phosphide nanoneedles and nanotubes
Large scale indium phosphide (InP) nanoneedles and nanotubes were synthesized through a facile solvothermal reaction. The morphology and microstructure of the samples were analyzed by employing scanning electron microscopy (SEM), transmission electron microscopy (TEM), Raman spectroscopy, and Ultraviolet-visible (UV–vis) spectroscopy. The room temperature photoluminescence (PL) measurements showed that the InP nanoneedles and nanotubes possessed a pronounced blue shift in contrast to the bulk counterpart, which was ascribed to the crystalline defects effect. Moreover, the InP nanotubes exhibited an enhanced photocatalytic performance as compared to the InP nanoneedles and nanoparticles. [All rights reserved Elsevier].

Optical and photocatalytic properties of indium phosphide nanoneedles and nanotubes
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Optimal estimation of single-particle diffusion coefficients and kinetics of hOgg1 repair protein on DNA

How does one optimally determine the diffusion coefficient of a diffusing particle from a single-time-lapse recorded trajectory of the particle? We answer this question with an explicit, unbiased, and practically optimal covariance-based estimator (CVE). This estimator is regression-free and is far superior to commonly used methods based on measured mean squared displacements. In experimentally relevant parameter ranges, it also outperforms the analytically intractable and computationally more demanding maximum likelihood estimator (MLE). For the case of diffusion on a flexible and fluctuating substrate, the CVE is biased by substrate motion. However, given some long time series and a substrate under some tension, an extended MLE can separate particle diffusion on the substrate from substrate motion in the laboratory frame. This provides benchmarks that allow removal of bias caused by substrate fluctuations in CVE. The resulting unbiased CVE is optimal also for short time series on a fluctuating substrate. We have applied our estimators to human 8-oxoguanine DNA glycolase proteins diffusing on flow-stretched DNA, a fluctuating substrate, and found that diffusion coefficients are severely overestimated if substrate fluctuations are not accounted for.

Optimized electrode configuration for current-in-plane characterization of magnetic tunnel junction stacks: Paper

The current-in-plane tunneling technique (CIPT) has been a crucial tool in the development of magnetic tunnel junction stacks suitable for magnetic random access memories (MRAM) for more than a decade. The MRAM development has now reached the maturity to make the transition from the R&D phase to the pilot production phase. This will require an improvement in the repeatability of the CIPT metrology technique. Here, we present an analytical model that can be used to simulate numerically the repeatability of a CIPT measurement for an arbitrary MTJ stack prior to any CIPT measurement. The model describes mathematically the main sources of error arising when a micro multi-electrode probe is used to perform a CIPT measurement. The numerically simulated repeatability values obtained on four different MTJ stacks are verified by experimental data and the model is used to optimize the choice of electrodes on a multi-electrode probe to reach up to 36% improvement on the repeatability for the resistance area product and the tunneling magnetoresistance measurement, without any hardware modification.
Optimizing silver-capped silicon nanopillars to simultaneously realize macroscopic, practical-level SERS signal reproducibility and high enhancement at low costs

The ideal surface-enhanced Raman spectroscopy (SERS) substrate should fulfil the following: (a) predictable SERS enhancement, (b) macroscale SERS signal uniformity, and (c) suitability for mass production at low costs. Macroscale SERS uniformity and reproducibility at practical levels are big obstacles, which have been preventing most SERS substrates from reliable sensing applications. We have previously shown that SERS-active nanopillar structures, fabricated by lithography-free processes, exhibit high average SERS enhancements and are mass producible. Here, we report an optimized process and show that the improved structures exhibit unrivalled macroscale SERS uniformities (RSD: ~2.5% in millimeter scale, ~7% in wafer scale) and reproducibility (RSD: ~1.5% across 3 wafers), while at the same time exhibiting a very large average SERS enhancement factor of >10^8. The obtained SERS uniformity (~2.5% RSD in millimeter scale) is the best to date measured on large-area solid SERS substrates. Fast and reproducible SERS analysis of trans-1,2-bis-(4-pyridyl) ethylene down to 4x10^-13 mol is demonstrated using the optimized structures. We emphasize that achieving simultaneously macroscopic, practical-level SERS signal reproducibility and high enhancement via a lithography-free process is a notable advance towards industrialization of substrate-based SERS sensors.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Wu, K. (Intern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern), Thilsted, A. H. (Intern), Boisen, A. (Intern)
Pages: 1808-1818
Publication date: 2017
Main Research Area: Technical/natural sciences

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Journal: Journal of Raman Spectroscopy
Volume: 48
Issue number: 12
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.05 SJR 0.888
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.71 SJR 0.926 SNIP 1.115
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.02 SNIP 0.891 CiteScore 2.25
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.15 SNIP 1.071 CiteScore 2.53
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.029 SNIP 1.073 CiteScore 2.49
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Optomagnetic detection of DNA triplex nanoswitches

We report on optomagnetic dose-dependent detection of DNA triplex-mediated and pH-switchable clusters of functionalised magnetic nanoparticles.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Ruhr University Bochum
Authors: Minero, G. K. A. (Intern), Fock, J. (Intern), McCaskill, J. S. (Ekstern), Hansen, M. F. (Intern)
Number of pages: 4
Pages: 582-585
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Main Research Area: Technical/natural sciences

Publication information

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Volume: 142
Issue number: 4
ISSN (Print): 0003-2654
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Optomagnetic Detection of MicroRNA Based on Duplex-Specific Nuclease-Assisted Target Recycling and Multilayer Core-Satellite Magnetic Superstructures

Superstructural assembly of magnetic nanoparticles enables approaches to biosensing by combining specially tailored properties of superstructures and the particular advantages associated with a magnetic or optomagnetic read-out such as low background signal, easy manipulation, cost-efficiency, and potential for bioresponsive multiplexing. Herein, we demonstrate a sensitive and rapid miRNA detection method based on optomagnetic read-out, duplex-specific nuclease (DSN)-assisted target recycling, and the use of multilayer core-satellite magnetic superstructures. Triggered by the presence of target miRNA and DSN-assisted target recycling, the core-satellite magnetic superstructures release their “satellites” to the suspension, which subsequently can be quantified accurately in a low-cost and user-friendly optomagnetic setup. Target miRNAs are preserved in the cleaving reaction and can thereby trigger more cleavage and release of “satellites”. For singleplex detection of let-7b, a linear detection range between 10 fM and 10 nM was observed, and a detection limit of 4.8 fM was obtained within a total assay time of 70 min. Multiplexing was achieved by releasing nanoparticles of different sizes in the presence of different miRNAs. The proposed method also has the advantages of single-nucleotide mismatch discrimination and the ability of quantification in a clinical sample matrix, thus holding great promise for miRNA routine multiplex diagnostics.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Uppsala University, BluSense Diagnostics
Authors: Tian, B. (Ekstern), Ma, J. (Ekstern), Qiu, Z. (Ekstern), Gómez de la Torre, T. Z. (Ekstern), Donolato, M. (Ekstern), Hansen, M. F. (Intern), Svedlindh, P. (Ekstern), Strömberg, M. (Ekstern)
Pages: 1798-1806
Optomagnetic Sequence-Specific Detection of Dengue Target DNA

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, BluSense Diagnostics, Uppsala University
Authors: Minero, G. K. A. (Intern), Nogueira, C. (Ekstern), Rizzi, G. (Intern), Tian, B. (Ekstern), Fock, J. (Intern), Dolonato, M. (Ekstern), Strömberg, M. (Ekstern), Hansen, M. F. (Intern)
Optothermally actuated capillary burst valve

We demonstrate the optothermal actuation of individual capillary burst valves in an all-polymer microfluidic device. The capillary burst valves are realised in a planar design by introducing a fluidic constriction in a microfluidic channel of constant depth. We show that a capillary burst valve can be burst by raising the temperature due to the temperature dependence of the fluid surface tension. We address individual valves by using a local heating platform based on a thin film of near infrared absorber dye embedded in the lid used to seal the microfluidic device [L. H. Thamdrup et al., Nano Lett. 10, 826–832 (2010)]. An individual valve is burst by focusing the laser in its vicinity. We demonstrate the capture of single polystyrene 7 μm beads in the constriction triggered by the bursting of the valve.
Organic ice resists: condensed small molecules as spin-free volatile E-beam resists

General information
State: Published
Organisations: DTU Danchip, Center for Electron Nanoscopy, Department of Micro- and Nanotechnology, Silicon Microtechnology
Authors: Tiddi, W. (Intern), Lê Thanh, H. (Intern), Elsukova, A. (Intern), Beleggia, M. (Intern), Han, A. (Intern)
Number of pages: 1
Publication date: 2017
Main Research Area: Technical/natural sciences
Electron-beam lithography, Negative organic resist, Condensed films
Electronic versions:
Abstract_William_Tiddi.pdf
Source: PublicationPreSubmission
Source-ID: 140682876
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Output Pressure and Pulse-Echo Characteristics of CMUTs as Function of Plate Dimensions

This paper presents an experimental study of the acoustic performance of Capacitive Micromachined Ultrasonic Transducers (CMUTs) as function of plate dimensions. The objective is to increase the output pressure without decreasing the pulse-echo signal. The CMUTs are fabricated with a LOCOS process, followed by direct wafer fusion bonding to a Silicon-On-Insulator (SOI) wafer. In this way, the plate thickness is determined by the SOI wafer device layer thickness, resulting in CMUTs with plate thicknesses of 2, 9.3 and 15 μm. The corresponding radii and gap heights resulting in an immersion frequency of 5MHz and a pull-in voltage of 200V are obtained using finite element analysis.
Hydrophone and plane reflector measurements are used to assess the acoustic performance. Increasing the plate thickness from 2μm to 15μm decreases the pulse-echo bandwidth from >100% to 30%. A maximum in both peak-to-peak output pressure and pulse-echo signal is obtained for the 9.3μm plate, which still has a moderate pulseecho bandwidth of 60%. The 9.3μm plate results in a 1.9 times higher peak-to-peak output pressure and a 3.6 times higher pulse-echo signal compared to the 2μm plate. By adjusting the plate dimensions of a CMUT it is possible to optimize its acoustic performance for medical imaging applications, including visualization of deeper structures in the body, as well as nonlinear imaging such as tissue harmonic imaging.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering
Authors: Diederichsen, S. E. (Intern), Hansen, J. M. F. (Intern), Engholm, M. (Intern), Jensen, J. A. (Intern), Thomsen, E. V. (Intern)
Number of pages: 4
Publication date: 2017

Host publication Information
Title of host publication: 2017 IEEE International Ultrasonics Symposium (IUS)
Publisher: IEEE
ISBN (Electronic): 978-1-5386-3383-0
Main Research Area: Technical/natural sciences
Conference: 2017 IEEE International Ultrasonics Symposium (IUS), Washington, United States, 06/09/2017 - 06/09/2017
Electronic versions:
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DOIs:
10.1109/ULTSYM.2017.8092352
Source: PublicationPreSubmission
Source-ID: 137394559
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

Pair correlation analysis of fixed PALM and live PALM applied on the water channel AQP3

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Aarhus University, University of Southern Denmark, US National Institute of Health
Number of pages: 1
Pages: S88-S88
Publication date: 2017

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Volume: 46
Publisher: Springer
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Series: European Biophysics Journal With Biophysics Letters
Volume: 46
Number: Suppl. 1
ISSN: 0175-7571
Main Research Area: Technical/natural sciences
Conference: 19th IUPAB and 11th EBSA Congress, Edinburgh, United Kingdom, 16/07/2017 - 16/07/2017
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Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2017

Pair correlation analysis of Fixed PALM and Powerspectral Point Analysis of Live PALM applied on AQP3

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, National Institutes of Health, Aarhus University
Pathogen concentration integrated molecular analysis for SMARTDIAGNOS: the next generation sepsis diagnosis

General information
State: Published
Organisations: National Food Institute, Research Group for Analytical and Predictive Microbiology, Department of Micro- and Nanotechnology, BioLabChip, Research Group for Diagnostic Engineering
Authors: Aaydha Chidambara, V. (Intern), Shahbazi, M. (Intern), Dave, V. P. (Intern), Ngo Anh, T. (Intern), Wolff, A. (Intern), Bang, D. D. (Intern)
Number of pages: 1
Pages: S29-S29
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Conference: 8th international congress “sepsis and multiorgan dysfunction”, 06/09/2017 - 06/09/2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Infection and Immunity
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Issue number: Suppl 1
Article number: 008
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.953 SJR 1.954
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.34 SJR 2.04 SNIP 0.915
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.361 SNIP 1.053 CiteScore 3.72
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.344 SNIP 1.08 CiteScore 3.74
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.433 SNIP 1.168 CiteScore 4.25
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.386 SNIP 1.167 CiteScore 4.32
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.298 SNIP 1.166 CiteScore 4.25
ISI indexed (2011): ISI indexed yes
Paving the way towards complex blood-brain barrier models using pluripotent stem cells

A tissue with great need to be modelled in vitro is the blood-brain barrier (BBB). The BBB is a tight barrier that covers all blood vessels in the brain and separates the brain microenvironment from the blood system. It consists of three cell types (neurovascular unit (NVU)) that contribute to the unique tightness and selective permeability of the BBB and has been shown to be disrupted in many diseases and brain disorders, such as, vascular dementia, stroke, multiple sclerosis and Alzheimer's disease. Given the progress that pluripotent stem cells (PSCs) have made in the last two decades, it is now possible to produce many cell types from the BBB and even partially recapitulate this complex tissue in vitro. In this review, we summarize the most recent developments in PSC differentiation and modelling of the BBB. We also suggest how patient-specific human induced PSCs could be used to model BBB dysfunction in the future. Lastly, we provide perspectives on how to improve production of the BBB in vitro, for example by improving pericyte differentiation protocols and by better modelling the NVU in the dish.
PET imaging with copper-64 as a tool for real-time in vivo investigations of the necessity for crosslinking of polymeric micelles in nanomedicine: Imaging the influence of polymeric micelle crosslinking

Polymeric micelles in nanomedicine are often crosslinked to prevent disintegration in vivo. This typically requires clinically problematic chemicals or laborious procedures. In addition, crosslinking may interfere with advanced release strategies. Despite this, it is often not investigated whether crosslinking is necessary for efficient drug delivery. We used PET imaging with $^{64}\text{Cu}$ to demonstrate general methodology for real-time in vivo investigations of micelle stability. Triblock copolymers with 4-methylcoumarin cores of ABC-type (PEG-PHEMA-PCMA) were functionalized in the handle region (PHEMA) with CB-TE2A chelators. Polymeric micelles were formed by dialysis and one half was core-crosslinked by UV light (CL) and the other half was not (nonCL). Both CL and nonCL were radiolabeled with $^{64}\text{Cu}$ and compared in vivo in tumor-bearing mice, with free $^{64}\text{Cu}$ as control. Accumulation in relevant organs was quantified by ROI analysis on PET images and ex vivo counting. It was observed that CL and nonCL showed limited differences in biodistribution from each other, whereas both differed markedly from control (free $^{64}\text{Cu}$). This demonstrated that 4-methylcoumarin core micelles may form micelles that are stable in circulation even without crosslinking. The methodology presented here where individual unimers are radiolabeled is applicable to a wide range of polymeric micelle types.

General information
State: Published
Organisations: Center for Nuclear Technologies, The Hevesy Laboratory, Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Copenhagen
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Phosphate tuned copper electrodeposition and promoted formic acid selectivity for carbon dioxide reduction

Fabrication of catalytically active electrodes by electrodeposition is attractive due to its in situ nature, easy controllability, and large-scale operation capability. Most recently, modifying the electrodes with phosphate ligands through electrodepositing electrode materials has shown promising results in improving the kinetics of some reactions. However, it is unclear how the presence of phosphate anions affects the electrodeposition process and functions in catalyzing reactions. Here, we report a systematic study on electrodeposition of Cu in the presence of phosphate anions. The phosphate anions form a complex with free Cu(II) cations, competing with the electrodeposition process. The competition between the two processes results in an insufficient supply of free Cu(II) for electrodeposition, especially at the diffusion layer. This is evidenced by the calculation of free Cu(II) concentration and the electrodeposition current at identical applied potentials. We also found that the electrodeposition of Cu in the presence of phosphate generates Cu-oxyo/hydroxyo-phosphate species on the deposited copper surface. The modified electrodes with phosphate species exhibit higher selectivity for HCOOH formation (faradaic efficiency similar to 80%) from the electrochemical reduction of CO₂ as compared with Cu foil (faradaic efficiency similar to 33%). The effect of phosphate ligands promoting HCOOH selectivity is further verified by stripping off the ligands and regenerating the ligands.
Photothermal IR spectroscopy with perforated membrane micromechanical resonators
Rapid progress in nanofabrication techniques resulted in the emergence of ultrasensitive nanomechanical sensors, commonly consisting of simple vibrating structures such as cantilevers, strings or membranes that exhibit resonance behavior. The principle of operation is based on monitoring the resonance frequency shift due to various external factors, including mass, force and temperature change. The high sensitivity of nanomechanical resonators has already been exploited to create a group of photothermal spectroscopy devices capable of exceptionally fast chemical analysis of compounds on the femtogram level.

Nanomechanical infrared spectroscopy (NAM-IR) originated from photothermal bilayer cantilever deflection spectroscopy and is based on the photothermal response of a nanomechanical resonator. It has already been presented with a string resonator, which was acting as sampling element and temperature sensor. The string could be considered as a single filter-fiber and guaranteed relatively high overall sampling efficiency through impaction of airborne nanoparticles on the resonator surface. When the analyte, collected by the sensor, is exposed to IR radiation it absorbs light at a certain wavelength corresponding to its specific molecular vibrations. This thermal energy heats the resonator and leads to its thermal expansion followed by a decrease of the tensile stress in the resonator. In turn it eventually causes the resonance frequency to shift towards lower values.

However, further development of this approach was curbed by difficult and inefficient coupling of the IR light beam to a nanometer-sized resonator. In addition, readout of vibration was done by laser Doppler vibrometer, a precise but bulky and expensive instrument. These issues hindered a realworld application of the NAM-IR method. In order to overcome them, string resonators were replaced by membranes. A reliable sampling technique was maintained by adding perforation to membranes and thereby essentially getting membrane porous filters. Membranes gave also access to fully integrated magnetic transduction that allowed for significant shrinkage and simplification of the system.

An analytical model of a locally heated membrane was developed and confirmed through FEM simulations. Then, low stress silicon nitride perforated membranes were fabricated and characterized using two different experimental setups that employed optical and magnetomotive readout. Finally, spectroscopic measurements and crystallization study of about 100 pg of the model drug 'indomethacin' were performed. Obtained IR spectra were in good agreement both with conventional Fourier transform IR spectroscopy (FTIR) reference and literature reports. The performance of the magnetic transduction scheme was found to be comparable to the traditionally used optical detection with a minimum sample mass required for analysis of roughly 100 fg.

NAM-IR technique requires exceptionally small amount of sample and does not involve timeconsuming sample preparation. Therefore, it is a promising alternative to standard IR spectroscopy with vast possible applications for example in the pharmaceutical industry.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Authors: Kurek, M. (Intern), Boisen, A. (Intern), Burger, R. (Intern), Keller, S. S. (Intern)
Number of pages: 112
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Original language: English
Main Research Area: Technical/natural sciences
Electronic versions: Untitled.pdf

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Projects:
Photothermal IR spectroscopy with perforated membrane micromechanical resonators
Source: PublicationPreSubmission
Source-ID: 131932922
Publication: Research › Ph.D. thesis – Annual report year: 2017

Photothermal Transport of DNA in Entropy-Landscape Plasmonic Waveguides
The ability to handle single, free molecules in lab-on-a-chip systems is key to the development of advanced biotechnologies. Entropic confinement offers passive control of polymers in nanofluidic systems by locally asserting a molecule's number of available conformation states through structured landscapes. Separately, a range of plasmonic configurations have demonstrated active manipulation of nano-objects by harnessing concentrated electric fields. The integration of these two independent techniques promises a range of sophisticated and complementary functions to handle, for example, DNA, but numerous difficulties, in particular, conflicting requirements of channel size, have prevented progress. Here, we show that metallic V-groove waveguides, embedded in fluidic nanoslits, form entropic potentials that trap and guide DNA molecules over well-defined routes while simultaneously promoting photothermal transport of DNA through the losses of plasmonic modes. The propulsive forces, assisted by in-coupling to propagating channel plasmon polaritons, extend along the V-grooves with a directed motion up to ≈0.5 μm·mW⁻¹ away from the input beam and λ-DNA
velocities reaching $\approx 0.2 \, \mu\text{m} \cdot \text{s}^{-1} \cdot \text{mW}^{-1}$. The entropic trapping enables the V-grooves to be flexibly loaded and unloaded with DNA by variation of transverse fluid flow, a process that is selective to biopolymers versus fixed-shape objects and also allows the technique to address the challenges of nanoscale interaction volumes. Our self-aligning, light-driven actuator provides a convenient platform to filter, route, and manipulate individual molecules and may be realized wholly by wafer-scale fabrication suitable for parallelized investigation.
Photovoltaic subretinal implants for blind patients

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Experimental Surface and Nanomaterials Physics, Aarhus University Hospital, Aarhus University
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Number of pages: 1
Publication date: 2017

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Publisher: Technical University of Denmark (DTU)
Article number: H-9
Main Research Area: Technical/natural sciences
Conference: Sustain 2017, Kgs. Lyngby, Denmark, 06/12/2017 - 06/12/2017
Electronic versions:
SustainAbstracts2017c.compressed_91.pdf
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2017

Plasmonic color metasurfaces fabricated by a high speed roll-to-roll method
Lab-scale plasmonic color printing using nano-structured and subsequently metallized surfaces have been demonstrated to provide vivid colors. However, upscaling these structures for large area manufacturing is extremely challenging due to the requirement of nanometer precision of metal thickness. In this study, we have investigated a plasmonic color metasurface design that can be easily upscaled. We have demonstrated the feasibility of fabrication of these plasmonic color surfaces by a high-speed roll-to-roll method, comprising roll-to-roll extrusion coating at 10 m min\(^{-1}\) creating a polymer foil having 100 nm deep pits of varying sub-wavelength diameter and pitch length. Subsequently this polymer foil was metallized and coated also by high-speed roll-to-roll methods. The perceived colors have high tolerance towards the thickness of the metal layer, when this thickness exceeds the depths of the pits, which enables the robust high-speed fabrication. This finding can pave the way for plasmonic meta-surfaces to be implemented in a broader range of applications such as printing, memory, surface enhanced Raman scattering (SERS), biosensors, flexible displays, photovoltaics, security, and product branding.

General information
State: Published
Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Heliac ApS, Danish Fundamental Metrology
Authors: Murthy, S. (Intern), Pranov, H. (Ekstern), Feidenhans'l, N. A. (Intern), Madsen, J. S. (Ekstern), Hansen, P. E. (Ekstern), Pedersen, H. C. (Intern), Taboryski, R. J. (Intern)
Number of pages: 8
Pages: 14280-14287
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Ratings:
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.442 SJR 2.934
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.46 SJR 2.789 SNIP 1.441
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Plasmonics for emerging quantum technologies

Expanding the frontiers of information processing technologies and, in particular, computing with ever increasing speed and capacity has long been recognized an important societal challenge, calling for the development of the next generation of quantum technologies. With its potential to exponentially increase computing power, quantum computing opens up possibilities to carry out calculations that ordinary computers could not finish in the lifetime of the Universe, while optical communications based on quantum cryptography become completely secure. At the same time, the emergence of Big Data and the ever increasing demands of miniaturization and energy saving technologies bring about additional fundamental problems and technological challenges to be addressed in scientific disciplines dealing with light-matter interactions. In this context, quantum plasmonics represents one of the most promising and fundamental research directions and, indeed, the only one that enables ultimate miniaturization of photonic components for quantum optics when being taken to extreme limits in light-matter interactions.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Photonics Engineering, Structured Electromagnetic Materials
Authors: Bozhevolnyi, S. I. (Intern), Mortensen, N. A. (Intern)
Number of pages: 4
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication Information
Journal: Nanophotonics
Volume: 6
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Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): SNIP 1.892 SJR 2.916
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 4.75 SNIP 1.989 SJR 2.385
Web of Science (2016): Indexed yes
Scopus rating (2015): SNIP 1.963 SJR 3.411
Web of Science (2015): Indexed yes
Plasmonic Waveguide-Integrated Nanowire Laser

Next-generation optoelectronic devices and photonic circuitry will have to incorporate on-chip compatible nanolaser sources. Semiconductor nanowire lasers have emerged as strong candidates for integrated systems with applications ranging from ultrasensitive sensing to data communication technologies. Despite significant advances in their fundamental aspects, the integration within scalable photonic circuitry remains challenging. Here we report on the realization of hybrid photonic devices consisting of nanowire lasers integrated with wafer-scale lithographically designed V-groove plasmonic waveguides. We present experimental evidence of the lasing emission and coupling into the propagating modes of the V-grooves, enabling on-chip routing of coherent and sub-diffraction-confined light with room-temperature operation. Theoretical considerations suggest that the observed lasing is enabled by a waveguide hybrid photonic-plasmonic mode. This work represents a major advance toward the realization of application-oriented photonic circuits with integrated nanolaser sources.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Barcelona Institute of Science and Technology, Ecole Polytechnique Federale de Lausanne (EPFL), Universidad Autonoma de Madrid
Authors: Bermudez-Urena, E. (Ekstern), Tutuncuoglu, G. (Ekstern), Cuerda, J. (Ekstern), Smith, C. (Intern), Bravo-Abad, J. (Ekstern), Bozhevolnyi, S. I. (Intern), Fontcuberta i Morral, A. (Ekstern), Garcia-Vidal, F. J. (Ekstern), Quidant, R. (Ekstern)
Number of pages: 8
Pages: 747-754
Publication date: 2017
Main Research Area: Technical/natural sciences

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Journal: Nano Letters
Volume: 17
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 13.4
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 14.76
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 14.04
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 14.23
Plasmons in Dimensionally Mismatched Coulomb Coupled Graphene Systems

We calculate the plasmon dispersion relation for Coulomb coupled metallic armchair graphene nanoribbons and doped monolayer graphene. The crossing of the plasmon curves, which occurs for uncoupled 1D and 2D systems, is split by the interlayer Coulomb coupling into a lower and an upper plasmon branch. The upper branch exhibits an unusual behavior with endpoints at finite q. Accordingly, the structure factor shows either a single or a double peak behavior, depending on the plasmon wavelength. The new plasmon structure is relevant to recent experiments, its properties can be controlled by varying the system parameters and be used in plasmonic applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Nanostructured Graphene, Theoretical Nanotechnology
Authors: Badalyan, S. M. (Intern), Shylau, A. A. (Intern), Jauho, A. (Intern)
Number of pages: 6
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Physical Review Letters
Volume: 119
Issue number: 12
Article number: 126801
ISSN (Print): 0031-9007
Ratings:
BFI (2018): BFI-level 2
Polyaniline coated Fe₃O₄ hollow nanospheres as anode materials for lithium ion batteries

Polyaniline (PANI) coated Fe₃O₄ hollow nanospheres (h-Fe₃O₄@PANI) have been successfully synthesized and investigated as anode materials for lithium ion batteries (LIBs). The structure and composition analyses have been performed by employing X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FTIR), and X-ray photoelectron spectroscopy (XPS). The results show a good combination between h-Fe₃O₄ and PANI with a conductive state. When evaluated as anode materials for LiBs, the h-Fe₃O₄@PANI nanocomposites exhibit excellent LIB performance with enhanced reversible capacity, good cycling performance and rate capability as compared to h-Fe₃O₄ and solid Fe₃O₄ (s-Fe₃O₄) nanospheres. The improved electrochemical performance of the nanocomposite is considered due to the hollow nature of the products and the coated PANI layers.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Hebei University of Science and Technology, Northeastern University at Qinhuangdao, Chinese Academy of Sciences, Tsinghua University
Authors: Wang, X. (Ekstern), Liu, Y. (Ekstern), Han, H. (Ekstern), Zhao, Y. (Ekstern), Ma, W. (Ekstern), Sun, H. (Intern)
Pages: 915-922
Publication date: 2017
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Publication information
Journal: Sustainable Energy & Fuels
Volume: 1
Issue number: 4
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Original language: English
DOIs: 10.1039/c7se00139h
Source: FindIt
Source-ID: 2357685042
Publication: Research - peer-review › Journal article – Annual report year: 2018

Position and mode dependent optical detection back-action in cantilever beam resonators

Optical detection back-action in cantilever resonant or static detection presents a challenge when striving for state-of-the-art performance. The origin and possible routes for minimizing optical back-action have received little attention in literature. Here, we investigate the position and mode dependent optical back-action on cantilever beam resonators. A high power heating laser (100 μW) is scanned across a silicon nitride cantilever while its effect on the first three resonance modes is detected via a low-power readout laser (1 μW) positioned at the cantilever tip. We find that the measured effect of back-action is not only dependent on position but also the shape of the resonance mode. Relevant silicon nitride material parameters are extracted by fitting finite element (FE) simulations to the temperature-dependent frequency response of the first three modes. In a second round of simulations, using the extracted parameters, we successfully fit the FEM results with the measured mode and position dependent back-action. From the simulations, we can conclude that the observed frequency tuning is due to temperature induced changes in stress. Effects of changes in material properties and dimensions are negligible. Finally, different routes for minimizing the effect of this optical detection back-action are described, allowing further improvements of cantilever-based sensing in general.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Technical University of Denmark, University of Melbourne
Authors: Larsen, T. (Intern), Schmid, S. (Intern), Dohn, S. (Intern), Sader, J. E. (Ekstern), Boisen, A. (Intern), Villanueva, L. (Ekstern)
Number of pages: 5
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Powder embossing method for selective loading of polymeric microcontainers with drug formulation

The present study introduces powder embossing as a novel method to enhance loading of polymeric microcontainers with drug. With current loading approaches, it is not possible to handle pure powder drug in a scalable, homogenous and reproducible manner. In this work, we demonstrate simultaneous loading of 625 microcontainers with powder formulation. This is achieved in a single step by aligning a shadow mask prepared by micro-milling to an array of microcontainers in order to limit drug deposition to the container cavities with diameters of 220 μm. A pressure of 8.9 MPa is applied by a bonding press and thereby the desired powder is embossed into the container cavities. Powder in the form of pure drug, lipid-based microparticles, and pure polymer was successfully loaded with minimal residues in between the microcontainers and with 100% loaded cavities demonstrating the versatility of the method. The current work is thus contributing to the loading of powder formulations into microscale drug delivery systems such as microcontainers in a facile and reproducible manner.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Physics, Neutrons and X-rays for Materials Physics, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Number of pages: 5
Pages: 20-24
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Microelectronic Engineering
Volume: 171
ISSN (Print): 0167-9317
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  BFI (2018): BFI-level 2
  Web of Science (2018): Indexed yes
  BFI (2017): BFI-level 2
  Scopus rating (2017): SNIP 0.937 SJR 0.604
  Web of Science (2017): Indexed yes
  BFI (2016): BFI-level 2
  Scopus rating (2016): CiteScore 1.69 SJR 0.589 SNIP 0.949
  Web of Science (2016): Indexed yes
  BFI (2015): BFI-level 2
  Scopus rating (2015): SJR 0.507 SNIP 0.796 CiteScore 1.35
  Web of Science (2015): Indexed yes
  BFI (2014): BFI-level 2
  Scopus rating (2014): SJR 0.586 SNIP 0.86 CiteScore 1.44
  Web of Science (2014): Indexed yes
  BFI (2013): BFI-level 2
  Scopus rating (2013): SJR 0.595 SNIP 0.964 CiteScore 1.45
  ISI indexed (2013): ISI indexed yes
  Web of Science (2013): Indexed yes
Precision of Micro Hall Effect Measurements in Scribe Line Test Pads of B-doped SiGe

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, IMEC, Capres A/S
Publication date: 2017
Main Research Area: Technical/natural sciences
Electronic versions: Poster_FCMN_2017.pdf

Preparation of high crystalline nanoparticles of rare-earth based complex pervoskites and comparison of their structural and magnetic properties with bulk counterparts: Paper
A simple route to prepare Gd0.7Sr0.3MnO3 nanoparticles by ultrasonication of their bulk powder materials is presented in this article. For comparison, Gd0.7Sr0.3MnO3 nanoparticles are also prepared by ball milling. The prepared samples are characterized by X-ray diffraction (XRD), field emission scanning electron microscope (FESEM), energy dispersive X-ray (EDX), X-ray photoelectron spectroscopy (XPS), and superconducting quantum interference device (SQUID) magnetometer. XRD Rietveld analysis is carried out extensively for the determination of crystallographic parameters and the amount of crystalline and amorphous phases. FESEM images demonstrate the formation of nanoparticles with average particle size in the range of 50–100 nm for both ultrasonication and 4 h (h) of ball milling. The bulk materials and nanoparticles synthesized by both ultrasonication and 4 h ball milling exhibit a paramagnetic to spin-glass transition. However, nanoparticles synthesized by 8 h and 12 h ball milling do not reveal any phase transition, rather show an upturn of magnetization at low temperature. The degradation of the magnetic properties in ball milled nanoparticles may be associated with amorphization of the nanoparticles due to ball milling particularly for milling time exceeding 8 h. This investigation demonstrates the potential of ultrasonication as a simple route to prepare high crystalline rare-earth based manganite nanoparticles with improved control compared to the traditional ball milling technique.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Bangladesh University of Engineering and Technology, S.N. Bose National Centre for Basic Sciences, India, Yamagata University
Authors: Basith, M. A. (Ekstern), Islam, M. A. (Ekstern), Ahmmad, B. (Ekstern), Sarowar Hossain, M. D. (Ekstern), Melhhave, K. (Intern)
Number of pages: 11
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Materials Research Express
Volume: 4
Issue number: 7
ISSN (Print): 2053-1591
Ratings:
Web of Science (2018): Indexed yes
Probing the Gas-Phase Dynamics of Graphene Chemical Vapour Deposition using *in-situ* UV Absorption Spectroscopy

The processes governing multilayer nucleation in the chemical vapour deposition (CVD) of graphene are important for obtaining high-quality monolayer sheets, but remain poorly understood. Here we show that higher-order carbon species in the gas-phase play a major role in multilayer nucleation, through the use of *in-situ* ultraviolet (UV) absorption spectroscopy. These species are the volatilized products of reactions between hydrogen and carbon contaminants that have backstreamed into the reaction chamber from downstream system components. Consequently, we observe a dramatic suppression of multilayer nucleation when backstreaming is suppressed. These results point to an important and previously undescribed mechanism for multilayer nucleation, wherein higher-order gas-phase carbon species play an integral role. Our work highlights the importance of gas-phase dynamics in understanding the overall mechanism of graphene growth.
Protease-Sensitive Liposomes in Chemotherapy & Chemoradiotherapy: From Material Development to In Vivo Application in Tumor-Bearing Mice

Chemotherapeutics is one of the most common treatments for cancer. Even so, systemic toxicity frequently requires a dose reduction to limit side effects, which subsequently limits the efficacy of the therapy. Nanomedicine is an effective strategy that can reduce side effects and enhance the therapeutic efficacy of the chemotherapeutic agents. However, availability of the drug payload after tumor accumulation remains a general challenge in many existing drug delivery systems (DDS). Designing DDSs that provide release of the drug payload in a controlled fashion is therefore of great importance to enhance therapeutic efficacies.

In this thesis, the development, characterization, and evaluation of an advanced liposomal DDS and its potential in chemoradiotherapy is presented from material development to in vivo application in tumor-bearing mice. In the first part of the thesis, we report the design of a matrix metalloproteinase (MMP)* sensitive liposomal DDS, wherein local expression of MMPs in the tumor microenvironment converts a PEGylated anionic liposome into a dePEGylated cationic liposome, which is readily internalized by cells. Specifically, we demonstrate the enzyme-mediated charge reversal concept of the liposomal DDS, which leads to rapid cellular uptake. Various lipid compositions are tested in uptake and cytotoxicity experiments in vitro, followed by in vivo experiments where the ability of the liposomal DDS to accumulate in tumors together with its anti-cancer activity is explored in tumor-bearing mice. The in vivo data demonstrates superior anti-cancer activity relative to the free drug and to conventional, long circulating liposomes. This indicates that the MMP-sensitive liposomal DDS holds potential in therapeutic applications.

In the second part of the thesis, the potential impact that the liposomal DDS employs in chemoradiotherapy is explored. Here, the liposomal DDS is evaluated as the chemotherapeutic agent in chemoradiotherapy with the aim of enhancing the outcome of radiotherapy. In vivo, the combinatorial treatment with the liposomal DDS and radiation showed a significantly higher anti-cancer effect than any of the monotherapies as well as the combinatorial treatment of the free drug and radiation. Furthermore, evaluation of tumor tissues indicated that the platinum* DNA chelation in tumor tissues correlated with the observed anti-cancer effects. Finally, we anticipate that the findings in this thesis will lead to future studies with the liposomal DDS and reveal some of the mechanistical uncertainties.
Pulsed laser deposition (PLD) of the CZTS absorber for thin solar cells with up to 5.2%-efficiency

QmeQ 1.0: An open-source Python package for calculations of transport through quantum dot devices

QmeQ is an open-source Python package for numerical modeling of transport through quantum dot devices with strong electron–electron interactions using various approximate master equation approaches. The package provides a framework for calculating stationary particle or energy currents driven by differences in chemical potentials or temperatures between the leads which are tunnel coupled to the quantum dots. The electronic structures of the quantum dots are described by their single-particle states and the Coulomb matrix elements between the states. When transport is treated perturbatively to lowest order in the tunneling couplings, the possible approaches are Pauli (classical), first-order Redfield, and first-order von Neumann master equations, and a particular form of the Lindblad equation. When all processes involving two-particle excitations in the leads are of interest, the second-order von Neumann approach can be applied. All these approaches are implemented in QmeQ. We here give an overview of the basic structure of the package, give examples of transport calculations, and outline the range of applicability of the different approximate approaches.

QmeQ 1.0: An open-source Python package for calculations of transport through quantum dot devices

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<td>BFI-level 1</td>
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**Quality assessment of graphene: Continuity, uniformity, and accuracy of mobility measurements**

With the increasing availability of large-area graphene, the ability to rapidly and accurately assess the quality of the electrical properties has become critically important. For practical applications, spatial variability in carrier density and carrier mobility must be controlled and minimized. We present a simple framework for assessing the quality and homogeneity of large-area graphene devices. The field effect in both exfoliated graphene devices encapsulated in hexagonal boron nitride and chemical vapor-deposited (CVD) devices was measured in dual current–voltage configurations and used to derive a single, gate-dependent effective shape factor, $\beta$, for each device. $\beta$ is a sensitive indicator of spatial homogeneity that can be obtained from samples of arbitrary shape. All 50 devices investigated in this study show a variation (up to tenfold) in $\beta$ as a function of the gate bias. Finite element simulations suggest that spatial doping inhomogeneity, rather than mobility inhomogeneity, is the primary cause of the gate dependence of $\beta$, and that measurable variations of $\beta$ can be caused by doping variations as small as $10^{10}$ cm$^{-2}$. Our results suggest that local
variations in the position of the Dirac point alter the current flow and thus the effective sample shape as a function of the gate bias. We also found that such variations lead to systematic errors in carrier mobility calculations, which can be revealed by inspecting the corresponding $\beta$ factor.

**General information**

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BFI (2016): BFI-level 2

Scopus rating (2016): CiteScore 6.91 SJR 2.896 SNIP 1.411

Web of Science (2016): Indexed yes

BFI (2015): BFI-level 2

Scopus rating (2015): SJR 3.09 SNIP 1.582 CiteScore 7.87

Web of Science (2015): Indexed yes

BFI (2014): BFI-level 2

Scopus rating (2014): SJR 3.034 SNIP 1.852 CiteScore 8.03

Web of Science (2014): Indexed yes

BFI (2013): BFI-level 2

Scopus rating (2013): SJR 3.551 SNIP 1.931 CiteScore 8.45

ISI indexed (2013): ISI indexed yes

BFI (2012): BFI-level 2

Scopus rating (2012): SJR 3.425 SNIP 1.623 CiteScore 7.24

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Scopus rating (2011): SJR 3.215 SNIP 1.64 CiteScore 6.85

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Scopus rating (2010): SJR 2.323 SNIP 1.015

Original language: English

CVD graphene, Doping inhomogeneity, Electrical measurements, van der Pauw, hBN-encapsulated graphene, Finite element simulations, Raman mapping

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**Quantification of a bacterial secondary metabolite by SERS combined with SLM extraction for bioprocess monitoring**

During the last few decades, great advances have been reached in high-throughput design and building of genetically engineered microbial strains, leading to a need for fast and reliable screening methods. We developed and optimized a microfluidic supported liquid membrane (SLM) extraction device and combined it with surface enhanced Raman scattering (SERS) sensing for the screening of a biological process, namely for the quantification of a bacterial secondary metabolite,
p-coumaric acid (pHCA), produced by Escherichia coli. The microfluidic device proved to be robust and reusable, enabling
efficient removal of interfering compounds from the real samples, reaching more than 13-fold up-concentration of the
donor at 10 μL min⁻¹ flow rate. With this method, we quantified pHCA directly from the bacterial supernatant,
distinguishing between various culture conditions based on the pHCA production yield. The obtained data showed good
correlation with HPLC analysis.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, BioLabChip, Novo Nordisk Foundation Center for Biosustainability, Bacterial Cell Factory Optimization, Research Groups, Bioanalytics, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.92
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.07
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.1
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 4.11
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.88
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 4.16
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Web of Science (2010): Indexed yes
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BFI (2008): BFI-level 1
Web of Science (2006): Indexed yes
Web of Science (2005): Indexed yes
Web of Science (2002): Indexed yes
Web of Science (2001): Indexed yes
Original language: English
Quantifying Chemical and Electrochemical Reactions in Liquids by in situ Electron Microscopy

Nanomaterial synthesis and electrochemical process usually involve liquid environments. Studying and understanding such processes in their native environment on the nanoscale is essential to improve the properties of advanced functional materials and nanodevices. In situ Liquid Cell Transmission Electron Microscopy (LCTEM), under rapid development, is a fascinating and versatile characterizing platform that has two advantages: (1) allows high spatial and temporal resolution; and (2) allows to observe dynamic processes in liquid directly.

This PhD thesis focuses in identifying the critical aspects and developing a robust imaging analysis method for quantitatively understand chemical and electrochemical process during in situ liquid electron microscopy. By using two custom-made liquid cells (an electrochemical scanning electron microscopy (EC-SEM) platform and Liquid Flow S/TEM holder) beam-induced and bias-induced nanocrystal growth was investigated. Also, the effect of surfactant on the formation of gold (Au) nanoparticles (NPs) by in situ liquid STEM was explored and quantified. Particularly, the crystal growth processes for Au NPs was observed directly. Moreover, systematic in situ study of electrochemical deposition of copper (Cu) by electrochemical liquid scanning electron microscopy (EC-SEM) was done in order to direct observe the formation of dendritic structures. Finally the shape evolution from solid to hollow structures through galvanic replacement reactions were observed for different silver (Ag) nanotemplates (cube, rod, nanowires) and gold chloride solution.

Results demonstrated that by combining in situ LTEM and ECSEM microscopy with quantitative analysis and systematic studies, meaningful information about the controllable synthesis of metal NPs is achievable.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Electron Nanoscopy
Authors: Canepa, S. (Intern), Mølhave, K. (Intern), Wagner, J. B. (Intern), Sun, H. (Intern)
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Publisher: DTU Nanotech
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Main Research Area: Technical/natural sciences

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Quantifying shape, size, and composition distributions of nanoparticle aerosols by impaction and electron microscopy

General information
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Organisations: Department of Micro- and Nanotechnology, Molecular Windows, National Research Center for Working Environment
Authors: Bluhme, A. B. (Intern), Kling, K. (Ekstern), Koponen, I. K. (Ekstern), Mølhave, K. (Intern)
Number of pages: 1
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Article number: U-2
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Conference: Sustain 2017, Kgs. Lyngby, Denmark, 06/12/2017 - 06/12/2017
Electronic versions:
SustainAbstracts2017c.compressed_169.pdf
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2017
Quantitative Detection of Trace Level Cloxacillin in Food Samples Using Magnetic Moleculary Imprinted Polymer Extraction and Surface-Enhanced Raman Spectroscopy Nanopillars

There is an increasing demand for rapid, sensitive, and low cost analytical methods to routinely screen antibiotic residues in food products. Conventional detection of antibiotics involves sample preparation by liquid-liquid or solid-phase extraction, followed by analysis using liquid chromatography-mass spectrometry (LC-MS), capillary electrophoresis (CE), or gas chromatography (GC). The process is labor-intensive, time-consuming, and expensive. In this study, we developed a new analytical method that combines magnetic molecularly imprinted polymer (MMIP)-based sample preparation with surface-enhanced Raman spectroscopy (SERS)-based detection for quantitative analysis of cloxacillin in pig serum. MMIP microspheres were synthesized using a core-shell technique. The large loading capacity and high selectivity of the MMIP microspheres enabled efficient extraction of cloxacillin, while the magnetically susceptible characteristics greatly simplified sample handling procedures. Low cost and robust SERS substrates consisting of vertical gold capped silicon nanopillars were fabricated and employed for the detection of cloxacillin. Quantitative SERS was achieved by normalizing signal intensities using an internal standard. By coherently combining MMIP extraction and silicon nanopillar-based SERS biosensor, good sensitivity toward cloxacillin was achieved. The detection limit was 7.8 pmol. Cloxacillin recoveries from spiked pig plasma samples were found to be more than 80%.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Magnetic Systems
Authors: Ashley, J. (Intern), Wu, K. (Intern), Hansen, M. F. (Intern), Schmidt, M. S. (Intern), Boisen, A. (Intern), Sun, Y. (Intern)
Pages: 11484–11490
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Analytical Chemistry
Volume: 89
Issue number: 21
ISSN (Print): 0003-2700
Ratings:
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2016): CiteScore 6.08
Web of Science (2016): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2015): CiteScore 6
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.79
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Scopus rating (2013): CiteScore 6.01
ISI indexed (2013): ISI indexed yes
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BFI (2012): BFI-level 2
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Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.86
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Quantum Coherent Multielectron Processes in an Atomic Scale Contact

The light emission from a scanning tunneling microscope operated on a Ag(111) surface at 6 K is analyzed from low conductances to values approaching the conductance quantum. Optical spectra recorded at sample voltages V reveal emission with photon energies \( \hbar \nu > 2eV \). A model of electrons interacting coherently via a localized plasmon-polariton mode reproduces the experimental data, in particular, the kinks in the spectra at \( eV \) and \( 2eV \) as well as the scaling of the intensity at low and intermediate conductances.
Quantum Corrections in Nanoplasmonics: Shape, Scale, and Material

The classical treatment of plasmonics is insufficient at the nanometer-scale due to quantum mechanical surface phenomena. Here, an extension of the classical paradigm is reported which rigorously remedies this deficiency through the incorporation of first-principles surface response functions—the Feibelman $d$ parameters—in general geometries. Several analytical results for the leading-order plasmonic quantum corrections are obtained in a first-principles setting; particularly, a clear separation of the roles of shape, scale, and material is established. The utility of the formalism is illustrated by the derivation of a modified sum rule for complementary structures, a rigorous reformulation of Kreibig’s phenomenological damping prescription, and an account of the small-scale resonance shifting of simple and noble metal nanostructures.
Raman spectral indicators of catalyst decoupling for transfer of CVD grown 2D materials

Through a combination of monitoring the Raman spectral characteristics of 2D materials grown on copper catalyst layers, and wafer scale automated detection of the fraction of transferred material, we reproducibly achieve transfers with over 97.5% monolayer hexagonal boron nitride and 99.7% monolayer graphene coverage, for up to 300 mm diameter wafers. We find a strong correlation between the transfer coverage obtained for graphene and the emergence of a lower wavenumber 2D peak component, with the concurrent disappearance of the higher wavenumber 2Dþ peak component during oxidation of the catalyst surface. The 2D peak characteristics can therefore act as an unambiguous predictor of the success of the transfer. The combined monitoring and transfer process presented here is highly scalable and amenable for roll-to-roll processing.

General information

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Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, University of Cambridge, AIXTRON Ltd, Leibniz-Institut für Oberflächenmodifizierung e.V.
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Scopus rating (2017): SJR 2.226 SNIP 1.666
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 6.49 SJR 2.091 SNIP 1.648
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 1.988 SNIP 1.71 CiteScore 6.53
Web of Science (2015): Indexed yes
Rapid and specific detection of cell-derived microvesicles using a magnetoresistive biochip

Microvesicles (MVs) are a promising source of diagnostic biomarkers which have gained a wide interest in the biomedical and biosensing field. They can be interpreted as a "fingerprint" of various diseases. Nonetheless, MVs implementation into clinical settings has been hampered by the lack of technologies to accurately characterize, detect and quantify them. Here, we report the specific sensing and quantification of MVs from endothelial cells using a portable magnetoresistive (MR) biochip platform, in less than one hour and within physiologically relevant concentrations (1 × 10^8 MVs per ml). MVs were isolated from both endothelial and epithelial cells undergoing apoptosis, and characterized by atomic force microscopy (AFM) and nanoparticle tracking analysis (NTA), which revealed similar MV sizes. Importantly, our results showed that the two distinct MV populations could be discriminated with the MR biochip platform, with over a 5-fold capture efficiency of endothelial MVs in comparison to the control (epithelial MVs). Also, unspecific binding of MVs to BSA was less than 1% of the specific signal. The detection strategy was based on a sandwich immunoassay, where MVs were labelled with magnetic nanoparticles (MNPs) functionalized with Annexin V and then captured by anti-CD31 antibodies previously immobilized on the surface of the sensor. Results suggest that this approach allows the detection of specific MVs from complex samples such as serum, and highlight the potential of this technology to become a suitable tool for MVs detection as a complementary method of diagnosis.
Real-time oxide evolution of copper protected by graphene and boron nitride barriers

Applying protective or barrier layers to isolate a target item from the environment is a common approach to prevent or delay its degradation. The impermeability of two-dimensional materials such as graphene and hexagonal boron nitride (hBN) has generated a great deal of interest in corrosion and material science. Owing to their different electronic properties (graphene is a semimetal, whereas hBN is a wide-bandgap insulator), their protection behaviour is distinctly different. Here we investigate the performance of graphene and hBN as barrier coatings applied on copper substrates through a real-time study in two different oxidative conditions. Our findings show that the evolution of the copper oxidation is remarkably different for the two coating materials.
Recent advances in compartmentalized synthetic architectures as drug carriers, cell mimics and artificial organelles

Compartmentalization is a key feature of biological cells which conduct their metabolic activity in individual steps isolated in distinct, separated compartments. The creation of architectures containing multiple compartments with a structure that resembles that of a biological cell has generated significant research attention and these assemblies are proposed as candidate materials for a range of biomedical applications. In this Review article, the recent successes of multicompartment architectures as carriers for the delivery of therapeutic cargo or the creation of micro- and nanoreactors that mimic metabolic activities, thus acting as artificial cells or organelles, are discussed. The developed technologies to assemble such complex architectures are outlined, the multicompartment carriers’ properties which contribute to their performance in diverse applications are discussed, and their successful applications are highlighted. Finally, future directions and developments in the field are suggested.
Recent advances in smart biotechnology: Hydrogels and nanocarriers for tailored bioactive molecules depot

Over the past ten years, the global biopharmaceutical market has remarkably grown, with ten over the top twenty worldwide high performance medical treatment sales being biologics. Thus, biotech R&D (research and development) sector is becoming a key leading branch, with expanding revenues. Biotechnology offers considerable advantages compared to traditional therapeutic approaches, such as reducing side effects, specific treatments, higher patient compliance and therefore more effective treatments leading to lower healthcare costs. Within this sector, smart nanotechnology and colloidal self-assembling systems represent pivotal tools able to modulate the delivery of therapeutics. A comprehensive understanding of the processes involved in the self-assembly of the colloidal structures discussed therein is essential for the development of relevant biomedical applications. In this review we report the most promising and best performing platforms for specific classes of bioactive molecules and related target, spanning from siRNAs, gene/plasmids, proteins/growth factors, small synthetic therapeutics and bioimaging probes.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Istituto Italiano di Tecnologia, University of Coimbra, University of Algarve, University of Trieste
Authors: Milcovich, G. (Ekstern), Lettieri, S. (Ekstern), Antunes, F. E. (Ekstern), Medronho, B. (Ekstern), Fonseca, A. C. (Ekstern), Coelho, J. F. (Ekstern), Marizza, P. (Intern), Perrone, F. (Ekstern), Farra, R. (Ekstern), Dapas, B. (Ekstern), Grassi, G. (Ekstern), Grassi, M. (Ekstern), Giordani, S. (Ekstern)
Pages: 163-180
Publication date: 2017
Main Research Area: Technical/natural sciences

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Web of Science (2018): Indexed yes
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Scopus rating (2017): SNIP 2.907 SJR 1.977
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 8 SJR 2.155 SNIP 2.757
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.221 SNIP 2.913 CiteScore 7.9
Recovery of lithium from the effluent obtained in the process of spent lithium-ion batteries recycling

A novel process of lithium recovery as lithium ion sieve from the effluent obtained in the process of spent lithium-ion batteries recycling is developed. Through a two-stage precipitation process using Na₂CO₃ and Na₃PO₄ as precipitants, lithium is recovered as raw Li₂CO₃ and pure Li₃PO₄, respectively. Under the best reaction condition (both the amounts of Na₂CO₃ and Li₃PO₄ vs. the theoretical ones are about 1.1), the corresponding recovery rates of lithium (calculated based on the concentration of the previous stage) are 74.72% and 92.21%, respectively. The raw Li₂CO₃ containing the impurity of Na₂CO₃ is used to prepare LiMn₂O₄ as lithium ion sieve, and the tolerant level of sodium on its property is studied through batch tests of adsorption capacity and corrosion resistance. When the weight percentage of Na₂CO₃ in raw Li₂CO₃ is controlled less than 10%, the Mn corrosion percentage of LiMn₂O₄ decreases to 21.07%, and the adsorption capacity can still keep at 40.08 mg g⁻¹. The results reveal that the conventional separation sodium from lithium may be avoided through the application of the raw Li₂CO₃ in the field of lithium ion sieve.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Central South University
Authors: Guo, X. (Ekstern), Cao, X. (Ekstern), Huang, G. (Ekstern), Tian, Q. (Ekstern), Sun, H. (Intern)
Number of pages: 6
Pages: 84-89
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.705 SJR 1.161
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.28 SJR 1.161 SNIP 1.809
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.189 SNIP 1.712 CiteScore 3.86
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.228 SNIP 1.913 CiteScore 3.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.203 SNIP 1.988 CiteScore 3.84
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.354 SNIP 2.51 CiteScore 4.01
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.212 SNIP 2.182 CiteScore 3.66
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.143 SNIP 1.741
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.962 SNIP 1.735
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.759 SNIP 1.344
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.899 SNIP 1.505
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.823 SNIP 1.423
Scopus rating (2005): SJR 0.677 SNIP 1.098
Scopus rating (2004): SJR 0.536 SNIP 1.056
Scopus rating (2003): SJR 0.64 SNIP 0.915
Scopus rating (2002): SJR 0.392 SNIP 0.817
Scopus rating (2001): SJR 0.473 SNIP 0.92
Scopus rating (2000): SJR 0.447 SNIP 0.956
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Original language: English
Adsorption capacity, Lithium ion sieve, Lithium manganese oxide, Lithium recovery, Spent lithium ion batteries

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Source: FindIt
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Regeneration of phase unlocked serial multiplexed DPSK signals in a single phase sensitive amplifier

We demonstrate phase-regeneration of phase unlocked OTDM-DPSK serial signals in a single phase sensitive amplifier through optical cross-phase modulation. The BER of an 8×10 Gbit/s OTDM-DPSK signal is improved by 2 orders of magnitude.

General information
State: Published
Organisations: Department of Photonics Engineering, High-Speed Optical Communication, Centre of Excellence for Silicon Photonics for Optical Communications, Department of Micro- and Nanotechnology
Authors: Guan, P. (Intern), Da Ros, F. (Intern), Kjøller, N. (Intern), Hu, H. (Intern), Røge, K. M. (Intern), Galili, M. (Intern), Morioka, T. (Intern), Oxenløwe, L. K. (Intern)
Number of pages: 3
Pages: 1-3
Publication date: 2017

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Replication of micro-sized pillars in polypropylene using the extrusion coating process

A recent advancement in nano-pattern replication using roll-to-roll extrusion coating (R2R-EC) shows potential for many biomimetic applications. For further development of the technique a study of the micro-replication regime is carried out. In this study a full and partial replication in polypropylene (PP) of micro-sized pillars has been demonstrated using the extrusion coating process. The replication fidelity of the pillars is investigated in a systematic variation of different process parameters: the line-speed of the rolls, the extruder output, the cooling roll temperature and the pressure on the cooling roll. The parameter making biggest impact on the replication is the temperature of the cooling roll. The micro-sized pillars show replication behavior opposite to what was found previously for the nano-patterns. The larger structures take the time to fill in and replicate best at the lower speeds. In this article a direct comparison of the speed at the same coating thickness is conducted.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Danapak Flexibles A/S
Authors: Okulova, N. (Intern), Johansen, P. (Ekstern), Christensen, L. (Ekstern), Taboryski, R. J. (Intern)
Pages: 54-57
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Microelectronic Engineering
Volume: 176
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Resonant laser printing of structural colors on high-index dielectric metasurfaces

Man-made structural colors, which originate from resonant interactions between visible light and manufactured nanostructures, are emerging as a solution for ink-free color printing. We show that non-iridescent structural colors can be conveniently produced by nanostructures made from high-index dielectric materials. Compared to plasmonic analogs, color surfaces with high-index dielectrics, such as germanium (Ge), have a lower reflectance, yielding a superior color contrast. Taking advantage of band-to-band absorption in Ge, we laser-postprocess Ge color metasurfaces with morphology-dependent resonances. Strong on-resonance energy absorption under pulsed laser irradiation locally elevates the lattice temperature (exceeding 1200 K) in an ultrashort time scale (1 ns). This forms the basis for resonant laser printing, where rapid melting allows for surface energy-driven morphology changes with associated modification of color appearance. Laser-printable high-index dielectric color metasurfaces are scalable to a large area and open a new paradigm for printing and decoration with nonfading and vibrant colors.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Authors: Zhu, X. (Intern), Yan, W. (Intern), Levy, U. (Intern), Mortensen, N. A. (Intern), Kristensen, A. (Intern)
Number of pages: 8
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Journal: Science Advances
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ISSN (Print): 2375-2548
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Web of Science (2016): Indexed yes
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Source: FindIt
Source-ID: 2358425135
Publication: Research - peer-review > Journal article – Annual report year: 2017

Revealing the compact structure of lactic acid bacterial hetero-exopolysaccharides by SAXS and DLS

Molecular structures of exopolysaccharides are required to understand their functions and the relationships between the structure and physical and rheological properties. Small-angle X-ray scattering and dynamic light scattering were used in conjunction with molecular modeling to characterize solution structures of three lactic acid bacterial hetero-exopolysaccharides (HePS-1, HePS-2 and HePS-3). Values of radius of gyration $R_G$, cross-sectional radius of gyration $R_{XS}$, approximate length $L$ and hydrodynamic diameter were not directly proportional to the molar mass and indicated the HePSs adopted a compact coil-like rather than an extended conformation. Constrained molecular modeling of 15,000 randomised HePS-1 conformers resulted in five best-fit structures with $R$ factor of 3.94.6% revealing random coil-like structure. $\Phi$ and $\Psi$ angle analysis of glycosidic linkages in HePS-1 structures suggests Galf residues significantly influence the conformation. Ab initio scattering modeling of HePS-2 and HePS-3 gave excellent curve fittings with $\chi^2$ of 0.43 and 0.34 for best-fit models, respectively, compatible with coil-like conformation. The findings disclose solution behaviour of HePS relevant for their interactions with biomacromolecules e.g. milk proteins.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Department of Biotechnology and Biomedicine, Enzyme and Protein Chemistry, Department of Chemistry, X-ray Crystallography, Agriculture and Agri-Food Canada, University of Copenhagen
Authors: Khan, S. (Intern), Birch, J. (Intern), Harris, P. (Intern), Van Calsteren, M. (Ekstern), Ipsen, R. (Ekstern), Peters, G. H. (Intern), Svensson, B. (Intern), Almdal, K. (Intern)
Pages: 747-757
Publication date: 2017
Main Research Area: Technical/natural sciences
Reversible hysteresis inversion in MoS$_2$ field effect transistors

The origin of threshold voltage instability with gate voltage in MoS$_2$ transistors is poorly understood but critical for device reliability and performance. Reversibility of the temperature dependence of hysteresis and its inversion with temperature in MoS$_2$ transistors has not been demonstrated. In this work, we delineate two independent mechanisms responsible for thermally assisted hysteresis inversion in gate transfer characteristics of contact-resistance-independent multilayer MoS$_2$ transistors. Variable temperature hysteresis measurements were performed on gated four-terminal van der Pauw and two-terminal devices of MoS$_2$ on SiO$_2$. Additional hysteresis measurements on suspended (~100 nm air gap between MoS$_2$ and SiO$_2$) transistors and under different ambient conditions (vacuum/nitrogen) were used to further isolate the mechanisms. Clockwise hysteresis at room temperature (300 K) that decreases with increasing temperature is shown to result from intrinsic defects/traps in MoS$_2$. At higher temperatures a second, independent mechanism of charge trapping and de-trapping between the oxide and p$^+$ Si gate leads to hysteresis collapse at ~350 K and anti-clockwise hysteresis (inversion) for temperatures >350 K. The intrinsic-oxide trap model has been corroborated through device simulations. Further, pulsed current–voltage (I–V) measurements were carried out to extract the trap time constants at different temperatures. Non-volatile memory and temperature sensor applications exploiting temperature dependent hysteresis inversion and its reversibility in MoS$_2$ transistors have also been demonstrated.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, Indian Institute of Technology, Bombay
Authors: Kaushik, N. (Ekstern), Mackenzie, D. M. A. (Intern), Thakar, K. (Ekstern), Goyal, N. (Ekstern), Mukherjee, B. (Ekstern), Bøggild, P. (Intern), Petersen, D. H. (Intern), Lodha, S. (Ekstern)
Number of pages: 9
Publication date: 2017
Main Research Area: Technical/natural sciences

Revisiting the use of sPLA$_2$-sensitive liposomes in cancer therapy

The first developed secretory phospholipase A$_2$ (sPLA$_2$) sensitive liposomal cisplatin formulation (LiPlaCis®) is currently undergoing clinical evaluation. In the present study we revisit and evaluate critical preclinical parameters important for the therapeutic potential and safety of platinum drugs, here oxaliplatin (L-OHP), formulated in sPLA$_2$ sensitive liposomes. We show the mole percentage of negatively charged phospholipid needed to obtain enzyme-sensitivity for saturated systems is ≥ 25% for 16-carbon chain lipid membranes, and > 40% for 18-chain lipid membranes, which was surprising as 25% is used clinically in LiPlaCis®. Efficient sPLA$_2$-dependent growth inhibition of colorectal cancer cells was demonstrated in vitro, where cell membrane degradation and cytolysis depends on the sensitivity of the formulation towards the enzyme and is governed by the amount of lysolipids generated and the presence of serum proteins. We found that serum proteins did not affect the lipase activity of the enzyme towards the membranes but instead sequester the lysolipid byproducts consequently inhibiting their detergent-like cytotoxic properties. In vivo therapeutic potential and safety of the liposomes was investigated in nude mice bearing sPLA$_2$-deficient FaDu squamous carcinoma and sPLA$_2$-expressing Colo205 colorectal adenocarcinoma. After intravenous injections, the tumor growth was suppressed for liposomal L-OHP relative to free drug, but only a weak response was observed for both slow- and fast-releasing sPLA$_2$-sensitive formulations compared to non-sensitive liposomes. Also, the mice did not show longer survival. In turn, for the highly sPLA$_2$-sensitive liposomes, multiple high doses caused petechial cutaneous hemorrhages, along with multifocal hepatonecrotic lesions, suggestive of premature activation in skin and liver irrespective of sPLA$_2$-status of the tumor engraft. These results
indicate that although liposomal carriers can improve the antitumor efficacy of platinum drugs, sPLA₂-triggered release suffers from a narrow therapeutic index and has safety concerns.

**General information**

**State:** Published  
**Organisations:** Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Copenhagen, Universitat Rovira i Virgili  
**Number of pages:** 11  
**Publication date:** 2017  
**Main Research Area:** Technical/natural sciences

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**Volume:** 261  
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BFI (2018): BFI-level 2  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 2  
Scopus rating (2017): SNIP 1.802 SJR 2.684  
Web of Science (2017): Indexed Yes  
BFI (2016): BFI-level 2  
Scopus rating (2016): CiteScore 7.56 SJR 2.463 SNIP 1.85  
BFI (2015): BFI-level 2  
Scopus rating (2015): SJR 2.738 SNIP 2.074 CiteScore 8.11  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 2  
Scopus rating (2014): SJR 2.438 SNIP 2.092 CiteScore 6.86  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 2  
Scopus rating (2013): SJR 2.441 SNIP 2.023 CiteScore 6.31  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 2  
Scopus rating (2012): SJR 2.454 SNIP 2.075 CiteScore 5.84  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 2  
Scopus rating (2011): SJR 2.763 SNIP 2.089 CiteScore 6.33  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 2  
Scopus rating (2010): SJR 3.225 SNIP 2.307  
Web of Science (2010): Indexed yes  
BFI (2009): BFI-level 2  
Scopus rating (2009): SJR 2.922 SNIP 2.033  
Web of Science (2009): Indexed yes  
BFI (2008): BFI-level 2  
Scopus rating (2008): SJR 2.272 SNIP 1.895  
Scopus rating (2007): SJR 2.168 SNIP 1.81  
Web of Science (2007): Indexed yes  
Scopus rating (2006): SJR 1.788 SNIP 1.779  
Scopus rating (2005): SJR 1.57 SNIP 1.826
Robust mapping of electrical properties of graphene from terahertz time-domain spectroscopy with timing jitter correction

We demonstrate a method for reliably determining the electrical properties of graphene including the carrier scattering time and carrier drift mobility from terahertz timedomain spectroscopy measurements (THz-TDS). By comparing transients originating from directly transmitted pulses and the echoes from internal reflections in a substrate, we are able to extract electrical properties irrespective of random time delays between pulses emitted in a THz-TDS setup. If such time delays are not accounted for they can significantly influence the extracted properties of the material. The technique is useful for a robust determination of electrical properties from THz-TDS measurements and is compatible with substrate materials where transients from internal reflections are well-separated in time.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Department of Photonics Engineering, Ultrafast Infrared and Terahertz Science, Center for Nanostructured Graphene, University of Cambridge
Authors: Whelan, P. R. (Intern), Iwaszczuk, K. (Intern), Wang, R. (Ekstern), Hofmann, S. (Ekstern), Bøggild, P. (Intern), Jepsen, P. U. (Intern)
Number of pages: 8
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Optics Express
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.567 SJR 1.519
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.48 SJR 1.532 SNIP 1.544
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.91 SNIP 1.674 CiteScore 3.78
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.313 SNIP 2.124 CiteScore 4.18
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.337 SNIP 2.196 CiteScore 4.38
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Screen-Printed All-Polymer Aptasensor for Impedance Based Detection of Influenza A Virus

In this chapter a detailed description of the fabrication and testing of an aptasensor for influenza A virus detection is given. The sensor chip is an all-polymer chip fabricated with screen-printed poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) electrodes. Chip substrates are made by CO2 laser cutting of Poly(methyl methacrylate) (PMMA) sheets. Influenza A virus specific aptamers are immobilized onto the electrodes by UV cross-linking. Impedance based measurements at a single frequency, measured over time, are used to detect the virus in a buffer solution.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Microsystems for Medical Diagnostics
Authors: Kirkegaard, J. (Intern), Rozlosnik, N. (Intern)
Number of pages: 16
Pages: 55-70
Publication date: 2017
Secretory phospholipase A₂ responsive liposomes exhibit a potent anti-neoplastic effect in vitro, but induce unforeseen severe toxicity in vivo

The clinical use of liposomal drug delivery vehicles is often hindered by insufficient drug release. Here we present the rational design of liposomes optimized for secretory phospholipase A₂ (sPLA₂) triggered drug release, and test their utility in vitro and in vivo. We hypothesized that by adjusting the level of cholesterol in anionic, unsaturated liposomes we could tune the enzyme specificity based on membrane fluidity, thus obtaining liposomes with an improved therapeutic outcome and reduced side effects. Cholesterol is generally important as a component in the membranes of liposome drug delivery systems due to its stabilizing effects in vivo. The incorporation of cholesterol in sPLA₂ sensitive liposomes has not previously been possible due to reduced sPLA₂ activity. However, in the present work we solved this challenge by optimizing membrane fluidity. In vitro release studies revealed enzyme specific drug release. Treatment of two different cancer cell lines with liposomal oxaliplatin revealed efficient growth inhibition compared to that of clinically used stealth liposomes. The in vivo therapeutic effect was evaluated in nude NMRI mice using the sPLA₂ secreting mammary carcinoma cell line MT-3. Three days after first treatment all mice having received the novel sPLA₂ sensitive lipid formulation were euthanized due to severe systemic toxicity. Thus the present study demonstrates that great caution should be implemented when utilizing sPLA₂ sensitive liposomes and that the real utility can only be disclosed in vivo. The present studies have clinical implications, as sPLA₂ sensitive formulations are currently undergoing clinical trials (LiPlaCis®).
Selective removal of heavy metal ions by disulfide linked polymer networks

Heavy metal contaminated surface water is one of the oldest pollution problems, which is critical to ecosystems and human health. We devised disulfide linked polymer networks and employed as a sorbent for removing heavy metal ions from contaminated water. Although the polymer network material has a moderate surface area, it demonstrated cadmium removal efficiency equivalent to highly porous activated carbon while it showed 16 times faster sorption kinetics compared to activated carbon, owing to the high affinity of cadmium towards disulfide and thiol functionality in the polymer network. The metal sorption mechanism on polymer network was studied by sorption kinetics, effect of pH, and metal complexation. We observed that the metal ions—copper, cadmium, and zinc showed high binding affinity in polymer network, even in the presence of competing cations like calcium in water.

General information

State: Published
Organisations: Department of Environmental Engineering, Water Technologies, Department of Micro- and Nanotechnology, Surface Engineering, Korea Advanced Institute of Science and Technology, Northwestern University, Seoul National University, University of Copenhagen
Self-assembly of ordered graphene nanodot arrays

The ability to fabricate nanoscale domains of uniform size in two-dimensional materials could potentially enable new applications in nanoelectronics and the development of innovative metamaterials. However, achieving even minimal control over the growth of two-dimensional lateral heterostructures at such extreme dimensions has proven exceptionally challenging. Here we show the spontaneous formation of ordered arrays of graphene nano-domains (dots), epitaxially embedded in a two-dimensional boron–carbon–nitrogen alloy. These dots exhibit a strikingly uniform size of 1.6 ± 0.2 nm and strong ordering, and the array periodicity can be tuned by adjusting the growth conditions. We explain this behaviour with a model incorporating dot-boundary energy, a moiré-modulated substrate interaction and a long-range repulsion between dots. This new two-dimensional material, which theory predicts to be an ordered composite of uniform-size semiconducting graphene quantum dots laterally integrated within a larger-bandgap matrix, holds promise for novel electronic and optoelectronic properties, with a variety of potential device applications.
Self-assembly of ordered graphene nanodot arrays (vol 8, 47, 2017)
An incorrect version of the Supplementary Information was inadvertently published with this article where the wrong file was included. The HTML has been updated to include the correct version of the Supplementary Information.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, Aarhus University, IBM Thomas J. Watson Research Center, Brookhaven National Laboratory
Authors: Camilli, L. (Intern), Jørgensen, J. H. (Ekstern), Tersoff, J. (Ekstern), Stoot, A. C. (Intern), Balog, R. (Ekstern), Cassidy, A. (Ekstern), Sadowski, J. T. (Ekstern), Bøggild, P. (Intern), Hornekaer, L. (Ekstern)
Number of pages: 1
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 2.912 SJR 6.582
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 11.8 SJR 6.414 SNIP 2.855
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 6.287 SNIP 2.86 CiteScore 11.23
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 6.41 SNIP 3.034 CiteScore 10.77
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 6.206 SNIP 2.797 CiteScore 9.85
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 5.866 SNIP 2.829 CiteScore 8.32
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 3.137 SNIP 1.825 CiteScore 4.44
ISI indexed (2011): ISI indexed no
Sequence-specific validation of LAMP amplicons in real-time optomagnetic detection of Dengue serotype 2 synthetic DNA

We report on an optomagnetic technique optimised for real-time molecular detection of Dengue fever virus under ideal as well as non-ideal laboratory conditions using two different detection approaches. The first approach is based on the detection of the hydrodynamic volume of streptavidin coated magnetic nanoparticles attached to biotinylated LAMP amplicons. We demonstrate detection of sub-femtomolar Dengue DNA target concentrations in the ideal contamination-free lab environment within 20 min. The second detection approach is based on sequence-specific binding of functionalised magnetic nanoparticles to loops of LAMP amplicons. Melting studies reveal that true positive and spurious amplicons have different melting points and this allows us to discriminate between them. This is found to be in a good agreement with subsequent studies on real-time sequence-specific discrimination of LAMP amplicons. The specific binding causes clustering of magnetic nanoparticles via binding to multiple sites (loops) emerging in the elongation phase of LAMP. Formation of nanoclusters is monitored via the depletion of the optomagnetic signal due to free nanoparticles. After sequence-specific validation, we claim detection of down to 100 fm of Dengue target after 20 min of LAMP with a contamination background.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, BluSense Diagnostics, Uppsala University
Authors: Minero, G. K. A. (Intern), Nogueira, C. (Ekstern), Rizzi, G. (Intern), Tian, B. (Ekstern), Fock, J. (Intern), Donolato, M. (Ekstern), Strömberg, M. (Ekstern), Hansen, M. F. (Intern)
Pages: 3441–3450
Publication date: 2017
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
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BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.92
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.07
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.1
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 4.11
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.88
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
SERS detection of the biomarker hydrogen cyanide from Pseudomonas aeruginosa cultures isolated from cystic fibrosis patients

Pseudomonas aeruginosa is the primary cause of chronic airway infections in cystic fibrosis (CF) patients. Persistent infections are seen from the first P. aeruginosa culture in about 75% of young CF patients, and it is important to discover new ways to detect P. aeruginosa at an earlier stage. The P. aeruginosa biomarker hydrogen cyanide (HCN) contains a triple bond, which is utilized in this study because of the resulting characteristic C≡N peak at 2135 cm⁻¹ in a Raman spectrum. The Raman signal was enhanced by surface-enhanced Raman spectroscopy (SERS) on a Au-coated SERS substrate. After long-term infection, a mutation in the patho-adaptive lasR gene can alter the expression of HCN, which is why it is sometimes not possible to detect HCN in the breath of chronically infected patients. Four P. aeruginosa reference strains and 12 clinical P. aeruginosa strains isolated from CF children were evaluated, and HCN was clearly detected from overnight cultures of all wild type-like isolates and half of the later isolates from the same patients. The clinical impact could be that P. aeruginosa infections could be detected at an earlier stage, because daily breath sampling with an immediate output could be possible with a point-of-care SERS device.
SERS spectroscopy for detection of hydrogen cyanide in breath from children colonised with P. aeruginosa

There is a need for a fast and non-invasive tool to detect Pseudomonas aeruginosa airway colonisation in cystic fibrosis (CF) patients unable to expectorate. Fifty CF children and 19 controls aged 5–17 years were included in the feasibility study. A surface-enhanced Raman spectroscopy (SERS) nanochip optimised for detection of trace amounts of the P. aeruginosa biomarker hydrogen cyanide (HCN) was mounted inside a Tedlar bag, which the patient breathed into. The SERS chip was then analysed in a Raman spectrometer, investigating the C≡N peak at 2131 cm⁻¹ and correlated with sputum cultures. One new P. aeruginosa colonisation occurred during the trial period. The C≡N peak intensity was enhanced in this sample in contrast to the subject’s 3 other samples. Three additional patients had intense C≡N SERS signals from their breath, but no P. aeruginosa was cultured from their sputum. It is concluded that SERS spectroscopy can be developed into an easy to use hypersensitive clinical prescreening method for detection of HCN in human breath.
Shape anisotropy enhanced optomagnetic measurement for prostate-specific antigen detection via magnetic chain formation

We demonstrate a homogeneous biosensor for the detection of multivalent targets by combination of magnetic nanoparticle (MNP) chains and a low-cost 405 nm laser-based optomagnetic system. The MNP chains are assembled in a rotating magnetic field and stabilized by multivalent target molecules. The number of chains remaining in zero field is proportional to the target concentration, and can be quantified by optomagnetic measurements. The shape anisotropy of the MNP chains enhances the biosensor system in terms of providing efficient mixing, reduction of depletion effects (via magnetic shape anisotropy), and directly increasing the optomagnetic signal (via optical shape anisotropy). We achieve a limit of detection (LOD) of 5.5 pM (0.82 ng/mL) for the detection of a model multivalent molecule, biotinylated anti-streptavidin, in PBS. For the measurements of prostate-specific antigen (PSA) in 50% serum using the proposed method, we achieve an LOD of 21.6 pM (0.65 ng/mL) and a dynamic detection range up to 66.7 nM (2 µg/mL) with a sample-to-result time of approximately 20 min. The performance for PSA detection therefore well meets the clinical requirements in terms of LOD (the threshold PSA level in blood is 4 ng/mL) and detection range (PSA levels span from <0.1–10⁴ ng/mL in blood), thus showing great promise for routine PSA diagnostics and for other in-situ applications.
Brownian relaxation, Magnetic chains, Magnetic nanoparticles, Optomagnetic biosensor, Prostate-specific antigen, Rotating magnetic field

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Sheet-Resistance Measurements in Nanometer-Wide Conductive Lines

General information
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Simulating CMUT Arrays Using Time Domain FEA

PZFlex is a commercial FEA software that has been optimized for the ultrasound industry and is commonly used to design piezoelectric ultrasound transducers. However, PZFlex is not commonly used within the CMUT research field. Nevertheless, it has an explicit modeling approach allowing large structures like CMUT arrays to be modeled and its transient analysis intrinsically supplies non-linear and broadband results from a single run. A 3-D model of a CMUT array is developed with multiple cells in each element and one active element surrounded by N passive elements. It is demonstrated that the electro-mechanics can precisely be predicted, within 3%, including the pull-in voltage and the spring softening effect. The transmit impulse response is simulated by deconvolving the extrapolated pressure with the excitation pulse, and it is in excellent agreement with the measured. It is shown that the impulse response can directly be used in Field II to assess the image quality of the transducer using the lateral, axial and cystic resolution for two different CMUT designs.

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Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering, PZFlex, PZFlex
Authors: Engholm, M. (Intern), Tweedie, A. (Ekstern), Jensen, J. (Intern), Harvey, G. (Ekstern), Diederichsen, S. E. (Intern), Jensen, J. A. (Intern), Thomsen, E. V. (Intern)
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Simulation of charge transport in organic semiconductors: A time-dependent multiscale method based on nonequilibrium Green's functions

In weakly interacting organic semiconductors, static disorder and dynamic disorder often have an important impact on transport properties. Describing charge transport in these systems requires an approach that correctly takes structural and electronic fluctuations into account. Here, we present a multiscale method based on a combination of molecular-dynamics simulations, electronic-structure calculations, and a transport theory that uses time-dependent nonequilibrium Green's functions. We apply the methodology to investigate charge transport in C-60-containing self-assembled monolayers, which are used in organic field-effect transistors.

General information
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Simulations of Pattern replication during Extrusion coating process

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Simultaneous modulation of surface composition, oxygen vacancies and assembly in hierarchical Co$_3$O$_4$ mesoporous nanostructures for lithium storage and electrocatalytic oxygen evolution

We developed a facile solution reductive method to simultaneously tune the surface composition, oxygen vacancies and three dimensional assembly in Co$_3$O$_4$ hierarchical nanostructures. The controllable surface composition, oxygen vacancies together with hierarchical micro/nanoarchitectures resulted in superior electrochemical properties when used as the anode materials for lithium-ion batteries and as an electrocatalyst for the oxygen evolution reaction. The excellent electrochemical performance is attributed to the synergistic effects of novel hierarchical morphology, crystal structure of the active materials, the improvement of intrinsic conductivity and inner surface area induced by the oxygen vacancies. The present strategy not only provides a facile method to assemble novel hierarchical architectures, but also paves a way to control surface structures (chemical composition and crystal defects) in other transition-metal compounds, and thus will hold great promise in the fields of energy storage and conversion.

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Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Department of Chemistry, NanoChemistry, Organic Chemistry, Boston College
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Simultaneous Profiling of DNA Mutation and Methylation by Melting Analysis Using Magnetoresistive Biosensor Array

Epigenetic modifications, in particular DNA methylation, are gaining increasing interest as complementary information to DNA mutations for cancer diagnostics and prognostics. We introduce a method to simultaneously profile DNA mutation and methylation events for an array of sites with single site specificity. Genomic (mutation) or bisulphite-treated (methylation) DNA is amplified using nondiscriminatory primers, and the amplicons are then hybridized to a giant magnetoresistive (GMR) biosensor array followed by melting curve measurements. The GMR biosensor platform offers scalable multiplexed detection of DNA hybridization, which is insensitive to temperature variation. The melting curve approach further enhances the assay specificity and tolerance to variations in probe length. We demonstrate the utility of this method by simultaneously profiling five mutation and four methylation sites in human melanoma cell lines. The method correctly identified all mutation and methylation events and further provided quantitative assessment of methylation density validated by bisulphite pyrosequencing.

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Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Fluidic Array Systems and Technology, Ewha Womans University, Stanford University, Danish Cancer Society
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Single step fabrication and loading of biopolymer microcontainers for oral drug delivery

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Organisations: Department of Micro- and Nanotechnology, Nanoprobes
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Solid-phase PCR for rapid multiplex detection of Salmonella spp. at the subspecies level, with amplification efficiency comparable to conventional PCR

Solid-phase PCR (SP-PCR) has attracted considerable interest in different research fields since it allows parallel DNA amplification on the surface of a solid substrate. However, the applications of SP-PCR have been hampered by the low efficiency of the solid-phase amplification. In order to increase the yield of the solid-phase amplification, we studied various parameters including the length, the density, as well as the annealing position of the solid support primer. A dramatic increase in the signal-to-noise (S/N) ratio was observed when increasing the length of solid support primers from 45 to 80 bp. The density of the primer on the surface was found to be important for the S/N ratio of the SP-PCR, and the optimal S/N was obtained with a density of 1.49 × 10¹¹ molecules/mm². In addition, the use of solid support primers with a short overhang at the 5’ end would help improve the S/N ratio of the SP-PCR. With optimized conditions, SP-PCR can achieve amplification efficiency comparable to conventional PCR, with a limit of detection of 1.5 copies/μl (37.5 copies/reaction). These improvements will pave the way for wider applications of SP-PCR in various fields such as clinical diagnosis, high-throughput DNA sequencing, and single-nucleotide polymorphism analysis.

Graphical abstract

Schematic representation of solid-phase PCR.
Spatial Control of Condensation on Chemically Homogeneous Pillar-Built Surfaces

The random nature of dropwise condensation impedes spatial control hereof and its use for creating microdroplet arrays, yet here we demonstrate the spatial control of dropwise condensation on a chemically homogeneous pillar array surface, yielding ~8000 droplets/mm² under normal atmospheric pressure conditions. The studied pillar array surface is defined by photolithography and etched in silicon by deep reactive ion etching. Subsequently, the surface is covered with a self-assembled monolayer of perfluorodecyltrichlorosilane (FDTS) to render the surface hydrophobic. To obtain a perfect droplet array, with one droplet per pillar, we exploit a phenomenon where the water vapor flux is focused on the apexes of surface asperities by diffusion while matching the nucleation point density to the array dimensions. Matching is here achieved through the variation of interpillar distance and vapor flow conditions.
Spin-Caloritronic Batteries

The thermoelectric performance of a topological energy converter is analyzed. The H-shaped device is based on a combination of transverse topological effects involving the spin: the inverse spin Hall effect and the spin Nernst effect. The device can convert a temperature drop in one arm into an electric power output in the other arm. Analytical expressions for the output voltage, the figure of merit (ZT), and energy-converting efficiency are reported. We show that the output voltage and the ZT can be tuned by the geometry of the device and the physical properties of the material. Importantly, contrary to a conventional thermoelectric device, here a low electric conductivity may, in fact, enhance the ZT value, thereby opening a path to strategies in optimizing the figure of merit.
Spray-coated Cu2ZnSnS4 thin films for large-scale photovoltaic applications

The kesterite material, Cu2ZnSnS4 (CZTS), has in the preceding ten years been investigated and developed as a new Earth-abundant material for solar cells. The interest in this inorganic semiconductor originates in its optimal energy band gap of approx. 1.5 eV, high absorption coefficient, and the high material abundance and low toxicity of all elements included. The current challenges are related to unavoidable antisite disordering stemming from the chemical similarity of the cations, which causes bulk defects and lowers the open-circuit voltage detrimentally. This, however, did not restrict the "cousin"-material, CuInGaSe2 (CIGS), which is currently one of the main thin-film photovoltaic (PV) technologies on the market. In this work, CZTS thin films have been fabricated by solution-processing, which allows relatively fast and inexpensive deposition when compared to vacuum-processed films. The nanoparticles are synthesized by the hot-injection method by mixing targeted ratios of metal salts with sulfur in diethylene glycol, resulting in a phase-pure CZTS material [1]. Inks are formulated by dispersing the particles in ethanol and water using a suitable dispersing agent. The solvents used allow that alkali metal chloride salts can also be dissolved in controllable amounts, which we have found enhances grain growth in the films during the subsequent annealing step. A Sono-tek spray-coating system with ultrasonic atomization is used. We investigate the effect of ink concentration, and spray-coating conditions, including spray power, flow rate from syringe pump, and time between consecutive spray layers. The films are annealed in a tube furnace, and to avoid decomposing the material into secondary phases, a graphite box is used to enable an overpressure of sulfur and tin-sulfide. The annealed, spray-coated films are characterized by scanning electron microscopy (SEM), optical microscopy, and Dektak profilometry.
Stat-6 signaling pathway and not Interleukin-1 mediates multi-walled carbon nanotube-induced lung fibrosis in mice: insights from an adverse outcome pathway framework

Background: The accumulation of MWCNTs in the lung environment leads to inflammation and the development of disease similar to pulmonary fibrosis in rodents. Adverse Outcome Pathways (AOPs) are a framework for defining and organizing the key events that comprise the biological changes leading to undesirable events. A putative AOP has been developed describing MWCNT-induced pulmonary fibrosis; inflammation and the subsequent healing response induced by inflammatory mechanisms have been implicated in disease progression. The objective of the present study was to address a key data gap in this AOP: empirical data supporting the essentiality of pulmonary inflammation as a key event prior to fibrosis. Specifically, Interleukin-1 Receptor1 (IL-1R1) and Signal Transducer and Activator of Transcription 6 (STAT6) knock-out (KO) mice were employed to target inflammation and the subsequent healing response using MWCNTs as a model pro-fibrotic stressor to determine whether this altered the development of fibrosis. Results: Wild type (WT) C57BL/6, IL-1R1 (KO) or STAT6 KO mice were exposed to a high dose of Mitsui-7 MWCNT by intratracheal administration. Inflammation was assessed 24 h and 28 days post MWCNT administration, and fibrotic lesion development was assessed 28 days post MWCNT administration. MWCNT-induced acute inflammation was suppressed in IL-1R1 KO mice at the 24 h time point relative to WT mice, but this suppression was not observed 28 days post exposure, and IL-1R1 KO did not alter fibrotic disease development. In contrast, STAT6 KO mice exhibited suppressed acute inflammation and attenuated fibrotic disease in response to MWCNT administration compared to STAT6 WT mice. Whole genome analysis of all post-exposure time points identified a subset of differentially expressed genes associated with fibrosis in both KO mice compared to WT mice.Conclusion: The findings support the essentiality of STAT6-mediated signaling in the development of MWCNT-induced fibrotic disease. The IL-1R1 KO results also highlight the nature of the inflammatory response associated with MWCNT exposure, and indicate a system with multiple redundancies. These data add to the evidence supporting an existing AOP, and will be useful in designing screening strategies that could be used by regulatory agencies to distinguish between MWCNTs of varying toxicity.
Stereolithographic 3D Printing of Hydrogels Using Light-controlled Radical Polymerization
Stereolithographic hydrogel printing of 3D culture chips with biofunctionalized complex 3D perfusion networks

Three-dimensional (3D) in vitro models capturing both the structural and dynamic complexity of the in vivo situation are in great demand as an alternative to animal models. Despite tremendous progress in engineering complex tissue/organ models in the past decade, approaches that support the required freedom in design, detail and chemistry for fabricating truly 3D constructs have remained limited. Here, we report a stereolithographic high-resolution 3D printing technique utilizing poly(ethylene glycol) diacrylate (PEGDA, MW 700) to manufacture diffusion-open and mechanically stable hydrogel constructs as self-contained chips, where confined culture volumes are traversed and surrounded by perfusable vascular-like networks. An optimized resin formulation enables printing of hydrogel chips holding perfusable microchannels with a cross-section as small as 100 μm × 100 μm, and the printed microchannels can be steadily perfused for at least one week. In addition, the integration of multiple independently perfusable and structurally stable channel systems further allows for easy combination of different bulk material volumes at exact relative spatial positions. We demonstrate this structural and material flexibility by embedding a highly compliant cell-laden gelatin hydrogel within the confines of a 3D printed resilient PEGDA hydrogel chip of intermediate compliance. Overall, our proposed strategy represents an automated, cost-effective and high resolution technique to manufacture complex 3D constructs containing microfluidic perfusion networks for advanced in vitro models.
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Scopus rating (2010): SJR 2.718 SNIP 1.876
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BFI (2009): BFI-level 2
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Scopus rating (2008): SJR 2.833 SNIP 1.849
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Scopus rating (2006): SJR 2.564 SNIP 1.61
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Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.962 SNIP 1.823
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**Stereolithographic hydrogel printing of 3D microfluidic cell culture chips**

Three-dimensional (3D) in vitro cell culture models capturing both the structural and dynamic complexity of the in vivo situation are in great demand as an alternative to animal models. Despite tremendous progress in engineering complex tissue/organ models in the past decade, approaches that support the required freedom in design, detail and chemistry for fabricating truly 3D constructs have remained limited. Here, we report a stereolithographic high-resolution 3D printing technique utilizing poly(ethylene glycol) diacrylate (PEGDA, MW 700) to manufacture diffusion-open and mechanically stable hydrogel constructs as self-contained chips, where confined culture volumes are supplied with oxygen and nutrients by perfusable vascular-like networks. An optimized resin formulation enables printing of hydrogel chips with perfusable multi-furcated microchannel networks, and the printed microchannels can be steadily perfused for at least one week. In addition, the integration of multiple independently perfusable and structurally stable channel systems further allows for easy combination of different bulk material volumes at exact relative spatial positions. We demonstrate this structural and material flexibility by embedding a highly compliant cell-laden gelatin hydrogel within the confines of a 3D printed resilient PEGDA hydrogel chip of intermediate compliance. Overall, our proposed strategy represents an automated, cost-effective and high resolution technique to manufacture complex 3D constructs containing microfluidic perfusion networks as advanced in vitro models for various biomedical applications such as drug development and in vitro disease modeling. Multi-material stereolithographic printing based on epoxy and acrylate has also been demonstrated. Perfusion chips composed of a stiff epoxy component as structural supports interfacing the external world as well as compliant PEGDA component as microfluidic channels have been manufactured and perfused. Although still in the preliminary stage, this dual-material printing approach shows the potential for constructing complex 3D structures with heterogeneous components fulfilling different purposes.
Strategies for stable water splitting via protected photoelectrodes

Photoelectrochemical (PEC) solar-fuel conversion is a promising approach to provide clean and storable fuel (e.g., hydrogen and methanol) directly from sunlight, water and CO₂. However, major challenges still have to be overcome before commercialization can be achieved. One of the largest barriers to overcome is to achieve a stable PEC reaction in either strongly basic or acidic electrolytes without degradation of the semiconductor photoelectrodes. In this work, we discuss fundamental aspects of protection strategies for achieving stable solid/liquid interfaces. We then analyse the charge transfer photocathodes. In addition, we review protection layer approaches and their stabilities for a wide variety of experimental photoelectrodes for water reduction. Finally, we discuss key aspects which should be addressed in continued work on realizing stable and practical PEC solar water splitting systems.
Strong paramagnon scattering in single atom Pd contacts

Among all transition metals, palladium (Pd) has the highest density of states at the Fermi energy at low temperatures yet does not fulfill the Stoner criterion for ferromagnetism. However, close proximity to magnetism renders it a nearly ferromagnetic metal, which hosts paramagnons, strongly damped spin fluctuations. Here we compare the total and the differential conductance of monoatomic contacts consisting of single Pd and cobalt (Co) atoms between Pd electrodes. Transport measurements reveal a conductance for Co of 1G(0), while for Pd we obtain 2G(0). The differential conductance of monoatomic Pd contacts shows a reduction with increasing bias, which gives rise to a peculiar Lambda-shaped spectrum. Supported by theoretical calculations, we correlate this finding with the lifetime of hot quasiparticles in Pd, which is strongly influenced by paramagnon scattering. In contrast to this, Co adatoms locally induce magnetic order, and transport through single cobalt atoms remains unaffected by paramagnon scattering, consistent with theory.

General information

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Number of pages: 5
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Strong Plasmon-Phonon Splitting and Hybridization in 2D Materials Revealed through a Self-Energy Approach

We reveal new aspects of the interaction between plasmons and phonons in 2D materials that go beyond a mere shift and increase in plasmon width due to coupling to either intrinsic vibrational modes of the material or phonons in a supporting substrate. More precisely, we predict strong plasmon splitting due to this coupling, resulting in a characteristic avoided crossing scheme. We base our results on a computationally efficient approach consisting in including many-body interactions through the electron self-energy. We specify this formalism for a description of plasmons based upon a tight-binding electron Hamiltonian combined with the random-phase approximation. This approach is valid provided vertex corrections can be neglected, as is the case in conventional plasmon-supporting metals and Dirac-Fermion systems. We illustrate our method by evaluating plasmonic spectra of doped graphene nanotriangles with varied size, where we predict remarkable peak splittings and other radical modifications in the spectra due to plasmon interactions with intrinsic optical phonons. Our method is equally applicable to other 2D materials and provides a simple approach for investigating coupling of plasmons to phonons, excitons, and other excitations in hybrid thin nanostructures.
Structural Transformations in Two-Dimensional Transition-Metal Dichalcogenide MoS$_2$ under an Electron Beam: Insights from First-Principles Calculations

The polymorphism of two-dimensional (w2D) transition-metal dichalcogenides (TMDs) and different electronic properties of the polymorphs make TMDs particularly promising materials in the context of applications in electronics. Recently, local transformations from the semiconducting trigonal prismatic H phase to the metallic octahedral T phase in 2D MoS$_2$ have been induced by electron irradiation [Nat. Nanotech. 2014, 9, 391], but the mechanism of the transformations remains elusive. Using density functional theory calculations, we study the energetics of the stable and metastable phases of 2D MoS$_2$ when additional charge, mechanical strain, and vacancies are present. We also investigate the role of finite temperatures, which appear to be critical for the transformations. On the basis of the results of our calculations, we propose an explanation for the beam-induced transformations, which are likely promoted by charge redistribution in the monolayer due to electronic excitations combined with formation of vacancies under electron beam and buildup of the associated mechanical strain in the sample. As this mechanism should be relevant to other 2D TMDs, our results provide hints for further development and optimization of electron-beam-mediated engineering of the atomic structure and electronic properties of 2D TMDs with subnanometer resolution.

General information
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Sulfide perovskites for solar energy conversion applications: computational screening and synthesis of the selected compound LaYS₃

One of the key challenges in photoelectrochemical water splitting is to identify efficient semiconductors with band gaps of the order of ~2 eV to operate as the large-band-gap component in water splitting tandem devices. Here, we address this challenge by extensive computational screening of ternary sulfides followed by synthesis and confirmation of the properties of one of the most promising materials. The screening focuses on materials with ABS₃ composition taking both perovskite and non-perovskite structures into consideration, and the material selection is based on descriptors for thermodynamic stability, light absorption, charge mobility, and defect tolerance. One of the most promising candidates identified is LaYS₃. This material was synthesized directly in thin-film form demonstrating its stability, crystal structure, light absorption, and strong photoluminescence. These data confirms its potential applicability in tandem photoelectrochemical devices for hydrogen production.

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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Within the field of nanoparticle-assisted photothermal cancer therapy, focus has mostly been on developing novel heat-generating nanoparticles with the right optical and dimensional properties. Comparison and evaluation of their performance in tumor-bearing animals are commonly assessed by changes in tumor volume; however, this is usually a late-occurring event. This study implements 2-deoxy-2-[F-18]fluoro-D-glucose positron emission tomography imaging to perform early evaluation of the treatment outcome of photothermal therapy. Silica-gold nanoshells (NS) are administered intravenously to nude mice bearing human neuroendocrine tumor xenografts and the tumors are irradiated by a near-infrared laser. The animals are positron emission tomography scanned with 2-deoxy-2-[F-18]fluoro-D-glucose one day before and one day after treatment. Using this setup, a significant decrease in tumor uptake of 2-deoxy-2-[F-18]fluoro-D-glucose is found already one day after therapy in the group receiving NS and laser treatment compared to control animals. At this time point no change in tumor volume can be detected. Moreover, the change in tumor uptake, is used to stratify the animals into responders and non-responders, where the responding group matched improved survival. Overall, these findings support the use of 2-deoxy-2-[F-18]fluoro-D-glucose positron emission tomography imaging for preclinical and clinical evaluation and optimization of photothermal therapy.
Superhydrophobic hierarchical structures produced with extrusion coating

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Department of Mechanical Engineering
Authors: Okulova, N. (Intern), Okulov, V. (Intern), Taboryski, R. J. (Intern)
Publication date: 2017
Main Research Area: Technical/natural sciences
Superhydrophobic, Extrusion coating, Droplet impact, Hierarchical structure
Electronic versions:
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DOIs: 10.1371/journal.pone.0177997
Source: FindIt
Source-ID: 2370663911
Publication: Research - peer-review › Journal article – Annual report year: 2017

Superhydrophobic hierarchical structures produced with extrusion coating

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Department of Mechanical Engineering
Authors: Okulova, N. (Intern), Okulov, V. (Intern), Taboryski, R. J. (Intern)
Publication date: 2017
Main Research Area: Technical/natural sciences
Superhydrophobic, Extrusion coating, Droplet impact, Hierarchical structure
Electronic versions:
Electronic versions: journal.pone.0177997.pdf
DOIs: 10.1371/journal.pone.0177997
Source: FindIt
Source-ID: 2370663911
Publication: Research - peer-review › Journal article – Annual report year: 2017
**Suppression of intrinsic roughness in encapsulated graphene**

Roughness in graphene is known to contribute to scattering effects which lower carrier mobility. Encapsulating graphene in hexagonal boron nitride (hBN) leads to a significant reduction in roughness and has become the de facto standard method for producing high-quality graphene devices. We have fabricated graphene samples encapsulated by hBN that are suspended over apertures in a substrate and used noncontact electron diffraction measurements in a transmission electron microscope to measure the roughness of encapsulated graphene inside such structures. We furthermore compare the roughness of these samples to suspended bare graphene and suspended graphene on hBN. The suspended heterostructures display a root mean square (rms) roughness down to 12 pm, considerably less than that previously reported for both suspended graphene and graphene on any substrate and identical within experimental error to the rms vibrational amplitudes of carbon atoms in bulk graphite. Our first-principles calculations of the phonon bands in graphene/hBN heterostructures show that the flexural acoustic phonon mode is localized predominantly in the hBN layer. Consequently, the flexural displacement of the atoms in the graphene layer is strongly suppressed when it is supported by hBN, and this effect increases when graphene is fully encapsulated.

**General information**

State: Published

Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Theoretical Nanoelectronics, Center for Nanostructured Graphene, National Institute for Materials Science

Authors: Thomsen, J. D. (Intern), Gunst, T. (Intern), Gregersen, S. S. (Ekstern), Gammelgaard, L. (Intern), Jessen, B. S. (Intern), Mackenzie, D. (Intern), Watanabe, K. (Ekstern), Taniguchi, T. (Ekstern), Bøggild, P. (Intern), Booth, T. (Intern)

Number of pages: 10

Publication date: 2017

Main Research Area: Technical/natural sciences

**Publication information**


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ISSN (Print): 1098-0121

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Web of Science (2018): Indexed yes

BFI (2017): BFI-level 2

Scopus rating (2017): SJR 1.604 SNIP 1.04

Web of Science (2017): Indexed yes

Scopus rating (2016): CiteScore 3.16 SJR 2.339 SNIP 1.151

Web of Science (2016): Indexed yes

Scopus rating (2015): SJR 2.377 SNIP 1.13 CiteScore 2.8

Web of Science (2015): Indexed yes

Scopus rating (2014): SJR 2.762 SNIP 1.316 CiteScore 3.3

Web of Science (2014): Indexed yes

Scopus rating (2013): SJR 2.813 SNIP 1.326 CiteScore 3.55

ISI indexed (2013): ISI indexed yes

Web of Science (2013): Indexed yes

Scopus rating (2012): SJR 3.173 SNIP 1.378 CiteScore 3.57

ISI indexed (2012): ISI indexed yes

Web of Science (2012): Indexed yes

Scopus rating (2011): SJR 3.326 SNIP 1.423 CiteScore 3.61

ISI indexed (2011): ISI indexed yes

Web of Science (2011): Indexed yes

Scopus rating (2010): SJR 3.318 SNIP 1.447

Web of Science (2010): Indexed yes


Web of Science (2009): Indexed yes

Scopus rating (2008): SJR 2.923 SNIP 1.516

Web of Science (2008): Indexed yes

Scopus rating (2007): SJR 2.892 SNIP 1.588
Suppression of Intrinsic Roughness in Suspended van der Waals Heterostructures

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Theoretical Nanoelectronics, Theoretical Nanotechnology, National Institute for Materials Science Tsukuba
Authors: Thomsen, J. D. (Intern), Gunst, T. (Intern), Gregersen, S. S. (Ekstern), Gammelgaard, L. (Intern), Jessen, B. S. (Intern), Mackenzie, D. (Intern), Bøggild, P. (Intern), Tanaguchi, T. (Ekstern), Booth, T. (Intern), Watanabe, K. (Ekstern)
Publication date: 2017
Main Research Area: Technical/natural sciences
Electronic versions:
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DOI:
10.1103/PhysRevB.96.014101

Suppression of Intrinsic Roughness in Suspended van der Waals Heterostructures

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon
Authors: Thomsen, J. D. (Intern)
Publication date: 2017
Event: Abstract from 2017 MRS Spring Meeting, Phoenix, United States.
Main Research Area: Technical/natural sciences
Electronic versions:
2016_MRS_Spring_Phoenix.pdf
Source-ID: 132904765
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017
Surface Enhanced Raman Scattering for Quantification of p-Coumaric Acid Produced by Escherichia coli

The number of newly developed genetic variants of microbial cell factories for production of biochemistry has been rapidly growing in recent years, leading to an increased need for new screening techniques. We developed a method based on surface-enhanced Raman scattering (SERS) coupled with liquid-liquid extraction (LLE) for quantification of p-coumaric acid (pHCA) in the supernatant of genetically engineered Escherichia coli (E. coli) cultures. pHCA was measured in a dynamic range from 1 μM up to 50 μM on highly uniform SERS substrates based on leaning gold-capped nanopillars, which showed an in-wafer signal variation of only 11.7%. LLE using dichloromethane as organic phase was combined with the detection in order to increase selectivity and sensitivity by decreasing the effect of interfering compounds from the analytes of interest. The difference in pHCA production yield between three genetically engineered E. coli strains was successfully evaluated using SERS and confirmed with high-performance liquid chromatography. As this novel approach has potential to be automated and parallelized, it can be considered for high-throughput screening in metabolic engineering.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Novo Nordisk Foundation Center for Biosustainability, Bacterial Cell Factory Optimization, Research Groups, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Morelli, L. (Intern), Zor, K. (Intern), Jendresen, C. B. (Intern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern), Nielsen, A. T. (Intern), Boisen, A. (Intern)
Number of pages: 7
Pages: 3981-3987
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Analytical Chemistry
Volume: 89
ISSN (Print): 0003-2700
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.08
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.79
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.01
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.8
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.86
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Surface passivation and carrier selectivity of the thermal-atomic-layer-deposited TiO$_2$ on crystalline silicon

Here, we demonstrate the use of an ultrathin TiO$_2$ film as a passivating carrier-selective contact for silicon photovoltaics. The effective lifetime, surface recombination velocity, and diode quality dependence on TiO$_2$ deposition temperature with and without a thin tunneling oxide interlayer (SiO$_2$ or Al$_2$O$_3$) on p-type crystalline silicon (c-Si) are reported. 5-, 10-, and 20-nm-thick TiO$_2$ films were deposited by thermal atomic layer deposition (ALD) in the temperature range of 80–300 °C using titanium tetrachloride (TiCl$_4$) and water. TiO$_2$ thin-film passivation layers alone result in a lower effective carrier lifetime compared with that with an interlayer. However, SiO$_2$ and Al$_2$O$_3$ interlayers enhance the TiO$_2$ passivation of c-Si surfaces. Further annealing at 200 °C in N$_2$ gas enhances the surface passivation quality of TiO$_2$ tremendously. From these findings, design principles for TiO$_2$–Si heterojunction with optimized photovoltage, interface quality, and electron extraction to maximize the photovoltage of TiO$_2$–Si heterojunction photovoltaic cells are formulated. Diode behaviour was analysed with the help of experimental, analytical, and simulation methods. It is predicted that TiO$_2$ with a high carrier concentration is a preferable candidate for high-performance solar cells. The possible reasons for performance degradation in those devices with and without interlayers are also discussed.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, DTU Danchip, Freiberg Instruments GmbH, SASTRA
Authors: Plakhotnyuk, M. (Intern), Schüler, N. (Ekstern), Shkondin, E. (Intern), Vijayan, R. A. (Ekstern), Masilamani, S. (Ekstern), Varadharajaperumal, M. (Ekstern), Crovetto, A. (Intern), Hansen, O. (Intern)
Number of pages: 8
Publication date: 2017
Main Research Area: Technical/natural sciences

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Volume: 56
Issue number: 8S2
Article number: 08MA11
ISSN (Print): 0021-4922
Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): SNIP 0.668 SJR 0.497
Web of Science (2017): Indexed Yes
Scopus rating (2016): CiteScore 0.67 SJR 0.497 SNIP 0.768
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 0.426 SNIP 0.682 CiteScore 0.58
Scopus rating (2014): SJR 0.209 SNIP 0.189 CiteScore 0.73
Scopus rating (2013): SJR 0.111 SNIP 0 CiteScore 0.65
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 0.151 SNIP 0.171 CiteScore 0.7
ISI indexed (2012): ISI indexed no
Surface Self-Assembly and Properties of Monolayers Formed by Reverse Poly(butylene oxide)-poly(ethylene oxide)-poly(butylene oxide) Triblock Copolymers with Lengthy Hydrophilic Blocks

The surface behavior and properties of several reverse poly(butylene oxide)-poly(ethylene oxide)-poly(butylene oxide) block copolymers, \( \text{BO}_8\text{EO}_{90}\text{BO}_8 \), \( \text{BO}_{12}\text{EO}_{227}\text{BO}_{12} \), \( \text{BO}_{14}\text{EO}_{378}\text{BO}_{14} \), \( \text{BO}_{20}\text{EO}_{411}\text{BO}_{20} \), and \( \text{BO}_{21}\text{EO}_{385}\text{BO}_{21} \) at the air/water interface have been analyzed by drop tensiometry, Langmuir film balance, and atomic force microscopy (AFM). The kinetic adsorption process of block copolymer chains at the air/water interface is a diffusion-controlled process, at short times. Structural rearrangements of the copolymer backbones are progressively more important as the adsorption carries on. The adsorption layers formed at the interface display evident solid-like behavior in the whole range of frequencies analyzed even at the lowest frequencies used probably as a result of the interconnection between hydrophobic ends of polymeric chains. All the copolymer display adsorption isotherm profiles are composed of four different regions in which the different characteristic regimes ("pancake, mushroom", "brush", and collapsed conformations) are observed. The differences observed between copolymers come from the different block lengths and, hence, hydrophilic to hydrophobic (EO/BO) block ratios. In this regard, it is observed that the shortest copolymer, \( \text{BO}_8\text{EO}_{90}\text{BO}_8 \), having the lowest block ratio, displays the complete adsorption profile at much lower areas per molecule and within the narrowest range. Images of copolymer films transfer at solid substrates at determined transfer pressures enable having direct information about the structure and size of formed structures. In this manner, relevant differences were observed between copolymers with the shortest blocks (\( \text{BO}_8\text{EO}_{90}\text{BO}_8 \) and \( \text{BO}_{12}\text{EO}_{227}\text{BO}_{12} \)) and those with the longest ones (\( \text{BO}_{20}\text{EO}_{411}\text{BO}_{20} \) and \( \text{BO}_{21}\text{EO}_{385}\text{BO}_{21} \)). In this regard, surface circular micelles were observed for the former at low surface transfer pressures, evolving to continent-like structures first and then dewetted structures as the transfer pressure increases. Conversely, for \( \text{BO}_{20}\text{EO}_{411}\text{BO}_{20} \) and \( \text{BO}_{21}\text{EO}_{385}\text{BO}_{21} \) copolymers micelle formation is noted at lower transfer pressures than the shortest counterparts, and the formed micelles appear to be elongated, interconnected and with larger thickness. As the transfer pressure increases, attractive micellar interactions are enhanced and then-lead to formation of a dense network of interconnected micelles, first followed by an evolvement to continent-like and dewetted structures, as also observed for \( \text{BO}_8\text{EO}_{90}\text{BO}_8 \), \( \text{BO}_{12}\text{EO}_{227}\text{BO}_{12} \) copolymers.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Universidad de Santiago de Compostela, Universidad de Sonora
Authors: Villar-Alvarez, E. (Ekstern), Freire, A. C. (Intern), Blanco, M. (Ekstern), Pardo, A. (Ekstern), Martinez, R. (Ekstern), Barbosa, S. (Ekstern), Valdez, M. A. (Ekstern), Juarez, J. (Ekstern), Taboada, P. (Ekstern)
Number of pages: 12
Pages: 12684-12695
Publication date: 2017
Main Research Area: Technical/natural sciences
Publication information
Journal: Journal of Physical Chemistry C
Volume: 121
Issue number: 23
Suspended 3D pyrolytic carbon microelectrodes for electrochemistry

Carbon microelectrodes have a wide range of applications because of their unique material properties and biocompatibility. This work presents the fabrication and characterization of suspended pyrolytic carbon microstructures serving as three-dimensional (3D) carbon microelectrodes for electrochemical applications. A 3D polymer template in
epoxy based photoresist (SU-8) was fabricated with multiple steps of UV photolithography and pyrolysed at 900 °C to obtain 3D carbon microelectrodes. The pyrolytic carbon microstructures were characterized by SEM, Raman spectroscopy and XPS to determine the mechanical stability, shrinkage and material properties. The smallest feature size fabricated in the suspended carbon layer was 2 μm. A three electrode microelectrode chip with 3D pyrolytic carbon microstructures as the working electrode was designed and fabricated. The electrodes were characterized with cyclic voltammetry (CV) and impedance spectroscopy (EIS) using potassium ferri-ferrocyanide redox probe in a custom made batch system with magnetic clamping. Different 3D pyrolytic carbon microelectrodes were compared and the optimal design displayed twice the peak current and half the charge transfer resistance as compared to 2D carbon electrodes. The higher sensitivity of 3D carbon microelectrodes for electrochemical sensing was illustrated by dopamine detection.

**General information**

State: Published  
Organisations: Department of Micro- and Nanotechnology  
Authors: Hemanth, S. (Intern), Caviglia, C. (Intern), Keller, S. S. (Intern)  
Number of pages: 9  
Pages: 226-234  
Publication date: 2017  
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Carbon  
Volume: 121  
ISSN (Print): 0008-6223  
Ratings:  
BFI (2018): BFI-level 1  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 1  
Scopus rating (2017): SJR 2.226 SNIP 1.666  
Web of Science (2017): Indexed yes  
BFI (2016): BFI-level 1  
Scopus rating (2016): CiteScore 6.49 SJR 2.091 SNIP 1.648  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 1  
Scopus rating (2015): SJR 1.988 SNIP 1.71 CiteScore 6.53  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 1  
Scopus rating (2014): SJR 2.132 SNIP 1.976 CiteScore 6.62  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 1  
Scopus rating (2013): SJR 2.289 SNIP 2.114 CiteScore 6.54  
ISI indexed (2013): ISI indexed yes  
BFI (2012): BFI-level 1  
Scopus rating (2012): SJR 2.518 SNIP 2.102 CiteScore 5.95  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 1  
Scopus rating (2011): SJR 2.193 SNIP 2.048 CiteScore 5.23  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 1  
Scopus rating (2010): SJR 2.392 SNIP 2.034  
Web of Science (2010): Indexed yes  
BFI (2009): BFI-level 1  
Scopus rating (2009): SJR 2.121 SNIP 2.103  
Web of Science (2009): Indexed yes  
BFI (2008): BFI-level 1  
Scopus rating (2008): SJR 2.126 SNIP 1.938  
Scopus rating (2007): SJR 1.835 SNIP 1.798
In this work we present an easy, fast, reliable and low cost microfabrication technique for fabricating suspended microstructures of epoxy based photoresists with UV photolithography. Two different fabrication processes with epoxy based resins (SU-8 and mr-DWL) using UV exposures at wavelengths of 313 nm and 405 nm were optimized and compared in terms of structural stability, control of suspended layer thickness and resolution limits. A novel fabrication process combining the two photoresists SU-8 and mr-DWL with two UV exposures at 365 nm and 405 nm respectively provided a wider processing window for definition of well-defined suspended microstructures with lateral dimensions down to 5 μm when compared to 313 nm or 365 nm UV photolithography processes.
Sustainable solar fuels and electricity through discovery and prototyping of new materials

General information
State: Published
Organisations: Department of Physics, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, Theoretical Atomic-scale Physics, Department of Micro- and Nanotechnology
Number of pages: 1
Publication date: 2017

Host publication information
Title of host publication: Book of Abstracts, Sustain 2017
Publisher: Technical University of Denmark (DTU)
Article number: M-1
Symmetry-forbidden intervalley scattering by atomic defects in monolayer transition-metal dichalcogenides

Intervalley scattering by atomic defects in monolayer transition metal dichalcogenides (TDMs; MX₂) presents a serious obstacle for applications exploiting their unique valley-contrasting properties. Here, we show that the symmetry of the atomic defects can give rise to an unconventional protection mechanism against intervalley scattering in monolayer TMDs. The predicted defect-dependent selection rules for intervalley scattering can be verified via Fourier transform scanning tunneling spectroscopy (FT-STS), and provide a unique identification of, e.g., atomic vacancy defects (M vs X). Our findings are consistent with the absence of the K K' intervalley FT-STS peak in recent experiments.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Theoretical Nanotechnology, University of Minnesota
Authors: Kaasbjerg, K. (Intern), Martiny, J. H. J. (Intern), Low, T. (Ekstern), Jauho, A. (Intern)
Number of pages: 6
Publication date: 2017
Main Research Area: Technical/natural sciences

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Volume: 96
Issue number: 24
Article number: 241411
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SJR 1.604 SNIP 1.04
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 3.16 SJR 2.339 SNIP 1.151
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 2.377 SNIP 1.13 CiteScore 2.8
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 2.762 SNIP 1.316 CiteScore 3.3
Web of Science (2014): Indexed yes
Scopus rating (2013): SJR 2.813 SNIP 1.326 CiteScore 3.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 3.173 SNIP 1.378 CiteScore 3.57
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 3.326 SNIP 1.423 CiteScore 3.61
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Scopus rating (2010): SJR 3.318 SNIP 1.447
Web of Science (2010): Indexed yes
Web of Science (2009): Indexed yes
Scopus rating (2008): SJR 2.923 SNIP 1.516
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.892 SNIP 1.588
Web of Science (2007): Indexed yes
Synthesis and characterization of ferrocene containing block copolymers

Narrowly dispersed diblock copolymers containing poly(methyl methacrylate) [PMMA] or poly(nonafluorohexyl methacrylate) [PF9MA] as the first block and poly(ferrocenylmethyl methacrylate) [PFMMMA] as the second block, were prepared by anionic polymerization for the first time. Disordered bulk morphologies in the case of PMMA-b-PFMMA were observed and explained in terms of low Flory–Huggins interaction parameter ($\chi \leq 0.04$). In the case of PF9MA-b-PFMMA hexagonally packed cylinder morphology (HEX) was substantiated from TEM and SAXS observations. Furthermore, high incompatibility between PF9MA and PFMMA blocks allowed for the formation of well-ordered ferrocene containing cylinders on silica substrate upon exposure of the thin films to a saturated solvent vapor. It was shown that the cylinder orientation, parallel or perpendicular to the surface, could easily be controlled by appropriate choice of the solvent and without the need for preliminary surface modification, for example by means of grafted brush layer.
Synthesis of fluorinated poly(arylene ether)s with dibenzodioxin and spirobisindane units from new bis(pentafluorophenyl)- 
and bis(nonafluorobiphenyl)-containing monomers

New series of 4,4′-bis(pentafluorophenyl)- and 4,4′-bis(nonafluorobiphenyl)-containing monomers based on 
hexafluorobenzene or decafluorobiphenyl as well as on para- and meta-connecting dihydroxyl-substituted compounds or 
tetrafluorobenzene- and 1,1,3,3,3-hexafluoropropane-based dihydroxyl-substituted compounds were synthesised.
Fluorinated poly(arylene ether)s having perfluorinated aromatic units as well as both rigid dibenzodioxin and spirobisindane fragments were successfully obtained by interaction of the synthesized core-fluorinated monomers with 5,5',6,6'-tetrahydroxy-3,3',3'-tetramethyl-1,1'-spirobisindane. The chemical structures of the prepared monomers and polymers were determined using $^1$H, $^{13}$C, and $^{19}$F NMR and FTIR spectroscopy techniques. All the obtained polymers were completely soluble in chloroform, tetrahydrofuran, dimethylformamide, and dimethyl sulfoxide. Polymers derived from 4,4'-bis(nonafluorophenyl)-containing monomers have higher average molecular masses ($M_w$) in the range 47,000–88,300 and are able to form robust, solvent-cast films. Good thermal stabilities in air (up to 350 °C) were observed in all fluorinated polymers. The Brunauer–Emmett–Teller specific surface area and the pore size of polymers can be controlled by varying the type of the initial fluorinated monomers. It was shown that introduction of perfluorobiphenyl units is an effective tool for increasing the surface area up to 156.8 m$^2$ g$^{-1}$.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Institute of Macromolecular Chemistry of the National Academy of Sciences of Ukraine, Russian Academy of Sciences
Authors: Tkachenko, I. M. (Ekstern), Belov, N. A. (Ekstern), Kobzar, Y. L. (Ekstern), Dorokhin, A. (Intern), Shekera, O. V. (Ekstern), Shantarovich, V. P. (Ekstern), Bekeshev, V. G. (Ekstern), Shevchenko, V. V. (Ekstern)
Number of pages: 12
Pages: 1-12
Publication date: 2017
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Journal of Fluorine Chemistry
Volume: 195
ISSN (Print): 0022-1139
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.657 SJR 0.645
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.87 SJR 0.758 SNIP 0.696
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.756 SNIP 0.761 CiteScore 2.14
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.676 SNIP 0.734 CiteScore 1.82
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.844 SNIP 0.959 CiteScore 2.09
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.837 SNIP 1.097 CiteScore 1.96
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.882 SNIP 0.993 CiteScore 1.97
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.795 SNIP 0.993
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.803 SNIP 0.96
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.767 SNIP 0.866
Scopus rating (2007): SJR 0.822 SNIP 0.79
Scopus rating (2006): SJR 0.736 SNIP 1.013
Scopus rating (2005): SJR 0.615 SNIP 0.905
System-Level Sensitivity Analysis of SiNW-bioFET-Based Biosensing Using Lock-In Amplification

Although Silicon Nanowire biological Field-Effect Transistors (SiNW-bioFETs) have steadily demonstrated their ability to detect biological markers at ultra-low concentration, they have not yet translated into routine diagnostics applications. One of the challenges inherent to the technology is that it requires an instrumentation capable of recovering ultra-low signal variations from sensors usually designed and operated in a highly-resistive configuration. Often overlooked, the SiNW-bioFET/instrument interactions are yet critical factors in determining overall system biodetection performances. Here, we carry out for the first time the system-level sensitivity analysis of a generic SiNW-bioFET model coupled to a custom-design instrument based on the lock-in amplifier. By investigating a large parametric space spanning over both sensor and instrumentation specifications, we demonstrate that systemwide investigations can be instrumental in identifying the design trade-offs that will ensure the lowest Limits-of-Detection. The generic character of our analytical model allows us to elaborate on the most general SiNW-bioFET/instrument interactions and their overall implications on detection performances. Our model can be adapted to better match specific sensor or instrument designs to either ensure that ultra-high sensitivity SiNW-bioFETs are coupled with an appropriately sensitive and noise-rejecting instrumentation, or to best tailor SiNW-bioFET design to the specifications of an existing instrument.

General information
State: Published
Organisations: Department of Management Engineering, Engineering Systems, Department of Micro- and Nanotechnology, Nano Bio Integrated Systems, Center for Bachelor of Engineering Studies, Afdelingen for El-technologi, Copenhagen Center for Health Technology, Department of Applied Mathematics and Computer Science, Embedded Systems Engineering
Authors: Patou, F. (Intern), Dimaki, M. (Intern), Kjærgaard, C. (Intern), Madsen, J. (Intern), Svendsen, W. E. (Intern)
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Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 0.655 SNIP 1.84 CiteScore 2.85
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.775 SNIP 1.894 CiteScore 2.5
The pharmacological manipulation of liver X receptors (LXRs) has been an attractive therapeutic strategy for atherosclerosis treatment as they control reverse cholesterol transport and inflammatory response. This study presents the development and efficacy of nanoparticles (NPs) incorporating the synthetic LXR agonist GW3965 (GW) in targeting atherosclerotic lesions. Collagen IV (Col IV) targeting ligands are employed to functionalize the NPs to improve targeting to the atherosclerotic plaque, and formulation parameters such as the length of the polyethylene glycol (PEG) coating molecules are systematically optimized. In vitro studies indicate that the GW-encapsulated NPs upregulate the LXR target genes and downregulate proinflammatory mediator in macrophages. The Col IV-GW-NPs successfully reaches atherosclerotic lesions when administered for 5 weeks to mice with preexisting lesions, substantially reducing macrophage content (∼30%) compared to the PBS group, which is with greater efficacy versus nontargeting NPs encapsulating GW (GW-NPs) (∼18%). In addition, mice administered the Col IV-GW-NPs do not demonstrate increased hepatic lipid biosynthesis or hyperlipidemia during the treatment period, unlike mice injected with the free GW. These findings suggest a new form of LXR-based therapeutics capable of enhanced delivery of the LXR agonist to atherosclerotic lesions without altering hepatic lipid metabolism.
Targeting transferrin receptors at the blood-brain barrier improves the uptake of immunoliposomes and subsequent cargo transport into the brain parenchyma

Drug delivery to the brain is hampered by the presence of the blood-brain barrier, which excludes most molecules from freely diffusing into the brain, and tightly regulates the active transport mechanisms that ensure sufficient delivery of nutrients to the brain parenchyma. Harnessing the possibility of delivering neuroactive drugs by way of receptors already present on the brain endothelium has been of interest for many years. The transferrin receptor is of special interest since its expression is limited to the endothelium of the brain as opposed to peripheral endothelium. Here, we investigate the possibility of delivering immunoliposomes and their encapsulated cargo to the brain via targeting of the transferrin receptor. We find that transferrin receptor-targeting increases the association between the immunoliposomes and primary endothelial cells in vitro, but that this does not correlate with increased cargo transcytosis. Furthermore, we show that the transferrin receptor-targeted immunoliposomes accumulate along the microvessels of the brains of rats, but find no evidence for transcytosis of the immunoliposome. Conversely, the increased accumulation correlated both with increased cargo uptake in the brain endothelium and subsequent cargo transport into the brain. These findings suggest that transferrin receptor-targeting is a relevant strategy of increasing drug exposure to the brain.
Target position uncertainty during visually guided deep-inspiration breath-hold radiotherapy in locally advanced lung cancer

Purpose: The purpose of this study was to estimate the uncertainty in voluntary deep-inspiration breath hold (DISH) radiotherapy for locally advanced non-small cell lung cancer (NSCLC) patients. Methods: Perpendicular fluoroscopic movies were acquired in free breathing (FB) and DISH during a course of visually guided DISH radiotherapy of nine patients with NSCLC. Patients had liquid markers injected in mediastinal lymph nodes and primary tumours. Excursion, systematic- and random errors, and inter-breath-hold position uncertainty were investigated using an image based tracking algorithm. Results: A mean reduction of 2-6 mm in marker excursion in DISH versus FB was seen in the anterior posterior (AP), left-right (LR) and cranio-caudal (CC) directions. Lymph node motion during DISH originated from cardiac motion. The systematic-(standard deviation (SD) of all the mean marker positions) and random errors (root-mean-square of the intra-BH SD) during DISH were 0.5 and 0.3 mm (AP), 0.5 and 0.3 mm (LR), 0.8 and 0.4 mm (CC), respectively. The mean inter-breath-hold shifts were -0.3 mm (AP), -0.2 mm (LR), and -0.2 mm (CC). Conclusion: Intra- and inter-breath-hold uncertainty of tumours and lymph nodes were small in visually guided breath-hold radiotherapy of NSCLC. Target motion could be substantially reduced, but not eliminated, using visually guided DISH. (C) 2017 Elsevier B.V. All rights reserved.
Temperature dependent photoreflectance study of Cu2SnS3 thin films produced by pulsed laser deposition

The energy band structure of Cu2SnS3 (CTS) thin films fabricated by pulsed laser deposition was studied by photoreflectance spectroscopy (PR). The temperature-dependent PR spectra were measured in the range of T = 10–150 K. According to the Raman scattering analysis, the monoclinic crystal structure (C1c1) prevails in the studied CTS thin film; however, a weak contribution from cubic CTS (F-43m) was also detected. The PR spectra revealed the valence band splitting of CTS. Optical transitions at EA = 0.92 eV, EB = 1.04 eV, and EC = 1.08 eV were found for monoclinic CTS at low-temperature (T = 10 K). Additional optical transition was detected at EAC = 0.94 eV, and it was attributed to the low-temperature band gap of cubic CTS. All the identified optical transition energies showed a blueshift with increasing temperature, and the temperature coefficient dE/dT was about 0.1 meV/K.
Termination of nanoscale zero-valent iron reactivity by addition of bromate as a reducing reactivity competitor

Remediation of contaminated groundwater by nanoscale zero-valent iron (nZVI) is widely becoming a leading environmentally friendly solution throughout the globe. Since a wide range of various nZVI-containing materials have been developed for effective remediation, it is necessary to determine an appropriate way to terminate the reactivity of any nZVI-containing material for a practical experimental procedure. In this study, bimetallic Ni/Fe-NPs were prepared to enhance overall reduction kinetics owing to the catalytic reactivity of nickel on the surface of nZVI. We have tested several chemical strategies in order to terminate nZVI reactivity without altering the concentration of volatile compounds in the solution. The strategies include surface passivation in alkaline conditions by addition of carbonate, and consumption of nZVI by a reaction competitor. Four halogenated chemicals, trichloroethylene, 1,1,1-trichloroethane, atrazine, and 4-chlorophenol, were selected and tested as model groundwater contaminants. Addition of carbonate to passivate the nZVI surface was not effective for trichloroethylene. Nitrate and then bromate were applied to competitively consume nZVI by their faster reduction kinetics. Bromate proved to be more effective than nitrate, subsequently terminating nZVI reactivity for all four of the tested halogenated compounds. Furthermore, the suggested termination method using bromate was successfully applied to obtain trichloroethylene reduction kinetics. Herein, we report the simple and effective method to terminate the reactivity of nZVI by addition of a reducing reactivity competitor.

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Micro- and Nanotechnology, Surface Engineering, Water Technologies, Kumoh National Institute of Technology, Seoul National University of Science and Technology (SNUST)
Authors: Mines, P. D. (Intern), Kaarsholm, K. M. S. (Intern), Droumpali, A. (Intern), Andersen, H. R. (Intern), Lee, W. (Ekstern), Hwang, Y. (Ekstern)
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BFI (2017): BFI-level 1
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BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.74 SJR 0.496 SNIP 0.557
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.568 SNIP 0.696 CiteScore 1.97
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.672 SNIP 0.861 CiteScore 2.17
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.753 SNIP 1.01 CiteScore 2.54
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BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.855 SNIP 1.024 CiteScore 2.56
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.092 SNIP 1.437 CiteScore 3.52
ISI indexed (2011): ISI indexed yes
The Atomic Simulation Environment - A Python library for working with atoms

The Atomic Simulation Environment (ASE) is a software package written in the Python programming language with the aim of setting up, steering, and analyzing atomistic simulations. In ASE, tasks are fully scripted in Python. The powerful syntax of Python combined with the NumPy array library make it possible to perform very complex simulation tasks. For example, a sequence of calculations may be performed with the use of a simple "for-loop" construction. Calculations of energy, forces, stresses and other quantities are performed through interfaces to many external electronic structure codes or force fields using a uniform interface. On top of this calculator interface, ASE provides modules for performing many standard simulation tasks such as structure optimization, molecular dynamics, handling of constraints and performing nudged elastic band calculations.

General information

State: Published
Organisations: Department of Physics, Theoretical Atomic-scale Physics, Department of Energy Conversion and Storage, Atomic scale modelling and materials, Department of Micro- and Nanotechnology, Theoretical Nanotechnology, Universitat de Barcelona, University of Copenhagen, Malmö University, SINTEF, Aarhus University, Brown University, University of Wisconsin-Madison, University of Warwick, Carnegie Mellon University, Purdue University, Siminn, Karlsruhe Institute of Technology KIT, ETH Zurich, University of Freiburg
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Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Physics: Condensed Matter
Volume: 29
The diffusion dynamics of PEGylated liposomes in the intact vitreous of the ex vivo porcine eye: A fluorescence correlation spectroscopy and biodistribution study

The diffusion dynamics of nanocarriers in the vitreous and the influence of nanocarrier physicochemical properties on these dynamics is an important aspect of the efficacy of intravitreal administered nanomedicines for the treatment of posterior segment eye diseases. Here we use fluorescence correlation spectroscopy (FCS) to determine liposome diffusion coefficients in the intact vitreous (DVit) of ex vivo porcine eyes using a modified Miyake-Apple technique to minimize the disruption of the vitreous fine structure. We chose to investigate whether the zeta potential of polyethylene glycol functionalized (i.e. PEGylated) liposomes altered liposome in situ diffusion dynamics in the vitreous. Non-PEGylated cationic nanocarriers have previously shown little to no diffusion in the vitreous, whilst neutral and anionic have shown diffusion. The liposomes investigated had diameters below 150nm and zeta potentials ranging from -20 to +12mV. We observed that PEGylated cationic liposomes had significantly lower DVit values (1.14μm²s⁻¹) than PEGylated neutral and anionic liposomes (2.78 and 2.87μm²s⁻¹). However, PEGylated cationic liposomes had a similar biodistribution profile across the vitreous to the other systems. These results show that PEGylated cationic liposomes with limited cationic charge can diffuse across the vitreous and indicate that the vitreous as a barrier to nanocarriers (Ø< 500 nm) is more complicated than simply an electrostatic barrier as previously suggested.
The effect of dopants on grain growth and PL in CZTS nanoparticle thin films for solar cell applications

We have studied the effect of dopants such as Na, Sb, and Li in Cu2ZnSnS4 nanoparticle thin films [1]. The as-synthesized CZTS nanoparticles were inherently ligand-free [2], which allows the use of polar solvents, such as water and ethanol. Another advantage of these particles is that the user- and environmentally-friendly chloride salts can be directly dissolved in controllable amounts. This further circumvents the need for later incorporation of dopants, or a ligand-exchange step to functionalize the surface of the nanoparticles. In addition, the homogeneous distribution of additives in the ink allows uniform grain growth within the deposited absorber layer. By including Na in the nanoparticle ink, micron-sized grains throughout the whole absorber are achieved after annealing in a sulfur atmosphere at 600°C. The absorber layer appeared to be of full density, and no closed porosity could be detected. In addition, the photoluminescence signal increased by a factor of 200 after Na-inclusion. Without Na, the grains were very difficult to sinter, the film was porous, and the photoluminescence was low. This suggests that including Na reduces interface recombination in CZTS nanoparticle absorber layers. A concentration of Na/(Cu+Zn+Sn)=30% was necessary for the densification of the absorber, which is significantly higher than that used in other Na-doped CZTS systems. The annealed films were found to be of the desired Cu-poor and Zn-rich composition.

General information
State: Published
Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Physics, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, Department of Micro- and Nanotechnology
Authors: Engberg, S. L. J. (Intern), Crovetto, A. (Intern), Hansen, O. (Intern), Schou, J. (Intern)
The future of the packaging industry: Roll-to-roll production of lotus leaves and rose petals

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Technical University of Denmark
Authors: Okulova, N. (Ekstern), Taboryski, R. J. (Intern)
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The random co-polymer glatiramer acetate rapidly kills primary human leukocytes through sialic-acid-dependent cell membrane damage

The formulation glatiramer acetate (GA) is widely used in therapy of multiple sclerosis. GA consists of random copolymers of four amino acids, in ratios that produce a predominantly positive charge and an amphipathic character. With the extraordinary complexity of the drug, several pharmacological modes-of-action were suggested, but so far none, which rationalizes the cationicity and amphipathicity as part of the mode-of-action. Here, we report that GA rapidly kills primary human T lymphocytes and, less actively, monocytes. LL-37 is a cleavage product of human cathelicidin with important roles in innate immunity. It shares the positive charge and amphipathic character of GA, and, as shown here, also the ability to kill human leukocyte. The cytotoxicity of both compounds depends on sialic acid in the cell membrane. The killing was associated with the generation of CD45 + debris, derived from cell membrane deformation. Nanoparticle tracking analysis confirmed the formation of such debris, even at low GA concentrations. Electric cell-substrate impedance sensing measurements also recorded stable alterations in T lymphocytes following such treatment. LL-37 forms oligomers through weak hydrophobic contacts, which is critical for the lytic properties. In our study, SAXS showed that GA also forms this type of contacts. Taken together, our study offers new insight on the immunomodulatory mode-of-action of positively charged co-polymers. The comparison of LL-37 and GA highlights a consistent requirement of certain oligomeric and chemical properties to support cytotoxic effects of cationic polymers targeting human leukocytes.

General information
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Organisations: Department of Micro- and Nanotechnology, Surface Engineering, Aarhus University
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Journal: Biochimica et Biophysica Acta. Biomembranes
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Scopus rating (2017): SNIP 1.094 SJR 1.495
Web of Science (2017): Indexed yes
We study thermoelectric effects in Coulomb-coupled quantum-dot (CCQD) systems beyond lowest-order tunneling processes and the often applied wide-band approximation. To this end, we present a master-equation (ME) approach based on a perturbative $T$-matrix calculation of the charge and heat tunneling rates and transport currents. Applying the method to transport through a noninteracting single-level QD, we demonstrate excellent agreement with the Landauer-
Büttiker theory when higher-order (cotunneling) processes are included in the ME. Next, we study the effect of cotunneling and energy-dependent lead couplings on the heat currents in a system of two CCQDs. We find that cotunneling processes (i) can dominate the off-resonant heat currents at low temperature and bias compared to the interdot interaction, and (ii) give rise to a pronounced reduction of the cooling power achievable with the recently demonstrated Maxwell's demon cooling mechanism. Furthermore, we demonstrate that the cooling power can be boosted significantly by carefully engineering the energy dependence of the lead couplings to filter out undesired transport processes. Our findings emphasize the importance of higher-order cotunneling processes as well as engineered energy-dependent lead couplings in the optimization of the thermoelectric performance of CCQD systems.
The rose petal effect and the role of advancing water contact angles for drop confinement

We studied the role of advancing water contact angles on superhydrophobic surfaces that exhibited strong pinning effects as known in nature from rose petals. Textured surfaces were engineered in silicon by lithographical techniques. The textures were comprised of hexagonal microstructures superimposed with randomly distributed nanospikes and were coated with a hydrophobic fluorocarbon agent. A step in the advancing water contact angle bounding specific areas was obtained by engineering a corresponding topographic step in the hexagonal micro-texture. This enabled a surface texture design confining drops to areas with a lower advancing contact angle.

General information
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Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Technical University of Denmark
Authors: Mandsberg, N. K. (Ekstern), Taboryski, R. J. (Intern)
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Volume: 5
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Scopus rating (2016): CiteScore 0.85 SJR 0.344 SNIP 0.518
Scopus rating (2015): SJR 0.351 SNIP 0.418
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Scopus rating (2014): SJR 0.323 SNIP 0.804
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One of the fundamental steps needed to design functional tissues and, ultimately organs is the ability to fabricate thick and densely populated tissue constructs with controlled vasculature and microenvironment. To date, bioprinting methods have been employed to manufacture tissue constructs with open vasculature in a square-lattice geometry, where the majority lacks the ability to be directly perfused. Moreover, it appears to be difficult to fabricate vascular tissue constructs targeting the stiffness soft tissues such as the liver. Here we present a method for the fabrication of thick (e.g. 1 cm) and densely populated (e.g. 10 million cells·mL⁻¹) tissue constructs with a three-dimensional (3D) four arm branch network and stiffness in the range of soft tissues (1-10 kPa), which can be directly perfused on a fluidic platform for long time periods (>14 days). Specifically, we co-print a 3D four-arm branch using water-soluble Poly(vinyl alcohol) (PVA) as main material and Poly(lactic acid) (PLA) as the support structure. The PLA support structure was selectively removed, and the water-soluble PVA structure was used for creating a 3D vascular network within a customized extracellular matrix (ECM) targeting the stiffness of the liver and with encapsulated hepatocellular carcinoma (HepG2) cells. These constructs were directly perfused with medium inducing the proliferation of HepG2 cells and the formation of spheroids. The highest spheroid density was obtained with perfusion, but overall the tissue construct displayed two distinct zones, one of rapid proliferation and one with almost no cell division and high cell death. The created model, therefore, simulate gradients in tissues of necrotic regions in tumors. This versatile method could represent a fundamental step in the fabrication of large functional and complex tissues and finally organs. Vascularization within hydrogels with mechanical properties in the range of soft tissues remains a challenge. To date, bioprinting have been employed to manufacture tissue constructs with open vasculature in a square-lattice geometry that are not perfused. This study shows the creation of densely populated tissue constructs with a 3D four arm branch network and stiffness in the range of soft tissues, which can be directly perfused. The cells encapsulated within the construct showed proliferation as a function of the vasculature distance, and the control of the micro-environment induced the encapsulated cells to aggregate in spheroids in specific positions. This method could be used for modeling tumors and for fabricating more complex and densely populated tissue constructs with translational potential.

General information
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Organisations: Department of Micro- and Nanotechnology, BioLabChip, Bioanalytics, Fluidic Array Systems and Technology, Technical University of Denmark
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.66 SJR 1.856 SNIP 1.947
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.02 SNIP 1.963 CiteScore 6.58
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.835 SNIP 2.28 CiteScore 6.53
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.988 SNIP 2.24 CiteScore 6.41
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.904 SNIP 2.108 CiteScore 5.51
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.831 SNIP 1.893 CiteScore 5.15
Web of Science (2011): Indexed yes
Three-dimensional ZnO hierarchical nanostructures: Solution phase synthesis and applications

Zinc oxide (ZnO) nanostructures have been studied extensively in the past 20 years due to their novel electronic, photonic, mechanical and electrochemical properties. Recently, more attention has been paid to assemble nanoscale building blocks into three-dimensional (3D) complex hierarchical structures, which not only inherit the excellent properties of the single building blocks but also provide potential applications in the bottom-up fabrication of functional devices. This review article focuses on 3D ZnO hierarchical nanostructures, and summarizes major advances in the solution phase synthesis, applications in environment, and electrical/electrochemical devices. We present the principles and growth mechanisms of ZnO nanostructures via different solution methods, with an emphasis on rational control of the morphology and assembly. We then discuss the applications of 3D ZnO hierarchical nanostructures in photocatalysis, field emission, electrochemical sensor, and lithium ion batteries. Throughout the discussion, the relationship between the device performance and the microstructures of 3D ZnO hierarchical nanostructures will be highlighted. This review concludes with a personal perspective on the current challenges and future research.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Hebei University of Science and Technology, Pakistan Institute of Nuclear Science and Technology
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Number of pages: 24
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Journal: Materials
Volume: 10
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Scopus rating (2017): SNIP 1.285 SJR 0.732
Web of Science (2017): Indexed Yes
Scopus rating (2016): CiteScore 3.26 SJR 0.838 SNIP 1.495
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 0.83 SNIP 1.457 CiteScore 3.11
Scopus rating (2014): SJR 0.767 SNIP 1.229 CiteScore 2.69
Web of Science (2014): Indexed yes
Scopus rating (2013): SJR 1.001 SNIP 1.631 CiteScore 3.12
ISI indexed (2013): ISI indexed yes
Scopus rating (2012): SJR 0.841 SNIP 1.465
ISI indexed (2012): ISI indexed no
Scopus rating (2011): SJR 0.651 SNIP 1.212
ISI indexed (2011): ISI indexed no
Time Lens based Optical Fourier Transformation for All-Optical Signal Processing of Spectrally-Efficient Data

We review recent progress in the use of time lens based optical Fourier transformation for advanced all-optical signal processing. A novel time lens based complete optical Fourier transformation (OFT) technique is introduced. This complete OFT is based on two quadratic phase-modulation stages using four-wave mixing (FWM), separated by a dispersive medium, which enables time-to-frequency and frequency-to-time conversions simultaneously, thus performing an exchange between the temporal and spectral profiles of the input signal. Using the proposed complete OFT, several advanced all-optical signal processing schemes for spectrally-efficient systems and networks have been achieved, including all-optical generation, detection and format conversion of spectrally-efficient signals. The spectrally-efficient signals in this paper mainly refer to efficiently multiplexed signals with a high symbol rate per Hz, such as orthogonal frequency division multiplexing (OFDM), Nyquist wavelength-division multiplexing (Nyquist-WDM) and Nyquist optical time division multiplexing (Nyquist-OTDM) signals.

General information
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Organisations: Department of Photonics Engineering, High-Speed Optical Communication, Centre of Excellence for Silicon Photonics for Optical Communications, National Space Institute, Department of Micro- and Nanotechnology
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Scopus rating (2017): SNIP 1.791 SJR 1.166
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.87 SJR 1.23 SNIP 1.819
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.598 SNIP 1.901 CiteScore 4.15
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.737 SNIP 2.411 CiteScore 4.23
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.622 SNIP 2.439 CiteScore 4.03
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Towards a fully automated lab-on-a-disc system integrating sample enrichment and detection of analytes from complex matrices

Lab-on-a-chip systems (LoC) has been actively researched and developed for at least the last 25 years, yet integration of an efficient and robust sample pretreatment method still proves to be a challenge in the field. This lack of sample pre-
treatment methods in LoC platforms prevents the technology on a large scale from fulfilling its potential for maturing into applied technologies and products. In this work, we have taken the first steps towards realizing a capable and truly automated “sample-to-answer” analysis system, aimed at small molecule detection and quantification from a complex sample matrix. The main result is a working prototype of a microfluidic system, integrating both centrifugal microfluidics for sample handling, supported liquid membrane extraction (SLM) for selective and effective sample treatment, as well as in-situ electrochemical detection. As a case study, the system is used to extract and quantify p-coumaric acid, a phenolic metabolite, produced by bacterial factories. The bacterial culture supernatant is a particularly challenging sample matrix as it contains both molecules that are derivatives of the target molecule, and therefore highly interfering for the analytical procedure, as well as a range of other compounds, e.g. vitamins, proteins, and salt ions. However, with the SLM extraction applied here, very clear and enhanced signals, with no sign of contaminants, is demonstrated. The strategies developed for the integration of the SLM extraction on the centrifugal platform, as well as the design, fabrication and optimization steps, are presented and discussed in this thesis.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Authors: Andreasen, S. Z. (Intern), Boisen, A. (Intern), Ernénéus, J. (Intern), Zor, K. (Intern)
Number of pages: 154
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Publication information
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Source: PublicationPreSubmission
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Publication: Research › Ph.D. thesis – Annual report year: 2017

Towards an optimisation and standardisation of the structural and magnetic arrangements of Iron-Oxide Nanoparticles for biomedical applications

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Institut Laue-Langevin, Universidad Complutense, nAnt PET Pharma GmbH, RISE Acreo, Universidad de Cantabria, University College London, Chalmers University of Technology, Micromod Partikeltechnologie GmbH
Publication date: 2017
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Main Research Area: Technical/natural sciences
Electronic versions:
Untitled.pdf
Source: PublicationPreSubmission
Source-ID: 140386078
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Transfection of primary brain capillary endothelial cells for protein synthesis and secretion of recombinant erythropoietin: a strategy to enable protein delivery to the brain
Treatment of chronic disorders affecting the central nervous system (CNS) is complicated by the inability of drugs to cross the blood-brain barrier (BBB). Non-viral gene therapy applied to brain capillary endothelial cells (BCECs) denotes a novel approach to overcome the restraints in this passage, as turning BCECs into recombinant protein factories by transfection could result in protein secretion further into the brain. The present study aims to investigate the possibility of transfecting primary rat brain endothelial cells (RBECs) for recombinant protein synthesis and secretion of the neuroprotective protein erythropoietin (EPO). We previously showed that 4% of RBECs with BBB properties can be transfected without disrupting the BBB integrity in vitro, but it can be questioned whether this is sufficient to enable protein secretion at therapeutic levels. The present study examined various transfection vectors, with regard to increasing the transfection efficiency without disrupting the BBB integrity. Lipofectamine 3000™ was the most potent vector compared to polyethylenimine (PEI) and Turbofect. When co-cultured with astrocytes, the genetically modified RBECs secreted recombinant EPO into the cell
culture medium both luminally and abluminally, and despite lower levels of EPO reaching the abluminal chamber, the amount of recombinant EPO was sufficient to evolve a biological effect on astrocytes cultured at the abluminal side in terms of upregulated gene expression of brain-derived neurotropic factor (BDNF). In conclusion, non-viral gene therapy to RBECs leads to protein secretion and signifies a method for therapeutic proteins to target cells inside the CNS otherwise omitted due to the BBB.
Portable ultrasound scanners (PUS) have, in recent years, raised a lot of attention, as they can potentially overcome some of the limitations of static scanners. However, PUS have a lot of design limitations including size and power consumption. These restrictions can compromise the image quality of the scanner. In order to overcome these restrictions, application specific integrated circuits (ASICs) are needed to implement the electronics. In this work, a comparative study of the transmitting performance of a capacitive micromachined ultrasonic transducer (CMUT) driven by a commercial generic ultrasound transmitter and an ASIC optimized for CMUT-based PUS is presented. A single CMUT element is pulsed with a 1% dutycycle at a frequency of 5 MHz. The DC bias voltage is 80 V and the pulsing voltage is 20 V. The acoustic performance is assessed by comparing the ultrasonic signals measured with a hydrophone both in the time and frequency domains. The difference in normalized signal amplitude evaluated at the center frequency of the CMUT is −1.9 dB and the measured bandwidth is equivalent. The ASIC consumes only 1.3% of the total power consumption used by the commercial transmitter.

Transport Properties of Nanostructured Graphene

Despite of its many wonderful properties, pristine graphene has one major drawback: it does not have a band gap, which complicates its applications in electronic devices. Many routes have been suggested to overcome this difficulty, such as cutting graphene into nanoribbons, using chemical methods, or making regular nanoperforations, also known antidot lattices. Theoretically, all these ideas lead to a reasonable band gap, but realizing them in the lab is very difficult because all fabrication steps induce disorder or other nonidealities, with potentially disastrous consequences for the intended device operation. In this talk I elaborate these ideas and review the state-of-the-art both from the theoretical and the experimental points of view. I also introduce two new ideas: (1) triangular antidots, and (2) nanobubbles formed in graphene. Both of these nanostructuring methods are predicted to yield novel transport signatures, which could form the basis of new types of devices. Our simulations show that it may be possible to generate very high quality spin- and/or valley polarized currents with these structures – something that has not yet been achieved in the lab. Importantly, our simulations involve millions of atoms which is necessary in order to address structures feasible in the lab.
Treatment of reduced sulphur compounds and SO$_2$ by Gas Phase Advanced Oxidation

Reduced sulphur compounds (RSCs) emitted from pig farms are a major problem for agriculture, due to their health and environmental impacts and foul odour. This study investigates the removal of RSCs, including H$_2$S, and their oxidation product SO$_2$ using Gas Phase Advanced Oxidation (GPAO). GPAO is a novel air cleaning technique which utilises accelerated atmospheric chemistry to oxidise pollutants before removing their oxidation products as particles. Removal efficiencies of 24.5% and 3.9% were found for 461 ppb of H$_2$S and 714 ppb of SO$_2$ in a laboratory system (volumetric flow Q = 75 m$^3$/h). A numerical model of the reactor system was developed to explore the basic features of the system; its output was in fair agreement with the experiment. The model verified the role of OH radicals in initiating the oxidation chemistry. All sulphur removed from the gas phase was detected as particulate matter, assuming the observed particles were made of sulphuric acid. In a second set of experiments a range of RSCs at mixing ratios typically found in pig farms were treated using a larger industry-scale system (Q = 600-1200 m$^3$/h) that included a wet scrubber. Removal efficiencies >90% were found for all compounds. The study demonstrates the ability of GPAO to control RSC emissions with a low energy input relative to many currently available techniques. (C) 2016 Elsevier B.V. All rights reserved.
Two-dimensional nanomaterials supported electrochemical energy storage for smart grids

General information
State: Published
Organisations: Department of Chemistry, NanoChemistry, Organic Chemistry, Department of Micro- and Nanotechnology
Authors: Cao, X. (Intern), Shen, F. (Intern), Zhang, M. (Intern), Halder, A. (Intern), Tang, Y. (Intern), Chi, Q. (Intern)
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Source: PublicationPreSubmission
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Publication: Research - peer-review › Book chapter – Annual report year: 2017

Two-dimensional salt and temperature DNA denaturation analysis using a magnetoresistive sensor

We present a microfluidic system and its use to measure DNA denaturation curves by varying the temperature or salt (Na$^+$) concentration. The readout is based on real-time measurements of DNA hybridization using magnetoresistive sensors and magnetic nanoparticles (MNPs) as labels. We report the first melting curves of DNA hybrids measured as a function of continuously decreasing salt concentration at fixed temperature and compare them to the corresponding curves obtained vs. temperature at fixed salt concentration. The magnetoresistive sensor platform provided reliable results under varying temperature as well as salt concentration. The salt concentration melting curves were found to be more reliable than temperature melting curves. We performed a two-dimensional mapping of the melting profiles of a target to probes.
targeting its wild type (WT) and mutant type (MT) variants in the temperature-salt concentration plane. This map clearly showed a region of optimum ability to differentiate between the two variants. We finally demonstrated single nucleotide polymorphism (SNP) genotyping using both denaturation methods on both separate sensors but also using a differential measurement on a single sensor. The results demonstrate that concentration melting provides an attractive alternative to temperature melting in on-chip DNA denaturation experiments and further show that the magnetoresistive platform is attractive due to its low cross-sensitivity to temperature and liquid composition.

General information
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Scopus rating (2015): SJR 2.239 SNIP 1.721 CiteScore 5.74
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Web of Science (2014): Indexed yes
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BFI (2012): BFI-level 2
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Scopus rating (2011): SJR 2.54 SNIP 1.788 CiteScore 5.76
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Ultrasonic 3D Carbon Microelectrodes for Electrochemical Biosensing Application

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Organisations: Department of Micro- and Nanotechnology, Department of Chemistry, NanoChemistry, Organic Chemistry
Authors: Hemanth, S. (Intern), Halder, A. (Intern), Caviglia, C. (Intern), Chi, Q. (Intern), Keller, S. S. (Intern)
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Ultra-thin Cu2ZnSnS4 solar cell by pulsed laser deposition
We report on the fabrication of a 5.2% efficiency Cu2ZnSnS4 (CZTS) solar cell made by pulsed laser deposition (PLD) featuring an ultra-thin absorber layer (less than 450 nm). Solutions to the issues of reproducibility and micro-particulate ejection often encountered with PLD are proposed. At the optimal laser fluence, amorphous CZTS precursors with optimal stoichiometry for solar cells are deposited from a single target. Such precursors do not result in detectable segregation of secondary phases after the subsequent annealing step. In the analysis of the solar cell device, we focus on the effects of the finite thickness of the absorber layer. Depletion region width, carrier diffusion length, and optical losses due to incomplete light absorption and back contact reflection are quantified. We conclude that material- and junction quality is comparable to that of thicker state-of-the-art CZTS devices, even though the efficiency is lower due to optical losses.

General information
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Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Micro- and Nanotechnology, Department of Physics, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, Department of Energy Conversion and Storage, Electrofunctional materials, The VILLUM Center for the Science for Sustainable Fuels and Chemicals, University of New South Wales, Technical University of Denmark
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Scopus rating (2010): SJR 2.494 SNIP 2.105
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BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.942 SNIP 1.957
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BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.626 SNIP 1.449
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.363 SNIP 1.49
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Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.15 SNIP 1.607
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.94 SNIP 1.174
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.997 SNIP 1.322
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.168 SNIP 1.102
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Unconventional Current Scaling and Edge Effects for Charge Transport through Molecular Clusters

Metal-molecule-metal junctions are the key components of molecular electronics circuits. Gaining a microscopic understanding of their conducting properties is central to advancing the field. In the present contribution we highlight the fundamental differences between single-molecule and ensemble junctions focusing on the fundamentals of transport through molecular clusters. In this way, we elucidate the collective behavior of parallel molecular wires, bridging the gap between single molecule and large-area monolayer electronics, where even in the latter case transport is usually dominated by finite-size islands. On the basis of first-principles charge-transport simulations, we explain why the scaling of the conductivity of a junction has to be highly non-linear in the number of molecules it contains. Moreover, transport through molecular clusters is found to be highly inhomogeneous with pronounced edge effects determined by molecules in locally different electrostatic environments. These effects are most pronounced for comparably small clusters, but electrostatic considerations show that they prevail also for more extended systems.
Valley-polarized quantum transport generated by gauge fields in graphene

We report on the possibility to simultaneously generate in graphene a bulk valley-polarized dissipative transport and a quantum valley Hall effect by combining strain-induced gauge fields and real magnetic fields. Such unique phenomenon results from a ‘resonance/anti-resonance’ effect driven by the superposition/cancellation of superimposed gauge fields which differently affect time reversal symmetry. The onset of a valley-polarized Hall current concomitant to a dissipative valley-polarized current flow in the opposite valley is revealed by a Hall conductivity plateau. We employ efficient linear scaling Kubo transport methods combined with a valley projection scheme to access valley-dependent conductivities and show that the results are robust against disorder.
Vascularization of soft tissue engineering constructs

Vascularization is recognized to be the biggest challenge for the fabrication of tissues and finally, organs in vitro. So far, several fabrication techniques have been proposed to create a perfusable vasculature within hydrogels, however, the vascularization and perfusion of hydrogels with mechanical properties in the range of soft tissues has not been fully achieved.

My project focused on the fabrication and the active perfusion of hydrogel constructs with multi-dimensional vasculature and controlled mechanical properties targeting soft tissues. Specifically, the initial part of the research has focused on: (1) the fabrication and characterization of gelatin constructs with 2D and 3D perfusable vasculature and (2) the development of a fluidic platform to allow the direct perfusion of the fabricated constructs. Throughout the developed technology, it was possible to fabricate and perfuse densely populated constructs integrating a 3D vasculature. Also, it was possible to fabricate and test a hydrogel-based fluidic system integrating sensors capable of simulating a barrier environment.

The research presented in this thesis is part of the EU-funded FP7 project NanoBio4Trans ("A new nanotechnology-based paradigm for engineering vascularised liver tissue for transplantation") and the Danish National Research Foundation and Villum Foundation’s Center for Intelligent Drug delivery and sensing Using microcontainers and Nanomechanics (Danish National Research Foundation (DNRF122)).

What Are We Looking At? Extracellular Vesicles, Lipoproteins, or Both?

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Authors: Simonsen, J. B. (Intern)
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What is the band alignment of Cu$_2$ZnSn(S,Se)$_4$ solar cells?
The band alignment at the Cu$_2$ZnSn(S,Se)$_4$/CdS solar cell heterojunction is a controversial issue, as different measurements and calculations point to substantially different conduction band offsets (CBO). As the actual value of the CBO has profound implications on solar cell performance, the aim of this work is to separate genuine process-dependent variations in the CBO from errors in its experimental determination. We argue that the two most likely mechanisms responsible for real CBO variations are Fermi level pinning (which tends to decrease the CBO) and chemical interdiffusion (which tends to increase the CBO). The experimental and computational approaches employed so far to determine the band alignment are analyzed to point out possible limitations for each approach, with an emphasis on photoemission-based approaches. The influence of Fermi level pinning on the CBO should be captured correctly by all types of measurements, except for measurements performed under flat-band conditions. This may explain some particularly large values of the CEO that have been measured under flat-band conditions. On the other hand, the influence of interdiffusion is difficult to resolve completely by most measurement approaches. Interestingly, a rough correlation can be established between the CEO measured at the Cu$_2$ZnSnS$_4$/CdS interface by different groups and their corresponding solar cell efficiency: lower-efficiency cells often have a large "cliff-like" offset, whereas most high-efficiency cells have a "spike-like" or nearly flat offset. Control of interdiffusion can be a powerful way to engineer the optimal band alignment in Cu$_2$ZnSnS$_4$/CdS solar cells, but it can be detrimental in Cu$_2$ZnSnSe$_4$/CdS solar cells, as it may increase the CBO above the optimal range for maximum efficiency.
Why iron oxide nanoflowers are great candidates for magnetic hyperthermia

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Department of Physics, Neutrons and X-rays for Materials Physics, Universidad de Cantabria, Technische Universität Braunschweig, Physikalisch-Technische Bundesanstalt, Uppsala University, University College London, AGH University of Science and Technology, Chalmers University of Technology, Micromod Partikeltechnologie GmbH, Institut Laue-Langevin, RISE Acreo
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Wireless Powered Lab-on-Disc Platform for Measurements on the Spin

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Wireless, smartphone controlled potentiostat integrated with lab-on-disc platform

A smartphone controlled wireless data transmitting and inductive powering Power Lab-on-disc (PLoD) platform is developed based on 2.4 GHz Bluetooth and 205 kHz Qi techniques, respectively. A potentiostat is integrated on the PLoD platform, and amperometric measurements are performed. The wireless potentiostat can provide -3~3 V with 14-bit resolution for amperometry in a range of -300~300 μA with a readout noise floor of 1.2 μA (p-p) in a static condition. A 0~3000 rpm spinning test shows that a phosphate buffer saline (400 mV potential) baseline noise is proportional to spinning acceleration and deceleration.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, National Taiwan Ocean University, National Taiwan University, Technical University of Denmark
Authors: Cheng, C. (Ekstern), Zor, K. (Intern), Wang, J. (Ekstern), Sanger, K. (Intern), Wang, W. (Ekstern), Capria, A. M. (Ekstern), Boisen, A. (Intern), Huang, K. (Ekstern), Hwu, E. T. (Intern)
Photothermal modification of plasmonic structures

There is presented a method for geometrically modifying plasmonic structures on a support structure, such as for printing or recording, said method comprising changing a geometry specifically of plasmonic structures, wherein said changing the geometry is carried out by photothermally melting at least a portion of each of the plasmonic structures within the second plurality of plasmonic structures by irradiating, the plasmonic structures with incident electromagnetic radiation having an incident intensity in a plane of the second plurality of plasmonic structures, wherein said incident intensity is less than an incident intensity required to melt a film of a corresponding material and a corresponding thickness as the plasmonic structures within the second plurality of plasmonic structures.

An etching mask and a method to produce an etching mask

The present invention relates to an etching mask comprising silicon containing block copolymers produced by self-assembly techniques onto silicon or graphene substrate. Through the use of the etching mask, nanostructures having long linear features having sub-10 nm width can be produced.
A substrate and a method of using it
A substrate for a plurality of different measurement set-ups such as SERS, SPR and LSPR which substrate has a base and a plurality of elongate elements with metallic tips. A metallic layer is present on the base surface between the elongate elements and gaps or cavities exist between the layer and the tips or elongate elements. When the elongate elements and the base are transparent, transmission measurement set-ups are also possible.

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Organisations: Department of Micro- and Nanotechnology, Department of Physics, Experimental Surface and Nanomaterials Physics, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Thilsted, A. H. (Intern), Schmidt, M. S. (Intern), Rindzevicius, T. (Intern), Boisen, A. (Intern)
Publication date: 5 Oct 2016

A device for extracting volatile species from a liquid
The invention relates to a device (10) for extracting volatile species from a liquid (20) connected to an inlet of an analysis instrument, such as a mass spectrometer (MS). The device has a chamber (4), a membrane (5) forming a barrier for the liquid at zero differential pressure between the inside and the outside of the chamber, and allowing passage of the volatile species at zero differential pressure between the inside and the outside of the chamber. The device has an inlet capillary channel (3) to feed in a carrier gas and prevent back-diffusion from the chamber, and an outlet capillary channel (6) which provides a significant pressure reduction, e.g. from atmospheric pressure in the chamber (4) to near-vacuum suitable for an MS. The invention combines the best of two worlds, i.e. the fast time-response of a DEMS system and the high sensitivity of a MIMS system, since a differential pumping stage is not needed.

General information
State: Published
Organisations: Department of Physics, Experimental Surface and Nanomaterials Physics, Department of Micro- and Nanotechnology, Silicon Microtechnology
Authors: Trimarco, D. B. (Intern), Vesborg, P. C. K. (Intern), Pedersen, T. (Intern), Hansen, O. (Intern), Chorkendorff, I. (Intern)
Publication date: 19 May 2016
Method of producing an item with enhanced wetting properties by fast replication and replication tool used in the method

The invention relates to a replication tool (1) for producing an item (4) with enhanced wetting properties by fast replication, such as injection moulding or extrusion coating. The replication tool (1) comprises a tool surface (2a, 2b) defining a general shape of the item (4). The tool surface (2a, 2b) comprises a microscale structured master surface (3a, 3b, 3c) having a lateral master pattern and a vertical master profile. The microscale structured master surface (3a, 3b, 3c) has been provided by localized pulsed laser treatment to generate microscale phase explosions. A method of producing an item with enhanced wetting properties uses the replication tool (1) to form an item (4) with a general shape as defined by the tool surface. The formed item (4) comprises a microscale textured replica surface (5a, 5b, 5c) with a lateral arrangement of polydisperse microscale protrusions.

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Organisations: Department of Micro- and Nanotechnology, BioLabChip, Polymer Micro & Nano Engineering
Authors: Poulsen, C. E. (Intern), Wolff, A. (Intern), Andersen, N. K. (Intern), Kistrup, K. (Intern), Taboryski, R. J. (Intern)
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MICRO-SCALE ENERGY DIRECTORS FOR ULTRASONIC WELDING

The invention relates to a replication tool (1) for producing a part (4) with a microscale textured replica surface (5a, 5b, 5c, 5d). The replication tool (1) comprises a tool surface (2a, 2b) defining a general shape of the item (4). The tool surface (2a, 2b) comprises a microscale structured master surface (3a, 3b, 3c, 3d) having a lateral master pattern and a vertical master profile. The microscale structured master surface (3a, 3b, 3c, 3d) has been provided by localized pulsed laser treatment to generate microscale phase explosions. A method for producing a part (4) with microscale energy directors on flange portions thereof uses the replication tool (1) to form an item (4) with a general shape as defined by the tool surface (2a, 2b). The formed item (4) comprises a microscale textured replica surface (5a, 5b, 5c, 5d) with a lateral arrangement of polydisperse microscale protrusions. The microscale protrusions may be provided on a flange portion of a first part (40) and are configured to act as energy directors when forming an ultrasonic joint with a cooperating flange portion of a second part (50).

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REPLICATION TOOL AND METHOD OF PROVIDING A REPLICATION TOOL

The invention relates to a replication tool (1, 1a, 1b) for producing a part (4) with a microscale textured replica surface (5a, 5b, 5c, 5d). The replication tool (1, 1a, 1b) comprises a tool surface (2a, 2b) defining a general shape of the item. The tool surface (2a, 2b) comprises a microscale structured master surface (3a, 3b, 3c, 3d) having a lateral master pattern and a vertical master profile. The microscale structured master surface (3a, 3b, 3c, 3d) has been provided by localized pulsed laser treatment to generate microscale phase explosions. A method for producing a part with microscale energy directors on flange portions thereof uses the replication tool (1, 1a, 1b) to form an item (4) with a general shape as defined by the tool surface (2a, 2b). The formed item (4) comprises a microscale textured replica surface (5a, 5b, 5c, 5d) with a lateral arrangement of polydisperse microscale protrusions. The microscale protrusions may be provided on a flange portion of a first part and are configured to act as energy directors when forming an ultrasonic joint with a cooperating flange portion of a second part.

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Working electrode holder and electrochemical cell

The present disclosure relates to a holder for a test object, more specifically to a holder for measuring electrochemical properties of the test object. One embodiment relates to a working electrode holder for measuring electrochemical properties of a front surface of a test object in a liquid, comprising: a housing comprising a bottom surface and a sidewall, the sidewall defining a first opening such that the test object can be placed inside the housing via the first opening and such that the front surface is facing the inner bottom surface; one or more electrically conductive pin(s) fixed to the bottom surface inside the housing such that the front surface of the test object is able to be placed on the pin(s), thereby providing an electrically contacted front surface, such that the electrically contacted front surface is able to operate as the working electrode; a second opening located in the bottom surface and configured for passage of said liquid, such that liquid is able to pass onto the electrically contacted front surface. The holder may be used in an electrochemical cell.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Nanointegration, Center for Nanostructured Graphene
Authors: Stoot, A. C. (Intern), Birney, R. (Intern), Booth, T. (Intern)
Publication date: 4 Feb 2016

Publication information
160 Gbit/s photonics wireless transmission in the 300-500 GHz band

To accommodate the ever increasing wireless traffic in the access networks, considerable efforts have been recently invested in developing photonics-assisted wireless communication systems with very high data rates. Superior to photonic millimeter-wave systems, terahertz (THz) band (300 GHz-10 THz) provides a much larger bandwidth and thus promises an extremely high capacity. However, the capacity potential of THz wireless systems has by no means been achieved yet. Here, we successfully demonstrate 160 Gbit/s wireless transmission by using a single THz emitter and modulating 25 GHz spaced 8 channels (20 Gbps per channel) in the 300-500 GHz band, which is the highest bitrate in the frequency band above 300 GHz, to the best of our knowledge.

2D and 3D pyrolytic carbon microelectrodes for electrochemistry

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Bibliographical note

2D and 3D pyrolytic carbon microelectrodes for electrochemistry

General information

State: Published
2D Material Device Architectures: Process Optimisation and Characterisation

A wide range of two-dimensional layered materials have been isolated and synthetically grown since the discovery of graphene. These layered materials can be thinned down to monolayer from their bulk crystals and re-stacked into arbitrary van der Waals heterostructures with atomic layer precision. The possible combinations of layers are nearly infinite, which leads to an extensive demand for robust and universal fabrication techniques and device architectures, that can enable the full potential of the extensive library of two-dimensional materials. Recent experimental development has made it possible to stack two-dimensional crystals with atomically clean interphases, through a procedure termed van der Waals assembly. We have further developed this assembly method with the 'Hot pick-up' method, which enables batch assembly as well as assembly with pre-patterned crystals. Inclusion of pre-patterned crystals increases the exibility of device architectures significantly.

In this work, devices and experiments have been performed with graphene, semi-conducting transition metal dichalcogenides and hexagonal boron nitride. Two robust and reliable approaches have been used. Firstly, stencil lithography has been applied in particular for process optimisation and fault-finding. Stencil lithography has the advantage of being fast, cheap and clean, and has in this thesis been applied for fabrication of graphene and transition metal dichalcogenides devices. Secondly, van der Waals heterostructures have been fabricated with both graphene and transition metal dichalcogenides layers encapsulated in hexagonal boron nitride. Electrical contacts to encapsulated graphene have been developed to accommodate the requirement of field-effect gating by top- and back gates. Devices of mono-, bi- and tri-layer graphene encapsulated in hexagonal boron nitride have been fabricated and studied electrically. These devices have field-effect mobilities comparable with the highest values reported. Furthermore, state of the art nano-patterns have been fabricated into encapsulated graphene. It was also explored how graphene layers perform as tunable contacts to transition metal dichalcogenides layers encapsulated in hexagonal boron nitride. This architecture yields high performance devices, where high mobilities of the air sensitive MoTe$_2$ crystals have measured, and metal-insulator transition have been observed in monolayer MoS$_2$ devices. Additionally, the long-term stability of transition metal dichalcogenides has been studied, and the order of the layers has been demonstrated detectable by atomic force microscopy.

The encapsulated van der Waals heterostructures give high performance and long-term stability of two-dimensional layered materials. The integration of pre-patterned layers, post-patterning of van der Waals heterostructures and detection of the layer order enables control not only of the vertical ordering of atomic layers but also in the lateral dimension, facilitating fabrication of advanced metamaterials and nano-devices with better or completely new functionalities.
3-D Imaging using Row–Column-Addressed 2-D Arrays with a Diverging Lens

It has been shown that row–column-addressed (RCA) 2-D arrays can be an inexpensive alternative to fully addressed 2-D arrays. Generally imaging with an RCA 2-D array is limited to its forward-looking volume region. Constructing a double-curved RCA 2-D array or applying a diverging lens over the flat RCA 2-D array, can extend the imaging field-of-view (FOV) to a curvilinear volume without increasing the aperture size, which is necessary for applications such as abdominal and cardiac imaging. Extended FOV and low channel count of double-curved RCA 2-D arrays make it possible to have 3-D imaging with equipment in the price range of conventional 2-D imaging. This study proposes a delay-and-sum (DAS) beamformation scheme specific to double-curved RCA 2-D arrays and validates its focusing ability based on simulations. A synthetic aperture imaging (SAI) sequence with single element transmissions at a time, is designed for imaging down to 14 cm at a volume rate of 88 Hz. The curvilinear imaging performance of a λ/2-pitch 3 MHz 62+62 RCA 2-D array is investigated as a function of depth, using a diverging lens with f-number of -1. The results of this study demonstrate that the proposed beamforming approach is accurate for achieving correct time-of-flight calculations, and hence avoids geometrical distortions.

3D network single-phase Ni0.9Zn0.1O as anode materials for lithium-ion batteries

A novel 3D network single-phase Ni0.9Zn0.1O has been designed and synthesized by calcining a special metal-organic precursor (MOP) (MeO2C3H6, Me=Ni and Zn, the molar ratio of Ni: Zn=9:1) as the self-sacrificing template for the first time. Comparing with NiO or the mixture of NiO and ZnO, the new two-step Li-ion storage mechanism in the 3D network single-phase Ni0.9Zn0.1O has been discovered and verified to be: a reversible conversion reaction between Ni0.9Zn0.1O and Ni-Zn alloy (Ni0.9Zn0.1), and a reversible Li-alloying reaction between Ni-Zn alloy and Ni0.9Zn0.1Li. More remarkably, due to the new mechanism, the anode material shows a low initial discharge platform around ~ 0.5 V (vs. Li+/Li). The first discharge voltage is lower than typical transition-metal oxides, which generally have higher initial discharge plateau around 1.0 V (vs. Li+/Li). It is shown that the novel 3D network single-phase Ni0.9Zn0.1O has outstanding electrochemical performances, demonstrating discharge capacities (e. g. 1465.3 mAh g⁻¹ at 100 mA g⁻¹ and 1055.6
mAh g\(^{-1}\) at 800 mA g\(^{-1}\), respectively), excellent capacity retention and superior rate capability (e.g., capacity retention ratio of 92.9% after 150 cycles at 800 mA g\(^{-1}\) current density).

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Central South University
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BFI (2014): BFI-level 1
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3D Printed Silicone-Hydrogel Scaffold with Enhanced Physicochemical Properties

Scaffolds with multiple functionalities have attracted widespread attention in the field of tissue engineering due to their ability to control cell behavior through various cues, including mechanical, chemical, and electrical. Fabrication of such scaffolds from clinically approved materials is currently a huge challenge. The goal of this work was to fabricate a tissue engineering scaffold from clinically approved materials with the capability of delivering biomolecules and direct cell fate. We have used a simple 3D printing approach, that combines polymer casting with supercritical fluid technology to produce 3D interpenetrating polymer network (IPN) scaffold of silicone-poly(2-hydroxyethyl methacrylate)-co-poly(ethylene glycol) methyl ether acrylate (pHEMA-co-PEGMEA). The pHEMA-co-PEGMEA IPN materials were employed to support growth of human mesenchymal stem cells (hMSC), resulting in high cell viability and metabolic activity over a 3 weeks period. In addition, the IPN scaffolds support 3D tissue formation inside the porous scaffold with well spread cell morphology on the surface of the scaffold. As a proof of concept, sustained doxycycline (DOX) release from pHEMA-co-PEGMEA IPN was demonstrated and the biological activity of released drug from IPN was confirmed using a DOX regulated green fluorescent reporter (GFP) gene expression assay with HeLa cells. Given its unique mechanical and drug releasing characteristics, IPN scaffolds may be used for directing stem cell differentiation by releasing various chemicals from its hydrogel network.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, Fluidic Array Systems and Technology, Colloids and Biological Interfaces, Department of Chemical and Biochemical Engineering, The Danish Polymer Centre, Bioanalytics, Biomodics ApS
3-D Vector Flow Estimation With Row–Column-Addressed Arrays

Simulation and experimental results from 3-D vector flow estimations for a 62 × 62 2-D row–column (RC) array with integrated apodization are presented. A method for implementing a 3-D transverse oscillation (TO) velocity estimator on a 3-MHz RC array is developed and validated. First, a parametric simulation study is conducted, where flow direction, ensemble length, number of pulse cycles, steering angles, transmit/receive apodization, and TO apodization profiles and spacing are varied, to find the optimal parameter configuration. The performance of the estimator is evaluated with respect to relative mean bias B̂ and mean standard deviation σ̂. Second, the optimal parameter configuration is implemented on the prototype RC probe connected to the experimental ultrasound scanner SARUS. Results from measurements conducted in a flow-rig system containing a constant laminar flow and a straight-vessel phantom with a pulsating flow are presented. Both an M-mode and a steered transmit sequence are applied. The 3-D vector flow is estimated in the flow rig for four representative flow directions. In the setup with 90° beam-to-flow angle, the relative mean bias across the entire velocity profile is (−4.7, −0.9, 0.4)% with a relative standard deviation of (8.7, 5.1, 0.8)% for (vx, vy, vz). The estimated peak velocity is 48.5 ± 3 cm/s giving a −3% bias. The out-of-plane velocity component perpendicular to the cross section is used to estimate volumetric flow rates in the flow rig at a 90° beam-to-flow angle. The estimated mean flow rate in this setup is 91.2 ± 3.1 L/h corresponding to a bias of −11.1%. In a pulsating flow setup, flow rate measured during five cycles is 2.3 ± 0.1 mL/stroke giving a negative 9.7% bias. It is concluded that accurate 3-D vector flow estimation can be obtained using a 2-D RC-addressed array.
This paper presents an in-house developed 2-D capacitive micromachined ultrasonic transducer (CMUT) applied for 3-D blood flow estimation. The probe breaks with conventional transducers in two ways; first, the ultrasonic pressure field is generated from thousands of small vibrating micromachined cells, and second, elements are accessed by row and/or column indices. The 62×62 2-D row-column addressed prototype CMUT probe was used for vector flow estimation by transmitting focused ultrasound into a flow-rig with a fully developed parabolic flow. The beam-to-flow angle was 90°. The received data was beamformed and processed offline. A transverse oscillation (TO) velocity estimator was used to estimate the 3-D vector flow along a line originating from the center of the transducer. The estimated velocities in the lateral and axial direction were close to zero as expected. In the transverse direction a characteristic parabolic velocity profile was estimated with a peak velocity of 0.48 m/s ± 0.02 m/s in reference to the expected 0.54 m/s. The results presented are the first 3-D vector flow estimates obtained with a row-column CMUT probe, which demonstrates that the CMUT technology is feasible for 3-D flow estimation.
400-GHz wireless transmission of 60-Gb/s nyquist-QPSK signals using UTC-PD and heterodyne mixer

We experimentally demonstrate an optical network compatible high-speed optoelectronics THz wireless transmission system operating at 400-GHz band. In the experiment, optical Nyquist quadrature phase-shift keying signals in a 12.5-GHz ultradense wavelength-division multiplexing grid is converted to the THz wireless radiation by photomixing in an antenna integrated unitravelling photodiode. The photomixing is transparent to optical modulation formats. We also demonstrate in the experiment the scalability of our system by applying single to four channels, as well as mixed three channels. Wireless transmission of a capacity of 60 Gb/s for four channels (15 Gb/s per channel) at 400-GHz band is successfully achieved, which pushes the data rates enabled by optoelectronics approach beyond the envelope in the frequency range above 300 GHz. Besides those, this study also validates the potential of bridging next generation 100 Gigabit Ethernet wired data stream for very high data rate indoor applications.
85 μm core rod fiber amplifier delivering 350 W/m

An improved version of the distributed modal filtering (DMF) rod fiber is tested in a high power setup delivering 350 W/m of extracted signal average power limited by the available pump power. The rod fiber is thoroughly tested to record the transverse modal instability (TMI) behavior and also measure degradation of the TMI threshold with operation time due to induced absorption in the active material increasing the thermo-optical heat load. Multiple testing degrades the rod fiber and TMI threshold from >360 W to a saturated power level of roughly 240 W.

General information

State: Published
Organisations: Department of Photonics Engineering, Fiber Optics, Devices and Non-linear Effects, Fiber Sensors and Supercontinuum Generation, Department of Micro- and Nanotechnology, NKT Photonics A/S
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Fibre lasers and amplifiers, Design of specific laser systems, Optical fibre testing and measurement of fibre parameters, Spectral and other filters, Other fibre optical devices and techniques, Optical coatings and filters, Fibre optics, laser stability, optical fibre amplifiers, optical fibre filters, optical fibre testing, optical pumping, thermo-optical effects, distributed modal filtering rod fiber, rod fiber amplifier, pump power, transverse modal instability threshold, absorption, size 85 μm, saturated power thermo-optical, thermo-optical heat load, active material, Applied Mathematics, Computer Science Applications, Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Condensed Matter Physics, Fiber, Fiber optics amplifiers and oscillators, Lasers, Thermal effects, Fiber lasers, Fibers, Laser applications, Active material, Induced absorption, Modal filtering, Modal instabilities, Multiple testing, Signal average, Thermo-optical, Fiber
A broadband tapered nanocavity for efficient nonclassical light emission

We present the design of a tapered nanocavity, obtained by sandwiching a photonic wire section between a planar gold reflector and a few-period Bragg mirror integrated into the tapered wire. Thanks to its ultrasmall mode volume ($0.71 \lambda^3/n^3$), this hybrid nanocavity largely enhances the spontaneous emission rate of an embedded quantum dot (Purcell factor: 6), while offering a wide operation bandwidth (full-width half-maximum: 20 nm). In addition, the top tapered section shapes the cavity far-field emission into a very directive output beam, with a Gaussian spatial profile. For realistic taper dimensions, a total outcoupling efficiency to a Gaussian beam of 0.8 is predicted. Envisioned applications include bright sources of non-classical states of light, such as widely tunable sources of indistinguishable single photons and polarization-entangled photon pairs.
A Centrifugal Microfluidic Platform Using SLM Extraction: for combined sample clean-up and enrichment of trace analytes

Here we present a pump-less microfluidic platform which performs sample clean-up and enrichment in a single step, by integrating Supported Liquid Membrane (SLM) extraction. Our platform offers a simple, yet very efficient, method for achieving sample pre-treatment and enrichment of rare analytes, in an easy to use and highly efficient device.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Bioanalytics
Authors: Andreasen, S. Z. (Intern), Burger, R. (Intern), Emnéus, J. (Intern), Boisen, A. (Intern)
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions:
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A clinical study of short-term sternal photoplethysmography: recordings from patients with obstructive airways diseases

Traditionally, measurements of the oxygen saturation ($S_p\text{O}_2$) has been confined to the extremities. In this study, we therefore investigated the possibility for reliable estimation of clinically relevant $S_p\text{O}_2$ levels from photoplethysmography (PPG) obtained on the sternum of patients with obstructive airway diseases. We initiated the study with a calibration of a
prototype sternal PPG sensor. In accordance with the ISO 80601-2-61:2011 guidelines, the calibration was conducted as a controlled desaturation study. We obtained a calibration accuracy of 1.75% which is well within the clinically and commercially accepted range. We then compared the $S_pO_2$ levels simultaneously obtained from the sternal PPGs and a commercially available finger pulse oximeter on 28 admitted patients with either asthma or Chronic Obstructive Pulmonary Disease (COPD). The Pearson correlation between the $S_pO_2$ levels estimated from the two body locations was found to be 0.89 ($p<0.05$) and the mean system bias was only 0.052% with upper and lower limits of agreement of 2.5% and -2.4%, respectively. This finding is very promising for the future design of new sternum based patch technologies that might be able to provide continuous estimates of the $S_pO_2$ levels on critically or chronically ill patients.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, BioTelemetry Technology ApS, University of Copenhagen
Authors: Chreiteh, S. (Intern), Saadi, D. B. (Ekstern), Belhage, B. (Ekstern), Nabipour, N. (Ekstern), Hoppe, K. (Ekstern), Thomsen, E. V. (Intern)
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A comprehensive investigation of copper binding properties of metformin using on-disc magnetic microbead agglomeration with real-time analysis

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Magnetic Systems
Authors: Uddin, R. (Intern), Quan, X. (Intern), Donolato, M. (Intern), Burger, R. (Intern), Boisen, A. (Intern)
Number of pages: 1
Publication date: 2016
Main Research Area: Technical/natural sciences
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A Comprehensive Study of the Polypropylene Fiber Reinforced Fly Ash Based Geopolymer

As a cementitious material, geopolymers show a high quasi-brittle behavior and a relatively low fracture energy. To overcome such a weakness, incorporation of fibers to a brittle matrix is a well-known technique to enhance the flexural properties. This study comprehensively evaluates the short and long term impacts of different volume percentages of polypropylene fiber (PPF) reinforcement on fly ash based geopolymer composites. Different characteristics of the composite were compared at fresh state by flow measurement and hardened state by variation of shrinkage over time to assess the response of composites under flexural and compressive load conditions. The fiber-matrix interface, fiber surface and toughening mechanisms were assessed using field emission scan electron microscopy (FESEM) and atomic force microscopy (AFM). The results show that incorporation of PPF up to 3 wt % into the geopolymer paste reduces the shrinkage and enhances the energy absorption of the composites. While, it might reduce the ultimate flexural and compressive strength of the material depending on fiber content.
Acylation of Therapeutic Peptides: Interaction with Lipid Membranes and Its Implications in Oral Delivery

Oral administration of therapeutic peptides could benefit millions of chronically ill people worldwide, through easier and less stigmatized therapy, and likely improve the long-term effects of currently widespread disease mismanagement. However, oral peptide delivery is a formidable task due to the harsh and selective gastrointestinal system, and development has lacked far behind injection therapy.

Peptide acylation is a powerful tool to alter the pharmacokinetics, biophysical properties and chemical stability of injectable peptide drugs, primarily used to prolong blood circulation, but it is not widely studied in an oral context. As acylation furthermore increases interactions with the lipid membranes of mammalian cells, it offers several potential benefits for oral delivery of therapeutic peptides, and we hypothesize that tailoring the acylation may be used to optimize intestinal translocation.

This work aims to characterize acylated analogues of two therapeutic peptides by systematically increasing acyl chain length in order to elucidate its influence on membrane interaction and intestinal cell translocation in vitro. The studied peptides are the 33 amino acid Glucagon-like peptide-2 (GLP-2), which promotes intestinal growth and is used to treat bowel disorders such as inflammatory bowel diseases and short bowel syndrome, and the 32 amino acid salmon calcitonin (sCT), which lowers blood calcium and is employed in the treatment of post-menopausal osteoporosis and hypercalcemia. The two peptides are similar in size and structure, but oppositely charged at physiological pH. Both peptides were acylated with linear acyl chains of systematically increasing length, where sCT was furthermore acylated at two different positions on the peptide backbone.

For GLP-2, we found that increasing acyl chain length caused increased self-association and binding to lipid and cell membranes, whereas translocation across intestinal cells displayed a nonlinear dependence on chain length. Short and medium chains improved translocation compared to the native peptide, whereas long chain acylation displayed no improvement in translocation. This indicates an initial translocation benefit for shorter chains through increased interaction with the cell membrane, which reverts to a hindrance for long chains, i.e. the analogues get stuck in the cell membrane. Co-administration of a paracellular absorption enhancer was found to increase translocation similarly for each analogue while retaining acyl chain length dependence. A transcellular enhancer displayed increased synergy with the long chain acylation, consistent with increased membrane fluidization ‘liberating’ bound peptide, although medium chain acylation remained optimal overall. The results indicate that rational acylation of GLP-2 can increase its in vitro intestinal absorption, alone or in combination with permeation enhancers, and are consistent with the initial project hypothesis.

For sCT, an unpredicted effect of acylation largely superseded the anticipated membrane interactions; i.e. acylated sCT acted as its own in vitro intestinal permeation enhancer. Acylated analogues permeabilized lipid membranes, causing drastically increased peptide permeability through reversible cell effect similar to transcellular permeation enhancers. The effect likely stems from a synergy between the positive peptide charge and membrane-active acyl moiety, supported by its pH-dependency, whereby the effect increased with decreasing pH and concomitant charge increase. The extent of permeation enhancing effect was highly dependent on acylation chain length and position, with highest peptide permeability for short chain N-terminal acylation or medium/long chain Lys18 acylation, whereas permeability and cell membrane binding appeared correlated only for some analogues. However, prolonged heating and/or solution storage of certain acylated sCT analogues caused aggregation in physiological buffer solutions, potentially forming fibril-like structures. Lys18 acylation appeared superior to N-terminal acylation, most clearly exemplified by the short chain analogues, however, no systematic dependence on acylation chain length was apparent. All analogues could be monomerized by addition of cyclodextrin, however, their separate permeability enhancing effects were reduced in the mixtures, and the additive was not investigated further. Thus, acylation of sCT for oral delivery purposes may not be indiscriminately applicable, and requires rational choices of acylation details and/or additives.

Further investigations of the most cell-permeable sCT analogues unveiled quite distinct permeation enhancer effects, ranging from high membrane binding / high permeability and non-specific enhancing effect on model compounds, to very low membrane binding / high permeability and very limited unspecific permeation enhancer effects, i.e. selective and efficient translocation.

Peptide receptor potency was retained for GLP-2 analogues following acylation, whereas sCT analogues displayed substantially reduced potency, depending on acylation position and length. Overall, rational acylation of the studied peptides can increase in vitro intestinal permeability, modestly for GLP-2 and drastically for sCT, and might benefit oral delivery. GLP-2 results provide a well-founded predictive power for future peptide analogues, whereas sCT results hold great promise for future analogues, albeit with a larger uncertainty in predictions.
Affinity Induced Surface Functionalization of Liposomes Using Cu-Free Click Chemistry

Functionalization of nanoparticles is a key element for improving specificity of drug delivery systems toward diseased tissue or cells. In the current study we report a highly efficient and chemoselective method for post-functionalization of liposomes with biomacromolecules, which equally well can be used for functionalization of other nanoparticles or solid surfaces. The method exploits a synergistic effect of having both affinity and covalent anchoring tags on the surface of the liposome. This was achieved by synthesizing a peptide linker system that uses Cu-free strain-promoted click chemistry in combination with histidine affinity tags. The investigation of post-functionalization of PEGylated liposomes was performed with a cyclic RGDfE peptide. By exploring both affinity and covalent tags a 98 ± 2.0% coupling efficiency was achieved, even a diluted system showed a coupling efficiency of 87 ± 0.2%. The reaction kinetics and overall yield were quantified by HPLC. The results presented here open new possibilities for constructing complex nanostructures and functionalized surfaces.
Al-doped ZnO: RF- or DC-sputtering?

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Energy Conversion and Storage, Fundamental Electrochemistry, Department of Photonics Engineering, Optical Microsensors and Micromaterials, Capres A/S, Technical University of Denmark
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Main Research Area: Technical/natural sciences

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Algal toxicity of platinum nanoparticles - Implications of NP aggregation, dissolution and shading
All-graphene edge contacts: Electrical resistance of graphene T-junctions

Using ab-initio methods we investigate the possibility of three-terminal graphene “T-junction” devices and show that these all-graphene edge contacts are energetically feasible when the 1D interface itself is free from foreign atoms. We examine the energetics of various junction structures as a function of the atomic scale geometry. Three-terminal equilibrium Green's functions are used to determine the transmission spectrum and contact resistance of the system. We find that the most symmetric structures have a significant binding energy, and we determine the contact resistances in the junction to be in the range of 1-10 kΩμm which is comparable to the best contact resistance reported for edge-contacted graphene-metal contacts. We conclude that conducting all-carbon T-junctions should be feasible.
All-Optical Switching Improvement Using Photonic-Crystal Fano Structures

We investigate the intensity and phase response of optical switches based on a photonic crystal waveguide coupled to a nanocavity. In particular, we compare the performances of switches with traditional Lorentzian transmission spectrum to switches displaying an asymmetric Fano shape, as obtained by incorporating a partially transmitting element in the waveguide. Compared to traditional Lorentzian structures, the Fano structure shows improved switching contrast and speed without adding any extra phase modulation, corresponding to a much lower chirp parameter. Using a simple and ultracompact InP photonic-crystal Fano structure with broken mirror symmetry, we experimentally demonstrate 20-Gb/s all-optical switching with low-energy consumption.

General information

State: Published
Organisations: Department of Photonics Engineering, Nanophotonics Theory and Signal Processing, High-Speed Optical Communication, Department of Micro- and Nanotechnology, Centre of Excellence for Silicon Photonics for Optical Communications, Nanophotonic Devices
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Publication date: 2016
Main Research Area: Technical/natural sciences
All-polymer microfluidic systems for droplet based sample analysis: Bringing droplet technologies to life: Bridging the gap between academia and industry

In this PhD project, I pursued to develop an all-polymer injection moulded microfluidic platform with integrated droplet based single cell interrogation. To allow for a proper “one device - one experiment” methodology and to ensure a high relevancy to non-academic settings, the systems presented here were fabricated exclusive using commercially relevant fabrication methods such as injection moulding and ultrasonic welding. Further, to reduce the complexity of the final system, I have worked towards an all-in-one device which includes sample loading, priming (removal of air), droplet formation, droplet packing, imaging and amplification (heating).

The project has been broken into sub-projects, in which several devices of simpler application have been developed. Most of these employ gravity for concentrating and packing droplets, which has been made possible by the use of large area chambers bonded by ultrasonic welding.

In the sub-projects of this PhD, improvements have been made to multiple aspects of fabricating and conducting droplet (or multiphase) microfluidics:

- Design phase: Numerical prediction of the capillary burst pressure of a multiphase system.
- Fabrication: Two new types of energy directors for ultrasonic welding of microfluidic systems have been presented:
  1. Tongue-and-groove energy directors.
  2. Laser ablated micropillar energy directors.
- Fabrication: Annealing of polymer devices for use with hydrocarbon based multiphase systems.
- Experimental design and data analysis: Optimised estimators for single-hit limiting-dilution assays.
A range of concurrent activities have also been undertaken:

• TransForm-technologies, a to-be spin-out of this PhD project has been initiated, and 725,000 DKK has been raised and spent on maturation of the mould microstructuring technology, incorporating and testing the technology in a commercial setting, and formulating a business plan.

• Three patent applications have been submitted to the European Patent Office.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, Fluidic Array Systems and Technology
Authors: Poulsen, C. E. (Intern), Wolff, A. (Intern), Dufva, M. (Intern)
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A microfluidic cell culture device with integrated microelectrodes for barrier studies.
We present an eight cell culture microfluidic device fabricated using thiol-ene ‘click’ chemistry with embedded microelectrodes for evaluating barrier properties of human intestinal epithelial cells. The capability of the microelectrodes for trans-epithelial electrical resistance (TEER) measurements was demonstrated by using confluent human colorectal epithelial cells (Caco-2) and rat fibroblast (CT 26) cells cultured in the microfluidic device.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Fluidic Array Systems and Technology, University of Copenhagen
Authors: Tan, H. (Intern), Dufva, M. (Intern), Kutter, J. P. (Ekstern), Andresen, T. L. (Intern)
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A microfluidic cell culture device with integrated microelectrodes for barrier studies.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Fluidic Array Systems and Technology, University of Copenhagen
Authors: Tan, H. (Intern), Dufva, M. (Intern), Kutter, J. P. (Ekstern), Andresen, T. L. (Intern)
Publication date: 2016
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Main Research Area: Technical/natural sciences
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Source: Publication: Research - peer-review › Poster – Annual report year: 2016

A Mouse Positron Emission Tomography Study of the Biodistribution of Gold Nanoparticles with Different Surface Coatings Using Embedded Copper-64
By taking advantage of the ability of (64)Cu to bind non-specifically to gold surfaces, we have developed a new methodology to embed this radionuclide inside gold nanoparticles (AuNPs). (64)Cu enables the in vivo imaging of AuNPs by positron emission tomography (PET). AuNPs have a multitude of uses within health technology and are useful tools for
general nanoparticle research. (64)Cu-AuNPs were prepared by incubating AuNP seeds with (64)Cu(2+), followed by the entrapment of the radionuclide by grafting a second layer of gold on the surface. This resulted in radiolabeling efficiencies of 53 ± 6%. The radiolabel showed excellent stability when challenging with EDTA for two days (>95% radioactivity retention) and showed no loss of (64)Cu when incubated with 50% mouse serum for two days. The methodology was chelator-free, and circumvents traditional concerns over chelator instability and altered AuNP properties due to surface modification. Radiolabeled (64)Cu-AuNP cores were prepared in a biomedically relevant size of 30 nm and used to investigate the in vivo stability of three different AuNP coatings by PET imaging in a murine xenograft tumor model. We found the longest plasma half-life (T½ = 9 hours) and highest tumor accumulation (3.9 %ID/g) by using polyethylene glycol (PEG) coating, while faster elimination from the bloodstream was observed with both a Tween 20-stabilized coating and a zwitterionic coating based on a mixture of sulfonic acids and quaternary amines, which has previously been reported to be superior to PEG. The new embedding method provides the utilization of PET imaging in combination with the multitude of uses that AuNPs have found in health technology, and the method can equally well be utilized for therapeutic copper radioisotopes for use in radiotherapy.
A Multimethod Approach for Investigating Algal Toxicity of Platinum Nanoparticles

The ecotoxicity of platinum nanoparticles (PtNPs) widely used in for example automotive catalytic converters, is largely unknown. This study employs various characterization techniques and toxicity end points to investigate PtNP toxicity toward the green microalgae Pseudokirchneriella subcapitata and Chlamydomonas reinhardtii. Growth rate inhibition occurred in standard ISO tests (EC50 values of 15–200 mg Pt/L), but also in a double-vial setup, separating cells from PtNPs, thus demonstrating shading as an important artifact for PtNP toxicity. Negligible membrane damage, but substantial oxidative stress was detected at 0.1–80 mg Pt/L in both algal species using flow cytometry. PtNPs caused growth rate inhibition and oxidative stress in P. subcapitata, beyond what was accounted for by dissolved Pt, indicating NP-specific toxicity of PtNPs. Overall, P. subcapitata was found to be more sensitive toward PtNPs and higher body burdens were measured in this species, possibly due to a favored binding of Pt to the polysaccharide-rich cell wall of this algal species. This study highlights the importance of using multimethod approaches in nanoecotoxicological studies to elucidate toxicity mechanisms, influence of NP-interactions with media/organisms, and ultimately to identify artifacts and appropriate end points for NP-ecotoxicity testing.

General information
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Organisations: Department of Environmental Engineering, Environmental Chemistry, Department of Chemistry, NanoChemistry, Organic Chemistry, Infection Microbiology, Department of Micro- and Nanotechnology, University of Geneva, IPM-Intelligent Pollutant Monitoring, Technical University of Denmark
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Scopus rating (2015): SJR 2.546 SNIP 1.838 CiteScore 5.61
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.777 SNIP 2.003 CiteScore 5.5
Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 2.952 SNIP 2.102 CiteScore 5.52
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
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Scopus rating (2012): SJR 3.115 SNIP 2.043 CiteScore 5.17
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Analyzing Engineered Nanoparticles using Photothermal Infrared Spectroscopy

Nanoparticles, particles having one or more dimensions smaller than 100 nm, show novel properties and functions that differ significantly from those of their corresponding bulk counterpart. Due to their small size and large surface to volume ratio they can e.g. diffuse easily and be highly reactive. To facilitate occupational safety and health there is a need to develop instruments to monitor and analyze nanoparticles in the industry, research and urban environments. The aim of this Ph.D. project was to develop new sensors that can analyze engineered nanoparticles. Two sensors were studied: (i) a miniaturized toxicity sensor based on electrochemistry and (ii) a photothermal spectrometer based on tensile-stressed mechanical resonators (string resonators).

Miniaturization of toxicity sensor targeting engineered nanoparticles was explored. This concept was based on the results of the biodurability test using redox activity measurements. With a new setup adapted to miniaturization, stable pH was achieved, platinum was found to be more suitable than gold for open circuit potential-time measurements, miniaturized platinum working electrodes and quasi silver/silver chloride reference electrodes were fabricated, and Gambles solution with dispersed iron oxide nanoparticles showed lowered potential as expected. Despite the potential of this concept instability and lack of reproducibility continued to be an unneglectable issue. The concept of utilizing string resonators for photothermal spectroscopy was, for the first time, studied in details both theoretically and experimentally. The string-based photothermal spectrometer consists of a string resonator on which an analyte is collected. Wavelength-dependent absorption by the analyte leads to heating of the string which is reflected in its resonance frequency. This setup allows for spectroscopic measurement of the analyte. An analytical model describing the resonance frequency of a string resonator
locally heated was developed. The developed model was in agreement with FEM simulations and experimental results. Theoretical and experimental work lead to a set of design rules for the responsivity of the string-based photothermal spectrometer. Responsivity is maximized for a thin, narrow and long string irradiated by high power radiation. Various types of nanoparticles and binary mixtures of them were successfully detected and analyzed. Detection of copper-chelation of the antidiabetic drug metformin was demonstrated as well. The estimated detection limit for the developed system is an analyte with a mass of ~150 ag (1 ag = 10^-18 g). In short, it has been demonstrated that the string-based photothermal spectrometer is a promising technique for nanoparticle detection and analysis.

**General information**

State: Published  
Organisations: Nanoprobes, Department of Micro- and Nanotechnology  
Authors: Yamada, S. (Intern), Boisen, A. (Intern), Schmid, S. (Intern)  
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Main Research Area: Technical/natural sciences  
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**An Analytical Approach to the Thrombogram**

**General information**

State: Published  
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Novo Nordisk A/S  
Authors: Markovich, D. (Intern), Røder, G. (Ekstern), Flyvbjerg, H. (Intern)  
Number of pages: 1  
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Event: Abstract from 3rd Maastricht Thrombin Summer School, Maastricht, Netherlands.  
Main Research Area: Technical/natural sciences  
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Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

**An ATP Binding Cassette Transporter Mediates the Uptake of α-(1,6)-Linked Dietary Oligosaccharides in Bifidobacterium and Correlates with Competitive Growth on These Substrates**

The molecular details and impact of oligosaccharide uptake by distinct human gut microbiota (HGM) are currently not well understood. Non-digestible dietary galacto- and gluco-(1,6)-oligosaccharides from legumes and starch, respectively, are preferentially fermented by mainly bifidobacteria and lactobacilli in the human gut. Here we show that the solute binding protein (BIG16BP) associated with an ATP binding cassette (ABC) transporter from the probiotic *Bifidobacterium animalis* subsp. lactis BI-04 binds -(1,6)-linked glucosides and galactosides of varying size, linkage, and monosaccharide composition with preference for the trisaccharides raffinose and panose. This preference is also reflected in the -(1,6)-galactoside uptake profile of the bacterium. Structures of BIG16BP in complex with raffinose and panose revealed the basis for the remarkable ligand binding plasticity of BIG16BP, which recognizes the non-reducing -(1,6)-diglycoside in its ligands. BIG16BP homologues occur predominantly in bifidobacteria and a few Firmicutes but lack in other HGMs. Among seven bifidobacterial taxa, only those possessing this transporter displayed growth on -(1,6)-glycosides. Competition assays revealed that the dominant HGM commensal *Bacteroides* ovatus was out-competed by *B. animalis* subsp. lactis BI-04 in mixed cultures growing on raffinose, the preferred ligand for the BIG16BP. By comparison, *B. ovatus* monocultures grew very efficiently on this trisaccharide. These findings suggest that the ABC-mediated uptake of raffinose provides an important competitive advantage, particularly against dominant *Bacteroides* that lack glycan-specific ABC-transporters. This novel insight highlights the role of glycan transport in defining the metabolic specialization of gut bacteria.
An ATP Binding Cassette Transporter Mediates the Uptake of 1,6-Linked Dietary Oligosaccharides in Bifidobacterium and Correlates with Competitive Growth on These Substrates.pdf. Embargo ended: 08/08/2017

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An ecofriendly graphene-based nanofluid for heat transfer applications
Herein, a new ecofriendly approach to generate a graphene-based nanofluid was established. Specifically, a novel mode of graphene oxide reduction through functionalization with polyphenol extracted from red wine was introduced. Comprehensive characterization methods were employed to confirm and understand the reduction process of graphene oxide in the red wine polyphenol solution. It was noted, that the deoxygenation level of the reduced graphene oxide is comparable with the levels obtained by conventional and non-ecofriendly methods. The physical and thermal properties of the generated nanofluid including chemical stability, viscosity, wettability, electrical conductivity and thermal conductivity were investigated in a comprehensive manner. A significant thermal conductivity enhancement amounting to 45.1% was obtained for a volume fraction of 4%. In addition, the convective heat transfer coefficient of the nanofluid in a laminar flow regime with uniform wall heat flux was investigated to estimate its cooling capabilities. These results, firmly confirm that the generated graphene-based nanofluid is a formidable transporter of heat and yet ecofriendly. Therefore, it's anticipate that the generated nanofluid will open a new avenue in the pursuit of ecofriendly thermal conductors for heat transfer applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Malaya, University of Wollongong
Authors: Mehrali, M. (Ekstern), Sadeghinezhad, E. (Ekstern), Akhiani, A. R. (Ekstern), Tahan Latibari, S. (Ekstern), Talebian, S. (Ekstern), Dolatshahi-Pirouz, A. (Intern), Metselaar, H. S. C. (Ekstern), Mehrali, M. (Intern)
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BFI (2017): BFI-level 2
An efficient magnetic tight-binding method for transition metals and alloys
An efficient parameterized self-consistent tight-binding model for transition metals using s, p and d valence atomic orbitals as a basis set is presented. The parameters of our tight-binding model for pure elements are determined from a fit to bulk...
ab-initio calculations. A very simple procedure that does not necessitate any further fitting is proposed to deal with systems made of several chemical elements. This model is extended to spin (and orbital) polarized materials by adding Stoner-like and spin–orbit interactions. Collinear and non-collinear magnetism as well as spin-spirals are considered. Finally the electron–electron intra-atomic interactions are taken into account in the Hartree–Fock approximation. This leads to an orbital dependence of these interactions, which is of a great importance for low-dimensional systems and for a quantitative description of orbital polarization and magneto-crystalline anisotropy. Several examples are discussed.
A neutral polyacrylate copolymer coating for surface modification of thiol-ene microchannels for improved performance of protein separation by microchip electrophoresis

We have investigated the behavior of thiol-ene substrates that is a class of promising materials for lab-on-a-chip electrophoresis applications. Two polymeric materials were prepared by copolymerization of N, N-dimethylacrylamide (DMA), (3-(methacryloyl-oxy)propyl)trimethoxysilane (PMA) and 3-trimethylsilanyl-prop-2-ynemethacrylate (MAPS) and specifically adapted to thiol-ene formulations in order to obtain a neutral and permanent coating for microchannels. The performance of two different thiol-ene substrates (with 20% and 40% excess of thiol groups, respectively) coated with either p-(DMA-PMA) or p-(DMA-PMAMAPS) copolymer were evaluated in terms of surface hydrophilicity, suppression and stability of electro-osmotic flow and prevention of protein adsorption. Surface modification of thiol-ene containing a 20% excess of thiols with the terpolymer p-(DMA-PMA-MAPS) was found to offer the most stable coating and most efficient charge shielding in the pH range from 3 to 9. The modified microchannels were successfully applied to electrokinetic separations of acidic and basic proteins.
A new application of plant virus nanoparticles as drug delivery in breast cancer

Nanoparticles based on non-pathogenic viruses have opened up a novel sector in nanotechnology. Viral nanoparticles based on plant viruses have clear advantages over any synthetic nanoparticles as they are biocompatible and biodegradable self-assembled and can be produced inexpensively on a large scale. From several such under-development platforms, only a few have been characterized in the target-specific drugs into the cells. Potato virus X is presented as a carrier of the chemotherapeutic drug Herceptin that is currently used as a targeted therapy in (HER2+) breast cancer patients. Here, we used nanoparticles formed from the potato virus X to conjugate the Herceptin (Trastuzumab) monoclonal antibody as a new option in specific targeting of breast cancer. Bioconjugation was performed by EDC/sulfo-N-hydroxysuccinimide (sulfo-NHS) in a two-step protocol. Then, the efficiency of conjugation was investigated by different methods, including sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE), Western blot, ELISA, Zetasizer, and transmission electron microscopy. SDS-PAGE and Western blot analysis confirmed an 82-kDa protein band that resulted from conjugation of potato virus X (PVX) coat protein (27 kDa) to heavy chain of Herceptin (55 kDa). Zeta potential values for conjugated particles, PVX, and HER were −7.05, −21.4, and −1.48, respectively. We investigated the efficiency of PVX-Herceptin to induce SK-OV-3 and SK-BR-3 cells (HER2 positive cell lines) apoptosis. We therefore counted cells and measured apoptosis by flow cytometry assay, then compared with Herceptin alone. Based on our data, we confirmed the conjugation of PVX and Herceptin. This study suggests that the PVX-Herceptin conjugates enable Herceptin to become more potential therapeutic tools.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems, Karolinska Institutet, Tarbiat Modares University, University of Tehran
Authors: Esfandiari, N. (Ekstern), Arzanani, M. K. (Ekstern), Soleimani, M. (Ekstern), Kohi-Habibi, M. (Ekstern), Svendsen, W. E. (Intern)
Number of pages: 8
Pages: 1229-1236
**A novel gold nanoparticle-DNA aptamer-based plasmonic chip for rapid and sensitive detection of bacterial pathogens**

Gold nanoparticles (AuNPs)-based biosensors are emerging technologies for rapid detection of pathogens. However, it is very challenging to develop chip-based AuNP-biosensors for whole cells. This paper describes a novel AuNPs-DNA aptamer-based plasmonic assay which allows DNA aptamers to be detached from AuNPs when interacting with bacteria. The new strategy greatly increases the sensitivity and specificity of chip-based whole-cell biosensing.

**General information**
State: Published
Organisations: BioLabChip, Department of Micro- and Nanotechnology, National Food Institute, Research Group for Diagnostic Engineering, Research Group for Analytical and Predictive Microbiology
Authors: Sun, Y. (Intern), Phuoc Long, T. (Intern), Wolff, A. (Intern), Bang, D. D. (Intern)
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**A novel lab-on-chip platform with integrated solid phase PCR and Supercritical Angle Fluorescence (SAF) microlens array for highly sensitive and multiplexed pathogen detection**

Solid-phase PCR (SP-PCR) has become increasingly popular for molecular diagnosis and there have been a few attempts to incorporate SP-PCR into lab-on-a-chip (LOC) devices. However, their applicability for on-line diagnosis is hindered by the lack of sensitive and portable on-chip optical detection technology. In this paper, we addressed this challenge by combining the SP-PCR with super critical angle fluorescence (SAF) microlens array embedded in a microchip. We fabricated miniaturized SAF microlens array as part of a microfluidic chamber in thermoplastic material and performed multiplexed SP-PCR directly on top of the SAF microlens array. Attribute to the high fluorescence collection efficiency of the SAF microlens array, the SP-PCR assay on the LOC platform demonstrated a high sensitivity of 1.6 copies/µL, comparable to off-chip detection using conventional laser scanner. The combination of SP-PCR and SAF microlens array allows for on-chip highly sensitive and multiplexed pathogen detection with low-cost and compact optical components. The LOC platform would be widely used as a high-throughput biosensor to analyze food, clinical and environmental samples.

**General information**
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Organisations: National Food Institute, Department of Micro- and Nanotechnology, BioLabChip
Authors: Hung, T. Q. (Intern), Chin, W. H. (Intern), Sun, Y. (Intern), Wolff, A. (Intern), Bang, D. D. (Intern)
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Scopus rating (2017): SNIP 1.65 SJR 2.373
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 7.22 SJR 2.095 SNIP 1.619
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
A Novel Nanohybrid Nanofibrous Adsorbent for Water Purification from Dye Pollutants

In this study, we devised a novel nanofibrous adsorbent made of polyethersulfone (PES) for removal of methylene blue (MB) dye pollutant from water. The polymer shows a low isoelectric point thus at elevated pHs and, being nanofibrous, can offer a huge highly hydroxylated surface area for adsorption of cationic MB molecules. As an extra challenge, to augment the adsorbent’s properties in terms of adsorption capacity in neutral and acidic conditions and thermal stability, vanadium pentoxide (V2O5) nanoparticles were added to the nanofibers. Adsorption data were analyzed according to the Freundlich adsorption model. The thermodynamic parameters verified that only at basic pH is the adsorption spontaneous and in general the process is entropy-driven and endothermic. The kinetics of the adsorption process was evaluated by the pseudo-first- and pseudo-second-order models. The latter model exhibited the highest correlation with data. In sum, the adsorbent showed a promising potential for dye removal from industrial dyeing wastewater systems, especially when envisaging their alkaline and hot conditions.
Aptasensor development for detection of virus in water

Contamination of water by waterborne viruses causes serious health issues worldwide. The current virus detection methods are expensive and time-consuming and require access to well-equipped laboratories. This thesis describes the development of an impedimetric all-polymer aptasensor for detection of three types of waterborne viruses: norovirus, rotavirus and hepatitis A virus. The development of the aptasensor involved sample preparation for aptamer selection of rotavirus and hepatitis A virus, an iterative design process of the aptasensor, investigation of the surface immobilisation of aptamers and finally an impedimetric electrical characterisation of the sensor.

The sample preparation of the rotavirus was based on purification and biotinylation of the virus to meet the requirements of the aptamer selection process. The selection process, performed by an external collaborator, was based on streptavidin coated magnetic bead separation, hence the needed biotinylation. It was found that the BPH linker gave the highest yield when the biotinylated rotavirus were immobilised onto the beads.

The design of the viral aptasensor was determined by an iterative design process. The final chip design was based on a SD card design with an injection moulded PC substrate and lid. The electrodes were screen-printed PEDOT:PSS. The surface immobilisation of aptamers through UV cross-linking onto different polymer substrates was tested. As the success of this step is crucial for the aptasensor specificity and performances, the surface immobilisation was thoroughly investigated. The aptamer UV cross-linking onto PEDOT:PSS was promising. Furthermore, some passive absorption of the aptamers onto the PEDOT:PSS was found.
The impedimetric electrical characterisation of the aptasensor chip was done with different media salinity and different pH values. The impedimetric measurements of the different media salinity showed the expected behaviour with the greatest change present in the region representing the solution resistance. The pH measurements did not show any significant change of the impedance, hence the chip was stable in the measured pH range, which corresponds to the expected pH range of water samples. The stability of the aptasensor chip was tested over a 2 week period in continuous flow. It was found that the electrodes were not damaged or degraded during the time period, as a constant impedance signal was measured.

A solid foundation for the further development of the aptasensor for viral detection has been established and from this a new cheap and simple viral detection method can emerge.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Microsystems for Medical Diagnostics, National Veterinary Institute, Virology, Nano Bio Integrated Systems
Authors: Kirkegaard, J. (Intern), Rozlosnik, N. (Intern), Larsen, L. E. (Intern), Svendsen, W. E. (Intern)
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Aptasensor development for detection of virus in water
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Publication: Research › Ph.D. thesis – Annual report year: 2017

A three-dimensional approach to in vitro culture of immune-related cells
T lymphocytes are key players during the initiation of an adaptive immune response. The activation of these cells in vivo requires migration within the lymph nodes until they encounter antigen presenting cells (APCs) that can activate them to secrete IFN-γ which mediates downstream effector functions. The in vitro reactivation of antigen-experienced T lymphocytes and detection of IFN-γ from cell cultures can be used in a diagnostic assay to test for disease or vaccine efficacy. Practical procedures of the IFN-γ release assay (IGRA) was investigated using bovine cells and whole blood cultures was found preferable compared to PBMC cultures, partly due to the risk of losing cell subsets after purification of PBMCs.

The development of in vitro culture systems for more than 50 years ago revolutionized the biomedical world. It became possible to study cell behavior using cell lines or primary cells in culture and to measure cell activity such as IGRA, as described above. The traditional way of culturing cells are done using polystyrene (PS) plastic ware in flask-, Petri dish- or micro titer plate format. However, these artificial two dimensional (2D) surfaces on which the cells grow, has shown to interfere with cell morphology, gene expression and overall behavior and as such gives a poor reflection of in vivo cell behavior. Therefore, it is believed that by mimicking the in vivo conditions within the cultures, this would generate "closer-to-in vivo" results. For this purpose three dimensional (3D) culture setups have been developed including artificial scaffolds and extracellular matrix gels.

Optimization of IGRA was attempted using solid 3D scaffolds in various formats. The purpose of the 3D scaffolds was to facilitate T lymphocyte migration and subsequently activation due to increased chances of T lymphocyte/APC encounter. However, it turned out that the addition of this extra dimension to the cultures did not translate into increased de novo secretion of IFN-γ in these cultures. Furthermore, we often observed a non-specific effect on the level of IFN-γ when cells were cultures in 3D. This suggested that cells were sensitive to the geometry surrounding them and that this was independent on antigen stimulation.

Based on these findings and a previous discovery that the polymer PDMS, gave rise to increased differentiation of a nerve cell line in vitro, we tested the effect of PDMS on the differentiation of porcine monocytes. Monocytes are immune cells of high plasticity, and thus we speculated that they might be sensitive to culture conditions. Indeed, monocytes differentiated into monocyte-derived DC (moDCs) when cultured conventionally (2D PS) in the presence of GM-CSF and IL-4, but adopted a macrophage-like gene expression profile when cultured on PDMS. Further it was found that 3D culturing resulted in increased activation of the monocyte-derived cells.

The work in this thesis covers several aspects within primary cell culture, but central to the work is the investigation of 3D cell culture setups for improved activation/differentiation of immune cells. Conclusively, this work highlights the importance of acknowledging the effect from external factors when analyzing data generated from in vitro cultures. This being even more important when working with immune cells since these cells adopt traits and functions simply based on the nature of the culture system.
Atomic Layer Deposition of Ruthenium with TiN Interface for Sub-10 nm Advanced Interconnects beyond Copper

Atomic layer deposition of ruthenium is studied as a barrierless metallization solution for future sub-10 nm interconnect technology nodes. We demonstrate the void-free filling in sub-10 nm wide single damascene lines using an ALD process in combination with 2.5 angstrom of ALD TiN interface and po'stdeposition annealing. At such small dimensions, the ruthenium effective resistance depends less on the scaling than that of Cu/barrier systems. Ruthenium effective resistance potentially crosses the Cu curve at 14 and 10 nm according to the semiempirical interconnect resistance model for advanced technology nodes. These extremely scaled ruthenium lines show excellent electromigration behavior. Time-dependent dielectric breakdown measurements reveal negligible ruthenium ion drift into low-kappa dielectrics up to 200 degrees C, demonstrating that ruthenium can be used as a barrierless metallization in interconnects. These results indicate that ruthenium is highly promising as a replacement to Cu as the metallization solution for future technology nodes.
Atomistic approach for modeling metal-semiconductor interfaces

We present a general framework for simulating interfaces using an atomistic approach based on density functional theory and non-equilibrium Green's functions. The method includes all the relevant ingredients, such as doping and an accurate value of the semiconductor band gap, required to model realistic metal-semiconductor interfaces and allows for a direct comparison between theory and experiments via the I–V curve. In particular, it will be demonstrated how doping — and bias — modifies the Schottky barrier, and how finite size models (the slab approach) are unable to describe these interfaces properly due to a poor representation of space-charge effects.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, QuantumWise A/S
Authors: Stradi, D. (Ekstern), Martinez, U. (Ekstern), Blom, A. (Ekstern), Brandbyge, M. (Intern), Stokbro, K. (Ekstern)
Number of pages: 4
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Publication date: 2016

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Autocrine CCL19 blocks dendritic cell migration toward weak gradients of CCL21

Background aims. Maturation of dendritic cells (DCs) induces their homing from peripheral to lymphatic tissues guided by CCL21. However, in vitro matured human monocyte-derived DC cancer vaccines injected intradermally migrate poorly to lymph nodes (LNs). In vitro maturation protocols generate DCs with high (type 1 DCs) or low (prostaglandin E2 [PGE2] DCs) autocrine CCL19 levels, which may potentially interfere with LN homing of DCs. Methods. Employing a threedimensional (3D) chemotaxis assay, chemokine competition/desensitization studies and short interfering RNA
(siRNA) against CCL19, we analyzed the effect of autocrine CCL19 on in vitro migration of human DCs toward CCL21. Results. Using human monocyte-derived DCs in a 3D chemotaxis assay, we are the first to demonstrate that CCL19 more potently induces directed migration of human DCs compared with CCL21. When comparing migration of type 1 DCs and PGE$_2$-DCs, migration of type 1 DCs was strikingly impaired compared with PGE$_2$-DCs, but only toward low concentrations of CCL21. When type 1 DCs were cultured overnight in fresh culture medium (reducing autocrine CCL19 levels), a rescuing effect was observed on migration toward low concentrations of CCL21 in a 3D chemotaxis assay. Finally, pre-incubation with CCL19 negatively affected PGE$_2$-DC migration, whereas silencing of CCL19 by siRNA improved type 1 DC migration. Importantly, in both cases, the effect was observed only at low concentrations of CCL21.

Conclusions. Our results demonstrate that autocrine CCL19 negatively affects DC migratory potential toward CCL21, the potency difference between CCL19 and CCL21 being the underlying cause. CCL19 secretion level of in vitro matured DCs is an important indicator of DC vaccine homing potential.
Automated Scanning Electron Microscopy Analysis of Sampled Aerosol

Airborne fine and ultrafine particles (aerodynamic diameters less than 2.5 and 0.1 μm respectively) have in recent years been recognized as major concerns for public health, due to their ability to penetrate deep into the lungs or even into the bloodstream. Recent studies have furthermore found that parameters such as morphology, size, number concentration, surface area, as well as the chemical composition of particles have a high influence on the observed toxicological effects. However current aerosol legislations focus only on aerosol mass, meaning that small particles are poorly regulated due to their small contribution to the total aerosol mass concentration. New or additional legislations and measurement techniques are therefore needed to deal with the complexity of aerosols in order to establish standard procedures for measuring and regulating aerosol exposure.

Here we present the current development of an automated software-based analysis of aerosols using Scanning Electron Microscopy (SEM) and Scanning Transmission Electron Microscopy (STEM) coupled with Energy-Dispersive X-ray Spectroscopy (EDS). The automated analysis will be capable of providing both detailed physical and chemical single particle information not provided by the current standard methods. Physical parameters such as area, diameter, aspect ratio, aggregation state, and estimates of surface area will be obtained for each individual particle based on the acquired images, while automated EDS analysis will yield single particle elemental composition data, allowing size resolved chemical classification of each individual particle. The automated analysis will furthermore be able to systematically map large areas of a sample without user intervention, enabling a fast and repeatable measurement, while obtaining sufficient data for statistical analysis.

General information
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Organisations: Department of Micro- and Nanotechnology, Molecular Windows, National Research Center for Working Environment
Authors: Bluhme, A. B. (Intern), Kling, K. (Ekstern), Mølhave, K. (Intern)
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Autorotation: Invited Comment
A continuous autorotation vector field along a framed space curve is defined, which describes the rotational progression of the frame. We obtain an exact integral for the length of the autorotation vector. This invokes the infinitesimal rotation vector of the frame progression and the unit vector field for the corresponding autorotation vector field. For closed curves we define an autorotation number whose integer value depends on the starting point of the curve. Upon curve deformations, the autorotation number is either constant, or can make a jump of (multiples of) plus-minus two, which corresponds to a change in rotation of multiples of 4π. The autorotation number is therefore not topologically conserved under all transformations. We discuss this within the context of generalised inflection points and of frame revisit points. The results may be applicable to physical systems such as polymers, proteins, and DNA. Finally, turbulence is discussed in the light of autorotation, as is the Philippine wine dance, the Dirac belt trick, and the 4π cycle of the flying snake.
Back-illuminated Si-based photoanode with nickel cobalt oxide catalytic protection layer

Si is an excellent photo-absorber for use in dual-band-gap photoelectrochemical water splitting. We investigate photoanodes with n⁺pp⁺-Si configuration under back-side illumination, which is suited to work in a tandem device stack. A co-sputtered NiCoOx film coupled to the Si was used as a protective catalyst for the water oxidation reaction in 1 m KOH. The sample showed a high photocurrent (21 mA cm⁻²) under red-light illumination (38.6 mW cm⁻²). Long-term stability testing showed a gradual decrease of activity in the beginning, and then the activity increased, yielding a cathodic shift of the onset voltage (>50 mV), likely owing to the divergent response of Ni and Co to the Fe present in KOH. Once the activity of the sample stabilized, no further degradation was observed for the following 6 days, indicating that the demonstrated back-illuminated photoanode configuration can be considered a promising architecture for use as a bottom cell of the tandem water-splitting device under alkaline conditions.
Behind the Nature of Titanium Oxide Excellent Surface Passivation and Carrier Selectivity of c-Si
We present an expanded study of the passivation properties of titanium dioxide (TiO₂) on p-type crystalline silicon (c-Si). We report a low surface recombination velocity (16 cm/s) for TiO₂ passivation layers with a thin tunnelling oxide interlayer (SiO₂ or Al₂O₃) on p-type crystalline silicon (c-Si). The TiO₂ films were deposited by thermal atomic layer deposition (ALD) at temperatures in the range of 80-300 °C using titanium tetrachloride (TiCl₄) as Ti precursor and water as the oxidant. The influence of TiO₂ thickness (5, 10, 20 nm), presence of additional tunneling interlayer (SiO₂ or Al₂O₃), and post-deposition annealing temperature were investigated.
We have observed that SiO₂ and Al₂O₃ interlayers enhance the TiO₂ passivation of c-Si. TiO₂ thin film passivation layers alone result in lower effective carrier lifetime. Further annealing at 200 °C in N₂ gas enhances the surface passivation quality of TiO₂ tremendously.
Binding of human serum albumin to PEGylated liposomes: insights into binding numbers and dynamics by fluorescence correlation spectroscopy

Liposomes for medical applications are often administered by intravenous injection. Once in the bloodstream, the liposomes are covered with a "protein corona", which impacts the behavior and eventual fate of the liposomes. Currently, many aspects of the liposomal protein corona are not well understood. For example, there is generally a lack of knowledge about the liposome binding affinities and dynamics of common types of blood plasma proteins. Fluorescence correlation spectroscopy (FCS) is a powerful experimental technique that potentially can provide such knowledge. In this study, we have used FCS to investigate the binding of human serum albumin (HSA) to standard types of PEGylated fluid-phase liposomes (consisting of DOPC and DOPE-PEG2k) and PEGylated gel-phase liposomes (consisting of DSPC and DSPE-PEG2k) with various PEG chain surface densities. We detected no significant binding of HSA to the PEGylated fluid-phase liposomes. In contrast, we found that HSA bound tightly to the PEGylated gel-phase liposomes, although only a low number of HSA molecules could be accommodated per liposome. Overall, we believe that our data provides a useful benchmark for other researchers interested in studying the liposomal protein corona.
Bioabsorbable materials for use in vena cava filters

Inferior vena cava (IVC) filters are used to prevent a blood clot from blocking the pulmonary vein causing a pulmonary embolism (PE). The filter is placed in the large vein, vena cava, through a minimally invasive procedure. The filter today are made from various metal alloys. Due to their long-term complications, such as filter fracture, filter migration, caval wall perforation, recurring deep vein thrombosis (DVT) and post-thrombotic syndrome, there is currently a need for an alternative to these IVC filters. A way to overcome the complications is to create a bioabsorbable IVC filter which is the main objective in this project. The aim was to investigate potential bioabsorbable materials for use in a bioabsorbable IVC filter. Certain requirements for the filter were identified, and the aim was to choose and optimize a material which could function in a filter, exhibit adequate radial force to avoid migration while withstanding the constant external force on the vena cava causing it to collapse continuously. Through investigation of the literature and performance of initial experiments on different bioabsorbable polymers, poly(L-lactide) (PLLA) was chosen as a possible material candidate and further investigated. It was hypothesized that PLLA could be optimized through strain-induced crystallization and was extruded into small tubes, which underwent a biaxial strain during an expansion process. The mechanical properties, such as stiffness and strength, were improved through the processing. Several optimal processing parameters, such as high straining temperature, fast axial processing strain and a large degree of strain in the radial direction proved to improve the properties further. The mechanical properties were shown not to be related to the crystal orientation obtained during straining but related to the alignment of amorphous chains. The biaxially strained tubes were laser cut into either appropriate filter designs or the body part of the filter (stent-base) and expanded to 27 mm during a heat treatment. The effect of processing, heat treatment and sterilization were evaluated under in vitro conditions. The radial force of the stent-base proved to correlate with the circumferential stiffness of the biaxially strained tubes. The fatigue properties of the stent-base were improved when tested under in vitro conditions. Based on these results the stent-bases were implanted in vivo in an ovine model for 2 and 3½ weeks using three sheep. Two stent-bases were implanted per sheep, one cranially and one caudally. After merely 2 weeks the stent-bases showed multiple fractures in the circumferential direction caused by the continuous cyclic compression. The fragments from the caudal device remained in the caval wall, whereas little remained of the cranial device. Histology showed that the PLLA fragments were embedded in neointima to a degree that fragmented pieces did not migrate. It also showed mild fibrosis around the struts caused by the radial force of the stent. It was concluded that PLLA did not exhibit the adequate flexibility in such a filter design to withstand the cyclic compression of the vein over the course of 2 weeks. To achieve the goal of creating a bioabsorbable IVC filter, the stent-base must be made from a different polymer.
Flexible biosensors are one of the most promising next generation wearable self-monitoring devices, as material flexibility is very crucial to attach on a patient’s body part and maintaining the mechanical stability as well as the sensing responses. In recent years, graphene based materials have invoked a new era for developing smart hybrid material based biosensors. Graphene could offer a perfect solution as an ideal signal transducer for the development of low-cost bioelectronics devices.

Bioinspired silica offers a novel, green and biocompatible alternative to traditional drug delivery systems

Bi-resonant structure with piezoelectric PVDF films for energy harvesting from random vibration sources at low frequency

This paper reports on a bi-resonant structure of piezoelectric PVDF films energy harvester (PPEH), which consists of two cantilevers with resonant frequencies of 15 Hz and 22 Hz. With increased acceleration, the vibration amplitudes of the two cantilever-mass structures are increased and collision occurs which causes strong mechanical coupling between the two subsystems. The experimental results show that the operating bandwidth is widened to 14 Hz (14–28 Hz) at an acceleration of 9.81 m/s², and the peak output...
power can be 0.35 W at a relatively low operation frequency of 16 Hz. Simulation and experiments with piezoelectric elements show that the energy harvesting device with the bi-resonant structure can generate higher power output than that of the sum of the two separate devices from random vibration sources at low frequency, and hence significantly improves the vibration-to-electricity conversion efficiency by 40–81%.

**General information**

State: Published
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Black silicon laser-doped selective emitter solar cell with 18.1% efficiency

We report fabrication of nanostructured, laser-doped selective emitter (LDSE) silicon solar cells with power conversion efficiency of 18.1% and a fill factor (FF) of 80.1%. The nanostructured solar cells were realized through a single step, mask-less, scalable reactive ion etch (RIE) texturing of the surface. The selective emitter was formed by means of laser doping using a continuous wave (CW) laser and subsequent contact formation using light-induced plating of Ni and Cu.

The combination of RIE-texturing and a LDSE cell design has to our knowledge not been demonstrated previously. The resulting efficiency indicates a promising potential, especially considering that the cell reported in this work is the first proof-of-concept and that the fabricated cell is not fully optimized in terms of plating, emitter sheet resistance and surface passivation. Due to the scalable nature and simplicity of RIE-texturing as well as the LDSE process, we consider this specific combination a promising candidate for a cost-efficient process for future Si solar cells.
Black silicon solar cells with black bus-bar strings

We present the combination of black silicon texturing and blackened bus-bar strings as a potential method for obtaining all-black solar panels, while using conventional, front-contacted solar cells. Black silicon was realized by maskless reactive ion etching resulting in total, average reflectance below 0.5% across a 156x156 mm2 silicon wafer. Four different methods to obtain blackened bus-bar strings were compared with respect to reflectance, and two of these methods (i.e., oxidized copper and etched solder) were used to fabricate functional all-black solar 9-cell panels. The black bus-bars (e.g., by...
oxidized copper) have a reflectance below 3% in the entire visible wavelength range. The combination of black silicon cells and blackened bus-bars results in aesthetic, all-black panels based on conventional, front-contacted solar cells without compromising efficiency.

**General information**
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Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Photonics Engineering, Diode Lasers and LED Systems, Experimental Surface and Nanomaterials Physics, Institute for Product Development, Gaia Solar A/S, Institute for Energy Technology
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**Black silicon solar cells with black bus-bar strings**

**General information**
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**Black Silicon Solar Cells with Black Ribbons.**
We present the combination of mask-less reactive ion etch (RIE) texturing and blackened interconnecting ribbons as a method for obtaining all-black solar panels, while using conventional, front-contacted solar cells. Black silicon made by mask-less reactive ion etching has total, average reflectance below 0.5% across a 156x156 mm2 silicon (Si) wafer. Black interconnecting ribbons were realized by oxidizing copper resulting in reflectance below 3% in the visible wavelength range. Screen-printed Si solar cells were realized on 156x156 mm2 black Si substrates with resulting efficiencies in the range 15.7-16.3%. The KOH-textured reference cell had an efficiency of 17.9%. The combination of black Si and black interconnecting ribbons may result in aesthetic, all-black panels based on conventional, front-contacted silicon solar cells.

**General information**
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Black silicon with black bus-bar strings
We present the combination of black silicon texturing and blackened bus-bar strings as a potential method for obtaining all-black solar panels, while using conventional, front-contacted solar cells. Black silicon was realized by mask-less reactive ion etching resulting in total, average reflectance below 0.5% across a 156x156 mm² silicon wafer. Black bus-bars were realized by oxidized copper resulting in reflectance below 3% in the entire visible wavelength range. The combination of these two technologies may result in aesthetic, all-black panels based on conventional, front-contacted solar cells without compromising efficiency.

General information
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Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Photonics Engineering, Diode Lasers and LED Systems, Experimental Surface and Nanomaterials Physics, Institute for Product Development, Gaia Solar A/S, Institute for Energy Technology
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Blu-ray based optomagnetic aptasensor for detection of small molecules
This paper describes an aptamer-based optomagnetic biosensor for detection of a small molecule based on target binding-induced inhibition of magnetic nanoparticle (MNP) clustering. For the detection of a target small molecule, two mutually exclusive binding reactions (aptamer-target binding and aptamer-DNA linker hybridization) are designed. An aptamer specific to the target and a DNA linker complementary to a part of the aptamer sequence are immobilized onto separate MNPs. Hybridization of the DNA linker and the aptamer induces formation of MNP clusters. The target-to-aptamer binding on MNPs prior to the addition of linker-functionalized MNPs significantly hinders the hybridization reaction, thus reducing the degree of MNP clustering. The clustering state, which is thus related to the target concentration, is then quantitatively determined by an optomagnetic readout technique that provides the hydrodynamic size distribution of MNPs and their clusters. A commercial Blu-ray optical pickup unit is used for optical signal acquisition, which enables the establishment of a low-cost and miniaturized biosensing platform. Experimental results show that the degree of MNP clustering correlates well with the concentration of a target small molecule, adenosine triphosphate (ATP) in this work, in the range between 10µM and 10mM. This successful proof-of-concept indicates that our optomagnetic aptasensor can be further developed as a low-cost biosensing platform for detection of small molecule biomarkers in an out-of-lab setting.

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Department of Applied Mathematics and Computer Science, Cognitive Systems, Magnetic Systems, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Columbia University, University of the Basque Country, Yonsei University, CIC nanoGUNE Consolider
Boronate-Modified Interdigitated Electrode Array for Selective Impedance-Based Sensing of Glycated Hemoglobin

An impedance-based label-free affinity sensor was developed for the recognition of glycated hemoglobin (HbA1c). Interdigitated gold microelectrode arrays (IDA) were first modified with a self-assembled monolayer of cysteamine followed by cross-linking with glutaraldehyde and subsequent binding of 3-aminophenylboronic acid (APBA), which selectively binds HbA1c via cis-diol interactions. Impedance sensing was demonstrated to be highly responsive to the clinically relevant HbA1c levels (0.1%-8.36%) with a detection limit of 0.024% (3σ). The specificity of the assay was evaluated with non-glycated hemoglobin (HbAo), showing that the impedance response remained unchanged over the concentration range of 10 to 20 g dL\(^{-1}\) HbAo. This demonstrated that the sensor system could be used to specifically distinguish HbA1c from HbAo. Moreover, the binding of HbA1c to the APBA-modified electrodes was reversible, providing a reusable sensing interface as well as showing a stable response after 4 weeks (96% of the initial response). When assaying normal (4.10%) and diabetic (8.36%) HbA1c levels (10 assays per day during a three-day period including a regeneration step after each assay), the overall assay reproducibility, expressed as relative standard error of mean (n = 30), was 1.1%. The performance of the sensor system was also compared with a commercial method (n =15) using patient-derived blood samples. A good agreement (Bland-Altman bias plot) and correlation (Passing-Bablok regression analysis) was demonstrated between the boronate-based affinity sensor and the standard method.

General information
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Burst Pressure of all-polymer phaseguide structures of different heights

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Authors: Garbarino, F. (Intern), Kistrup, K. (Intern), Rizzi, G. (Intern), Hansen, M. F. (Intern)
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Calibration of a Numerical Model for Heat Transfer and Fluid Flow in an Extruder
This paper discusses experiments performed in order to validate simulations on a fused deposition modelling (FDM) extruder. The nozzle has been simulated in terms of heat transfer and fluid flow. In order to calibrate and validate these simulations, experiments were performed giving a significant look into the physical behaviour of the nozzle, heating and cooling systems. Experiments on the model were performed at different sub-mm diameters of the extruder. Physical parameters of the model – especially temperature dependent parameters – were set into analytical relationships in order to receive dynamical parameters. This research sets the foundation for further research within melted extrusion based additive manufacturing. The heating process of the extruder will be described and a note on the material feeding will be given.

General information
"Calibration-on-the-spot": How to calibrate an EMCCD camera from its images

In localization-based microscopy, super-resolution is obtained by analyzing isolated diffraction-limited spots imaged, typically, with EMCCD cameras. To compare experiments and calculate localization precision, the photon-to-signal amplification factor is needed but unknown without a calibration of the camera. Here we show how this can be done post festum from just a recorded image. We demonstrate this (i) theoretically, mathematically, (ii) by analyzing images recorded with an EMCCD camera, and (iii) by analyzing simulated EMCCD images for which we know the true values of parameters. In summary, our method of calibration-on-the-spot allows calibration of a camera with unknown settings from old images on file, with no other info needed. Consequently, calibration-on-the-spot also makes future camera calibrations before and after measurements unnecessary, because the calibration is encoded in recorded images during the measurement itself, and can at any later time be decoded with calibration-on-the-spot.

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Authors: Mortensen, K. (Intern), Flyvbjerg, H. (Intern)
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"Calibration-on-the-spot": How to calibrate an EMCCD camera from its images

In order to count photons with a camera, the camera must be calibrated. Photon counting is necessary, e.g., to determine the precision of localization-based super-resolution microscopy. Here we present a protocol that calibrates an EMCCD camera from information contained in isolated, diffraction-limited spots in any image taken by the camera, thus making dedicated calibration procedures redundant by enabling calibration post festum, from images filed without calibration information.

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Can We Trust Real Time Measurements of Lung Deposited Surface Area Concentrations in Dust from Powder Nanomaterials?

A comparison between various methods for real-time measurements of lung deposited surface area (LDSA) using spherical particles and powder dust with specific surface area ranging from 0.03 to 112 m$^2$ g$^{-1}$ was conducted. LDSA concentrations measured directly using Nanoparticle Surface Area Monitor (NSAM) and Aerotrak and were compared to LDSA concentrations recalculated from size distribution measurements using Electrical Low Pressure Impactor (ELPI) and Fast Mobility Particle Sizer (FMPS). FMPS and ELPI measurements were also compared to dust surface area concentrations estimated from gravimetric filter measurements and specific surface areas. Measurement of LDSA showed very good correlation in measurements of spherical particles ($R^2 > 0.97$, Ratio 1.0 to 1.04). High surface area nanomaterial powders showed a fairly reliable correlation between NSAM and Aerotrak ($R^2 0.73-0.93$) and a material-dependent offset in the ratios (1.04-2.8). However, the correlation and ratio were inconsistent for lower LDSA concentrations. Similar levels of correlation were observed for the NSAM and the FMPS for high surface area materials, but with the FMPS overestimating the LDSA concentration. The ELPI showed good correlation with NSAM data for high LDSA materials ($R^2 > 0.98$) but not for lower LDSA concentrations ($R^2 0.50-0.72$). Comparisons of respirable dust surface area from ELPI data correlated well ($R^2 > 0.98$) with that calculated from filter samples, but materials-specific exceptions were present. We conclude that there is currently insufficient reliability and comparability between methods in the measurement of LDSA concentrations. Further development is required to enable use of LDSA for reliable dose metric and regulatory enforcement of exposure.
Capacitive Substrate Coupling of Row–Column-Addressed 2-D CMUT Arrays

Row–column-addressed CMUT arrays suffer from low receive sensitivity of the bottom elements due to a capacitive coupling to the substrate. The capacitive coupling increases the parasitic capacitance. A simple approach to reduce the parasitic capacitance is presented, which is based on depleting the semiconductor substrate. To reduce the parasitic capacitance by 80% the bulk doping concentration should be at most $10^{12}$ cm$^{-3}$. Experimental results show that the parasitic capacitance can be reduced by 87% by applying a substrate potential of 6V relative to the bottom electrodes. The depletion of the semiconductor substrate can be sustained for at least 10 minutes making it applicable for row–column-addressed CMUT arrays for ultrasonic imaging. Theoretically the reduced parasitic capacitance indicates that the receive sensitivity of the bottom elements can be increased by a factor of 2:1.
Cardiovascular health effects of oral and pulmonary exposure to multi-walled carbon nanotubes in ApoE-deficient mice

Exposure to high aspect ratio nanomaterials, such as multi-walled carbon nanotubes (MWCNTs) may be associated with increased risk of atherosclerosis, pulmonary disease, and cancer. In the present study, we investigated the cardiovascular and pulmonary health effects of 10 weeks of repeated oral or pulmonary exposures to MWCNTs (4 or 40μg each week) in Apolipoprotein E-deficient (ApoE−/−) mice fed a Western-type diet. Intratracheal instillation of MWCNTs was associated with oxidative damage to DNA in lung tissue and elevated levels of lipid peroxidation products in plasma, whereas the exposure only caused a modest pulmonary inflammation in terms of increased numbers of lymphocytes in bronchoalveolar lavage fluid. Ultrasound imaging in live animals revealed an increase in the inner and outer wall thickness of the aortic arch at 10 weeks after pulmonary exposure to MWCNTs, which may suggest artery remodelling. However, we did not find accelerated plaque progression in the aorta or the brachiocephalic artery by histopathology. Furthermore, repeated oral exposure to MWCNTs did not cause changes in the composition of gut microbiota of exposed mice. Collectively, this study indicates that repeated pulmonary exposure to MWCNTs was associated with oxidative stress, whereas cardiovascular effects encompassed remodelling of the aorta wall.
Catalyst Interface Engineering for Improved 2D Film Lift-Off and Transfer

The mechanisms by which chemical vapor deposited (CVD) graphene and hexagonal boron nitride (h-BN) films can be released from a growth catalyst, such as widely used copper (Cu) foil, are systematically explored as a basis for an improved lift-off transfer. We show how intercalation processes allow the local Cu oxidation at the interface followed by selective oxide dissolution, which gently releases the 2D material (2DM) film. Interfacial composition change and selective dissolution can thereby be achieved in a single step or split into two individual process steps. We demonstrate that this method is not only highly versatile but also yields graphene and h-BN films of high quality regarding surface contamination, layer coherence, defects, and electronic properties, without requiring additional post-transfer annealing. We highlight how such transfers rely on targeted corrosion at the catalyst interface and discuss this in context of the wider CVD growth and 2DM transfer literature, thereby fostering an improved general understanding of widely used transfer processes, which is essential to numerous other applications.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, University of Cambridge, Massachusetts Institute of Technology
Cell derived microvesicles: Novel preparative and characterization methods

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Microsystems for Medical Diagnostics, Statens Serum Institut
Authors: Cherré, S. (Intern), Rozlosnik, N. (Intern), Heegaard, N. H. (Ekstern)
Number of pages: 216
Characterization Of Biaxial Strain Of Poly(L-Lactide) Tubes

Poly(L-lactide) (PLLA) in its L-form has promising mechanical properties. Being a semi-crystalline polymer, it can be subjected to strain-induced crystallization at temperatures above Tg and can thereby become oriented. Following a simultaneous (SIM) biaxial strain process or a sequential (SEQ) biaxial strain process, the mechanical properties of biaxial strained tubes can be further improved. This study investigated these properties in relation to their morphology and crystal orientation. Both processes yield the same mechanical strength and modulus, yet exhibit different crystal orientation. Through further WAXS analysis it was found that the SEQ biaxial strain yields larger interplanar spacing and distorted crystals and looser packing of chains. However, this does not influence the mechanical properties negatively. A loss of orientation in SEQ biaxial strained samples at high degrees of strain was detected, but not seen for SIM biaxial strain, and did not correlate with mechanical performance in either case. However, post-annealing reduced the orientation to the same level in both cases, and the modulus and strength is decreased for both SIM and SEQ biaxial. It is therefore concluded that mechanical properties after biaxial strain are related to strain-induced amorphous orientation and the packing of crystals, rather than strain-induced crystallinity.
Charge distribution and stability in electret materials

The objective of the work presented in this Ph.D. thesis is to give a broader understanding of which key parameters influence the charge stability of polymer electrets, and how the electrical charges are distributed. This has been achieved using polypropylene as an electret polymer model system.

Theoretical considerations have been made concerning the effect of the size of the crystalline areas known as spherulites and the degree of crystallinity, on the charge retention. The considerations showed that small spherulites and a high degree of crystallinity is favouring a high charge retention. This was also showed experimentally where the size of the spherulites was controlled through different cooling methods, and the degree of crystallinity was controlled by mixing atactic-polypropylene (α-PP) and isotactic-polypropylene (i-PP). The reason why the crystallinity have been controlled by
mixing a-PP and i-PP, is because the charge retention is extremely sensitive to the sample preparation. This was seen in regard to the thermal history of the samples and the influence of micron and nano size particles in the polymer electret. Through adding micron and nano size calcium carbonate and aluminium oxide particles in the polymer matrix is was seen that the charge retention could be enhanced compared to samples with no particles. However, these results also showed that the thermal history for the samples played an equivalent importance role regarding the charge retention. The morphology of the spherulites at the surface was visualised after a selective etch through scanning electron microscopy. The selective etch was to enhance the contrast between the amorphous and crystalline regions. Spherulites in three different size interval was seen, 50 μm to 100 μm, 3 μm to 7 μm, and 0.7 μm to 1.5 μm respectively. By means of kinetic rate theory the discharge behaviour could be explained for polypropylene when thermally stimulated. This resulted in the determination of several activation energies, which could be used for describing the discharging seen at isothermal conditions. This theory is a powerful tool of predicting the lifetime of an electret at various thermal conditions. Through the experimental obtained release currents, for different polypropylene samples, the critical temperature was determined from the largest current peak. If an electret is to avoid significant discharging it should be kept well below its critical temperature.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Brüel & Kjær A/S
Authors: Thyssen, A. (Intern), Thomsen, E. V. (Intern), Almdal, K. (Intern), Gramtorp, J. (Ekstern)
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Projects:
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Click chemistry based biomolecular conjugation monitoring using surface-enhanced Raman spectroscopy mapping
We describe here a novel surface-enhanced Raman spectroscopy (SERS) based technique for monitoring the conjugation of small molecules by the well-known click reaction between an alkyne and azido moiety on the partner molecules. The monitoring principle is based on the loss of the characteristic alkyne/azide Raman signal with triazole formation in the reaction as a function of time. Since these universal Raman reporter groups are specific for click reactions, this method may facilitate a broad range of applications for monitoring the conjugation efficiency of molecules in diverse areas such as bioconjugation, material science or drug discovery. Additionally, as an attractive advantage of this technique, no significant background signal is expected during the measurements, since these signals reside in a Raman silent region of 2000–2300 cm⁻¹, where virtually all biological molecules are transparent.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Columbia University
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Number of pages: 3
Publication date: 2016

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10.1109/ICSENS.2016.7808595
Source: FindIt
Comment on "Temporal Correlations of the Running Maximum of a Brownian Trajectory"

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals
Authors: Mortensen, K. (Intern), Pedersen, J. N. (Intern)
Number of pages: 1
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Main Research Area: Technical/natural sciences

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Scopus rating (2016): CiteScore 6.33 SJR 4.196 SNIP 2.61
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.656 SNIP 2.538 CiteScore 5.76
Web of Science (2015): Indexed yes
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Scopus rating (2014): SJR 5.232 SNIP 2.71 CiteScore 6.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 5.675 SNIP 2.781 CiteScore 7.46
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Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 6.292 SNIP 2.867 CiteScore 7.19
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
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Scopus rating (2011): SJR 6.314 SNIP 2.905 CiteScore 7.02
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 6.45 SNIP 2.757
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 6.325 SNIP 2.947
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 6.194 SNIP 2.837
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 5.95 SNIP 2.738
Comparative study of the interfaces of graphene and hexagonal boron nitride with silver

Silver opens up interesting perspectives in the fabrication of complex systems based on heteroepitaxial layers after the growth of a silicene layer on its (111) face has been proposed. In this work we explore different synthesis methods of hexagonal boron nitride (h-BN) and graphene sheets on silver. The resulting layers have been examined by high-resolution scanning tunneling microscopy. A comparison of the interfacial electronic band structure upon growth of the distinct two-dimensional (2D) layers has been performed by scanning tunneling spectroscopy and complementary first-principle calculations. We demonstrate that the adsorption of the 2D layers has an effect on the binding energy of the Shockley state and the surface potential by lowering the local work function. These effects are larger in the case of graphene where the surface state of Ag(111) is depopulated due to charge transfer to the graphene. Furthermore, we show that the electronic properties of the h-BN/silver system can be tuned by employing different thicknesses of silver ranging from a few monolayers on Cu(111) to the single crystal Ag substrate.
Comparison of a Coupled Near and Far Wake Model With a Free Wake Vortex Code

This paper presents the integration of a near wake model for trailing vorticity, which is based on a prescribed wake lifting line model proposed by Beddoes, with a BEM-based far wake model and a 2D shed vorticity model. The resulting coupled aerodynamics model is validated against lifting surface computations performed using a free wake panel code.
The focus of the description of the aerodynamics model is on the numerical stability, the computation speed and the accuracy of 5 unsteady simulations. To stabilize the near wake model, it has to be iterated to convergence, using a relaxation factor that has to be updated during the computation. Further, the effect of simplifying the exponential function approximation of the near wake model to increase the computation speed is investigated in this work. A modification of the dynamic inflow weighting factors of the far wake model is presented that ensures good induction modeling at slow time scales. Finally, the unsteady airfoil aerodynamics model is extended to provide the unsteady bound circulation for the near wake model and to improve the modeling of the unsteady behavior of cambered airfoils. The model comparison with results from a free wake panel code and a BEM model is centered around the NREL 5 MW reference turbine. The response to pitch steps at different pitching speeds is compared. By means of prescribed vibration cases, the effect of the aerodynamic model on the predictions of the aerodynamic work is investigated. The validation shows that a BEM model can be improved by adding near wake trailed vorticity computation. For all prescribed vibration cases with high aerodynamic damping, results similar to those obtained by the free wake model can be achieved in a small fraction of computation time with the proposed model. In the cases with low aerodynamic damping, the addition of trailed vorticity modeling shifts the results closer to those obtained by using the free wake code, but differences remain.
Comparison of Pulsed Electron Deposition and Pulsed Laser Deposition of selected materials

General information
State: Published
Organisations: Department of Photonics Engineering, Department of Micro- and Nanotechnology, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, Photovoltaic Materials and Systems, Consiglio Nazionale delle Ricerche, Technical University of Denmark
Authors: Ettlinger, R. B. (Intern), Pattini, F. (Ekstern), Rampino, S. (Ekstern), Cazzaniga, A. C. (Intern), Crovetto, A. (Intern), Bosco, E. (Ekstern), Gilioli, E. (Ekstern), Hansen, O. (Intern), Schou, J. (Intern)
Number of pages: 1
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Event: Abstract from EMRS Spring Meeting 2016, Lille, France.
Main Research Area: Technical/natural sciences
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Comparison of Ultrasonic Welding and Thermal Bonding for the Integration of Thin Film Metal Electrodes in Injection Molded Polymeric Lab-on-Chip Systems for Electrochemistry

We compare ultrasonic welding (UW) and thermal bonding (TB) for the integration of embedded thin-film gold electrodes for electrochemical applications in injection molded (IM) microfluidic chips. The UW bonded chips showed a significantly superior electrochemical performance compared to the ones obtained using TB. Parameters such as metal thickness of electrodes, depth of electrode embedding, delivered power, and height of energy directors (for UW), as well as pressure and temperature (for TB), were systematically studied to evaluate the two bonding methods and requirements for optimal electrochemical performance. The presented technology is intended for easy and effective integration of polymeric Lab-on-Chip systems to encourage their use in research, commercialization and education.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Bioanalytics, Polymer Micro & Nano Engineering
Authors: Matteucci, M. (Intern), Heiskanen, A. (Intern), Zor, K. (Intern), Emméus, J. (Intern), Taboryski, R. J. (Intern)
Number of pages: 12
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Scopus rating (2017): SJR 0.584 SNIP 1.55
Web of Science (2017): Indexed yes
Composite magnetic-fluorescent nanoparticles for bioassays: CRP

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, University of Queensland
Authors: KC, S. (Ekstern), Ranzoni, A. (Ekstern), Phetsang, W. (Ekstern), Hansen, M. F. (Intern), Cooper, M. A. (Ekstern)
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions:
Composition-dependent variation of magnetic properties and interstitial ordering in homogeneous expanded austenite

The crystal structure and magnetic properties of austenitic stainless steel with a colossal interstitial content, so-called expanded austenite, are currently not completely understood. In the present work, the magnetic properties of homogeneous samples of expanded austenite, as prepared by lowerature nitriding of thin foils, were investigated with magnetometry and Mössbauer spectroscopy. At room temperature, expanded austenite is paramagnetic for relatively low and for relatively high nitrogen contents ($y_N = 0.13$ and $0.55$, respectively, where $y_N$ is the interstitial nitrogen occupancy), while ferromagnetism is observed for intermediate nitrogen loads. Spontaneous volume magnetostriction was observed in the ferromagnetic state and the Curie temperature was found to depend strongly on the nitrogen content. For the first time, X-ray diffraction evidence for the occurrence of long-range interstitial order of nitrogen atoms in expanded austenite was observed for high nitrogen contents.
Computational Tools and Studies of Graphene Nanostructures

Nano-electronics industry has during the past decade decreased feature sizes to roughly 10nm. Such feature sizes are at the quantum limit, requiring a description at the quantum mechanical level. Parallel to the experimental work reside the theoretical tools used to investigate and understand such systems. These theoretical tools still have a high computational requirement. Thus more efficient algorithms are needed to perform studies on even larger systems. Although the gap between the theoretical tools and the experimental setups are reduced, there is still a gap, and the used theoretical methods require revised algorithms.

Furthermore, the advent of 2D materials may prove prominent in future nanoelectronics for electronic and heat transport devices. Such materials include the Nobel Prize winning material, graphene which has unique properties.

The main focus of the work presented in this thesis has been to introduce extensions to the non-equilibrium Green function code TranSIESTA which will help reduce the gap between experimental and theoretical studies. One main achievement in this work is a truly \( N_e \geq 1 \) electrode implementation. Another contribution is a general \( N_e \geq 1 \) tight-binding transport code which enables not only electronic transport but also phonon transport. This tight-binding code includes features such as, bond-currents, transmission projections and bias-interpolations. For both codes the inversion algorithm for calculating the Green function is revised. We implement a high performing block-tridiagonal algorithm for calculating the Green function and spectral density function — even for \( N_e > 2 \). This is accomplished by bandwidth reduction schemes that increase the quasi-1D interpretation.

We also present a new gating method capable of calculating gating effects. A graphite example is used to highlight the importance of the quantum capacitance that is evident in low density of states systems. Additionally the gating method was used in nonequilibrium to study the gate-bias dependence on graphene nano-constrictions. This indicated a pinning effect arising due to differences in coupling strength between the device and the two electrodes.
Two studies are presented using the non-equilibrium method with \( N_e = 3 \). First, graphene T-junctions are studied to uncover potential interconnects in future graphene based devices. This T-junction is studied under two non-equilibrium situations. Our second study is a graphene Scanning Tunnelling Microscopy setup where the inelastic current is calculated. We show, that the experimental inelastic signal may be fully recovered using density functional theory and non-equilibrium Green function techniques.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Nanostructured Graphene, Theoretical Nanoelectronics
Authors: Papior, N. R. (Intern), Brandbyge, M. (Intern)
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**Constellation Shaping for WDM systems using 256QAM/1024QAM with Probabilistic Optimization**

In this paper, probabilistic shaping is numerically and experimentally investigated for increasing the transmission reach of wavelength division multiplexed (WDM) optical communication system employing quadrature amplitude modulation (QAM). An optimized probability mass function (PMF) of the QAM symbols is first found from a modified Blahut-Arimoto algorithm for the optical channel. A turbo coded bit interleaved coded modulation system is then applied, which relies on many-to-one labeling to achieve the desired PMF, thereby achieving shaping gain. Pilot symbols at rate at most 2% are used for synchronization and equalization, making it possible to receive input constellations as large as 1024QAM. The system is evaluated experimentally on a 10 Gbaud, 5 channels WDM setup. The maximum system reach is increased w.r.t. standard 1024QAM by 20% at input data rate of 4.65 bits/symbol and up to 75% at 5.46 bits/symbol. It is shown that rate adaptation does not require changing the modulation format. The performance of the proposed 1024QAM shaped system is validated on all 5 channels of the WDM signal for selected distances and rates. Finally, it was shown via EXIT charts and BER analysis that iterative demapping, while generally beneficial to the system, is not a requirement for achieving the shaping gain.

**General information**

State: Published
Organisations: Department of Photonics Engineering, Coding and Visual Communication, Centre of Excellence for Silicon Photonics for Optical Communications, High-Speed Optical Communication, Department of Telecommunication, Department of Micro- and Nanotechnology
Authors: Yankov, M. P. (Intern), Da Ros, F. (Intern), Porto da Silva, E. (Intern), Forchhammer, S. (Intern), Larsen, K. J. (Intern), Oxenløwe, L. K. (Intern), Galili, M. (Intern), Zibar, D. (Intern)
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Scopus rating (2017): SNIP 1.791 SJR 1.166
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BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.87 SJR 1.23 SNIP 1.819
Web of Science (2016): Indexed yes
Contactless graphene conductance measurements: the effect of device fabrication on terahertz time-domain spectroscopy
We perform contactless full-wafer maps of the electrical conductance of a 4-inch wafer of single-layer CVD graphene using terahertz time-domain spectroscopy both before and after deposition of metal contacts and fabrication of devices via laser ablation. We find that there is no significant change in the measured conductance of graphene before and after device fabrication. We also show that precise terahertz time-domain spectroscopy can be performed when the beam spot is at sufficient distance (>1.2 mm) from metal contacts.

Controlling nanowire growth through electric field-induced deformation of the catalyst droplet
Semiconductor nanowires with precisely controlled structure, and hence well-defined electronic and optical properties, can be grown by self-assembly using the vapour-liquid-solid process. We find that...
nanowire is typically determined by global parameters such as source gas pressure, gas composition and growth temperature. Here we describe a more local approach to the control of nanowire structure. We apply an electric field during growth to control nanowire diameter and growth direction. Growth experiments carried out while imaging within an in situ transmission electron microscope show that the electric field modifies growth by changing the shape, position and contact angle of the catalytic droplet. This droplet engineering can be used to modify nanowires into three dimensional structures, relevant to a range of applications, and also to measure the droplet surface tension, important for quantitative development of strategies to control nanowire growth.
Contructive delivery of cancer chemotherapeutics using virus inspired liposomes.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Technical University of Denmark, Harvard Medical School
Authors: Larsen, J. B. (Ekstern), Clergeaud Veiga, G. (Intern), Eliasen, R. (Intern), Melander, F. (Intern), Kirchhausen, T. (Ekstern), Andresen, T. L. (Intern)
Publication date: 2016
Event: Poster session presented at 14th European Symposium on Controlled Drug Delivery, Egmond aan Zee, Netherlands.
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Electronic versions:
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Publication: Research - peer-review › Poster – Annual report year: 2016

Copper Oxidation through Nucleation Sites of Chemical Vapor Deposited Graphene
We investigate the nucleation defect-triggered oxidation of Cu covered by CVD graphene during postannealing in air. The results reveal that different growth conditions may induce imperfect nucleation of graphene, and cause creation of defects near the nucleation point such as pin holes and amorphous carbon. These defects would serve as a pathway for the diffusion of O₂ during thermal annealing, allowing oxidation of Cu to progress gradually from the nucleation center toward the growth edge. The oxidation process follows the graphene morphology closely; the shape of the oxidized area of Cu has a striking resemblance to that of the graphene flakes. Our work demonstrates that inferior graphene nucleation in CVD processes can compromise the oxidation resistance of a graphene-coated Cu substrate, and indirectly reveal the structure and integrity of graphene, which is of fundamental importance for the quality monitoring and control of graphene growth, for understanding the mechanisms of graphene nucleation and growth, and has implications for graphene’s use in electronic and passivation applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene
Authors: Luo, B. (Intern), Whelan, P. R. (Intern), Shivayogimath, A. (Intern), Mackenzie, D. (Intern), Bøggild, P. (Intern), Booth, T. (Intern)
Number of pages: 7
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 8.89 SJR 4.136 SNIP 1.883
Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 3.958 SNIP 2.061 CiteScore 9.38
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Correlated Coulomb drag in capacitively coupled quantum-dot structures
We study theoretically Coulomb drag in capacitively coupled quantum dots (CQDs) -- a bias-driven dot coupled to an unbiased dot where transport is due to Coulomb mediated energy transfer drag. To this end, we introduce a master-equation approach which accounts for higher-order tunneling (cotunneling) processes as well as energy-dependent lead couplings, and identify a mesoscopic Coulomb drag mechanism driven by nonlocal multi-electron cotunneling processes. Our theory establishes the conditions for a nonzero drag as well as the direction of the drag current in terms of microscopic system parameters. Interestingly, the direction of the drag current is not determined by the drive current, but by an interplay between the energy-dependent lead couplings. Studying the drag mechanism in a graphene-based CQD heterostructure, we show that the predictions of our theory are consistent with recent experiments on Coulomb drag in CQD systems.
Co$_9$S$_8$ nanoparticles encapsulated in nitrogen-doped mesoporous carbon networks with improved lithium storage properties

We report the designed synthesis of unique Co$_9$S$_8$ nanoparticles encapsulated in nitrogen-doped mesoporous carbon networks (Co$_9$S$_8@$NMCN nanocomposites). Uniform zeolitic imidazolate framework-67 was first synthesized and then transformed into Co$_9$S$_8@$NMCN nanocomposites by thermal annealing with sulfur powders in an Ar atmosphere. The structural and compositional analysis were conducted by employing X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and X-ray photoelectron spectroscopy (XPS), which show that each Co$_9$S$_8$ nanoparticle is well encapsulated in nitrogen-doped carbon layers. When evaluated as an anode material for LIBs, the as-prepared composite electrodes delivered superior capacity, excellent cycling stability and rate capability, which are attributed to the advantageous structural features.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, University of New South Wales, Tsinghua University, Hong Kong University of Science and Technology
Authors: Mujtaba, J. (Ekstern), Sun, H. (Intern), Huang, G. (Ekstern), Zhao, Y. (Ekstern), Arandiyan, H. (Ekstern), Sun, G. (Ekstern), Xu, S. (Ekstern), Zhu, J. (Ekstern)
Number of pages: 7
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.736 SJR 0.863
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.06 SJR 0.889 SNIP 0.757
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.947 SNIP 0.834 CiteScore 3.42
Web of Science (2015): Indexed yes
Coupling between a plasmonic V-groove waveguide and single fluorescent bacterial cells
We experimentally demonstrate coupling of fluorescent light from a single bacterium into a plasmonic V-groove waveguide mode. This result is the first step in the construction of an efficient bioplasmonic chip for diverse sensing applications.

Current-induced runaway vibrations in dehydrogenated graphene nanoribbons
We employ a semi-classical Langevin approach to study current-induced atomic dynamics in a partially dehydrogenated armchair graphene nanoribbon. All parameters are obtained from density functional theory. The dehydrogenated carbon dimers behave as effective impurities, whose motion decouples from the rest of carbon atoms. The electrical current can couple the dimer motion in a coherent fashion. The coupling, which is mediated by nonconservative and pseudo-magnetic current-induced forces, change the atomic dynamics, and thereby show their signature in this simple system. We study the atomic dynamics and current-induced vibrational instabilities using a simplified eigen-mode analysis. Our study illustrates how armchair nanoribbons can serve as a possible testbed for probing the current-induced forces.
In this thesis I shall present the most scientifically interesting and/or practically useful results achieved in my PhD project. Such results are related to fundamental properties and technological aspects of \( \text{Cu}_2\text{ZnSnS}_4 \) (CZTS) and related materials for solar cells. By "related materials" I mean two things: i) alternative solar absorbers (notably, \( \text{Cu}_2\text{SnS}_3 \)) that are chemically related to CZTS and that have similar selling points; ii) other materials included in the device stack of CZTS solar cells. Here I list what I believe the main highlights of my work are.

First, we achieve the highest reported power conversion efficiency (5.2\%) for a CZTS solar cell using pulsed laser deposition as a fabrication method for CZTS precursors. This is thanks to joint work of PhD student Andrea Cazzaniga, PhD student Chang Yan (University of New South Wales, Australia) and myself. Perhaps more importantly, we finally understand, albeit very roughly, the "rules of the game" for successful pulsed laser deposition of high-quality chalcogenide precursors for solar cells. This kind of understanding is not evident in the existing literature and is mostly the result of the work of PhD student Andrea Cazzaniga.

Second, I propose and test experimentally a modification of the standard CZTS solar cell architecture by inserting a very thin (few nm) CeO\(_2\) layer between the CZTS absorber and the CdS buffer. Despite being already known in the fields of catalysis and fuel cells, application of CeO\(_2\) in CZTS solar cells is completely new, even though the two materials have a nearly perfect lattice match. In a first investigation over a two-month external research stay at the University of New South Wales, I demonstrate that the open circuit voltage of standard CZTS solar cells fabricated by PhD student Chang Yan is boosted when I include a CeO\(_2\) interface passivation layer.

Third, I critically examine one of the mechanisms that are believed to be the major current issues of CTZS solar cells,
Defect evolution and dopant activation in laser annealed Si and Ge

Defect evolution and dopant activation are intimately related to the use of ion implantation and annealing, traditionally used to dope semiconductors during device fabrication. Ultra-fast laser thermal annealing (LTA) is one of the most promising solutions for the achievement of abrupt and highly doped junctions. In this paper, we report some recent investigations focused on this annealing method, with particular emphasis on the investigation of the formation and evolution of implant/anneal induced defects and their impact on dopant activation. In the case of laser annealed Silicon, we show that laser anneal favours the formation of "unconventional" (001) loops that, following non-melt anneals; act as carrier scattering centres, leading to carrier mobility degradation. In contrast, in the case of melt anneals, the molten region itself is of excellent crystalline quality, defect-free and with very high activation rates. As for laser annealed Germanium, we studied in detail the amorphous to crystalline Ge phase transition as a function of the increasing LTA region itself is of excellent crystalline quality, defect-free and with very high activation rates. As for laser annealed Silicon, we show that laser anneal favours the formation of "unconventional" (001) loops that, following non-melt anneals; act as carrier scattering centres, leading to carrier mobility degradation. In contrast, in the case of melt anneals, the molten region itself is of excellent crystalline quality, defect-free and with very high activation rates. As for laser annealed Germanium, we studied in detail the amorphous to crystalline Ge phase transition as a function of the increasing LTA.
energy density and we found that using LTA, very high carrier concentrations (above $10^{20}$ cm$^{-3}$) were achieved in As doped regions, which are unachievable with conventional rapid thermal annealing (RTA) processes.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Universite de Toulouse, University College Cork, Laser Systems and Solutions of Europe, Probion Analysis, Capres A/S, Istituto per la Microelettronica e i Microsistemi, Università di Catania
Authors: Cristiano, F. (Ekstern), Shayesteh, M. (Ekstern), Duffy, R. (Ekstern), Huet, K. (Ekstern), Mazzamuto, F. (Ekstern), Qiu, Y. (Ekstern), Quillec, M. (Ekstern), Henrichsen, H. (Ekstern), Nielsen, P. F. (Ekstern), Petersen, D. H. (Intern), La Magna, A. (Ekstern), Garuso, G. (Ekstern), Boninelli, S. (Ekstern)
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.32 SJR 0.637 SNIP 0.993
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Scopus rating (2015): SJR 0.552 SNIP 0.963 CiteScore 2.21
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.554 SNIP 1 CiteScore 2.08
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Scopus rating (2013): SJR 0.47 SNIP 0.831 CiteScore 1.65
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.443 SNIP 0.738 CiteScore 1.29
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.43 SNIP 0.695 CiteScore 0.91
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.401 SNIP 0.465
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.607 SNIP 0.581
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.864 SNIP 0.818
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Scopus rating (2006): SJR 0.623 SNIP 0.676
Scopus rating (2005): SJR 0.554 SNIP 0.502
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Scopus rating (2003): SJR 0.394 SNIP 0.458
Scopus rating (2002): SJR 0.657 SNIP 0.681
Scopus rating (2001): SJR 0.409 SNIP 0.428
Scopus rating (2000): SJR 0.436 SNIP 0.596
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Delivery of TLR7 agonist to monocytes and dendritic cells by DCIR targeted liposomes induces robust production of anti-cancer cytokines.

General information
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Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Department of Systems Biology, Center for Biological Sequence Analysis
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Event: Poster session presented at The 43rd Annual Meeting & Exposition of the Controlled Release Society, Seattle, WA, United States.
Main Research Area: Technical/natural sciences
Electronic versions:
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Source-ID: 127726617
Publication: Research - peer-review › Poster – Annual report year: 2016

Denaturing strategies for detection of double stranded PCR products on GMR magnetic sensors

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Fluidic Array Systems and Technology, Stanford University, Danish Cancer Society
Authors: Rizzi, G. (Intern), Lee, J. (Ekstern), Guldberg, P. (Ekstern), Dufva, M. (Intern), Wang, S. X. (Ekstern), Hansen, M. F. (Intern)
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions:
- Abstract_v2_1.pdf

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Source-ID: 127523013
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Depth-dependent composition of sputtered ZnO:Al

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Energy Conversion and Storage, Fundamental Electrochemistry, Department of Photonics Engineering, Optical Microsensors and Micromaterials, Experimental Surface and Nanomaterials Physics, Technical University of Denmark
Authors: Crovetto, A. (Intern), Ottsen, T. (Ekstern), Stamate, E. (Intern), Kjær, D. (Intern), Schou, J. (Intern), Hansen, O. (Intern)
Number of pages: 1
Publication date: 2016
Event: Poster session presented at 6th International Symposium on Transparent Conductive Materials, Chania, Greece.
Main Research Area: Technical/natural sciences
Electronic versions:
- Andrea_Poster_TCM2016_final.pdf
Source: PublicationPreSubmission
Source-ID: 126934871
Publication: Research - peer-review › Poster – Annual report year: 2016
Detection methods for centrifugal microfluidic platforms

Centrifugal microfluidics has attracted much interest from academia as well as industry, since it potentially offers solutions for affordable, user-friendly and portable biosensing. A wide range of so-called fluidic unit operations, e.g. mixing, metering, liquid routing, and particle separation, have been developed and allow automation and integration of complex assay protocols in lab-on-a-disc systems. Besides liquid handling, the detection strategy for reading out the assay is crucial for developing a fully integrated system. In this review, we focus on biosensors and readout methods for the centrifugal microfluidics platform and cover optical as well as mechanical and electrical detection principles.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Burger, R. (Intern), Amato, L. (Intern), Boisen, A. (Intern)
Pages: 54-67
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Main Research Area: Technical/natural sciences

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Volume: 76
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Scopus rating (2016): CiteScore 7.22 SJR 2.095 SNIP 1.619
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.057 SNIP 1.716 CiteScore 6.57
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.029 SNIP 1.726 CiteScore 6.34
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.397 SNIP 1.592 CiteScore 5.7
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.126 SNIP 1.704 CiteScore 5.85
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.143 SNIP 1.609
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.991 SNIP 1.771
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 2.495 SNIP 1.782
Web of Science (2008): Indexed yes
Detection of nerve gases using surface-enhanced Raman scattering substrates with high droplet adhesion

Threats from chemical warfare agents, commonly known as nerve gases, constitute a serious security issue of increasing global concern because of surging terrorist activity worldwide. However, nerve gases are difficult to detect using current analytical tools and outside dedicated laboratories. Here we demonstrate that surface-enhanced Raman scattering (SERS) can be used for sensitive detection of femtomol quantities of two nerve gases, VX and Tabun, using a handheld Raman device and SERS substrates consisting of flexible gold-covered Si nanopillars. The substrate surface exhibits high droplet adhesion and nanopillar clustering due to elasto-capillary forces, resulting in enrichment of target molecules in plasmonic hot-spots with high Raman enhancement. The results may pave the way for strategic life-saving SERS detection of chemical warfare agents in the field.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Chalmers University of Technology, Swedish Defence Research Agency
Authors: Hakonen, A. (Ekstern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern), Andersson, P. O. (Ekstern), Juhlin, L. (Ekstern), Svedendahl, M. (Ekstern), Boisen, A. (Intern), Käll, M. (Ekstern)
Number of pages: 4
Pages: 1305-1308
Publication date: 2016
Main Research Area: Technical/natural sciences

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Journal: Nanoscale
Volume: 8
Issue number: 3
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Web of Science (2018): Indexed yes
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Scopus rating (2017): SNIP 1.442 SJR 2.934
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.46 SJR 2.789 SNIP 1.441
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.77 SNIP 1.542 CiteScore 7.97
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.646 SNIP 1.649 CiteScore 7.64
Web of Science (2014): Indexed yes
Determination of stamp deformation during imprinting on semi-spherical surfaces

We developed a process for double curved injection molding inserts presenting nanostructured surfaces. Line gratings with a line width and spacing of 500 nm as well as arrays of pillars, both up to an aspect ratio of unity, have been successfully transferred onto steel mold surfaces. A thin film of sol-gel was applied onto spherical injection mold inserts and subsequently imprinted using a flexible stamp. A hard curing step transformed the sol-gel into a quartz-like and durable material.

As an example, we present theory and results regarding the imprint of pillar nanostructures on semi-spherical mold surfaces. Imprints were realized on three different radii of circumference of the spherical mold: \( R = 0.5 \) mm, \( R = 1.0 \) mm, and \( R = 2 \) mm. After hard-curing of the imprinted sol-gel, the inserts were used for cold-mold as well as vario-therm injection molding. The polymer replicas and the inserts were characterized by analyzing the center-to-center distance of the pillars at several points across the spheres. From the measurements and the observed deviation of the distance of pillars, the stamp deformation was calculated. Finally, the experimentally determined deformation of the flexible stamp was compared with predictions provided by a geometrical model [1]. Simulated and experimental observations were in good accordance.

Future work will include the application of current results to design nanostructured patterns for which the stamp deformation will be compensated to achieve more reliable surface characteristics.

General information
State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, InMold Biosystems A/S, Nanyang Technological University
Authors: Kafka, J. (Ekstern), Matschuk, M. (Ekstern), Pranov, H. (Ekstern), Kofod, G. (Ekstern), Taboryski, R. J. (Intern), Sonne, M. R. (Intern), Lam, Y. C. (Ekstern)
Number of pages: 1
Publication date: 2016
Event: Abstract from The 15th International Conference on Nanoimprint and Nanoprint Technology (NNT 2016), Braga, Portugal.
Main Research Area: Technical/natural sciences
Electronic versions: kafka_NNT2016.pdf
Source: PublicationPreSubmission
Source-ID: 126680103
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Developing 3D microstructures for tissue engineering
casting process to generate various large scale tissue engineering constructs with single pore geometry with the desired mechanical stiffness and porosity. In addition, a new technique was developed to fabricate dual-pore scaffolds for various
tissue-engineering applications where 3D printing of the PVA mould was combined with a salt leaching process. In this case, the sacrificial PVA mould, defining a structured network-architecture of micro-channels, was filled with salt crystals to define random porous regions between the structured regions of the scaffold. The compatibility of fabrication methods were tested with various biocompatible synthetic polymers such as polydimethylsiloxane (silicone), poly-(caprolactone) and poly(2-hydroxyethyl methacrylate), but other natural and synthetic materials can also be adopted to this process. The in-vitro biocompatibility of the fabricated scaffolds was successfully tested with HepG2 cells. To demonstrate the potential of scaffolds to release drugs and hereby control the behavior of cells growing on its surface, the silicone elastomer based perfusable capillary network scaffolds, generated from previous steps, was exposed to supercritical CO₂ in the presence of a hydrogel to create an additional interpenetrating network (IPN) of hydrogel nanodeposits. Biocompatible IPNs of silicone elastomer with poly(2-hydroxyethyl methacrylate) (pHEMA) and Poly(ethylene glycol) methylthether acrylate (PEGMEA) hydrogel 3D scaffolds were produced in this way. The model drug doxycycline was loaded into the hydrogel of the IPN materials, and the biological activity of released doxycycline was tested using a doxycycline regulated green fluorescent reporter gene expression assay in HeLa cells. Additionally, decellularized liver extracellular matrix (ECM) and natural silk protein materials have been developed and tested for enhancing the differentiation of hiPSC-derived hepatocytes and fabricating biodegradable scaffolds for in-vivo tissue engineering applications.

Along with various scaffolds fabrication methods we finally presented an optimized study of hepatic differentiation of hiPSC-derived DE cells cultured for 25 days in a 3D perfusion bioreactor system with an array of 16 small-scale tissue-bioreactors with integrated dual-pore pore scaffolds and flow rates. Hepatic differentiation and functionality of hiPSC-derived hepatocytes were successfully assessed and compared against freshly obtained human precision-cut liver slices (hPCLS) as an ex vivo liver representative model as gold standard, developed by other project partners.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, Bioanalytics, Fluidic Array Systems and Technology
Authors: Mohanty, S. (Intern), Wolff, A. (Intern), Emnéus, J. (Intern), Dufva, M. (Intern)
Number of pages: 220
Publication date: 2016

Development and validation of a colorimetric sensor array for fish spoilage monitoring
Given the need for non-destructive methods and sensors for food spoilage monitoring, we have evaluated sixteen chemo-sensitive compounds incorporated in an array for colorimetric detection of typical spoilage compounds (trimethylamine, dimethylamine, cadaverine, putrescine) and characterized their color changes in response to compounds present in fresh products (hexanal, 1-octane-3-ol) used as negative controls. The colorimetric sensor array was used to follow fish spoilage over time at room temperature for up to 24 h as well as at 4 °C for 9 days. Additionally, fish decay was monitored using traditional assays measuring the quantity of thiobarbituric acid, total volatile basic nitrogen, changes in pH, O2 level, as well as following bacterial growth. We found a linear correlation between changes in pH, thiobarbituric acid content and the signal intensity recorded with the colorimetric array over time. During spoilage, the increase in signal intensity of the chemo-sensitive compounds showed a similar trend as the increase in microbial growth. We observed that the sensitivity of the chemo-sensitive compounds depends on the spoilage conditions (room temperature vs. 4 °C), highlighting the importance of the application of an array instead of single chemo-sensitive compounds when following complex changes during food spoilage.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Applied Mathematics and Computer Science, Cognitive Systems, Bioanalytics, Surface Engineering, Benha University, University College Cork
Number of pages: 7
Pages: 346-352
Publication date: 2016
Main Research Area: Technical/natural sciences
Development of a video-microscopic method to compare the effect of a precipitation inhibitor

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, University of Copenhagen
Authors: Christfort, J. (Ekstern), Plum, J. (Ekstern), Madsen, C. (Ekstern), Nielsen, L. H. (Intern), Müllertz, A. (Ekstern), Rades, T. (Ekstern)
Publication date: 2016
Event: Poster session presented at 2016 AAPS Annual Meeting and Exposition, Denver, CO, United States.
Main Research Area: Technical/natural sciences
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Publication: Research - peer-review › Poster – Annual report year: 2016

Development of Novel Biomaterials for Potentiation of Radiotherapy

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces
Authors: Bruun, L. M. (Intern), Andresen, T. L. (Intern)
Number of pages: 206
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Main Research Area: Technical/natural sciences

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Projects:
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Source: PublicationPreSubmission
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Publication: Research › Ph.D. thesis – Annual report year: 2017

Development of smart molecularly imprinted polymers for use in sustainable food nanosensors
In this project we aim to develop core shell imprinted polymers for use in microfluidic based biosensors. By combining the magnetic properties of iron oxide for facile sample preparation, the fluorescent properties of quantum dots as the optical transducer, as well as molecularly imprinted polymers as the receptor, an optical based biosensor will be developed, capable of detecting antibiotic residues in pork products. Iron nanoparticles and CdTe quantum dots were synthesized using standard synthesis protocols. The resultant Fe3O4 nanoparticles were treated with tetraethyl orthosilicate (TEOS),
and the CdTe quantum dots were then encapsulated. Finally a thin MIP layer was polymerized round the nanoparticles using azobisisobutyronitrile (AIBN) as the initiator, ethylene dimethacrylate (EDMA) as the crosslinker, acrylamide (AAm) and methacrylic acid (MAA) as the monomers and the antibiotic as the template. By incorporating a microfluidic based platform with the developed smart nanomaterials, a handheld sensor capable of multiplex detection will be developed. It can be used within a food manufacturing environment for the routine screening of pork products and provide a more sustainable replacement for animal derived antibodies.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip
Authors: Ashley, J. (Intern), Sun, Y. (Intern)
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Main Research Area: Technical/natural sciences
Links:
http://www.sustain.dtu.dk/

Bibliographical note
Sustain Abstract F-3
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Development of solid supports for electrochemical study of biomimetic membrane systems
Biomimetic membranes are model membrane systems used as an experimental tool to study fundamental cellular membrane physics and functionality of reconstituted membrane proteins. By exploiting the properties of biomimetic membranes resembling the functions of biological membranes, it is possible to construct biosensors for high-throughput screening of potential drug candidates. Among a variety of membrane model systems used for biomimetic approach, lipid bilayers in the form of black lipid membranes (BLMs) and lipo-polymersomes (vesicle structures composed of lipids and polymers), both with reconstituted membrane spanning proteins, are attractive tools. However, BLMs suffer from intrinsic fragility, therefore, requiring techniques to increase their robustness and stability. This PhD thesis presents strategies to construct solid supports for electrochemical studies of two biomimetic membrane systems, BLMs and protein-loaded lipopolymersomes.

The solid support for BLMs was constructed as a reusable device comprising an ethylene tetrafluoroethylene (ETFE) aperture array supported by an in situ polymerized hydrogel covalently attached to both the ETFE and a gold electrode microchip. The hydrogel facilitated BLM formation without the need of manual painting and increased membrane stability in comparison with freestanding membranes. The functionality of the hydrogel supported BLMs (hsBLMs) were demonstrated by electrochemical impedance spectroscopic (EIS) characterization of incorporated ion transporter valinomycin. The presented work also includes a comprehensive EIS analysis and cryological scanning electron microscopic (cryo-SEM) imaging of hydrogels formulated in various molar ratios (1:100; 1:200; 1:400) of the cross-linker poly(ethylene glycol)dimethacrylate (PEGDMA) and 2-hydroxyethylene methacrylate (HEMA) monomers.

Lipo-polymersomes have proved to be suitable for reconstitution of a model G-protein coupled receptor (GPCR) - bacteriorhodopsin (bRh). The bRh-loaded lipo-polymersomes were interfaced to gold electrodes using two different strategies, layer-by-layer deposited polyelectrolyte cushion directly on a gold electrode microchip and on a polyethersulfone (PES) support grafted by in situ polymerized hydrogel. Both strategies proved to be suitable for immobilization of functional bRh loaded lipo-polymersomes. Amperometric monitoring showed that the PES membrane support facilitated recording of a steady-state photocurrent while only a transient photocurrent peak was recorded on the polyelectrolyte cushion without a PES membrane.

This PhD thesis also comprises the design and fabrication process of a modular microfluidic system with automated fluid delivery (micropumps and valves), providing a possibility for future applications of biomimetic membranes in the form of hsBLMs and polymersomes. This thesis presents both strategies for formulation robust biomimetic membrane systems and devices, which could be developed further to construct biosensor technology for high-throughput screening of drug candidates.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Bioanalytics, Department of Environmental Engineering, Water Technologies
Authors: Mech-Dorosz, A. (Intern), Heiskanen, A. (Intern), Emnéus, J. (Intern), Hélix-Nielsen, C. (Intern)
Publication date: 2016

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Original language: English
Main Research Area: Technical/natural sciences
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Source-ID: 123470503
Dielectric function and double absorption onset of monoclinic Cu$_2$SnS$_3$: Origin of experimental features explained by first-principles calculations

In this work, we determine experimentally the dielectric function of monoclinic Cu$_2$SnS$_3$ (CTS) by spectroscopic ellipsometry from 0.7 to 5.9 eV. An experimental approach is proposed to overcome the challenges of extracting the dielectric function of Cu$_2$SnS$_3$ when grown on a glass/Mo substrate, as relevant for photovoltaic applications. The ellipsometry measurement reveals a double absorption onset at 0.91 eV and 0.99 eV. Importantly, we demonstrate that calculation within the density functional theory (DFT) confirms this double onset only when a very dense k-mesh is used to reveal fine details in the electronic structure, and this can explain why it has not been reported in earlier calculated spectra. We can now show that the double onset originates from optical transitions at the Γ-point from three energetically close-lying valence bands to a single conduction band. Thus, structural imperfection, like secondary phases, is not needed to explain such an absorption spectrum. Finally, we show that the absorption coefficient of CTS is particularly large in the near-band gap spectral region when compared to similar photovoltaic materials.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Photonics Engineering, Optical Microsensors and Micromaterials, Experimental Surface and Nanomaterials Physics, KTH - Royal Institute of Technology, University of Oslo
Authors: Crovetto, A. (Intern), Chen, R. (Ekstern), Ettlinger, R. B. (Intern), Cazzaniga, A. C. (Intern), Schou, J. (Intern), Persson, C. (Ekstern), Hansen, O. (Intern)
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.97 SJR 1.599 SNIP 1.71
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.8 SNIP 1.851 CiteScore 5.16
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.19 SNIP 2.348 CiteScore 5.87
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.179 SNIP 2.529 CiteScore 5.58
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.441 SNIP 2.654 CiteScore 5.25
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.182 SNIP 2.577 CiteScore 5.16
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Differential proteome and cellular adhesion analyses of the probiotic bacterium *Lactobacillus acidophilus* NCFM grown on raffinose - an emerging prebiotic

Whole cell and surface proteomes were analyzed together with adhesive properties of the probiotic bacterium *Lactobacillus acidophilus* NCFM (NCFM) grown on the emerging prebiotic raffinose, exemplifying a synbiotic. Adhesion of NCFM to mucin and intestinal HT-29 cells increased three-fold after culture with raffinose versus glucose, as also visualized by scanning electron microscopy. Comparative proteomics using 2D-DIGE showed 43 unique proteins to change in relative abundance in whole cell lysates from NCFM grown on raffinose compared to glucose. Furthermore, 14 unique proteins in 18 spots of the surface subproteome underwent changes identified by differential 2DE, including elongation factor G, thermostable pullulanase, and phosphate starvation inducible stress-related protein increasing in a range of +2.1 to +4.7 fold. By contrast five known moonlighting proteins decreased in relative abundance by up to −2.4 fold. Enzymes involved in raffinose catabolism were elevated in the whole cell proteome; α-galactosidase (+13.9 fold); sucrose phosphorylase (+5.4 fold) together with metabolic enzymes from the Leloir pathway for galactose utilization and the glycolysis; β-galactosidase (+5.7 fold); galactose (+2.9+3.1 fold) and fructose (+2.8 fold) kinases. The insights at the molecular and cellular levels contributed to the understanding of the interplay of a synbiotic composed of NCFM and raffinose with the host.

**General information**

State: Published  
Organisations: Department of Systems Biology, Enzyme and Protein Chemistry, Department of Micro- and Nanotechnology, Center for Biological Sequence Analysis, Molecular Windows, Technical University of Denmark, North Carolina State University, DuPont  
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.85 SJR 1.564 SNIP 0.889
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
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BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.449 SNIP 0.973 CiteScore 3.73
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.488 SNIP 0.978 CiteScore 3.88
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.497 SNIP 1.094 CiteScore 4.1
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.691 SNIP 1.175 CiteScore 4.49
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.514 SNIP 1.123
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.518 SNIP 1.12
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.61 SNIP 1.126
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.855 SNIP 1.2
Web of Science (2007): Indexed yes
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Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.945 SNIP 1.388
Web of Science (2005): Indexed yes
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Web of Science (2004): Indexed yes
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Web of Science (2003): Indexed yes
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Web of Science (2002): Indexed yes
Original language: English
Adhesion, HT-29 cells, Moonlighting proteins, Probiotics, Raffinose, Surface and whole cell proteomes
Direct vacuum inlet system enabling highly sensitive in-situ analysis of chemical reaction products

Electrochemical reactions play an increasingly important role in sustainable energy conversion and chemical synthesis. Better understanding of catalytic mechanisms at electrode surfaces is thus important for the transition to a clean-energy economy, but is hindered by the difficulty of real-time detection of products and reaction intermediates during electrochemistry experiments. Electrochemical mass spectrometry (EC-MS), including techniques referred to as DEMS and OLEMS, can enable in-situ detection of electrochemical products, but often fails to provide quantitative or reproducible results.

Herein, we present a new type of EC-MS based on a versatile gas inlet to vacuum fabricated onto a silicon microchip, and compare it to established techniques with focus on sensitivity, time response, and mass transport. The chip consists of a perforated membrane stabilizing a large liquid-gas interface, a capillary maintaining a controlled flow over a pressure drop to ultra-high vacuum, and inlet and outlet channels for an inert make up gas. The use of a direct inlet enables orders of magnitude higher sensitivity than differentially pumped systems without a loss in time response for volatile products, while clean-room techniques for chipfabrication and a precisely controlled working distance between the electrode and chip membrane provide for a highly reproducible experimental setup. The make up gas can also be used to saturate the electrolyte from through the chip membrane enabling quick and precise exchange of dissolved gases. The well-characterized mass transport of both reactants and products in this setup enables single-turnover resolution for analysis of electrochemical reactions, as will be demonstrated with examples.

Discovering Challenges in Fabrication of Nanostructured c-Si Solar Cells with Metal Oxides Carrier Selective Contacts

Discovering Challenges in Fabrication of Nanostructured c-Si Solar Cells with Metal Oxides Carrier Selective Contacts

Discovering Challenges in Fabrication of Nanostructured c-Si Solar Cells with Metal Oxides Carrier Selective Contacts
DNA self-assembly on graphene surface studied by SERS mapping

The self-assembly of double-stranded DNA (dsDNA) segments on two variations of graphene surfaces having nano-platelets with different lateral sizes and thicknesses was investigated using surface enhanced Raman spectroscopy (SERS) and electrical impedance spectroscopy (EIS) techniques. Due to the strong local field-enhancement, the SERS signals from functional molecules bound to the graphene edges and from DNA moieties were recorded. Relative intensities of specific Raman modes were used as contrast parameters to build Raman signal intensity maps. The observed variation in the SERS signal intensity was related to the different configuration (tilted or flattened) in which dsDNA segments are assembled on the carbon surface, depending on the graphene platelet size. EIS was used to characterize the conductive properties of nano-structured films containing pristine or DNA-functionalized graphene nano-platelets. Results from the EIS analysis supported the SERS findings and confirmed that SERS mapping is a reliable method for a rapid monitoring of the procedures used to interface DNA with graphene surfaces. The present study, linking DNA anchoring morphology to the conductive properties of nano-structured hybrid films, contribute to define a new approach in the optimization of biosensor design.
Do planetary seasons play a fundamental role in attaining habitable climates?

Deep generative models parameterized by neural networks have recently achieved state-of-the-art performance in unsupervised and semi-supervised learning. We extend deep generative models with auxiliary variables which improves the variational approximation. The auxiliary variables leave the generative model unchanged but make the variational distribution more expressive. Inspired by the structure of the auxiliary variable we also propose a model with two stochastic layers and skip connections. Our findings suggest that more expressive and properly specified deep generative models converge faster with better results. We show state-of-the-art performance within semi-supervised learning on MNIST (0.96%), SVHN (16.61%) and NORB (9.40%) datasets.

Effect of nitrogen-doped graphene nanofluid on the thermal performance of the grooved copper heat pipe

Thermal performance of a grooved heat pipe using aqueous nitrogen-doped graphene (NDG) nanofluids was analysed. This study in particular focused on the effect of varying NDG nanosheets concentrations, heat pipe inclination angles and input heating powers. The results indicated that the inclination angle had a major influence on the heat transfer performance of heat pipes and the inclination angle (θ) of 90° was corresponded to the best thermal performance. The maximum thermal resistance reduction of 58.6% and 99% enhancement in the evaporator heat transfer coefficient of the heat pipe were observed for NDG nanofluid with concentration of 0.06wt%, inclination angle of θ=90° and a heating power of 120W in comparison to DI-water under the exact same condition. Additionally, the surface temperature distribution was decreased by employing NDG nanosheets, which can in return increase the thermal performance of a grooved heat pipe.
The present investigation indicated that the thermal performance of the grooved heat pipe can be improved significantly by using NDG nanofluids.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Malaya, Massachusetts Institute of Technology
Authors: Mehrali, M. (Ekstern), Sadeghinezhad, E. (Ekstern), Azizian, R. (Ekstern), Akhiani, A. R. (Ekstern), Tahan Latibari, S. (Ekstern), Mehrali, M. (Intern), Metselaar, H. S. C. (Ekstern)
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- Web of Science (2016): Indexed yes
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- Web of Science (2014): Indexed yes
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- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 1
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 1
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 1
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 1
- Web of Science (2009): Indexed yes
- BFI (2008): BFI-level 1
- Web of Science (2008): Indexed yes
- BFI (2007): BFI-level 1
- Web of Science (2007): Indexed yes
- BFI (2006): BFI-level 1
- Web of Science (2006): Indexed yes
- BFI (2005): BFI-level 1
- Web of Science (2005): Indexed yes
Effect of Synthesis Parameters on the Structure and Magnetic Properties of Magnetic Manganese Ferrite/Silver Composite Nanoparticles Synthesized by Wet Chemistry Method

In the present work, magnetic manganese ferrite/silver (MnFe$_2$O$_4$-Ag) composite nanoparticles were synthesized by wet chemistry method. This synthesis process consists of two steps: first, the seed of manganese ferrite nanoparticles (MnFe$_2$O$_4$ NPs) was prepared by a coprecipitation method; second, growth of silver nanoparticles (AgNPs) on the MnFe$_2$O$_4$ seed by modified photochemical reaction. We have conducted systematically the effects of synthesis parameters such as pH value, synthesis time, precursor salts concentration, mass ratio and stabilizing agents on the structure and magnetic properties of nanocomposites. In an optimized condition of synthesis parameters, the high quality MnFe$_2$O$_4$ NPs are obtained at pH value = 13, Mn$^{2+}$ cation concentration = 0.4 M and synthesis time about 105 min; and the use of PVP stabilizing agent is found to optimize the formation of Ag-NPs on the surface of MnFe$_2$O$_4$ NPs. The as-prepared MnFe$_2$O$_4$-Ag magnetic nanocomposites display excellent properties of high crystallinity, long-term aggregation stability in aqueous medium, large saturation magnetization in the range of 15-20 emu/g, and small sizes of Ag-NPs similar to 20 nm. These exhibited properties made the MnFe$_2$O$_4$-Ag nanocomposites attractive candidate for various technological applications in biomedicine, catalyst and environmental monitoring.

General information

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Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Hanoi University of Science and Technology, Hung Yen University of Technology and Education, Tien Giang University, Vietnamese Academy of Science and Technology, Technical University of Denmark
Authors: Huy, L. (Ekstern), Tam, L. (Ekstern), Phan, V. (Ekstern), Trung, T. (Ekstern), Tung, L. (Ekstern), Thanh, D. (Ekstern), Hoa, N. (Ekstern), Vinh, L. (Ekstern), Ngo, D. (Ekstern), Mølhave, K. (Intern), Le, A. (Ekstern)
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.334 SNIP 0.477 CiteScore 1.23
BFI (2014): BFI-level 1
Effects of carbon doping on the microstructural, micro/nano-mechanical, and mesenchymal stromal cells biocompatibility and osteogenic differentiation properties of alumina

It has been demonstrated that carbon (C) doped aluminium oxide (Al₂O₃) nanocomposite (C ~0.012wt%) had greater wear resistance and lower surface grains pull out percentage when compared with monolithic Al₂O₃. In the present study, we investigated the physicochemical, micro- and nanomechanical, cell attachment, in vitro biocompatibility and osteogenic differentiation properties of Al₂O₃ doped carbon (0.012wt%) nanocomposite (Al₂O₃/C). Data were compared to values obtained for monolithic alumina (Al₂O₃). The calcined Al₂O₃/C nanocomposite was densified using cold isostatic pressing and followed by pressureless sintering. For physicochemical and microstructural characterisation, Energy dispersive X-ray (EDX), X-ray diffraction (XRD), Raman spectroscopy, and X-ray photoemission spectrometer (XPS) were used. EDX, XRD peaks and Raman spectroscopy demonstrated correlating to Al₂O₃/C. Surface profiling and contact angle investigations demonstrated highly contoured micro-surface topography. The micro and nano-hardness indicate an improved wear resistance of the Al₂O₃/C when compared with monolithic Al₂O₃. SEM, confocal images and alamar blue reduction assay suggested good cell attachment and proliferation of human bone marrow derived mesenchymal stromal cells (hBMSCs). Osteogenic protein and gene expression indicated Al₂O₃/C had a significant osteogenic potential.

General information
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Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Malaya
Authors: Krishnamurithy, G. (Ekstern), Yahya, N. A. (Ekstern), Mehrali, M. (Intern), Mehrali, M. (Ekstern), Mohan, S. (Ekstern), Murali, M. R. (Ekstern), Raghavendran, H. R. B. (Ekstern), Kamarul, T. (Ekstern)
Al2O3, Carbon, Microstructure-final, Hardness, Mechanical properties, Biomedical applications
Electrical impedance tomography methods for miniaturised 3D systems

In this study, we explore the potential of electrical impedance tomography (EIT) for miniaturised 3D samples to provide a noninvasive approach for future applications in tissue engineering and 3D cell culturing. We evaluated two different electrode configurations using an array of nine circular chambers (Ø ~ 10 mm), each having eight gold plated needle electrodes vertically integrated along the chamber perimeter. As first method, the adjacent electrode configuration was tested solving the computationally simple back-projection algorithm using Comsol Multiphysics in time-difference EIT (t-EIT). Subsequently, a more elaborate method based on the "polar-offset" configuration (having an additional electrode at the centre of the chamber) was evaluated using linear t-EIT and linear weighted frequency-difference EIT (f-EIT). Image reconstruction was done using a customised algorithm that has been previously validated for EIT imaging of neural activity. All the finite element simulations and impedance measurements on test objects leading to image reconstruction utilised an electrolyte having an ionic strength close to physiological solutions. The chosen number of electrodes and consequently number of electrode configurations aimed at maximising the quality of image reconstruction while minimising the number of required measurements. This is significant when designing a technique suitable for tissue engineering applications where time-based monitoring of cellular behaviour in 3D scaffolds is of interest. The performed tests indicated that the method based on the adjacent configuration in combination with the backprojection algorithm was only able to provide image reconstruction when using a test object having a higher conductivity than the background electrolyte. Due to limitations in the mesh quality, the reconstructed image had significant irregularities and the position was slightly shifted toward the perimeter of the chamber. On the other hand, the method based on the polar-offset configuration combined with the customised algorithm proved to be suitable for image reconstruction when using non-conductive and cell-based test objects (down to 1% of the measurement chamber volume), indicating its suitability for future tissue engineering applications with polymeric scaffolds.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, BioLabChip, Fluidic Array Systems and Technology, Bioanalytics, Technical University of Denmark, University College London, University of Oslo
Authors: Canali, C. (Intern), Aristovich, K. (Ekstern), Ceccarelli, L. (Ekstern), Larsen, L. B. (Intern), Martinsen, Ø. (Ekstern), Wolff, A. (Intern), Dufva, M. (Intern), Emméus, J. (Intern), Heiskanen, A. (Intern)
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Electrochemical sensing of biomarker for diagnostics of bacteria-specific infections
Aim: Pseudomonas aeruginosa is a pathogen that is prevalent in serious infections in compromised patients worldwide. A unique virulence factor of this bacterium is the redox-active molecule pyocyanin, which is a potential biomarker for the identification of P. aeruginosa infections. Here we report a direct, selective and rapid detection technique of pyocyanin.
Materials & methods: Pyocyanin was detected by amperometry at a relatively high potential where the pyocyanin signal
was unaffected by background contributions. Results & conclusion: Pyocyanin was detected at concentrations down to 125 nM in a 50 μM mixture of interfering compounds with a reproducibility of r² = 0.999 (n = 5) within 200 s. The results document a step toward apoint-of-care technique for diagnosis of *P. aeruginosa* infections.

**General information**

**State:** Published

**Organisations:** Department of Systems Biology, Infection Microbiology, Department of Micro- and Nanotechnology, Novo Nordisk Foundation Center for Biosustainability, Department of Microbiology, Risø National Laboratory for Sustainable Energy, Department of Photonics Engineering, Nano Bio Integrated Systems

**Authors:** Al Atrakchi, F. A. (Intern), Johansen, H. K. (Intern), Molin, S. (Intern), Svendsen, W. E. (Intern)

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- Scopus rating (2017): SNIP 0.89 SJR 1.302
- Web of Science (2017): Indexed Yes
- BFI (2016): BFI-level 1
- Scopus rating (2016): CiteScore 4.08 SJR 1.27 SNIP 0.908
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 1
- Scopus rating (2015): SJR 1.395 SNIP 1.016 CiteScore 3.92
- BFI (2014): BFI-level 1
- Scopus rating (2014): SJR 1.462 SNIP 1.108 CiteScore 4.04
- BFI (2013): BFI-level 2
- Scopus rating (2013): SJR 1.739 SNIP 1.176 CiteScore 4.44
- ISI indexed (2013): ISI indexed yes
- BFI (2012): BFI-level 2
- Scopus rating (2012): SJR 1.67 SNIP 1.144 CiteScore 4.21
- ISI indexed (2012): ISI indexed yes
- BFI (2011): BFI-level 2
- Scopus rating (2011): SJR 1.741 SNIP 1.041 CiteScore 4.29
- ISI indexed (2011): ISI indexed yes
- BFI (2010): BFI-level 2
- Scopus rating (2010): SJR 2.26 SNIP 1.455
- BFI (2009): BFI-level 1
- Scopus rating (2009): SJR 1.855 SNIP 1.168
- BFI (2008): BFI-level 1
- Scopus rating (2008): SJR 1.536 SNIP 1.084
- Web of Science (2008): Indexed yes
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Electron and phonon drag in thermoelectric transport through coherent molecular conductors

We study thermoelectric transport through a coherent molecular conductor connected to two electron and two phonon baths using the nonequilibrium Green's function method. We focus on the mutual drag between electron and phonon transport as a result of 'momentum' transfer, which happens only when there are at least two phonon degrees of freedom. After deriving expressions for the linear drag coefficients, obeying the Onsager relation, we further investigate their effect on nonequilibrium transport. We show that the drag effect is closely related to two other phenomena: (1) adiabatic charge pumping through a coherent conductor; (2) the current-induced nonconservative and effective magnetic forces on phonons.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Huazhong University of Science and Technology, University of Copenhagen, National University of Singapore
Authors: Lü, J. (Ekstern), Wang, J. (Ekstern), Hedegård, P. (Ekstern), Brandbyge, M. (Intern)
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Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 3.16 SJR 2.339 SNIP 1.151
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 2.377 SNIP 1.13 CiteScore 2.8
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 2.762 SNIP 1.316 CiteScore 3.3
Web of Science (2014): Indexed yes
Scopus rating (2013): SJR 2.813 SNIP 1.326 CiteScore 3.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 3.173 SNIP 1.378 CiteScore 3.57
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 3.326 SNIP 1.423 CiteScore 3.61
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Scopus rating (2010): SJR 3.318 SNIP 1.447
Web of Science (2010): Indexed yes
Web of Science (2009): Indexed yes
Scopus rating (2008): SJR 2.923 SNIP 1.516
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.892 SNIP 1.588
Electron energy-loss spectroscopy of branched gap plasmon resonators

The miniaturization of integrated optical circuits below the diffraction limit for high-speed manipulation of information is one of the cornerstones in plasmonics research. By coupling to surface plasmons supported on nanostructured metallic surfaces, light can be confined to the nanoscale, enabling the potential interface to electronic circuits. In particular, gap surface plasmons propagating in an air gap sandwiched between metal layers have shown extraordinary mode confinement with significant propagation length. In this work, we unveil the optical properties of gap surface plasmons in silver nanoslot structures with widths of only 25 nm. We fabricate linear, branched and cross-shaped nanoslot waveguide components, which all support resonances due to interference of counter-propagating gap plasmons. By exploiting the superior spatial resolution of a scanning transmission electron microscope combined with electron energy-loss spectroscopy, we experimentally show the propagation, bending and splitting of slot gap plasmons.

General information
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Organisations: Department of Micro- and Nanotechnology, Center for Nanostructured Graphene, Department of Photonics Engineering, Structured Electromagnetic Materials, University of Southern Denmark, Stanford University
Authors: Raza, S. (Ekstern), Esfandyarpour, M. (Ekstern), Koh, A. L. (Ekstern), Mortensen, N. A. (Intern), Brongersma, M. L. (Ekstern), Bozhevolnyi, S. I. (Ekstern)
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Scopus rating (2017): SNIP 2.912 SJR 6.582
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 11.8 SJR 6.414 SNIP 2.855
Electronic transport in graphene nanoribbons with sublattice-asymmetric doping
Recent experimental findings and theoretical predictions suggest that nitrogen-doped CVD-grown graphene may give rise to electronic band gaps due to impurity distributions which favor segregation on a single sublattice. Here, we demonstrate theoretically that such distributions lead to more complex behavior in the presence of edges, where geometry determines whether electrons in the sample view the impurities as a gap-opening average potential or as scatterers. Zigzag edges give rise to the latter case, and remove the electronic band gaps predicted in extended graphene samples. We predict that such behavior will give rise to leakage near grain boundaries with a similar geometry or in zigzag-edged etched devices. Furthermore, we examine the formation of one-dimensional metallic channels at interfaces between different sublattice domains, which should be observable experimentally and offer intriguing waveguiding possibilities.

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Organisations: Department of Micro- and Nanotechnology, Center for Nanostructured Graphene, Theoretical Nanotechnology
Authors: Aktor, T. (Intern), Jauho, A. (Intern), Power, S. (Intern)
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Scopus rating (2017): SJR 1.604 SNIP 1.04
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 3.16 SJR 2.339 SNIP 1.151
Web of Science (2016): Indexed yes
Electron Interference in Ballistic Graphene Nanoconstrictions

We realize nanometer size constrictions in ballistic graphene nanoribbons grown on sidewalls of SiC mesa structures. The high quality of our devices allows the observation of a number of electronic quantum interference phenomena. The transmissions of Fabry-Perot-like resonances are probed by in situ transport measurements at various temperatures. The energies of the resonances are determined by the size of the constrictions, which can be controlled precisely using STM lithography. The temperature and size dependence of the measured conductances are in quantitative agreement with tight-binding calculations. The fact that these interference effects are visible even at room temperature makes the reported devices attractive as building blocks for future carbon based electronics.
Electrophoretic deposition of calcium silicate-reduced graphene oxide composites on titanium substrate

Calcium silicate (CS)/graphene coatings have been used to improve the biological and mechanical fixation of metallic prosthesis. Among the extraordinary features of graphene is its very high mechanical strength, which makes it an attractive nanoreinforcement material for composites. Calcium silicate-reduced graphene oxide (CS-rGO) composites were synthesized, using an in situ hydrothermal method. CS nanowires were uniformly decorated on the rGO, with an appropriate interfacial bonding. The CS-rGO composites behaved like hybrid composites when deposited on a titanium substrate by cathodic electrophoretic deposition (EPD). Compared to a pure CS coating on Ti, the CS-1. wt% rGO coating has improved adhesion by 70%, hardness by 150% and the elastic modulus by 240%. The CS-rGO composite coatings exhibit good apatite-forming ability in simulated body fluid (SBF). Moreover, the effect of addition of rGO on morphology, adhesion and proliferation of human osteoblast cells (hFOB) was investigated in vitro.

General information
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Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Malaya
Authors: Mehrali, M. (Ekstern), Akhiani, A. R. (Ekstern), Talebian, S. (Ekstern), Mehrali, M. (Ekstern), Latibari, S. T. (Ekstern), Dolatshahi-Pirouz, A. (Intern), Metselaar, H. S. C. (Ekstern)
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Web of Science (2017): Indexed Yes
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Scopus rating (2016): CiteScore 3.25 SJR 1.142 SNIP 1.888
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Electrospraying Chitosan Particles for Oral Vaccine Delivery

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, National Food Institute, Research Group for Nano-Bio Science
Authors: Nielsen, L. H. (Intern), Sevilla Moreno, J. A. (Intern), Boutrup Stephansen, K. (Intern), Chronakis, I. S. (Intern), Boisen, A. (Intern)
Publication date: 2016
Event: Abstract from 2016 AAPS Annual Meeting and Exposition, Denver, CO, United States.
Electrospraying particles for loading into microcontainers for drug delivery

General information
State: Published
Organisations: National Food Institute, Research Group for Nano-Bio Science, Department of Micro- and Nanotechnology, Nanoprobes
Authors: Sevilla Moreno, J. A. (Intern), Boutrup Stephansen, K. (Intern), Nielsen, L. H. (Intern), Chronakis, I. S. (Intern), Boisen, A. (Intern)
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Main Research Area: Technical/natural sciences
Electronic versions:
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Electrosynthesis of acetate from CO₂ by a highly structured biofilm assembled with reduced graphene oxide–tetraethylene pentamine

Microbes can reduce CO₂ into multicarbon chemicals with electrons acquired from the cathode of a bioelectrochemical reactor. This bioprocess is termed microbial electrosynthesis (MES). One of the main challenges for the development of highly productive MES reactors is achieving efficient electron transfer from the cathode to microbes. Here, carbon cloth cathodes modified with reduced graphene oxide functionalized with tetraethylene pentamine (rGO-TEPA) were readily self-assembled in the cathodic chamber of a MES reactor. Electroactive biofilms with unique spatial arrangement were subsequently formed with *Sporomusa ovata* at the surface of rGO-TEPA-modified electrodes resulting in a more performant MES process. The acetate production rate from CO₂ was increased 3.6 fold with the formation of dense biofilms when wild type *S. ovata* was combined with rGO-TEPA. An improvement of 11.8 fold was observed with a highly structured biofilm including multiple spherical structures possibly consisting of bioinorganic networks of rGO-TEPA and bacterial cells from a novel strain of *S. ovata* adapted to reduce CO₂ faster. The three dimensional biofilms observed in this study enabled highly effective electric interactions between *S. ovata* and the cathode, demonstrating that the development of dense cathode biofilms is an effective approach to improve MES productivity.

General information
State: Published
Organisations: Novo Nordisk Foundation Center for Biosustainability, Research Groups, Bioelectrochemical Systems, BioLabChip, Department of Micro- and Nanotechnology, Center for Nuclear Technologies, The Hevesy Laboratory, Radioecology and Tracer Studies
Authors: Chen, L. (Intern), Tremblay, P. (Intern), Mohanty, S. (Intern), Xu, K. (Intern), Zhang, T. (Intern)
Number of pages: 7
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Main Research Area: Technical/natural sciences

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Journal: Journal of Materials Chemistry A
Volume: 4
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Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Elimination of Second-Harmonics in CMUTs using Square Pulse Excitation

The harmonic imaging mode is today a fundamental part of ultrasound imaging; it is not only used for suppressing the grating lobe artifact, but also to reduce many other acoustical artifacts in the ultrasound image. A vital performance parameter for accepting CMUT probes as a clinical usable transducer technology is, that it can support harmonic imaging. The large bandwidth of the CMUT is a clear advantage for harmonic imaging, but the inherent nonlinear behavior of the CMUT poses an issue as it is difficult to dissociate the harmonics generated in the tissue from the harmonic content of the transmitted signal. This work presents how proper pulse coding of a bipolar pulser, which is present in most commercial ultrasound scanners, can reduce the intrinsic generated harmonic to fundamental pressure amplitude ratio to below −35 dB, making CMUT probes usable for clinical applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-Applied Sensors, Department of Electrical Engineering, Biomedical Engineering, Center for Fast Ultrasound Imaging, BK Ultrasound
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Electron versions: manuscript_2.pdf
DOIs: 10.1109/ULTSYM.2016.7728824
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

Elucidating the role of free polycations in gene knockdown by siRNA polyplexes

Future improvements of non-viral vectors for siRNA delivery require better understanding of intracellular processing and vector interactions with target cells. Here, we have compared the siRNA delivery properties of a lipid derivative of bPEI 1.8. kDa (DOPE-PEI) with branched polyethyleneimine (bPEI) with average molecular weights of 1.8. kDa (bPEI 1.8. kDa) and 25. kDa (bPEI 25. kDa). We find mechanistic differences between the DOPE-PEI conjugate and bPEI regarding siRNA condensation and intracellular processing. bPEI 1.8. kDa and bPEI 25. kDa have similar properties with respect to condensation capability, but are very different regarding siRNA decondensation, cellular internalization and induction of reporter gene knockdown. Lipid conjugation of bPEI 1.8. kDa improves the siRNA delivery properties, but with markedly different formulation requirements and mechanisms of action compared to conventional PEIs. Interestingly, strong
knockdown using bPEI 25 kDa is dependent on the presence of a free vector fraction which does not increase siRNA uptake. Finally, we have investigated the effect on lysosomal pH induced by these vectors to elucidate the differences in the proton sponge effect between lipid conjugated PEI and conventional PEI: Neither DOPE-PEI nor bPEI 25 kDa affected lysosomal pH as a function of time, underlining that the possible proton sponge effect is not associated with changes in lysosomal pH. Statement of Significance: Gene silencing therapy has the potential to treat diseases which are beyond the reach of current small molecule-based medicines. However, delivery of the small interfering RNAs (siRNAs) remains a bottleneck to clinical implementation, and the development of safe and efficient delivery systems would be one of the most important achievements in medicine today. A major reason for the lack of progress is insufficient understanding of cell-polyplex interaction. We investigate siRNA delivery using polyethyleneimine (PEI) based vectors and examine how crucial formulation parameters determine the challenges associated with PEI as a delivery vector. We further evaluate how lipid conjugation of PEI influences formulation, cytotoxicity and polymer interaction with cells and cargo as well as the proton sponge capabilities of the vectors.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Northeastern University
Authors: Klauber, T. C. B. (Intern), Søndergaard, R. V. (Intern), Sawant, R. R. (Ekstern), Torchilin, V. P. (Ekstern), Andresen, T. L. (Intern)
Pages: 248-259
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Main Research Area: Technical/natural sciences

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BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.815 SJR 1.967
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.66 SJR 1.856 SNIP 1.947
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.02 SNIP 1.963 CiteScore 6.58
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.835 SNIP 2.28 CiteScore 6.53
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.988 SNIP 2.24 CiteScore 6.41
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.904 SNIP 2.108 CiteScore 5.51
ISI indexed (2012): ISI indexed yes
Scopus rating (2011): SJR 1.831 SNIP 1.893 CiteScore 5.15
ISI indexed (2011): ISI indexed yes
Scopus rating (2010): SJR 1.805 SNIP 1.955
Web of Science (2010): Indexed yes
Scopus rating (2009): SJR 1.404 SNIP 1.657
Scopus rating (2008): SJR 1.414 SNIP 1.961
Scopus rating (2007): SJR 1.206 SNIP 1.473
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.866 SNIP 1.14
Original language: English
Engineering complex tissue-like microgel arrays for evaluating stem cell differentiation

Development of tissue engineering scaffolds with native-like biology and microarchitectures is a prerequisite for stem cell mediated generation of off-the-shelf-tissues. So far, the field of tissue engineering has not full-filled its grand potential of engineering such combinatorial scaffolds for engineering functional tissues. This is primarily due to the many challenges associated with finding the right microarchitectures and ECM compositions for optimal tissue regeneration. Here, we have developed a new microgel array to address this grand challenge through robotic printing of complex stem cell-laden microgel arrays. The developed microgel array platform consisted of various microgel environments that where composed of native-like cellular microarchitectures resembling vascularized and bone marrow tissue architectures. The feasibility of our array system was demonstrated through localized cell spreading and osteogenic differentiation of human mesenchymal stem cells (hMSCs) into complex tissue-like structures. In summary, we have developed a tissue-like microgel array for evaluating stem cell differentiation within complex and heterogeneous cell microenvironments. We anticipate that the developed platform will be used for high-throughput identification of combinatorial and native-like scaffolds for tissue engineering of functional organs.
Engineering Plasmonic Nanopillar Arrays for Surface-enhanced Raman Spectroscopy

This Ph.D. thesis presents (i) an in-depth understanding of the localized surface plasmon resonances (LSPRs) in the nanopillar arrays (NPs) for surface-enhanced Raman spectroscopy (SERS), and (ii) systematic ways of optimizing the fabrication process of NPs to improve their SERS efficiencies. This Ph.D. project is part of the NAPLAS - NAnoPLAsmonic Sensors project, funded by The Danish Council for Independent Research. LSPRs in silver capped silicon NPs are studied using numerical simulations and dark-field scattering microscopy. Simulations show that a standalone NP supports two LSPR modes, i.e., the particle mode and the cavity mode. The particle mode can be hybridized via leaning of pillars. The LSPR wavelength of the cavity mode is dominant only by the diameter of the Si pillar. The presence of a substrate dramatically changes the intensities of these two LSPR modes, by introducing constructive and destructive interference patterns with the excitation fields. Experimental scattering spectra can be interpreted using theoretical simulations. The processes, which affect the SERS efficiencies of the silver NPs, are systematically evaluated. Short exposures to the O2-plasma and the use of 1-3 nm Cr adhesion layers are advantageous for reducing the SERS background signals. Influence of the NP height and silver deposition thickness on SERS intensities is also investigated. Using an optimized recipe, the measured SERS enhancement factor (EF) reaches 10⁸, and the SERS signal intensity exhibits a standard deviation of ~14% (660 data points) across a 5 x 5 mm² surface area. Lastly, a further improved process shows that high-density NPs exhibit unrivalled macroscale SERS uniformities (RSD: ∼2.5% in mm scale, ∼7% in inch scale) and SERS reproducibilities (RSD: ∼1.5% across three wafers), while at the same time displaying a very large average SERS EF of >10⁸. From a practical point of view, the developed SERS substrates are particularly interesting, since they are easy to handle and store and the fabrication is scalable, facilitating a wide and simple use of SERS in sensing applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Wu, K. (Intern), Boisen, A. (Intern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern)
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Engineering Plasmonic Nanopillar Arrays for Surface-enhanced Raman Spectroscopy
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Source-ID: 125167642
Publication: Research › Ph.D. thesis – Annual report year: 2016

Engineering the surface of rutile TiO₂ nanoparticles with quantum pits towards excellent lithium storage
Engineering the surface structure of nanomaterials is of great importance for applications in energy conversion and storage. Herein, unique rutile TiO₂ nanoparticles have been successfully synthesized by a facile solution and subsequent thermal annealing method. Each particle surface has been etched to form pits with an average size of 2-5 nm, producing abundant steps and vacancies. When evaluated as anode materials for lithium-ion batteries, the yielded rutile TiO₂
nanoparticle electrode exhibits a maximum specific capacity of ~145 mA h g⁻¹ at a current density of 0.5C (1C = 335 A g⁻¹) with outstanding charge/discharge rate capability (~102 mA h g⁻¹ at 5C) and good cycling performance.

**General information**

**State:** Published  
**Organisations:** Department of Micro- and Nanotechnology, Molecular Windows, Tsinghua University  
**Authors:** Huang, J. (Ekstern), Fang, F. (Ekstern), Huang, G. (Ekstern), Sun, H. (Intern), Zhu, J. (Ekstern), Yu, R. (Ekstern)  
**Number of pages:** 7  
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- Web of Science (2018): Indexed yes  
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- Scopus rating (2017): SNIP 0.736 SJR 0.863  
- Web of Science (2017): Indexed yes  
- BFI (2016): BFI-level 1  
- Scopus rating (2016): CiteScore 3.06 SJR 0.889 SNIP 0.757  
- Web of Science (2016): Indexed yes  
- BFI (2015): BFI-level 1  
- Scopus rating (2015): SJR 0.947 SNIP 0.834 CiteScore 3.42  
- Web of Science (2015): Indexed yes  
- BFI (2014): BFI-level 1  
- Scopus rating (2014): SJR 1.113 SNIP 0.962 CiteScore 3.87  
- Web of Science (2014): Indexed yes  
- BFI (2013): BFI-level 1  
- Scopus rating (2013): SJR 1.119 SNIP 0.904 CiteScore 3.74  
- ISI indexed (2013): ISI indexed yes  
- Web of Science (2013): Indexed yes  
- Scopus rating (2012): SJR 0.872 SNIP 0.619 CiteScore 2.4  
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- Web of Science (2012): Indexed yes

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**Publication:** Research - peer-review → Journal article – Annual report year: 2016

**Enhanced Differentiation of Human Embryonic Stem Cells Toward Definitive Endoderm on Ultrahigh Aspect Ratio Nanopillars**

Differentiation of human embryonic stem cells is widely studied as a potential unlimited source for cell replacement therapy to treat degenerative diseases such as diabetes. The directed differentiation of human embryonic stem cells relies mainly on soluble factors. Although, some studies have highlighted that the properties of the physical environment, such as substrate stiffness, affect cellular behavior. Here, mass-produced, injection molded polycarbonate nanopillars are presented, where the surface mechanical properties, i.e., stiffness, can be controlled by the geometric design of the ultrahigh aspect ratio nanopillars (stiffness can be reduced by 25,000X). It is found that tall nanopillars, yielding softer surfaces, significantly enhance the induction of definitive endoderm cells from pluripotent human embryonic stem cells, resulting in more consistent differentiation of a pure population compared to planar control. By contrast, further differentiation toward the pancreatic endoderm is less successful on “soft” pillars when compared to “stiff” pillars or control, indicating differential cues during the different stages of differentiation. To accompany the mechanical properties of the nanopillars, the concept of surface shear modulus is introduced to describe the characteristics of engineered elastic surfaces through micro or nanopatterning. This provides a framework whereby comparisons can be drawn between such materials and bulk elastomeric materials.
Entangled Polymer Melts in Extensional Flow

Many commercial materials derived from synthetic polymers exhibit a complex response under different processing operations such as fiber formation, injection molding, film blowing, film casting or coatings. They can be processed both in the solid or in the melted state. Often they may contain two or more different polymers in addition to additives, fillers or solvents in order to modify the properties of the final product. Usually, it is also desired to improve the processability. For example, the supplement of a high molecular weight component improves the stability in elongational flows. On the other hand, addition of low-volatility solvents to polymers is also a common industrial practice that offers a means for lowering the $T_g$ of the polymers. Moreover, industrial polymers present a wide distribution of chain lengths and/or branched architectures that strongly influence their response.

Understanding the behavior of polymer melts and solutions in complex non-linear flows is crucial for the design of polymeric materials and polymer processes. Through rheological characterization, in shear and extensional flow, of model polymer systems, i.e., narrow molar mass distribution polymer melts and solutions or well-defined polymer molecules architecture, researchers develop constitutive equations that can relate the stress induced into a material with its flow deformation history. Indeed, experiments on samples with well-defined structure supply data that can be compared with models.

Current models have been shown to be quite successful in describing the dynamics of polymers although they are still continuously challenged by new experimental data on model polymer systems. At the same time, new methods for generating extensional flows [McKinley and Sridhar (2002), Sentmanat (2004), Bach et al. (2003b)] are being constantly refined to improve the quality of the data and to explore a wider range of rates and deformations. Moreover, recently rheometry methods have been supplemented by other techniques such as dielectric spectroscopy that can probe chain dynamics and neutron scattering which can monitor macromolecular chain orientation associated with induced flow fields. This work concerns linear and non-linear rheology of polystyrene melts and solutions coupled with neutron scattering experiments. The aim of this thesis is to investigate the extensional properties of well-characterized polymer samples and provide new experimental data on extensional rheology that can validate constitutive models. Moreover, we show how the extensional technique may be used in combination with small-angle neutron scattering (SANS) to perform single chain structural studies after uniaxial elongation both after steady extensional flow and at several times during true stress relaxation. Extensional experiments have been performed on a Filament Stretching Rheometer (FSR), placed at the Technical University of Denmark (DTU), equipped with an online controlled scheme that allows to operate in controlled strain rate or controlled stress mode. High temperatures measurements can be performed due to an oven that surrounds the sample environment. Also a new implemented version of the device, named VADER 1000, has been employed to prepare the neutron scattering samples. The reduced dimension, compared to the FSR, and the particular design of the oven meets the requirement of fast cooling of the sample, so that it can freeze the particular molecular orientation of the chains at different stages of the stretching or relaxing of the sample.

General information
State: Published
Organisations: Department of Chemical and Biochemical Engineering, The Danish Polymer Centre, Department of Micro-and Nanotechnology, Amphiphilic Polymers in Biological Sensing
Authors: Hengeller, L. (Intern), Hassager, O. (Intern), Skov, A. L. (Intern), Almdal, K. (Intern)
Number of pages: 127
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Relations
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Epoxy composite dusts with and without carbon nanotubes cause similar pulmonary responses, but differences in liver histology in mice following pulmonary deposition

Background: The toxicity of dusts from mechanical abrasion of multi-walled carbon nanotube (CNT) epoxy nanocomposites is unknown. We compared the toxic effects of dusts generated by sanding of epoxy composites with and without CNT. The used CNT type was included for comparison. Methods: Mice received a single intratracheal instillation of
18, 54 and 162 μg of CNT or 54, 162 and 486 μg of the sanding dust from epoxy composite with and without CNT. DNA damage in lung and liver, lung inflammation and liver histology were evaluated 1, 3 and 28 days after intratracheal instillation. Furthermore, the mRNA expression of interleukin 6 and heme oxygenase 1 was measured in the lungs and serum amyloid A1 in the liver. Printex 90 carbon black was included as a reference particle.

Results: Pulmonary exposure to CNT and all dusts obtained by sanding epoxy composite boards resulted in recruitment of inflammatory cells into lung lumen: On day 1 after instillation these cells were primarily neutrophils but on day 3, eosinophils contributed significantly to the cell population. There were still increased numbers of neutrophils 28 days after intratracheal instillation of the highest dose of the epoxy dusts. Both CNT and epoxy dusts induced DNA damage in lung tissue up to 3 days after intratracheal instillation but not in liver tissue. There was no additive effect of adding CNT to epoxy resins for any of the pulmonary endpoints. In livers of mice instilled with CNT and epoxy dust with CNTs inflammatory and necrotic histological changes were observed, however, not in mice instilled with epoxy dust without CNT.

Conclusions: Pulmonary deposition of epoxy dusts with and without CNT induced inflammation and DNA damage in lung tissue. There was no additive effect of adding CNT to epoxies for any of the pulmonary endpoints. However, hepatic inflammatory and necrotic histopathological changes were seen in mice instilled with sanding dust from CNT-containing epoxy but not in mice instilled with reference epoxy.

General information
State: Published
Organisations: National Food Institute, Division of Risk Assessment and Nutrition, Department of Micro- and Nanotechnology, National Research Center for Working Environment, University of Warmia and Mazury in Olsztyn, European Centre for the Sustainable Impact of Nanotechnology, European Commission - Joint Research Center
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.638 SJR 2.253
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 9.4 SJR 2.755 SNIP 2.144
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.074 SNIP 2.023 CiteScore 8.84
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.411 SNIP 1.86 CiteScore 6.94
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.857 SNIP 2.552 CiteScore 8.5
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.221 SNIP 2.215 CiteScore 8.84
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.76 SNIP 1.883 CiteScore 7.51
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Evaluating liposomal nanoparticles for controlled release of chemotherapeutics in vitro and in vivo

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Copenhagen
Authors: Østrem, R. G. (Intern), Nielsen, O. L. (Ekstern), Hansen, A. E. (Intern), Andresen, T. L. (Intern)
Number of pages: 3
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions:
Abstract_CLINAM16_1.pdf
Source: PublicationPreSubmission
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Evaluation of bone loss in antibacterial coated dental implants: An experimental study in dogs

The aim of this study was to evaluate the in vivo effect of antibacterial modified dental implants in the first stages of peri-implantitis. Thirty dental implants were inserted in the mandibular premolar sites of 5 beagle dogs. Sites were randomly assigned to Ti (untreated implants, 10 units), Ti_Ag (silver electrodeposition treatment, 10 units), and Ti_TSP (silanization treatment, 10 units). Coated implants were characterized by scanning electron microscopy, interferometry and X-ray photoelectron spectroscopy. Two months after implant insertion, experimental peri-implantitis was initiated by ligature placement. Ligatures were removed 2 months later, and plaque formation was allowed for 2 additional months. Clinical and radiographic analyses were performed during the study. Implant-tissue samples were prepared for micro computed tomography, backscattered scanning electron microscopy, histomorphometric and histological analyses and ion release measurements. X-ray, SEM and histology images showed that vertical bone resorption in treated implants was lower than in the control group (P < 0.05). This effect is likely due to the capacity of the treatments to reduce bacteria colonization on the implant surface. Histological analysis suggested an increase of peri-implant bone formation on silanized implants. However, the short post-ligature period was not enough to detect differences in clinical parameters among implant groups. Within the limits of this study, antibacterial surface treatments have a positive effect against bone resorption induced by peri-implantitis.

General information
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Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Barcelona, Escola Universitària Salesiana de Sarrià, Universitat Internacional de Catalunya, Polytechnic University of Catalonia, University of Calgary
Authors: Gallardo, M. G. (Intern), Manzanares-Céspedes, M. C. (Ekstern), Sevilla, P. (Ekstern), Nart, J. (Ekstern), Manzanares, N. (Ekstern), Manero, J. M. (Ekstern), Gil, F. J. (Ekstern), Boyd, S. K. (Ekstern), Rodríguez, D. (Ekstern)
Pages: 538-545
Publication date: 2016
Evolvable Smartphone-Based Platforms for Point-Of-Care In-Vitro Diagnostics Applications

The association of smart mobile devices and lab-on-chip technologies offers unprecedented opportunities for the emergence of direct-to-consumer in vitro medical diagnostics applications. Despite their clear transformative potential, obstacles remain to the large-scale disruption and long-lasting success of these systems in the consumer market. For instance, the increasing level of complexity of instrumented lab-on-chip devices, coupled to the sporadic nature of point-of-care testing, threatens the viability of a business model mainly relying on disposable/consumable lab-on-chips. We argued recently that system evolvability, defined as the design characteristic that facilitates more manageable transitions between system generations via the modification of an inherited design, can help remedy these limitations. In this paper, we discuss how platform-based design can constitute a formal entry point to the design and implementation of evolvable smart device/lab-on-chip systems. We present both a hardware/software design framework and the implementation details of a platform prototype enabling at this stage the interfacing of several lab-on-chip variants relying on current- or impedance-based biosensors. Our findings suggest that several change-enabling mechanisms implemented in the higher abstraction software layers of the system can promote evolvability, together with the design of change-absorbing hardware/software interfaces. Our platform architecture is based on a mobile software application programming interface coupled to a modular hardware accessory. It allows the specification of lab-on-chip operation and post-analytic functions at the mobile software layer. We demonstrate its potential by operating a simple lab-on-chip to carry out the detection of dopamine using various electroanalytical methods.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems, Center for Bachelor of Engineering Studies, Afdelingen for El-teknologi, Department of Applied Mathematics and Computer Science, Embedded Systems Engineering, Copenhagen Center for Health Technology
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Publication date: 2016
Main Research Area: Technical/natural sciences
Evolvable Smartphone-Based Point-of-Care Systems For In-Vitro Diagnostics

Recent developments in the life-science -omics disciplines, together with advances in micro- and nanoscale technologies offer unprecedented opportunities to tackle some of the major healthcare challenges of our time. Lab-on-Chip technologies coupled with smart-devices in particular, constitute key enablers for the decentralization of many in-vitro medical diagnostics applications to the point-of-care, supporting the advent of a preventive and personalized medicine. Although the technical feasibility and the potential of Lab-on-Chip/smart-device systems is repeatedly demonstrated, direct-to-consumer applications remain scarce. This thesis addresses this limitation. After identifying system evolvability as a key enabler to the adoption and long-lasting success of next-generation point-of-care systems by favoring the integration of new technologies, streamlining the reengineering efforts for system upgrades and limiting the risk of premature system obsolescence. Among possible strategies, platform-based design represents a particularly suitable entry point to the development of evolvable systems. One necessary condition, is for change-absorbing and change-enabling mechanisms to be incorporated in the platform architecture at initial design-time. Important considerations arise as to where in Lab-on-Chip/smart-device platforms can these mechanisms be integrated, and how to implement them.

Our investigation revolves around the silicon-nanowire biological field effect transistor, a promising biosensing technology for the detection of biological analytes at ultra low concentrations. We discuss extensively the sensitivity and instrumentation requirements set by the technology before we present the design and implementation of an evolvable smartphone-based platform capable of interfacing lab-on-chips embedding such sensors. We elaborate on the implementation of various architectural patterns throughout the platform and present how these facilitated the evolution of the system towards one accommodating for electrochemical sensing. Model-based development was undertaken throughout the engineering process. A formal SysML system model fed our evolvability assessment process. We introduce, in particular, a model-based methodology enabling the evaluation of modular scalability: the ability of a system to scale the current value of one of its specification by successively reengineering targeted system modules. The research work presented in this thesis provides a roadmap for the development of evolvable point-of-care systems, including those targeting direct-to-consumer applications. It extends from the early identification of anticipated change, to the assessment of the ability of a system to accommodate for these changes. Our research should thus interest industrials eager not only to disrupt, but also to last in a shifting socio-technical paradigm.
Excitation of surface plasmon polariton modes with multiple nitrogen vacancy centers in single nanodiamonds

Nitrogen-vacancy (NV) centers in diamonds are interesting due to their remarkable characteristics that are well suited to applications in quantum-information processing and magnetic field sensing, as well as representing stable fluorescent sources. Multiple NV centers in nanodiamonds (NDs) are especially useful as biological fluorophores due to their chemical neutrality, brightness and room-temperature photostability. Furthermore, NDs containing multiple NV centers also have potential in high-precision magnetic field and temperature sensing. Coupling NV centers to propagating surface plasmon polariton (SPP) modes gives a base for lab-on-a-chip sensing devices, allows enhanced fluorescence emission and collection which can further enhance the precision of NV-based sensors. Here, we investigate coupling of multiple NV centers in individual NDs to the SPP modes supported by silver surfaces protected by thin dielectric layers and by gold V-grooves (VGs) produced via the self-terminated silicon etching. In the first case, we concentrate on monitoring differences in fluorescence spectra obtained from a source ND, which is illuminated by a pump laser, and from a scattering ND illuminated only by the fluorescence-excited SPP radiation. In the second case, we observe changes in the average NV lifetime when the same ND is characterized outside and inside a VG. Fluorescence emission from the VG terminations is also observed, which confirms the NV coupling to the VG-supported SPP modes.
Experimental demonstration of graphene plasmons working close to the near-infrared window

Due to strong mode confinement, long propagation distance, and unique tunability, graphene plasmons have been widely explored in the mid-infrared and terahertz windows. However, it remains a big challenge to push graphene plasmons to shorter wavelengths to integrate graphene plasmon concepts with existing mature technologies in the near-infrared region. We investigate localized graphene plasmons supported by graphene nanodisks and experimentally demonstrate graphene plasmon working at 2 μm with the aid of a fully scalable block copolymer self-assembly method. Our results show a promising way to promote graphene plasmons for both fundamental studies and potential applications in the near-infrared window.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Self-Organized Nanoporous Materials, Amphiphilic Polymers in Biological Sensing, Department of Photonics Engineering, Structured Electromagnetic Materials
Authors: Wang, Z. (Intern), Li, T. (Intern), Almdal, K. (Intern), Mortensen, N. A. (Intern), Xiao, S. (Intern), Ndoni, S. (Intern)
Pages: 5345-5348
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Experimental investigation of the effect of graphene nanofluids on heat pipe thermal performance

An experimental investigation has been carried out to examine the thermal performance of a sintered wick heat pipe using aqueous graphene nanoplatelets (GNP) nanofluids. The study focuses on changes in the effects of GNP concentration, heat pipe inclination angle and input heating power. The maximum reduction in the thermal resistance of a sintered wick heat pipe filled with 0.1 wt% of GNP is determined to be 48.4% compared with distilled water (DW). The results show that the maximum effective thermal conductivity enhancements for the heat pipe at a GNP concentration of 0.1 wt% and a tilt angle of 60° for heat input rates of 20, 40, 60 and 80 W are 23.4, 29.8, 37.2 and 28.3%, respectively, compared with a horizontal position (θ=0°). It is observed after the experiments that the deposition of GNP creates a coating on the sintered wick surfaces in the evaporator section. This coating layer increases the surface wettability, thereby enhancing the thermal performance of the heat pipe.

General Information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Malaya, University of Ontario Institute of Technology
Authors: Sadeghinezhad, E. (Ekstern), Mehrali, M. (Ekstern), Rosen, M. A. (Ekstern), Akhiani, A. R. (Ekstern), Tahan Latibari, S. (Ekstern), Mehrali, M. (Intern), Metselaar, H. S. C. (Ekstern)
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Scopus rating (2017): SNIP 1.837 SJR 1.505
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.78 SJR 1.438 SNIP 1.851
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.683 SNIP 1.884 CiteScore 3.32
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.539 SNIP 2.187 CiteScore 3.16
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.466 SNIP 2.469 CiteScore 3.31
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.492 SNIP 2.422 CiteScore 2.7
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.338 SNIP 2.186 CiteScore 2.83
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Experimental investigation of thermophysical properties, entropy generation and convective heat transfer for a nitrogen-doped graphene nanofluid in a laminar flow regime

Nitrogen-doped graphene (NDG) nanofluids are prepared using a two-step method in an aqueous solution of 0.025 wt% Triton X-100 as a surfactant with various nanosheets at several concentrations (0.01, 0.02, 0.04, 0.06 wt%). The results are reported of experiments on the thermal conductivity, viscosity and convective heat transfer behavior of NDG nanofluids undergoing laminar flowing in a circular tube. The results indicate that, compared to the base liquid, the thermal conductivity is enhanced for NDG nanofluids by between 22.15% and 36.78%, and the heat transfer coefficient of the NDG nanofluids is increased by 7-50%. The measurements also show that the pressure drop of the nanofluids increased by between 0.08% and 14.4%. In addition, the overall performance of the tested nanofluids are assessed based on the performance index and optimum work conditions, demonstrating that the nanofluids can be advantageous in practical applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, University of Malaya, University of Ontario Institute of Technology
Authors: Mehrali, M. (Ekstern), Sadeghinezhad, E. (Ekstern), Rosen, M. A. (Ekstern), Akhiani, A. R. (Ekstern), Tahan Latibari, S. (Ekstern), Mehrali, M. (Intern), Metselaar, H. S. C. (Ekstern)
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Journal: Advanced Powder Technology
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Scopus rating (2017): SNIP 1.206 SJR 0.694
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BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.151 SNIP 1.617
Scopus rating (2007): SJR 0.884 SNIP 1.495
Scopus rating (2006): SJR 1.191 SNIP 1.585
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.14 SNIP 1.43
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.969 SNIP 1.243
Scopus rating (2003): SJR 0.862 SNIP 1.105
Scopus rating (2002): SJR 0.875 SNIP 1.001
Scopus rating (2001): SJR 0.964 SNIP 1.107
Scopus rating (2000): SJR 0.943 SNIP 1.04
Scopus rating (1999): SJR 0.903 SNIP 0.89

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In this study, we perform experimental studies as well as simulations for cyclic voltammetry (CV) of the redox couple FeIII(CN)63-/FeII(CN)64- on a gold plated EC biosensor encapsulated by a microfluidic system. We examine the effect of flow rate, scan rate, varying supporting electrolyte, exchange current density and the position of electrode on the CV measurements. The results show that at a relatively high flow (250 μL) and low scan rates (50 - 200 mV/s), the current response is limited by the convection due to quick supply of fresh ions at the electrode surface which leads to fading hysteresis of the recorded CV. However, at high scan rates (250 mV/s) and slow flow rates (50 - 200 μL), peak currents are recorded which means that mass transport is dominated by the diffusion mechanism and a quasi-steady state of CV is recorded. In the case of insufficient supporting electrolyte, the excess charges generated during scan will lead to ohmic distortion of the electrolyte solution and consequently result into a ramping effect of the recorded CV. However, for sufficient amount of supporting electrolyte (200 mM), the simulation results show good agreement with the experimental data. In addition, the results also show that a decrease in exchange current density leads to a shift in the peak current of the recorded CV. Finally, the results also demonstrate that the working electrode at the center of the fluidic cell records accurate measurement than placing the electrode at the bottom of the cell. The numerical results and the experimental data show both qualitative good agreement and quantitative good agreement.
Cyclic voltammetry, Microelectrode location, Nernst–Planck, Navier–Stokes, Finite element method

Electronic versions:
Experimentation_and_numerical_modeling_of_cyclic_voltagmetry_for_electrochemical_micro_sized_sensors_under_the_influence_of_electrolyte_flow_postprint.pdf. Embargo ended: 14/01/2018
Fabrication and characterization of 3D pyrolytic carbon microelectrodes for electrochemistry

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, DTU Danchip, Bioanalytics
Authors: Hemanth, S. (Intern), Caviglia, C. (Intern), Hassan, Y. M. (Intern), Anhøj, T. A. (Intern), Emnéus, J. (Intern), Keller, S. S. (Intern)
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Fabrication and characterization of Au dimer antennas on glass pillars with enhanced plasmonic response

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Technische Universität Wien
Authors: Sadeghi, P. (Ekstern), Wu, K. (Intern), Rindzevicius, T. (Intern), Boisen, A. (Intern), Schmid, S. (Ekstern)
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Fabrication and characterization of pyrolytic carbon string resonators

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Nguyen, Q. L. (Intern), Kurek, M. (Intern), Larsen, P. E. (Intern), Schmid, S. (Intern), Boisen, A. (Intern), Keller, S. S. (Intern)
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Fabrication of Capacitive Micromachined Ultrasonic Transducers Using a Boron Etch-Stop Method

Capacitive Micromachined Ultrasonic Transducers (CMUTs) fabricated using Silicon-On-Insulator (SOI) wafers often have large thickness variation of the flexible plate, which causes variation in both pull-in voltage and resonant frequency across the CMUT array. This work presents a bond and boron etch-stop scheme for fabricating the flexible plate of a CMUT. The
The proposed fabrication method enables precise control of the plate thickness variation and is a low-cost alternative to the SOI-based process. N-type silicon wafers are doped with boron to a surface concentration of > 10^{20} cm^{-3} using solid planar diffusion predeposition at 1125 °C for 30, 60, and 90 min. Process simulations are used to predict the boron doping profiles and validated with secondary ion mass spectrometry measurements. The doped wafers are fusion-bonded to a silicon dioxide surface and thinned down using an 80 °C, 20 wt% potassium hydroxide solution with isopropyl alcohol added to increase the etch selectivity to the highly doped boron layer. The resulting plate thickness uniformity is estimated from scanning electron micrographs to a mean value of 2.00 μm ± 2.5%. The resonant frequency in air for a 1-D linear CMUT array is measured to 12 MHz ± 2.5%. Furthermore, hydrophone measurements show that the fabricated devices can be used to emit sound pressure in the ultrasonic frequency domain.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering, Center for Fast Ultrasound Imaging, Technical University of Denmark
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Number of pages: 4
Publication date: 2016

Fabrication of Nanostructured Polymer Surfaces and Characterization of their Wetting Properties: Enabling mass fabrication of superhydrophobic surfaces
In the past decade, there have been numerous examples of surfaces created with novel functionalities. These functional surfaces are predicted to have a massive impact on a range of commercial sectors within the next five years. Most realized functional surfaces rely on tailored micro- and nanoscale roughness, which cannot be produced with current mass fabrication technologies. The technology platform needed to create these surfaces has to be directly compatible with current mass production platforms, to commercially realize micro- and nanotextured surfaces. This comparability can be achieved by direct micro- and nanostructuring of commercial injection molding tools to create the desired surface structures directly in the molding process.

The aim of this project was to enable the fabrication of surfaces with controlled wetting by injection molding. During the project, I have demonstrated improvements in many of the fields related to mass-fabrication of water repellent surfaces. Including:
• Basic research in wetting phenomena; studying the role of multiple heights, irregular structures, and the transition to hierarchical structures.
• Development of algorithms for improved contact angle fitting.
• Simulations of wetting transitions.
• Clean room fabrication of functional surfaces, and production of micro- and nanostructured mold inserts.
• Injection molding of micro- and nanostructured polymer parts on a commercial injection molding machine.
• Co-invented a patented technique for microstructuring steel molds able to produce superhydrophobic polymer parts. The patented microstructuring technique generates microstructures similar to those found on the leaf of the lotus flower, without the overlaying nanostructure. Despite the lack of hierarchical structures, the microstructured surface shows excellent water repellent properties. The demonstration of a single level, superhydrophobic, structure with low aspect ratio, served as inspiration for studies in the underlying wetting mechanisms. This resulted in two published studies. The first study concerns the differences between lattice based clean room structures and the irregular structures produced by the patented microstructuring technique. The second study bridges the gap between silicon structures produced by planar processes in the clean room and the smooth multi-height structures often found in nature.

Finally I have demonstrated a novel type of hierarchical structures to get a better understanding of the role of hierarchy in wetting phenomena. I have produced and characterized hierarchical structures with the same surface coverage achieved in several different configurations. This leads to an interesting finding, not covered by modern wetting theories, where the local configuration of nanostructures governs the wetting behavior of the hierarchical structure.
Fabrication of scalable tissue engineering scaffolds with dual-pore microarchitecture by combining 3D printing and particle leaching

Limitations in controlling scaffold architecture using traditional fabrication techniques are a problem when constructing engineered tissues/organs. Recently, integration of two pore architectures to generate dual-pore scaffolds with tailored physical properties has attracted wide attention in tissue engineering community. Such scaffolds features primary structured pores which can efficiently enhance nutrient/oxygen supply to the surrounding, in combination with secondary random pores, which give high surface area for cell adhesion and proliferation. Here, we present a new technique to fabricate dual-pore scaffolds for various tissue engineering applications where 3D printing of poly(vinyl alcohol) (PVA) mould is combined with salt leaching process. In this technique the sacrificial PVA mould, determining the structured pore architecture, was filled with salt crystals to define the random pore regions of the scaffold. After crosslinking the casted polymer the combined PVA-salt mould was dissolved in water. The technique has advantages over previously reported ones, such as automated assembly of the sacrificial mould, and precise control over pore architecture/dimensions by 3D printing parameters. In this study, polydimethylsiloxane and biodegradable poly(-caprolactone)were used for fabrication. However, we showthat this technique is also suitable for other biocompatible/biodegradable polymers. Various physical and mechanical properties of the dual-pore scaffolds were compared with control scaffolds with either only structured or only random pores, fabricated using previously reported methods. The fabricated dual-pore scaffolds supported high cell density, due to the random pores, in combination with uniform cell distribution throughout the scaffold, and higher cell proliferation and viability due to efficient nutrient/oxygen transport through the structured pores. In conclusion, the described fabrication technique is rapid, inexpensive, scalable, and compatible with different polymers, making it suitable for engineering various large scale organs/tissues.
Failure of multi-layer graphene coatings in acidic media

Being impermeable to all gases, graphene has been proposed as an effective ultrathin barrier film and protective coating. However, here it is shown how the gastight property of graphene-based coatings may indirectly lead to their catastrophic failure under certain conditions. When nickel coated with thick, high-quality chemical vapor deposited multilayered graphene is exposed to acidic solutions, a dramatic evolution of gas is observed at the coating–substrate interface. The gas bubbles grow and merge, eventually rupturing and delaminating the coating. This behavior, attributed to cathodic hydrogen evolution, can also occur spontaneously on a range of other technologically important metals and alloys based on iron, zinc, aluminum and manganese; this makes these findings relevant for practical applications of graphene-based coatings.
Fast Selective Detection of Pyocyanin Using Cyclic Voltammetry

Pyocyanin is a virulence factor uniquely produced by the pathogen Pseudomonas aeruginosa. The fast and selective detection of pyocyanin in clinical samples can reveal important information about the presence of this microorganism in patients. Electrochemical sensing of the redox-active pyocyanin is a route to directly quantify pyocyanin in real time and in situ in hospitals and clinics. The selective quantification of pyocyanin is, however, limited by other redox-active compounds existing in human fluids and by other metabolites produced by pathogenic bacteria. Here we present a direct selective method to detect pyocyanin in a complex electroactive environment using commercially available electrodes. It is shown that cyclic voltammetry measurements between −1.0 V to 1.0 V reveal a potential detection window of pyocyanin of 0.58–0.82 V that is unaffected by other redox-active interferents. The linear quantification of pyocyanin has an $R^2$ value of 0.991 across the clinically relevant concentration range of 2–100 nM. The proposed method was tested on human saliva showing a standard deviation of 2.5% ±1% (n = 5) from the known added pyocyanin concentration to the samples. This inexpensive procedure is suggested for clinical use in monitoring the presence and state of P. aeruginosa infection in patients.

General information
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BFI (2016): BFI-level 2
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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.647 SNIP 1.643 CiteScore 2.21
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.707 SNIP 1.796 CiteScore 2.4
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.636 SNIP 1.758 CiteScore 2.72
ISI indexed (2013): ISI indexed yes
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BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.671 SNIP 1.709 CiteScore 2.53
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BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.641 SNIP 1.439 CiteScore 2.44
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BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.579 SNIP 1.244
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.526 SNIP 1.092
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.516 SNIP 0.887
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.516 SNIP 0.942
Scopus rating (2006): SJR 0.512 SNIP 0.768
Scopus rating (2005): SJR 0.388 SNIP 0.872
Scopus rating (2004): SJR 0.56 SNIP 0.882
Scopus rating (2003): SJR 0.381 SNIP 1.168
Scopus rating (2002): SJR 0.261 SNIP 0.159
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Finite Element Modelling of a Magneto Elastic Broadband Energy Harvester

General information
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Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors
Authors: Alcala, L. R. (Intern), Lei, A. (Intern), Thomsen, E. V. (Intern)
First-principles method for electron-phonon coupling and electron mobility: Applications to two-dimensional materials

We present density functional theory calculations of the phonon-limited mobility in n-type monolayer graphene, silicene, and MoS2. The material properties, including the electron-phonon interaction, are calculated from first principles. We provide a detailed description of the normalized full-band relaxation time approximation for the linearized Boltzmann transport equation (BTE) that includes inelastic scattering processes. The bulk electron-phonon coupling is evaluated by a supercell method. The method employed is fully numerical and does therefore not require a semianalytic treatment of part of the problem and, importantly, it keeps the anisotropy information stored in the coupling as well as the band structure. In addition, we perform calculations of the low-field mobility and its dependence on carrier density and temperature to obtain a better understanding of transport in graphene, silicene, and monolayer MoS2. Unlike graphene, the carriers in silicene show strong interaction with the out-of-plane modes. We find that graphene has more than an order of magnitude higher mobility compared to silicene in the limit where the silicene out-of-plane interaction is reduced to zero (by substrate interaction, clamping, or similar). If the out-of-plane interaction is not actively reduced, the mobility of silicene will essentially be zero. For MoS2, we obtain several orders of magnitude lower mobilities compared to graphene in agreement with other recent theoretical results. The simulations illustrate the predictive capabilities of the newly implemented BTE solver applied in simulation tools based on first-principles and localized basis sets.
Formation of copper tin sulfide films by pulsed laser deposition at 248 and 355 nm

The influence of the laser wavelength on the deposition of copper tin sulfide (CTS) and SnS-rich CTS with a 248-nm KrF excimer laser (pulse length \( \tau = 20 \) ns) and a 355-nm frequency-tripled Nd:YAG laser (\( \tau = 6 \) ns) was investigated. A comparative study of the two UV wavelengths shows that the CTS film growth rate per pulse was three to four times lower with the 248-nm laser than the 355-nm laser. SnS-rich CTS is more efficiently ablated than pure CTS. Films deposited at high fluence have submicron and micrometer size droplets, and the size and area density of the droplets do not vary significantly from 248 to 355 nm deposition. Irradiation at low fluence resulted in a non-stoichiometric material transfer with significant Cu deficiency in the as-deposited films. We discuss the transition from a non-stoichiometric material transfer at low fluence to a nearly stoichiometric ablation at high fluence based on a transition from a dominant evaporation regime to an ablation regime.

General information
State: Published
Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Energy Conversion and Storage, Electrofunctional materials, Technical University of Denmark
Authors: Ettlinger, R. B. (Intern), Crovetto, A. (Intern), Canulescu, S. (Intern), Cazzaniga, A. C. (Intern), Ravnkilde, L. (Ekstern), Youngman, T. H. (Intern), Hansen, O. (Intern), Pryds, N. (Intern), Schou, J. (Intern)
Number of pages: 10
Pages: 1-10
Publication date: 2016
Main Research Area: Technical/natural sciences
Free-form nanostructured tools for plastic injection moulding

We present results on a recently developed process to provide nanostructured surfaces on curved free-form injection moulding tools. The nanostructures are prepared using a sol-gel type coating, which can be applied by various means. Nanostructures are transferred from master structures originated typically by lithography. The nanostructures are imprinted by means of flexible stamps. After imprinting, nanostructures in the sol-gel are cured by baking, by which the material is converted to a quartz-like substance. Line patterns with depths up to about 500 nm and aspect ratio of up to 1 have been realized and successfully transferred to plastic parts during injection moulding. As an example, we present theory and results regarding the imprint of pillar nanostructures on a semi-spherical mold surface, followed by injection molding of the same. The deformation of the flexible stamp is characterized by measurement of inter-pillar distance on various points on the sphere, and compared to predictions provided by a geometrical model. Moulded plastic parts show good replication of the pillar structure. There are various practical advantages to the new process: the application of the coating is possible on both flat, single-curved and double-curved surfaces; the coating and the baking step is compatible with typical steel types in common usage for injection moulding; the coating is conformal with a relatively high surface roughness up to Ra ≈ 100 nm, accommodating several surface finishing methods such as fine milling and diamond polishing; the coating has slightly insulating properties, which improves the nanostructure transfer properties compared to metal nanostructures; several durability studies have shown that the nanostructures on the injection moulding tool surface are unaffected for at least 100,000 injection moulding cycles; the imprinting of nanostructures has been successfully attempted with several types of thermoplastic polymer, including PS, ABS, PE, PP, COC (Topaz), and PA (Nylon), showing that most polymers are compatible, while some may require an increase in mold temperature for full transfer of nanostructure depth. In conclusion, the process for nanostructured surfaces on double-curved or free-form injection moulding tools relies on flexible stamps, giving rise to predictable deformation of the pattern. The sol-gel process provides for a durable tool with accommodation of imperfect injection tool surface.

General information

State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Technical University of Denmark, Nanyang Technological University, InMold Biosystems A/S
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Number of pages: 1
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Main Research Area: Technical/natural sciences
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Source-ID: 124123496
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From rice husk to high performance shape stabilized phase change materials for thermal energy storage

A novel shape-stabilized phase change material (SSPCM) was fabricated by using a vacuum impregnation technique. The lightweight, ultra-high specific surface area and porous activated carbon was prepared from waste material (rice husk) through the combination of an activation temperature approach and a sodium hydroxide activation procedure. Palmitic acid as a phase change material was impregnated into the porous carbon by a vacuum impregnation technique. Graphene nanoplatelets (GNPs) were employed as an additive for thermal conductivity enhancement of the SSPCMs. The attained composites exhibited exceptional phase change behavior, having a desirable latent heat storage capacity of 175 kJ kg⁻¹. When exposed to high solar radiation intensities, the composites can absorb and store the thermal energy. An FTIR analysis of the SSPCMs indicated that there was no chemical interaction between the palmitic acid and the activated carbon with GNPs. The thermal conductivity of the prepared composites improved by more than 97% for the highest loading of GNPs (6 wt%) compared with that of pure palmitic acid. Moreover, the SSPCMs exhibit high thermal stability, with a stable melting/freezing enthalpy and excellent reversibility. The prepared SSPCMs with enhanced heat transfer and phase change properties provide a beneficial option for building energy conservation and solar energy applications owing to the low cost of raw materials and the simple synthetic technique.
Full-field hard x-ray microscopy with interdigitated silicon lenses

Full-field x-ray microscopy using x-ray objectives has become a mainstay of the biological and materials sciences. However, the inefficiency of existing objectives at x-ray energies above 15 keV has limited the technique to weakly absorbing or two-dimensional (2D) samples. Here, we show that significant gains in numerical aperture and spatial resolution may be possible at hard x-ray energies by using silicon-based optics comprising 'interdigitated' refractive silicon lenslets that alternate their focus between the horizontal and vertical directions. By capitalizing on the nano-manufacturing processes available to silicon, we show that it is possible to overcome the inherent inefficiencies of silicon-based optics and interdigitated geometries. As a proof-of-concept of Si-based interdigitated objectives, we demonstrate a prototype interdigitated lens with a resolution of ≈255 nm at 17 keV.
Functionalization and microfluidic integration of silicon nanowire biologically gated field effect transistors

This thesis deals with the development of a novel biosensor for the detection of biomolecules based on a silicon nanowire biologically gated field-effect transistor and its integration into a point-of-care device. The sensor and electrical on-chip integration was developed in a different project. The presented research is based on this sensor structure and investigates its potential as a versatile biomarker detection platform by evaluating different functionalization approaches. The functionalization of the silicon sensor surface with organic molecules was investigated in detail to determine the suitability of different methods for the preparation of organic interfaces for protein attachment. Oxide-free silicon surfaces offer unique possibilities to create highly sensitive sensor surfaces for charge detection due to the lack of an insulating oxide layer, but the highly reactive surface presents a challenge for modification under ambient conditions. Self-assembled monolayer formation by hydrosilylation with alkenes and alkynes was thus investigated under different conditions, both ambient and controlled, and quantified using x-ray photoelectron spectroscopy.

With the aim to create a platform for subsequent immobilization of receptor molecules, amine-and carboxylic acid- as well as alkyne-terminated surfaces were prepared that allow for the conjugation of biomolecules using established cross-linking schemes. Using a receptor-ligand model system protein detection experiments were performed with nanowire sensors functionalized using different modification schemes. To facilitate functionalization and measurement and as a first step towards integration into a point-of-care device, several microfluidic tools were developed for sample delivery to the sensor surface and as a modular platform for the further development of automated functionalization and sample preparation schemes.

Fundamental Limits to Coherent Scattering and Photon Coalescence from Solid-State Quantum Emitters [arXiv]

The desire to produce high-quality single photons for applications in quantum information science has lead to renewed interest in exploring solid-state emitters in the weak excitation regime. Under these conditions it is expected that photons are coherently scattered, and so benefit from a substantial suppression of detrimental interactions between the source and its phonon environment. Nevertheless, we demonstrate here that this reasoning is incomplete, and phonon interactions continue to play a crucial role in determining solid-state emission characteristics even for very weak excitation. We find that the sideband resulting from non-Markovian relaxation of the phonon environment leads to a fundamental limit to the fraction of coherently scattered light and to the visibility of two-photon coalescence at weak driving, both of which are absent for atomic systems or within simpler Markovian treatments.

General information
State: Published
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General atomistic approach for modeling metal-semiconductor interfaces using density functional theory and nonequilibrium Green's function

Metal-semiconductor contacts are a pillar of modern semiconductor technology. Historically, their microscopic understanding has been hampered by the inability of traditional analytical and numerical methods to fully capture the complex physics governing their operating principles. Here we introduce an atomistic approach based on density functional theory and nonequilibrium Green's function, which includes all the relevant ingredients required to model realistic metal-semiconductor interfaces and allows for a direct comparison between theory and experiments via I-V bias curve simulations. We apply this method to characterize an Ag/Si interface relevant for photovoltaic applications and study the rectifying-to-Ohmic transition as a function of the semiconductor doping. We also demonstrate that the standard "activation energy" method for the analysis of I-V bias data might be inaccurate for nonideal interfaces as it neglects electron tunneling, and that finite-size atomistic models have problems in describing these interfaces in the presence of doping due to a poor representation of space-charge effects. Conversely, the present method deals effectively with both issues, thus representing a valid alternative to conventional procedures for the accurate characterization of metal-semiconductor interfaces.

General information
State: Published
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Scopus rating (2012): SJR 3.173 SNIP 1.378 CiteScore 3.57
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Geometric Optimization of Microcontainers for Oral Drug Delivery

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes
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Gold Nanoparticle Aggregations on Recyclable Hierarchical Nanotrays for Surface-enhanced Raman Spectroscopy with Macroscale Uniformity

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Self-Organized Nanoporous Materials
Gold Nanoparticles with Stably Embedded Cu-64 and Their Use in Nanoparticle Research

64Cu is a popular radionuclide for PET imaging and when 64Cu2+ is mixed with gold nanoparticles (AuNPs) it adheres to the gold surface. Taking advantage of this, we developed methods to trap the 64Cu within the AuNPs by embedding under additional layers of gold. This resulted in radiolabeling efficiencies around 53 ± 6%. EDTA challenge for two days revealed the embedded 64Cu to possess excellent stability with 94-98% of the radioactivity remaining associated with the AuNPs. Testing for two days against serum likewise showed no loss of 64Cu from the AuNPs. Accordingly, the technology was shown to yield a very stable radiolabel that can accurately trace AuNPs in vivo. Such chelator-free radiolabeling removes traditional concerns over the use of chelators for 64Cu, notably instabilities of chelators, such as DOTA, and their ability to alter the surface and thus the biodistribution of the compounds onto which they are attached. Radiolabeled 64Cu-AuNPs were prepared in biomedically relevant sizes of 20-30 nm and decorated with three different coatings, in order to investigate their in vivo performance by PET imaging in a murine xenograft model. We found the longest plasma half-life (T1/2 about 9 hours) to result from a polyethylene glycol (PEG) coating, while faster elimination from the bloodstream was observed for both a Tween-20 stabilized coating and a zwitterionic coating based on sulfonic acids and quaternary amines. Accordingly, our data concluded the PEG coating to be most beneficial for long circulation in vivo. In the in vivo model, the 64Cu was observed to closely follow the AuNPs for each coating, again attributing to the excellent stability of the radiolabel. Further, 64Cu-AuNPs were prepared in three different sizes ranging from 30 to 70 nm and injected intravenously (I.V.) or intratumorally (I.T.) in murine xenograft models, either coated with PEG or stabilized by citrate (only 30 nm). In the I.T. experiments, citrate-stabilized 64Cu-AuNPs were retained best in the tumors with about 100 %ID/g after 24 hours. For the PEG-coated 64Cu-AuNPs, a tendency for increased retention as larger particles were injected was observed (30 nm: ~ 30 %ID/g, 70 nm: ~ 60%ID/g). In the I.V. experiments, the opposite tendency was observed, with smaller particles showing higher tumor accumulation and citrate stabilized 64Cu-AuNPs being rapidly taken up in liver and spleen. Our group continues work with embedding of radionuclides in solid nanoparticles and further results will be presented as available.

General information
State: Published
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Graphene Nanobubbles as Valley Filters and Beam Splitters

The energy band structure of graphene has two inequivalent valleys at the K and K' points of the Brillouin zone. The possibility to manipulate this valley degree of freedom defines the field of valleytronics, the valley analogue of spintronics. A key requirement for valleytronic devices is the ability to break the valley degeneracy by filtering and spatially splitting valleys to generate valley polarized currents. Here, we suggest a way to obtain valley polarization using strain-induced inhomogeneous pseudomagnetic fields (PMFs) that act oppositely on the two valleys. Notably, the suggested method does not involve external magnetic fields, or magnetic materials, unlike previous proposals. In our proposal the strain is due to experimentally feasible nanobubbles, whose associated PMFs lead to different real space trajectories for K and K' electrons, thus allowing the two valleys to be addressed individually. In this way, graphene nanobubbles can be exploited in both valley filtering and valley splitting devices, and our simulations reveal that a number of different functionalities are possible depending on the deformation field.
Graphene Oxide/Silver Nanohybrid as Multi-functional Material for Highly Efficient Bacterial Disinfection and Detection of Organic Dye

In this work, a multi-functional hybrid system consisting of graphene oxide and silver nanoparticles (GO-Ag NPs) was successfully synthesized by using a two-step chemical process. We firstly demonstrated noticeable bactericidal ability of the GO-Ag hybrid system. We provide more chemo-physical evidence explaining the antibacterial behavior of GO-Ag nanohybrid against Gram-negative Escherichia Coli and Gram-positive Staphylococcus aureus in light of ultrastructural damage analyses and Ag¹⁺ ions release rate onto the cells/medium. A further understanding of the mode of antimicrobial action is very important for designing and developing advanced antimicrobial systems. Secondly, we have also demonstrated that the GO-Ag nanohybrid material could be used as a potential surface enhanced Raman scattering (SERS) substrate to detect and quantify organic dyes, e.g., methylene blue (MB), in aqueous media. Our findings revealed that the GO-Ag hybrid system showed better SERS performance of MB detection than that of pure Ag-NPs. MB could be detected at a concentration as low as 1 ppm. The GO-Ag-based SERS platform can be effectively used to detect trace concentrations of various types of organic dyes in aqueous media. With the aforementioned properties, the GO-Ag hybrid system is found to be very promising as a multi-functional material for advanced biomedicine and environmental monitoring applications.

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Scopus rating (2015): SJR 0.555 SNIP 0.802 CiteScore 1.53
Graphene-plasmon polaritons: from fundamental properties to potential applications [arXiv]

With the unique possibilities for controlling light in nanoscale devices, graphene plasmonics has opened new perspectives to the nanophotonics community with potential applications in metamaterials, modulators, photodetectors, and sensors. This paper briefly reviews the recent exciting progress in graphene plasmonics. We begin with a general description for optical properties of graphene, particularly focusing on the dispersion of graphene-plasmon polaritons. The dispersion relation of graphene-plasmon polaritons of spatially extended graphene is expressed in terms of the local response limit with intraband contribution. With this theoretical foundation of graphene-plasmon polaritons, we then discuss recent exciting progress, paying specific attention to the following topics: excitation of graphene plasmon polaritons, electron-phonon interactions in graphene on polar substrates, and tunable graphene plasmonics with applications in modulators and sensors. Finally, we seek to address some of the apparent challenges and promising perspectives of graphene plasmonics. [Front. Phys. 11(2), 117801 (2016) doi:10.1007/s11467-016-0551-z].

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Photonics Engineering, Structured Electromagnetic Materials, Department of Micro- and Nanotechnology, Optofluidics
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High tensile strength fly ash based geopolymer composite using copper coated micro steel fiber

As a ceramic-like material, geopolymers show a high quasi-brittle behavior and relatively low fracture energy. To overcome this, the addition of fibers to a brittle matrix is a well-known method to improve the flexural strength. Moreover, the success of the reinforcements is dependent on the fiber-matrix interaction. In this present study, effects of micro steel fibers (MSF) incorporation on mechanical properties of fly ash based geopolymer was investigated at different volume ratio of matrix. Various properties of the composite were compared in terms of fresh state by flow measurement and hardened state by variation of shrinkage over time to assess performance of the composites subjected to flexural and compressive load. The fiber-matrix interface, fiber surface and toughening mechanisms were assessed using field emission scan electron microscopy (FESEM) and atomic force microscopy (AFM) through a period of 56 days. Test results confirmed that MSF additions could significantly improve both ultimate flexural capacity and ductility of fly ash based geopolymer, especially at early ages without an adverse effect on ultimate compressive strength.
Hole Selective NiO Contact for Silicon Solar Cells

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Technical University of Denmark
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Hollow MEMS: An Integrated Sensor for Combined Density, Viscosity, Buoyant Mass and IR Absorption Spectrometry

Miniaturization of electro mechanical sensor systems to the micro range and beyond has shown impressive sensitivities measuring sample properties like mass, viscosity, acceleration, pressure and force just to name a few applications. In order to enable these kinds of measurements on liquid samples a hollow MEMS sensor has been designed, fabricated and tested. Combined density, viscosity, buoyant mass spectrometry and IR absorption spectroscopy are possible on liquid samples and micron sized suspended particles (e.g. single cells). Measurements are based on changes in the resonant behavior of these sensors.

Optimization of the microfabrication process has led to a process yield of almost 100% . This is achieved despite the fact, that the process still offers a high degree of flexibility. By simple modifications the Sensor shape can be optimized for different size ranges and sensitivities.

Microfluidic interfacing has been realized using high throughput and low cost technologies such as injection molding and ultra-sonic welding. Standard fluidic LUER connections were used that are widely applied in other micro fluidic projects at DTU Nanotech to enable future interfacing of the system with other technologies and pre-concentration approaches.

A thorough theoretical analysis of the expected sensor responsivity and sensitivity is performed. Predictions made are confirmed by finite element simulations. Using these tools the sensor geometry is optimized for ideal performance in both mass density and IR spectroscopy measurements of samples, the size of single yeast cells (~ 5 μm). A relative frequency shift of 69 ppm/single cell buoyant mass in case of the mass spectroscopy measurements and 40 ppm/μW in case of the IR absorption spectroscopy measurements are calculated and confirmed by FE simulations for the sensor geometry fabricated.

In order to verify sufficient frequency stability, Allan Deviation measurements are performed on the fabricated sensors. In combination with the calculated responsivities these measurements confirm that the sensor sensitivity will enable single cell measurements.

Initial experiments confirming the calculated responsivities are performed. Experiments filling the sensor with liquids of different densities confirmed the predicted mass responsivity. The resonance frequency shifts 29% when filled with water compared to air.

By irradiating the sensor with a tunable IR laser source and tracking the resonance frequency the capability of the sensor to perform spectroscopic measurements is tested. Experiments with both an empty and a paraffin wax filled channel confirm the predicted heating responsivity. A resonance shift of >8000 ppm at the absorption peak of paraffin is observed. Individual absorption peaks can be resolved with a wavenumber resolution below 1 cm⁻¹.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes
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Amphiphilic polybutadiene polyethylene oxide (PB-PEO) is one of the best known chemistries to form stable vesicular morphologies, stated as polymersomes, in aqueous environment. Mimicking cell membranes, these structures self-assemble in an “amphiphilic window” determined by 0.15 < f < 0.35 where f is the ratio between the hydrophilic block volume and the entire diblock volume. However the polymersome size distribution also depends on molecular weight (Mn) and in order to gain insight on how f and Mn together determine polymersome size, we prepared PB-PEO diblock copolymers with different block lengths and analyzed vesicle morphology via Dynamic light scattering (DLS) and Freeze-fracture transmission electron microscopy (FF-TEM). We found three main regimes: high f / low Mn with polymersomes of mixed diameter, high f / high Mn with mainly large polymersomes and low f, with mainly small polymersomes. In the first region, the polymersomes are highly polydisperse. There is a tendency towards increased diameter with increasing f and Mn. Taken together our findings can help to identify how polymersome self-assembly can be controlled to achieve size distribution specificity alleviating the need for subsequent tuning of size via extrusion. This can pave the way for cost-effective upscaling of polymersome production for biomedical and biomimetic applications. ©
How preparation and modification parameters affect PB-PEO polymersome properties in aqueous solution

The effect of formation and modification methods on the physical properties of polymersomes is critical for their use in applications relying on their ability to mimic functional properties of biological membranes. In this study, we compared two formation methods for polymersomes made from polybutadiene-polyethylene oxide diblock copolymers: detergent-mediated film rehydration (DFR) and solvent evaporation (SE). DFR-prepared polymersomes showed a three times higher permeability compared to SE-prepared polymersomes as revealed by stopped-flow light scattering. SE-prepared polymersomes broke down faster to structures <50 nm diameter when processed with extrusion, which was more pronounced at 5 mg mL⁻¹, compared to 10, 20, and 25 mg mL⁻¹. Our results indicate that the bilayer of SE-prepared polymersomes has a lower apparent fluidity. We also investigated the role of n-octyl-β-d-glucopyranoside (OG), a detergent typically used for reconstitution of membrane proteins into lipid bilayers. Specifically, we compared dialysis and biobeads for OG removal to investigate the influence of these methods on bilayer conformation and polymer rearrangement following detergent removal. There was no significant difference found between method, temperature, or time within each method. Our findings provide insight on how biocompatible polymersome production affects the physical properties of the resulting polymersomes.

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Water Technologies, Aquaporin A/S, University of Copenhagen
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How to connect time-lapse recorded trajectories of motile microorganisms with dynamical models in continuous time

We provide a tool for data-driven modeling of motility, data being time-lapse recorded trajectories. Several mathematical properties of a model to be found can be gleaned from appropriate model-independent experimental statistics, if one understands how such statistics are distorted by the finite sampling frequency of time-lapse recording, by experimental errors on recorded positions, and by conditional averaging. We give exact analytical expressions for these effects in the simplest possible model for persistent random motion, the Ornstein-Uhlenbeck process. Then we describe those aspects of these effects that are valid for any reasonable model for persistent random motion. Our findings are illustrated with experimental data and Monte Carlo simulations.

General information
State: Published
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Scopus rating (2015): SJR 1.183 SNIP 1.043 CiteScore 1.89
Web of Science (2015): Indexed yes
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Scopus rating (2012): SJR 1.414 SNIP 1.205 CiteScore 2.28
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 1.48 SNIP 1.211 CiteScore 2.28
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Web of Science (2011): Indexed yes
Scopus rating (2010): SJR 1.692 SNIP 1.203
Web of Science (2010): Indexed yes
Scopus rating (2009): SJR 1.708 SNIP 1.246
Web of Science (2009): Indexed yes
Scopus rating (2008): SJR 1.972 SNIP 1.298
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.615 SNIP 1.063
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.266 SNIP 0.867
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.204 SNIP 0.795
How to determine local stretching and tension in a flow-stretched DNA molecule

We determine the nonuniform stretching of and tension in a mega base pairs-long fragment of deoxyribonucleic acid (DNA) that is flow-stretched in a nanofluidic chip. We use no markers, do not know the contour length of the DNA, and do not have the full DNA molecule inside our field of view. Instead, we analyze the transverse thermal motion of the DNA. Tension at the center of the DNA adds up to 16 pN, giving almost fully stretched DNA. This method was devised for optical mapping of DNA, specifically, DNA denaturation patterns. It may be useful also for other studies, e.g., DNA-protein interactions, specifically, their tension dependence. Generally, wherever long strands of DNA—e.g., native DNA extracted from human cells or bacteria—must be stretched with ease for inspection, this method applies.
How to Measure Separations and Angles Between Intramolecular Fluorescent Markers

Structure and function of an individual biomolecule can be explored with minimum two fluorescent markers of different colors. Since the light of such markers can be spectrally separated and imaged simultaneously, the markers can be colocalized. Here, we describe the method used for such two-color colocalization microscopy. Then we extend it to fluorescent markers with fixed orientations and in intramolecular proximity. Our benchmarking of this extension produced two extra results: (a) we established short double-labeled DNA molecules as probes of 3D orientation of anything to which one can attach them firmly; (b) we established how to map with super-resolution between color-separated channels, which should be useful for all dual-color colocalization measurements with either fixed or freely rotating fluorescent molecules. Throughout, we use only simple means: from each color-separated microscope image in a time-lapse movie, we simultaneously determine both the relative (x,y)-separation of the fluorophores and their individual orientations in space, both with accuracy and precision. The relative positions and orientations of two domains of the same molecule are thus time-resolved. Using short double-stranded DNA (dsDNA) molecules internally labeled with two fixed fluorophores, we (i) demonstrate the accuracy and precision of our localization- and mapping-methods, using the known structure of dsDNA as benchmark; (ii) resolve 10 base pair differences in fluorophore separations; (iii) determine the unique 3D orientation of...
The H$_2$/D$_2$ exchange reaction was studied on mono-disperse Pt$_8$ clusters in a μ-reactor. The chemical activity was studied at temperatures varying from room temperature to 180 °C using mass spectrometry. It was found that minute amounts of O$_2$ in the gas stream increased the chemical activity significantly. XPS and ISS before and after reaction suggest little or no sintering during reaction. A reaction pathway is suggested based on DFT. H$_2$ desorption is identified as the rate-limiting step and O$_2$ is confirmed as the source of the increased activity. The binding energy of platinum atoms in a SiO$_2$ supported Pt$_8$ cluster is found to be comparable to the interatomic binding energies of bulk platinum, underlining the stability of the model system.
Hybridized reactive iron-containing nano-materials for water purification

Groundwater is an important source for drinking water in all corners of the globe, and in places like Denmark, it is the primary source for drinking water. Climate change and population growth will only lead to further dependence on groundwater as the supply for drinking water. However, the expanding population and industrialization of human civilization also leads to environmental consequences affecting groundwater sources. Storm-water and agricultural runoff, industrial spillage and dumping, acid mine drainage, and leakage from landfills are a few prime examples of routes of contamination for pollutants to enter groundwater systems. In order to make these contaminated water sources viable for human consumption, the use of reactive iron (i.e. Fe0 or zero-valent iron), and in particular nanoscale zero-valent iron (nZVI), is being employed to reductively degrade and/or adsorb many of these pollutants. However, the use of nZVI, as it currently stands, has its limitations. These limitations are primarily rapid oxidation and aggregation, resulting in loss of reactivity and applicability. Therefore, development of new materials incorporating nZVI and improving synthesis strategies to increase the applicability of nZVI is paramount to its future success as a remediation technique. This PhD project has investigated various materials aimed at solving the reactivity loss of reactive iron to create a robust treatment system capable of treating polluted waters. This PhD project also investigated and developed a procedure to appropriately measure the reactivity of reactive iron for a universal testing method. The colloidal stability, reactive iron, and reactivity towards nitrate were impregnated with nZVI and evaluated similarly as with the MgAC. All COPs exhibited high uptake of nZVI, approximately 10% by mass. Reactivity quantification proved to be difficult when degrading an azo dye, due to the very high propensity of the COPs to adsorb both the dye and its degradation products. However, these COPs acted as extremely efficient carriers of nZVI for maintaining colloidal stability. In one case, the COP used (COP-19) increased the colloidal stability of nZVI by two orders of magnitude. Building on the application of these composite materials, investigating how best to handle the synthesized materials can prolong their lifetime. To do this, three washing and storage strategies of the MgAC coated nZVI were investigated. They were: washing the particles immediately after synthesis with a NaHCO3 buffer, washing the particles after storing with a NaHCO3 buffer, and washing the particles immediately after synthesis with a MgAC solution. For all the particle reactivity tests done, it was apparent that washing the particles after storing was detrimental to the material. The colloidal stability, reactive iron, and reactivity towards nitrate dropped rapidly through one week of storage. The other strategies, where washing was done immediately was able to preserve the three aforementioned properties much more efficiently though one week of storage, with MgAC washed particles faring better of the two. This pre-washing technique removes residual reactants in the synthesis mixture that can corrode the iron, and furthermore, pre-washing with MgAC adds more of the stabilizer to the material that protects the nZVI even more. Moreover, by looking deeper into the characteristics of uncoated nZVI, depending on the washing method, allowed for more insight to the nature of the mechanisms taking place during storage. It was observed that washing nZVI with MilliQ water after synthesis created an environment where the particles were slightly more oxidized from the start, which led to an increased formation of an iron-hydroxide shell during storage. Not washing nZVI or washing with the reductant NaBH4 prohibited initial oxidation, leading to subsequent iron-oxide formation during storage. This is...
important, because the hydroxide shell promotes more electron transfer, whereas the oxide shell acts as a depassivation layer. The increased electron transfer then allowed for higher reactivity during storage, up to one week. To make comparison and quantification for researchers, a simple and effective method to assess the reactivity of nZVI is extremely important. And, as it is now, most of the reactivity characterization methods are often analytically intensive, requiring expensive equipment, and often don’t respond uniformly to different nZVI-based materials. This study sought to solve this problem, by developing a simple colorimetric assay that is capable to taking a degradation product produced by nZVI reacting with a compound, and creating a color reaction detectable with a simple spectrophotometer. This was done by utilizing the indophenol reaction, which uses phenol and selected other reagents to produce a blue color. Phenol can be produced from the dehalogenation of 4-chlorophenol by nZVI, and to a greater extent by bimetallic nickel-nZVI. That simple method was then optimized to reduce reagent volumes, nickel concentration, and to broaden the range of detectable compounds. These compounds capable of being used in the color assay with the same set of reagents were ultimately aniline, ammonium, and phenol; all of which can be produced by the degradation reaction from nZVI. Finally, to compare the applicability of the colorimetric assay to common halogenated groundwater contaminants; it was compared to the dehalogenation of TCE, TCA, and atrazine. The colorimetric assay performed similarly to the degradation of those chlorinated compounds; meaning the assay can be a simple tool to assess the reactivity of any nZVI when ultimately targeting more difficult to analyze compounds in real-world sources.

Ultimately, the primary goal of this PhD study was to develop a robust nanocomposite material containing nZVI for water treatment systems. Taking the lessons learned from initial composite work using MgAC and COPs, the final material combined granular activated carbon with COP and nZVI. After a lengthy process in developing a method to chemically graft COP material to the surface of activated carbon, it was possible to impregnate that composite material with nZVI. Because of the activated carbon backbone, the final material proved to be an extremely robust material with the structural integrity to be used in a packed-bed column that is common when treating high volumes of water. Although, continued optimization of the material is necessary, preliminary results when adsorbing and degrading contaminants were very promising, outperforming activated carbon alone and just the carbon impregnated with nZVI. Also, a bonus effect was achieved in the process. In that the entire composite material, in particular the COP attached to the surface of the carbon, acted as a protective barrier from the effects of oxidation. The carbon-COP-nZVI composites exhibited nearly 100% reactive iron content upon synthesis, compared to much lower amounts in other reported nZVI composites or the carbon-nZVI produced in this study having only 80% reactive iron content.

The results of this PhD concluded in various advances in the application and assessment of nZVI and nZVI composite materials. Various composite materials provided increased colloidal stability and reactivity for nZVI. Various washing and storage strategies elucidated better methods for delivering nZVI to a water contaminant and the underlying mechanisms taking place in the nZVI corrosion process. Finally, novel materials combining three different technologies were developed to eventually lead to a robust water treatment system capable of degrading typically hard to remediate water pollutants.
**Imaging the Liquid Processes via in-situ Transmission Electron Microscopy**

**General information**
- **State:** Published
- **Organisations:** Department of Micro- and Nanotechnology, Molecular Windows
- **Authors:** Sun, H. (Intern), Yesibolati, M. N. (Intern), Canepa, S. (Intern), Laganà, S. (Intern), Mølhave, K. (Intern)
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**Impedance characterization of PV modules in outdoor conditions**

Impedance spectroscopy (IS) has been used for laboratory characterizations of photovoltaic (PV) technologies under well controlled conditions. This work applies IS for outdoor characterization of PV panels, in order to observe the effect of irradiance (G) and temperature (T) on the PV module’s impedance spectrum, and further construct an impedance model that can link environmental changes to the model's parameters. To achieve this, an optimized setup has been developed for long-term impedance spectra monitoring synchronised with accurate irradiance and temperature data. Preliminary results show clear correlation between the determined parameters and ambient conditions.

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- **Organisations:** Department of Micro- and Nanotechnology, Department of Photonics Engineering, Diode Lasers and LED Systems, Aalborg University, EmaZys Technologies ApS
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**Improved in vitro evaluation of novel antimicrobials: potential synergy between human plasma and antibacterial peptidomimetics, AMPs and antibiotics against human pathogenic bacteria**

Stable peptidomimetics mimicking natural antimicrobial peptides (AMPs) have emerged as a promising class of potential novel antibiotics. In the present study, we aimed at determining whether the antibacterial activity of two α-peptide/β-peptoid peptidomimetics against a range of bacterial pathogens was affected by conditions mimicking in vivo settings. Their activity was enhanced to an unexpected degree in the presence of human blood plasma for thirteen pathogenic
Gram-positive and Gram-negative bacteria. MIC values typically decreased 2- to 16-fold in the presence of a human plasma concentration that alone did not damage the cell membrane. Hence, MIC and MBC data collected in these settings appear to represent a more appropriate basis for in vivo experiments preceding clinical trials. In fact, concentrations of peptidomimetics and peptide antibiotics (e.g. polymyxin B) required for in vivo treatments might be lower than traditionally deduced from MICs determined in laboratory media. Thus, antibiotics previously considered too toxic could be developed into usable last-resort drugs, due to ensuing lowered risk of side effects. In contrast, the activity of the compounds was significantly decreased in heat-inactivated plasma. We hypothesize that synergistic interactions with complement proteins and/or clotting factors most likely are involved.
Incorporation of mesoporous silica nanoparticles into random electrospun PLGA and PLGA/gelatin nanofibrous scaffolds enhances mechanical and cell proliferation properties

Poly(lactic-co-glycolic acid) (PLGA) and PLGA/gelatin random nanofibrous scaffolds embedded with different amounts of mesoporous silica nanoparticles (MSNPs) were fabricated using electrospinning method. To evaluate the effects of nanoparticles on the scaffolds, physical, chemical, and mechanical properties as well as in vitro degradation behavior of scaffolds were investigated. The mean diameters of nanofibers were 974 ± 68 nm for the pure PLGA scaffolds vs 832 ± 70, 764 ± 80, and 486 ± 64 for the PLGA/gelatin, PLGA/10 wt% MSNPs, and the PLGA/gelatin/10 wt% MSNPs scaffolds, respectively. The results suggested that the incorporation of gelatin and MSNPs into PLGA-based scaffolds enhances the hydrophilicity of scaffolds due to an increase of hydrophilic functional groups on the surface of nanofibers. With porosity examination, it was concluded that the incorporation of MSNPs and gelatin decrease the porosity of scaffolds. Nanoparticles also improved the tensile mechanical properties of scaffolds. Using in vitro degradation analysis, it was shown that the addition of nanoparticles to the nano fibers matrix increases the weight loss percentage of PLGA-based samples, whereas it decreases the weight loss percentage in the PLGA/gelatin composites. Cultivation of rat pheochromocytoma cell line (PC12), as precursor cells of dopaminergic neural cells, on the scaffolds demonstrated that the introduction of MSNPs into PLGA and PLGA/gelatin matrix leads to improved cell attachment and proliferation and enhances cellular processes.

General information

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Inelastic vibrational signals in electron transport across graphene nanoconstrictions

We present calculations of the inelastic vibrational signals in the electrical current through a graphene nanoconstriction. We find that the inelastic signals are only present when the Fermi-level position is tuned to electron transmission resonances, thus, providing a fingerprint which can link an electron transmission resonance to originate from the nanoconstriction. The calculations are based on a novel first-principles method which includes the phonon broadening due to coupling with phonons in the electrodes. We find that the signals are modified due to the strong coupling to the electrodes, however, still remain as robust fingerprints of the vibrations in the nanoconstriction. We investigate the effect of including the full self-consistent potential drop due to finite bias and gate doping on the calculations and find this to be of minor importance.
Inhomogeneous broadening in non-interacting nonlocal plasmonic ensembles

The importance of inhomogeneous broadening due to the size dependence of plasmon resonances in few-nm metallic particle ensembles is investigated through different models describing the nonlocal optical response of plasmonic nanospheres. Modal shifts and plasmon line broadening are shown to become important within the first-order correction to classical electrodynamics provided by the hydrodynamic Drude model, but turn out to be less prominent once additional single-particle size-dependent damping mechanisms are accounted for through the recently developed Generalized Nonlocal Optical Response theory. Our work is therefore expected to provide insight and facilitate the design of nanoscale spectroscopy experiments.
Injectable shear-thinning nanoengineered hydrogels for stem cell delivery

Injectable hydrogels are investigated for cell encapsulation and delivery as they can shield cells from high shear forces. One of the approaches to obtain injectable hydrogels is to reinforce polymeric networks with high aspect ratio nanoparticles such as two-dimensional (2D) nanomaterials. 2D nanomaterials are an emerging class of ultrathin materials with a high degree of anisotropy and they strongly interact with polymers resulting in the formation of shear-thinning hydrogels. Here, we present 2D nanosilicate reinforced kappa-carrageenan (κCA) hydrogels for cellular delivery. κCA is a natural polysaccharide that resembles native glycosaminoglycans and can form brittle hydrogels via ionic crosslinking. The chemical modification of κCA with photocrosslinkable methacrylate groups renders the formation of a covalently crosslinked network (MκCA). Reinforcing the MκCA with 2D nanosilicates results in shear-thinning characteristics, and enhanced mechanical stiffness, elastomeric properties, and physiological stability. The shear-thinning characteristics of nanocomposite hydrogels are investigated for human mesenchymal stem cell (hMSC) delivery. The hMSCs showed high cell viability after injection and encapsulated cells showed a circular morphology. The proposed shear-thinning nanoengineered hydrogels can be used for cell delivery for cartilage tissue regeneration and 3D bioprinting.

General information
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Injectable silver nanosensors: in vivo dosimetry for external beam radiotherapy using positron emission tomography

Development of safe and efficient radiotherapy routines requires quantification of the delivered absorbed dose to the cancer tissue in individual patients. In vivo dosimetry can provide accurate information about the absorbed dose delivered during treatment. In the current study, a novel silver-nanosensor formulation based on poly(vinylpyrrolidinone)-coated silver nanoparticles formulated in a gelation matrix composed of sucrose acetate isobutyrate has been developed for use as an in vivo dosimeter for external beam radiotherapy. In situ photonuclear reactions trigger the formation of radioactive (106)Ag, which enables post treatment verification of the delivered dose using positron emission tomography imaging. The silver-nanosensor was investigated in a tissue equivalent thorax phantom using clinical settings and workflow for both standard fractionated radiotherapy (2 Gy) and stereotactic radiotherapy (10- and 22 Gy) in a high-energy beam setting (18 MV). The developed silver-nanosensor provided high radiopacity on the planning CT-scans sufficient for patient positioning in image-guided radiotherapy and provided dosimetric information about the absorbed dose with a 10% and 8% standard deviation for the stereotactic regimens, 10 and 22 Gy, respectively.

General information
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In-situ SEM electrochemistry and radiolysis

Electron microscopy is a ubiquitous technique to see effects which are too small to see with traditional optical microscopes. Recently it has become possible to also image liquid samples by encapsulating them from the vacuum of the microscope and a natural evolution from that has been to include microelectrodes on the windows to enable studies of electrochemical processes. In this way it is possible to perform in-situ electrochemical experiments such as electroplating and charge and discharge analysis of battery electrodes.

In a typical liquid cell, electrons are accelerated to sufficiently high energies to traverse a thin window made by a silicon nitride membrane, and interact with the sample immersed in liquid. In transmission electron microscopy (TEM) the majority of the electrons continue through the sample to form an image. In scanning electron microscopy (SEM) a fraction of the electrons are backscattered and an image is reconstructed by the microscope. But the high energy electrons are a form of ionising radiation which can significantly affect the chemistry in liquid experiments. Ionising radiation can split water, produce radicals, reduce dissolved metal ions to metal particles, and more. It is therefore essential to understand and control the radiolytic processes that results from in-situ electron microscopy experiments.

Although radiolysis has been studied extensively in connection with the advent of e.g. nuclear reactors the information obtained for that purpose often has to be extrapolated many orders of magnitude to reach the radiation conditions of the extremely focused beam of typical electron microscopes. To date there is a distinct lack of direct measurements and quantification of the radiolytic conditions for in-in-situ liquid cells.

In this thesis an electrochemical in-situ SEM cell is used to study the radiolytic effects of the electron beam. Potentiometric measurements in-situ demonstrate that the electrolyte contains hydrogen upon irradiation, and that the ratio of $H_2O_2$ to $H_2$ is only 1:2.5, much less than the predicted ratio of 1:1.1. Electrochemical impedance spectroscopy (EIS) measurements between two electrodes when irradiating at an average intensity of 6 MGy/s indicate that the conductivity may be at least 200 $\mu$S/cm, two orders of magnitude higher than what would be expected from $H^+$ alone. Finally, the radiolytic yield of copper is measured by gradually increasing the radiation intensity until copper precipitated. Based on the amount of backscattered electrons it has been possible to quantify the amount of reduced copper, resulting in an average radiolytic yield per 100 eV of deposited energy (g-value) of 0.05, lower than the value of 4.4 seen in pulse radiolysis experiments. During the course of these studies it has also been possible to improve on the EC-SEM system. This has resulted in pyrolysed carbon electrodes, which offer the benefit of stability at 0.75 V higher potentials than traditional gold thin-film electrodes.

With the quantitative insight into the radiolytic conditions in liquid electron microscopy cells that this thesis provides it may be possible to design and analyse experiments where such effects are correctly accounted for. The results are therefore of high value for the in-situ community who until now have had to rely on only limited experimental data in combination with theoretical predictions that have been extrapolated several orders of magnitude.

General information
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In Situ TEM Electrical Measurements

Transmission electron microscopy (TEM) offers high spatial and temporal resolution that provides unique information for understanding the function and properties of nanostructures on their characteristic length scales. Under controlled environmental conditions and with the ability to dynamically influence the sample by external stimuli, e.g. through electrical connections, the TEM becomes a powerful laboratory for performing quantitative real time in situ experiments. Such TEM setups enable the characterization of nanostructures and nanodevices under working conditions, thereby providing a deeper understanding of complex physical and chemical interactions in the pursuit to optimize nanostructure function and device performance. Recent developments of sample holder technology for TEM have enabled a new field of research in the study of functional nanomaterials and devices via electrical stimulation and measurement of the specimen.

Recognizing the benefits of electrical measurements for in situ TEM, many research groups have focused their effort in this field and some of these methods have transferred to ETEM. This chapter will describe recent advances in the in situ TEM investigation of nanostructured materials and devices with the specimen being contacted by electrical, mechanical or other means, with emphasis on in situ electrical measurements performed in a gaseous or liquid environment. We will describe the challenges and prospects of electrical characterization of devices and processes induced by a voltage in gas and liquids. We will also provide a historical perspective of in situ TEM electrical measurements and applications using electrical contacts.

In-Situ Transmission Electron Microscopy on Operating Electrochemical Cells

Solid oxide cells (SOC) have the potential of playing a significant role in the future efficient energy systems scenario. In order to become widely commercially available, an improved performance and durability of the cells has to be achieved [1]. Conventional scanning and transmission SEM and TEM have been often used for ex-situ post mortem characterization of SOFCs and SOECs [2,3]. However, in order to get fundamental insight of the microstructural development of SOFC/SOEC during operation conditions in-situ studies are necessary [4]. The development of advanced TEM chips and holders makes it possible to undertake analysis during exposure to the SOFC/SOEC sample of reactive gas flow, elevated temperatures and electrical biasing in combination. This allows the study of nanostructure development under temperature and electrode polarisation conditions similar to operation conditions. In this work, we have for the first time performed in-situ analysis of a symmetric cell inside a TEM under different configurations. In order to be able to perform in-situ experiments while drawing a current through the sample, we used a homemade TEM chip [5,6] and an 80-300kV Titan ETEM (FEI Company) equipped with an image corrector and a differential pumping system. A symmetric cell was prepared by depositing a cell consisting of three thin films on a strontium titanate (STO) single crystal substrate by pulsed laser deposition (PLD). Lanthanum strontium cobaltite La0.6Sr0.4CoO3-δ (LSC) was chosen as electrode and yttria stabilized zirconia ZrO2: 8%
mol Y2O3 (YSZ) as electrolyte, see figure 1. High-resolution TEM analysis on PLD samples after the deposition, did not reveal any second phase formation at the interface between YSZ and LSC. The in-situ experiment was firstly conducted in vacuum at temperature between 25 °C and 900 °C. Secondly, it was repeated in presence of oxygen with an oxygen partial pressure of about 2 mbar and a maximum temperature of 750 °C. Subsequently, the symmetric cell will be exposed to oxygen at 600 °C and 1 V overpotential within the ETEM. In order to do that, a symmetric cell has been placed on the chip with the use of a focus ion beam (FIB) microscope, see figure 2. To do so, a lamella was first extracted by the bulk sample and attached to a conventional TEM grid. Afterwards, the grid was tilted by 90 degrees and the lamella was detached once again and placed on the chip. STEM-EDS investigation was used for ex-situ post mortem analysis. Finally, a bulk symmetric cell, coming from the same batch as the in-situ treated TEM samples, was tested in a furnace with similar environmental conditions. This comparison is vital for distinguishing possible surface diffusion effects caused by having a thin lamella for in-situ TEM analysis. Electrochemical properties were also investigated by electrochemical impedance spectroscopy (EIS). In the figure 3 the cell was heat treated at 400 °C in vacuum, whereas in figure 4, the cell was treated at the same temperature but in presence of oxygen, with PO2 of 2 mbar. Comparing the two figures, the cell exposed to oxygen showed structural changes in the LSC thin film in comparison with the sample heated in vacuum. These changes refer to the formation of grains as is confirmed by electron diffraction patterns.

In SITU Transmission Electron Microscopy on Operating Electrochemical CELLS

Solid oxide cells (SOC) have the potential of playing a significant role in the future efficient energy system scenario. In order to become widely commercially available, an improved performance and durability of the cells has to be achieved [1]. Conventional scanning and transmission SEM and TEM have been often used for ex-situ post mortem characterization of SOFCs and SOECs [2,3]. However, in order to get fundamental insight of the microstructural development of SOFC/SOEC during operation conditions in situ studies are necessary [4].
Integrating a dual-silicon photoelectrochemical cell into a redox flow battery for unassisted photocharging

Solar rechargeable flow cells (SRFCs) provide an attractive approach for in situ capture and storage of intermittent solar energy via photoelectrochemical regeneration of discharged redox species for electricity generation. However, overall SRFC performance is restricted by inefficient photoelectrochemical reactions. Here we report an efficient SRFC based on a dual-silicon photoelectrochemical cell and a quinone/bromine redox flow battery for in situ solar energy conversion and storage. Using narrow bandgap silicon for efficient photon collection and fast redox couples for rapid interface charge injection, our device shows an optimal solar-to-chemical conversion efficiency of similar to 5.9% and an overall photochemical-electricity energy conversion efficiency of similar to 3.2%, which, to our knowledge, outperforms previously reported SRFCs. The proposed SRFC can be self-photocharged to 0.8V and delivers a discharge capacity of 730 mAh⁻¹. Our work may guide future designs for highly efficient solar rechargeable devices.

General information
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Interplay between magnetism and energetics in Fe-Cr alloys from a predictive noncollinear magnetic tight-binding model

Magnetism is a key driving force controlling several thermodynamic and kinetic properties of Fe-Cr systems. We present a tight-binding model for Fe-Cr, where magnetism is treated beyond the usual collinear approximation. A major advantage of this model consists in a rather simple fitting procedure. In particular, no specific property of the binary system is explicitly required in the fitting database. The present model is proved to be accurate and highly transferable for electronic, magnetic, and energetic properties of a large variety of structural and chemical environments: surfaces, interfaces, embedded clusters, and the whole compositional range of the binary alloy. The occurrence of noncollinear magnetic configurations caused by magnetic frustrations is successfully predicted. The present tight-binding approach can apply to other binary magnetic transition-metal alloys. It is expected to be particularly promising if the size difference between the alloying elements is rather small and the electronic properties prevail.

General information
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Scopus rating (2016): CiteScore 3.16 SJR 2.339 SNIP 1.151
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 2.377 SNIP 1.13 CiteScore 2.8
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 2.762 SNIP 1.316 CiteScore 3.3
Web of Science (2014): Indexed yes
Scopus rating (2013): SJR 2.813 SNIP 1.326 CiteScore 3.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 3.173 SNIP 1.378 CiteScore 3.57
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 3.326 SNIP 1.423 CiteScore 3.61
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Scopus rating (2010): SJR 3.318 SNIP 1.447
Web of Science (2010): Indexed yes
Web of Science (2009): Indexed yes
Scopus rating (2008): SJR 2.923 SNIP 1.516
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.892 SNIP 1.588
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.62 SNIP 1.468
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.126 SNIP 1.156
Interplay of nonlocal response, damping, and low group velocity in surface-plasmon polaritons

The miniaturization of metal structures down to the nanoscale has been accompanied with several recent studies demonstrating plasmonic effects not explainable by classical electromagnetic theory. Describing the optical properties of materials solely through the bulk dielectric function has been augmented with quantum mechanical corrections, such as the electron spill-out effect and nonlocal response. Here, we discuss the latter and its implications on the waveguiding characteristics, such as dispersion and group velocity, of the surface-plasmon polariton mode supported at a metal-air interface.
Investigating the Role of Surface Materials and Three Dimensional Architecture on In Vitro Differentiation of Porcine Monocyte-Derived Dendritic Cells

In vitro generation of dendritic-like cells through differentiation of peripheral blood monocytes is typically done using two-dimensional polystyrene culture plates. In the process of optimising cell culture techniques, engineers have developed fluidic micro-devices usually manufactured in materials other than polystyrene and applying three-dimensional structures more similar to the in vivo environment. Polydimethylsiloxane (PDMS) is an often used polymer for lab-on-a-chip devices but not much is known about the effect of changing the culture surface material from polystyrene to PDMS. In the present study the differentiation of porcine monocytes to monocyte-derived dendritic cells (moDCs) was investigated using CD172apos pig blood monocytes stimulated with GM-CSF and IL-4. Monocytes were cultured on surfaces made of two- and three-dimensional polystyrene as well as two- and three-dimensional PDMS and carbonised three-dimensional PDMS. Cells cultured conventionally (on two-dimensional polystyrene) differentiated into moDCs as expected. Interestingly, gene expression of a wide range of cytokines, chemokines, and pattern recognition receptors was influenced by culture surface material and architecture. Distinct clustering of cells, based on similar expression patterns of 46 genes of interest, was seen for cells isolated from two- and three-dimensional polystyrene as well as two- and three-dimensional PDMS. Changing the material from polystyrene to PDMS resulted in cells with expression patterns usually associated with macrophage expression (upregulation of CD163 and downregulation of CD1a, FLT3, LAMP3 and BATF3). However, this was purely based on gene expression level, and no functional assays were included in this study which would be necessary in order to classify the cells as being macrophages. When changing to three-dimensional culture the cells became increasingly activated in terms of IL6, IL8, IL10 and CCR5 gene expression. Further stimulation with LPS resulted in a slight increase in the expression of maturation markers (SLA-DRB1, CD86 and CD40) as well as cytokines (IL6, IL8, IL10, and IL23A) but the influence of the surfaces was unchanged. These findings highlights future challenges of combining and comparing data generated from microfluidic cell culture-devices made using alternative materials to data generated using conventional polystyrene plates used by most laboratories today.

Intrinsic roughness in suspended van der Waals heterostructures

Intrinsic roughness in suspended van der Waals heterostructures

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon
Authors: Thomsen, J. D. (Intern), Bøggild, P. (Intern), Booth, T. (Intern)
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Investigating the Role of Surface Materials and Three Dimensional Architecture on In Vitro Differentiation of Porcine Monocyte-Derived Dendritic Cells

In vitro generation of dendritic-like cells through differentiation of peripheral blood monocytes is typically done using two-dimensional polystyrene culture plates. In the process of optimising cell culture techniques, engineers have developed fluidic micro-devices usually manufactured in materials other than polystyrene and applying three-dimensional structures more similar to the in vivo environment. Polydimethylsiloxane (PDMS) is an often used polymer for lab-on-a-chip devices but not much is known about the effect of changing the culture surface material from polystyrene to PDMS. In the present study the differentiation of porcine monocytes to monocyte-derived dendritic cells (moDCs) was investigated using CD172apos pig blood monocytes stimulated with GM-CSF and IL-4. Monocytes were cultured on surfaces made of two- and three-dimensional polystyrene as well as two- and three-dimensional PDMS and carbonised three-dimensional PDMS. Cells cultured conventionally (on two-dimensional polystyrene) differentiated into moDCs as expected. Interestingly, gene expression of a wide range of cytokines, chemokines, and pattern recognition receptors was influenced by culture surface material and architecture. Distinct clustering of cells, based on similar expression patterns of 46 genes of interest, was seen for cells isolated from two- and three-dimensional polystyrene as well as two- and three-dimensional PDMS. Changing the material from polystyrene to PDMS resulted in cells with expression patterns usually associated with macrophage expression (upregulation of CD163 and downregulation of CD1a, FLT3, LAMP3 and BATF3). However, this was purely based on gene expression level, and no functional assays were included in this study which would be necessary in order to classify the cells as being macrophages. When changing to three-dimensional culture the cells became increasingly activated in terms of IL6, IL8, IL10 and CCR5 gene expression. Further stimulation with LPS resulted in a slight increase in the expression of maturation markers (SLA-DRB1, CD86 and CD40) as well as cytokines (IL6, IL8, IL10, and IL23A) but the influence of the surfaces was unchanged. These findings highlights future challenges of combining and comparing data generated from microfluidic cell culture-devices made using alternative materials to data generated using conventional polystyrene plates used by most laboratories today.

General information
State: Published
Organisations: National Veterinary Institute, Section for Immunology and Vaccinology, BioLabChip, Department of Micro- and Nanotechnology, Eucaryotic Molecular Cell Biology, Bioanalytics, Institute of Virology and Immunology
Authors: Hartmann, S. B. (Intern), Mohanty, S. (Intern), Skovgaard, K. (Intern), Brogaard, L. (Intern), Flagstad, F. B. (Intern), Erménus, J. (Intern), Wolff, A. (Intern), Summerfield, A. (Ekstern), Jungersen, G. (Intern)
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Web of Science (2018): Indexed yes
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Scopus rating (2017): SJR 1.164 SNIP 1.111
Web of Science (2017): Indexed yes
Investigation of Sternal Photoplethysmography – Design of a Vital Sign Patch

It is important to obtain reliable measures of vital sign parameters, e.g. heart rate, respiratory rate (RR), and the oxygen saturation of the blood ($S_\text{O}_2$). In current clinical practice the RR is assessed by manual count of the chest movements and pulse oximetry probes have been limited to the fingertip or the earlobe. These methods are documented to be time consuming or inaccurate when monitoring patients with low blood flow or decreased perfusion at the extremities (e.g. patients with obstructive lung diseases, diabetes, or heart failure). Furthermore, they are obtrusive for long-term recordings.

The main focus of this project is to investigate the clinical applicability of photoplethysmography (PPG) measured at the chest bone (sternum). PPG is an optical method from which the RR and the $S_\text{O}_2$ level can be obtained. For this purpose we have developed a prototype of a wearable PPG sensor and conducted three clinical studies both on healthy participants and on patients with obstructive lung diseases. The first clinical study was a controlled desaturation study. All 14 subjects were exposed to hypoxia by breathing an air mixture of reduced oxygen concentration in a closed system. We obtained an average root mean squared error ($A_{\text{rms}}$) of 1.75 % compared to invasive measures of the oxygen saturation in the radial artery ($S_\text{O}_2$) which is within the clinically and commercially accepted range. Furthermore, this study served as a calibration of the PPG sensor in a clinical relevant range (100 % - 70 %).
In the second study, sternal PPG recording was conducted from 30 admitted patients with either asthma or Chronic Obstructive Pulmonary Disease (COPD). We compared the $S_pO_2$ levels simultaneously obtained from the sternal PPG recording and a conventional finger pulse oximeter. The Pearson correlation between the $S_pO_2$ levels estimated from the two body locations was found to be 0.89 ($p < 0.05$) and the mean system bias was only 0.052 % with upper and lower limits of agreement of 2.5 % and -2.4 %, respectively. The RR was also obtained from sternal PPG and compared to conventional capnography. In a range of 11 to 36 breaths/min the Pearson correlation was 0.93 ($p < 0.001$) and the system mean bias was 0.6 breaths/min. The upper and lower limits of agreement were found to be -2.8 to 4 breaths/min. In the last clinical study, the focus was to investigate the clinical reliability of long-term PPG recordings from the sternum. Fifteen admitted patients were included in the study and were monitored with the sternal PPG sensor for approximately 20 hours. On average it was found that clinically reliable $S_pO_2$ and RR estimates could be calculated for 58 % of the recording time. Furthermore, the average longest period of time with unreliable data in terms of the $S_pO_2$ level and the RR was only 23.6 minutes and 20 minutes, respectively. The results of this project show that it is possible to obtain reliable quasi-continuous recording of the $S_pO_2$ level and the RR from sternal PPG in many different clinical applications in the future.
In vivo Evaluation of PEGylated $^{64}$Cu-liposomes with Theranostic and Radiotherapeutic Potential using Micro PET/CT

The objective of this study was to evaluate the potential of PEGylated $^{64}$Cu-liposomes in clinical diagnostic positron emission tomography (PET) imaging and PEGylated $^{177}$Lu-liposomes in internal tumor radiotherapy through in vivo characterization and dosimetric analysis in a human xenograft mouse model. Liposomes with 5 and 10 mol% PEG were characterized with respect to size, charge, and $^{64}$Cu- and $^{177}$Lu-loading efficiency. The tumor imaging potential of $^{64}$Cu-loaded liposomes was evaluated in terms of in vivo biodistribution, tumor accumulation and tumor-to-muscle (T/M) ratios, using PET imaging. The potential of PEGylated liposomes for diagnostic and therapeutic applications was further evaluated through dosimetry analysis using OLINDA/EXM software. The $^{64}$Cu-liposomes were used as biological surrogates to estimate the organ and tumor kinetics of $^{177}$Lu-liposomes. High remote loading efficiency (>95%) was obtained for both $^{64}$Cu and $^{177}$Lu radionuclides with PEGylated liposomes, and essentially no leakage of the encapsulated radionuclides was observed upon storage and after serum incubation for 24 h at 37 °C. The 10 mol% PEG liposomes...
showed higher tumor accumulation (6.2±0.2 %ID/g) than the 5mol% PEG liposomes, as evaluated by PET imaging. Thedosimetry analysis of the 64Cu-liposomes estimated an acceptable total effective dose of 3.3·10^{-2} mSv/MBq for diagnostic imaging in patients. A high absorbed tumor dose (114 mGy/MBq) was estimated for the potential radiotherapeutic 177Lu-liposomes. The overall preclinical profile of PEGylated 64Cu-liposomes showed high potential as a new PET theranostic tracer for imaging in humans. Dosimetry results predicted that initial administered activity of 200 MBq of 64Cu-liposomes should be acceptable in patients. Work is in progress to validate the utility of PEGylated 64Cu-liposomes in a clinical research programme. The high absorbed tumor dose (114 mGy/MBq) estimated for 177Lu-liposomes and the preliminary dosimetric studies justify further therapeutic and dosimetry investigation of 177Lu-liposomes in animals before potential testing in man.
Lab-on-a-disc agglutination assay for protein detection by optomagnetic readout and optical imaging using nano- and micro-sized magnetic beads

We present a biosensing platform for the detection of proteins based on agglutination of aptamer coated magnetic nano- or microbeads. The assay, from sample to answer, is integrated on an automated, low-cost microfluidic disc platform. This ensures fast and reliable results due to a minimum of manual steps involved. The detection of the target protein was achieved in two ways: (1) optomagnetic readout using magnetic nanobeads (MNBs); (2) optical imaging using magnetic microbeads (MMBs). The optomagnetic readout of agglutination is based on optical measurement of the dynamics of MNB aggregates whereas the imaging method is based on direct visualization and quantification of the average size of MMB aggregates. By enhancing magnetic particle agglutination via application of strong magnetic field pulses, we obtained identical limits of detection of 25 pM with the same sample-to-answer time (15 min 30 s) using the two differently sized beads for the two detection methods. In both cases a sample volume of only 10 μl is required. The demonstrated automation, low sample-to-answer time and portability of both detection instruments as well as integration of the assay on a low-cost disc are important steps for the implementation of these as portable tools in an out-of-lab setting.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Magnetic Systems, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, BluSense Diagnostics
Authors: Uddin, R. (Intern), Burger, R. (Ekstern), Donolato, M. (Ekstern), Fock, J. (Intern), Creagh, M. (Ekstern), Hansen, M. F. (Intern), Boisen, A. (Intern)
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BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.65 SJR 2.373
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 7.22 SJR 2.095 SNIP 1.619
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.044 SNIP 1.671 CiteScore 7.07
Web of Science (2015): Indexed yes
Lab-on-a-disc device for screening of genetically engineered E.coli cells

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Novo Nordisk Foundation Center for Biosustainability, Bacterial Cell Factory Optimization, Research Groups
Authors: Sanger, K. (Intern), Zor, K. (Intern), Jendresen, C. B. (Intern), Amato, L. (Intern), Burger, R. (Intern), Boisen, A. (Intern), Nielsen, A. T. (Intern)
Number of pages: 1
Publication date: 2016
Large-Scale mRNA Transfection of Dendritic Cells by Electroporation in Continuous Flow Systems

Electroporation is well established for transient mRNA transfection of many mammalian cells, including immune cells such as dendritic cells used in cancer immunotherapy. Therapeutic application requires methods to efficiently electroporate and transfect millions of immune cells in a fast process with high cell survival. Continuous flow of suspended dendritic cells through a channel incorporating spatially separated microporous meshes with a synchronized electrical pulsing sequence can yield dendritic cell transfection rates of >75 % with survival rates of >90 %. This chapter describes the instrumentation and methods needed for the efficient transfection by electroporation of millions of dendritic cells in one continuous flow process.

Laser ablated micropillar energy directors for ultrasonic welding of microfluidic systems

We present a new type of energy director (ED) for ultrasonic welding of microfluidic systems. These micropillar EDs are based on the replication of cone like protrusion structures introduced using a pico-second laser and may therefore be added to any mould surface accessible to a pico-second laser beam. The technology is demonstrated on an injection moulded microfluidic device featuring high-aspect ratio (h × w = 2000 μm × 550 μm) and free-standing channel walls, where bonding is achieved with no detectable channel deformation. The bonding strength is similar to conventional EDs and the fabricated system can withstand pressures of over 9.5 bar.
Lattice-matched Cu$_2$ZnSnS$_4$/CeO$_2$ solar cell with open circuit voltage boost

We report a reproducible enhancement of the open circuit voltage in Cu$_2$ZnSnS$_4$ solar cells by introduction of a very thin CeO$_2$ interlayer between the Cu$_2$ZnSnS$_4$ absorber and the conventional CdS buffer. CeO$_2$, a non-toxic earth-abundant compound, has a nearly optimal band alignment with Cu$_2$ZnSnS$_4$ and the two materials are lattice-matched within 0.4%. This makes it possible to achieve an epitaxial interface when growing CeO$_2$ by chemical bath deposition at temperatures as low as 50 °C. The open circuit voltage improvement is then attributed to a decrease in the interface recombination rate through formation of a high-quality heterointerface.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Center for Electron Nanoscopy, Department of Photonics Engineering, Optical Microsensors and Micromaterials, University of New South Wales
Authors: Crovetto, A. (Intern), Yan, C. (Ekstern), Iandolo, B. (Intern), Zhou, F. (Ekstern), Stride, J. (Ekstern), Schou, J. (Intern), Hao, X. (Ekstern), Hansen, O. (Intern)
Number of pages: 5
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Scopus rating (2017): SNIP 1.167 SJR 1.382
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.67 SJR 1.673 SNIP 1.249
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.499 SNIP 1.226 CiteScore 2.47
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.861 SNIP 1.492 CiteScore 3.25
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.146 SNIP 1.633 CiteScore 3.77
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.57 SNIP 1.739 CiteScore 3.76
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Lattice-matched Cu₂ZnSnS₄/CeO₂ solar cell with open circuit voltage boost

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, University of New South Wales
Authors: Crovetto, A. (Intern), Yan, C. (Ekstern)
Number of pages: 1
Publication date: 2016
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Main Research Area: Technical/natural sciences
Electronic versions:
andrea_crovetto_EU_kesterites_2016_abstract.pdf
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Source-ID: 127335554
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016
# Lifetime of ALD Al2O3 Passivated Black Silicon Nanostructured for Photovoltaic Applications

Black silicon nano-structures provide significant reduction of silicon surface reflection due to highly corrugated nano-structures with excellent light trapping properties. However, most recent RIE techniques for black silicon nano-structuring have one very important limitation for PV applications – high surface recombination velocity due to intensive plasma ion bombardment of the silicon surface. In an attempt to optimize black silicon for PV applications we develop a mask-less one step reactive ion nano-structuring of silicon with low ion surface damage with reflectance below 0.5%. For passivation purposes we used 37 nm ALD Al2O3 films and conducted lifetime measurements and found 1220 µs and to 4170 µs, respectively, for p- and n-type CZ silicon wafers. Such results are promising results to introduce for black silicon RIE nano-structuring in solar cell process flow.

## General information

State: Published  
Organisations: Department of Energy Conversion and Storage, Department of Micro- and Nanotechnology, Silicon Microtechnology, Nanoprobes, Department of Photonics Engineering, Plasmonics and Metamaterials, Experimental Surface and Nanomaterials Physics  
Authors: Plakhotnyuk, M. (Intern), Davidsen, R. S. (Intern), Schmidt, M. S. (Intern), Malureanu, R. (Intern), Stamate, E. (Intern), Hansen, O. (Intern)  
Number of pages: 1  
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## Relations

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Publication: Research - peer-review › Poster – Annual report year: 2017

# Lifetime of Nano-Structured Black Silicon for Photovoltaic Applications

In this work, we present recent results of lifetime optimization for nano-structured black silicon and its photovoltaic applications. Black silicon nano-structures provide significant reduction of silicon surface reflection due to highly corrugated nanostructures with excellent light trapping properties. We applied reactive ion etching technology at -20ºC to create nano-structures on silicon samples and obtained an average reflectance below 0.5%. For passivation purposes, we used 37 nm ALD Al2O3 films. Lifetime measurements resulted in 1220 µs and to 4170 µs for p- and n-type CZ silicon wafers, respectively. This is promising for use of black silicon RIE nano-structuring in a solar cell process flow.

## General information

State: Published  
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Nanoprobes, Department of Photonics Engineering, Plasmonics and Metamaterials, Department of Energy Conversion and Storage, Fundamental Electrochemistry, Experimental Surface and Nanomaterials Physics  
Authors: Plakhotnyuk, M. (Intern), Davidsen, R. S. (Intern), Schmidt, M. S. (Intern), Malureanu, R. (Intern), Stamate, E. (Intern), Hansen, O. (Intern)  
Number of pages: 4  
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## Relations

Projects:  
Lifetime of Nano-Structured Black Silicon for Photovoltaic Applications  
Source: PublicationPreSubmission  
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2016
Linear epitope mapping of peanut allergens demonstrates individualized and persistent antibody-binding patterns

General information
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Organisations: Department of Civil Engineering, Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology, National Food Institute, Research Group for Gut Microbiology and Immunology, Technical University of Denmark, Roche NimbleGen, Medical University of Vienna, Medical University of Vienna, Universidad Nacional de San Martin
Authors: Hansen, C. S. (Intern), Dufva, M. (Intern), Bøgh, K. L. (Intern), Sullivan, E. (Ekstern), Patel, J. (Ekstern), Eiwegger, T. (Ekstern), Szépfalusi, Z. (Ekstern), Nielsen, M. (Ekstern), Christiansen, A. (Intern)
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Scopus rating (2017): SNIP 2.6 SJR 5.049
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.87 SJR 5.618 SNIP 2.901
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 5.739 SNIP 2.849 CiteScore 6.62
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 4.969 SNIP 2.935 CiteScore 6.61
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BFI (2013): BFI-level 2
Scopus rating (2013): SJR 4.917 SNIP 3.069 CiteScore 7.1
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 4.819 SNIP 2.847 CiteScore 6.94
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 5.161 SNIP 2.717 CiteScore 6.8
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 4.061 SNIP 2.352
BFI (2009): BFI-level 2
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BFI (2008): BFI-level 2
Scopus rating (2008): SJR 4.146 SNIP 2.388
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 3.682 SNIP 2.554
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 3.53 SNIP 2.628
Scopus rating (2005): SJR 3.018 SNIP 2.439
Scopus rating (2004): SJR 2.971 SNIP 2.43
Liposome based radiosensitizer cancer therapy: Potential of enzymesensitive liposomes

Liposome-encapsulated chemotherapeutics have been used in the treatment of a variety of cancers and are feasible for use as mono-therapeutics as well as for combination therapy in conjunction with other modalities. Despite widespread use of liposomal drugs in cancer patient care, insufficient drug bioavailability following accumulation in solid tumors remains one of the major obstacles limiting their clinical efficacy.

Long-circulating stimuli-responsive liposomes offer apart from increased tumor accumulation, control over the level of drug exposure from an ability to trigger the release of entrapped biomolecules. By modulating the liposomal membrane, liposomes can become sensitive towards enzymatically-driven destabilization and/or functionalization, thereby allowing control of the release of encapsulated therapeutics within the diseased tissue upon intrinsic stimulation from tumor-associated enzymes. And may thereby improve therapeutic outcome. Two types of enzymes commonly overexpressed in solid cancers and exploited for liposomal drug delivery purposes, are secretory phospholipase A2 (sPLA2) and matrix metalloproteinases (MMPs). Furthermore, as platinum-based chemotherapeutic compounds are renowned for their radiosensitizing capacity, tumor-associated enzyme-sensitive liposomal platinum drugs can enhance the effect of radiotherapy (RT) specifically in the tumor tissue. In this thesis, we investigate the utility of enzyme-sensitive liposomal oxaliplatin (L-OHP) to improve inhibition of tumor growth and increase survival in tumor-bearing mice. The safety and efficacy of sPLA2-sensitive liposomal L-OHP was assessed in sPLA2-deficient FaDu hypopharyngeal squamous cell carcinoma and sPLA2-expressing Colo205 colorectal adenocarcinoma. Also, the feasibility of multimodal cancer therapy employing L-OHP encapsulated in MMP-sensitive liposomes with fractionated RT was evaluated in MMP-proficient FaDu cancer xenografts.

General information
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Organisations: Department of Micro- and Nanotechnology
Authors: Pourhassan, H. (Intern), Andresen, T. L. (Intern), Hansen, A. E. (Intern)
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Publisher: DTU Nanotech
Original language: English
Main Research Area: Technical/natural sciences

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Liposome based radiosensitizer cancer therapy
Source: PublicationPreSubmission
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Liquid fiducial marker performance during radiotherapy of locally advanced non small cell lung cancer

We analysed the positional and structural stability of a long-term biodegradable liquid fiducial marker (BioXmark) for radiotherapy in patients with locally advanced lung cancer. Markers were injected via endoscopic- or endobronchial ultrasound in lymph nodes and reachable primary tumours. Marker volume and Hounsfield Units (HU) changing rates were estimated using breath-hold CBCT. Inter-fraction variation in marker position relative to gross tumour volume (GTV) position was established, as well as the inter-fraction variation in mediastinal marker registration relative to a carina registration through the treatment. Fifteen patients were included and 29 markers analysed. All markers that were in situ at planning were visible through the treatment. Mean HU was 902±165HU for lymph node and 991±219HU for tumour markers. Volume degradation rates were -5% in lymph nodes and -23% in primary tumours. Three-dimensional inter-fraction variation for marker position relative to the GTV position was -0.1±0.7mm in lymph nodes and -1.5±2.3mm in primary tumours. Inter-fraction variations in marker registration relative to carina registration were -0.4±1.2mm in left-right,
0.2±2.0mm in anterior-posterior and -0.5±2.0mm in cranio-caudal directions. The liquid fiducial markers were visible and stable in size and position throughout the treatment course.
Tunable plasmonic platforms are important for a variety of applications such as photovoltaics, LED’s, optoelectronics, medical research, and biosensors. In particular, development of label-free plasmonic biosensors is one of the key research areas that utilizes plasmonic nanostructures for detection of biologically relevant molecules at low concentrations. The authors have developed a cost-effective, fast, and lithography-free method to fabricate transparent fused silica nanocylinders. The technique allows tuning of nanocylinder height, diameter, and density and can be scaled to large surface areas, such as 8 in. wafers. The authors demonstrate that gold coated nanocylinders support localized surface plasmon resonances (LSPR) from visible to near infrared wavelengths. The plasmonic platform can be characterized as suspended gold nanorings and exhibits a sensitivity of 658 nm RIU^{-1} with a figure-of-merit of 10, comparable to other state-of-the-art LSPR sensing platforms that utilize more complex nanofabrication pathways. It was observed that the LSPR peak positions can be controlled by varying the geometry of the nanocylinders. The authors illustrate surface functionalization, biosensing, and surface regeneration properties of the platform using thiols and detection of bovine serum albumin (BSA). The observed LSPR shifts for 11-mercaptopoundecanoic acid and BSA was 12 and 26 nm, respectively.
Localized electronic states at grain boundaries on the surface of graphene and graphite

Recent advances in large-scale synthesis of graphene and other 2D materials have underscored the importance of local defects such as dislocations and grain boundaries (GBs), and especially their tendency to alter the electronic properties of the material. Understanding how the polycrystalline morphology affects the electronic properties is crucial for the development of applications such as flexible electronics, energy harvesting devices or sensors. We here report on atomic scale characterization of several GBs and on the structural-dependence of the localized electronic states in their vicinity. Using low temperature scanning tunneling microscopy and spectroscopy, together with tight binding and ab initio numerical simulations we explore GBs on the surface of graphite and elucidate the interconnection between the local density of states and their atomic structure. We show that the electronic fingerprints of these GBs consist of pronounced resonances which, depending on the relative orientation of the adjacent crystallites, appear either on the electron side of the spectrum or as an electron-hole symmetric doublet close to the charge neutrality point. These two types of spectral features will impact very differently the transport properties allowing, in the asymmetric case to introduce transport anisotropy which could be utilized to design novel growth and fabrication strategies to control device performance.

General information
State: Published
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Publication date: 2016
Main Research Area: Technical/natural sciences

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Long-term quasi-continuous oxygen saturation levels obtained from sternal photoplethysmography on patients with obstructive lung diseases

Calculation of long-term quasi-continuous oxygen saturation ($S_{O_2}$) levels is highly relevant for critically ill patients. The purpose of this study is therefore to conduct a preliminary investigation of the clinical reliability of long-term photoplethysmography (PPG) recordings obtained from the sternum of patients admitted to the hospital with obstructive lung diseases. Due to the lack of a gold standard reference that is suitable for long-term monitoring without interfering with the patient’s activity level, we extracted reliable segments based on knowledge from the basic pulse oximeter theory as well as knowledge about the inherent physiological regulation of the $S_{O_2}$ levels. We included 15 admitted patients who were monitored with a prototype of a sternal PPG sensor for approximately 20 hours. On average, we found that clinically reliable $S_{O_2}$ levels could be calculated for 58% of the recording time. Furthermore, the average and standard deviation of the longest period of time with unreliable data was only 23.6 ± 19.38 minutes. This indicates a high potential for quasi-continuous calculation of $S_{O_2}$ levels from sternal PPGs in many different clinical applications in the future.

General information

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Magnetic edge states and magnetotransport in graphene antidot barriers

Magnetic fields are often used for characterizing transport in nanoscale materials. Recent magnetotransport experiments have demonstrated that ballistic transport is possible in graphene antidot lattices (GALs). These experiments have inspired the present theoretical study of GALs in a perpendicular magnetic field. We calculate magnetotransport through graphene antidot barriers (GABs), which are finite rows of antidots arranged periodically in a pristine graphene sheet, using a tight-binding model and the Landauer-Buttiker formula. We show that GABs behave as ideal Dirac mass barriers for antidots smaller than the magnetic length and demonstrate the presence of magnetic edge states, which are localized states on the periphery of the antidots due to successive reflections on the antidot edge in the presence of a magnetic field. We show that these states are robust against variations in lattice configuration and antidot edge chirality. Moreover, we calculate the transmittance of disordered GABs and find that magnetic edge states survive a moderate degree of disorder. Due to the long phase-coherence length in graphene and the robustness of these states, we expect magnetic edge states to be observable in experiments as well.
Magnetocrystalline anisotropy of Fe and Co slabs and clusters on SrTiO$_3$ by first-principles

In this paper, we present a detailed theoretical investigation of the electronic and magnetic properties of ferromagnetic slabs and clusters deposited on SrTiO$_3$ via first-principles calculations, with a particular emphasis on the magnetocrystalline anisotropy (MCA). We found that in the case of Fe ultrathin films deposited on SrTiO$_3$ the effect of the interface is to quench the MCA whereas for Co we observe a spin reorientation from in-plane to out-of-plane as compared to the free surface. We also find a strong enhancement of MCA for small clusters upon deposition on a SrTiO$_3$ substrate. The origin of this enhancement of MCA is attributed to the hybridization between the substrate and the d orbitals of the cluster extending in-plane for Fe and out-of-plane for Co. As a consequence, we predict that the Fe nanocrystals (even rather small) should be magnetically stable and are thus good potential candidates for magnetic storage devices.

General information
State: Published
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Main Research Area: Technical/natural sciences
Manipulating the voltage drop in graphene nanojunctions using a gate potential

Graphene is an attractive electrode material to contact nanostructures down to the molecular scale since it can be gated electrostatically. Gating can be used to control the doping and the energy level alignment in the nanojunction, thereby influencing its conductance. Here we investigate the impact of electrostatic gating in nanojunctions between graphene electrodes operating at finite bias. Using first principles quantum transport simulations, we show that the voltage drop across \emph{symmetric} junctions changes dramatically and controllably in gated systems compared to non-gated junctions. In particular, for \emph{p}-(\emph{n}-type) carriers the voltage drop is located close to the electrode with positive(negative) polarity, i.e. the potential of the junction is pinned to the negative(positive) electrode. We trace this behaviour back to the vanishing density of states of graphene in the proximity of the Dirac point. Due to the electrostatic gating, each electrode exposes different density of states in the bias window between the two different electrode Fermi energies, thereby leading to a non-symmetry in the voltage drop across the device. This selective pinning is found to be independent of device length when carriers are induced either by the gate or dopant atoms, indicating a general effect for electronic circuitry based on graphene electrodes. We envision this could be used to control the spatial distribution of Joule heating in graphene nanostructures, and possibly the chemical reaction rate around high potential gradients.
Manipulation of the extracellular microenvironment by micro- and nanotechnology approaches to improve the generation of pancreatic endocrine cells from human embryonic stem cells

Human embryonic stem (hES) cells have the ability to generate all cell types in the body, which suggest that they can provide an unlimited source of cells for cell replacement therapy to treat degenerative diseases such as diabetes mellitus. To achieve a stem cell therapy treatment for diabetes mellitus, the hES cells must be differentiated into mature functional insulin producing beta-cells. Current differentiation protocols focus on the addition of soluble molecules whereas the impact of the physical microenvironment has been mainly unattended. However, the physical microenvironment plays an essential role in cellular behaviour during development and recent studies have demonstrated the effect of the physical environment in in vitro stem cell differentiation. Thus, understanding the role of the physical microenvironment is vital for the development of effective and consistent differentiation protocols. In this study we manipulated the physical environment during the first two differentiation steps towards beta-cells; definitive endoderm (DE) and pancreatic endoderm (PE). Three different approaches were used: 1) systematically screening of extracellular matrix (ECM) substrates (paper 1), 2) alteration of substrate topography and elasticity (paper 2) and 3) initial seeding and cell distribution (paper 3). With the first strategy an array screen was performed to systematically identify ECM protein coatings, which induced or inhibited the differentiation of hES cells towards DE. Almost 500 different ECM protein combinations were screened and several candidates were found. The majority of these candidates could be validated in microtitre well plates and further studies demonstrated that certain ECM proteins regulate the differentiation of hES cells towards DE. Netrin 1, collagen 1 and collagen 2 induced DE differentiation to a higher degree than the control fibronectin. Especially, all the analyses pointed to collagen 1 having unique properties. Cultures on collagen 1 had distinct morphology, proliferated faster and most importantly resulted in purer DE cultures with very few undifferentiated cells. Currently, the underlying biological mechanism is not known and is a subject for further studies. However, to our knowledge collagen 1, collagen 2 and netrin 1 have previous not been linked to embryonic stem cell differentiation. Notable, this study demonstrated that the ECM...
proteins do have a functional role in stem cell differentiation and should be taken into consideration in order to obtain efficient and consistent differentiation protocols.

With the second strategy the physical microenvironment was manipulated with topographies in micro and nanoscale which have different elastic characters. The study consisted of an investigation of the differentiation of hES cells towards DE and PE on nanopillars. The nanopillars with soft character were not favoured by hES cells with regards to attachment and growth. However, DE cells appeared earlier during the DE differentiation on the soft nanopillars when compared to the flat control surface. Moreover, DE cells intensively repopulated the area with soft nanopillars, whereas the undifferentiated cells remained on the flat surface area. The very fast repopulation of DE cells indicated DE cells migrated onto the soft nanopillars, implying that the DE differentiation could be durotaxin driven, where the differentiated cells migrated from rigid substrates towards soft substrates. In contrast, the differentiation towards PE was to a large extent repressed on the soft nanopillars in comparison to the flat control surface. This indicated that the requirements of the physical environment changes during the different stages of differentiation. Our study demonstrated that the differentiation and cellular behaviour of embryonic stem cells are affected by altering the physical properties of the cell culture surface with nanopillars. Such observations have previously not been reported with embryonic stem cells, indicating that additional dimensions, such as the physical environment, should be taken into account when directing stem cell differentiation.

With the last strategy, the cell seeding density and cell distribution across a well was investigated. With a simple cell seeder device, an even and consistent distribution of cells across individual experiments was obtained for human fibroblast cells, hES cells and DE cells derived from hES cells. A uniform seeding of DE cells resulted in a more uniform differentiation towards PE across the entire well (12-well plate). Such uniformity is important in reproducibility and for assays which includes material from the entire well.

General information
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Number of pages: 82
Publication date: 2016

Mannose 6-Phosphate Receptor Is Reduced in -Synuclein Overexpressing Models of Parkinsons Disease
Increasing evidence points to defects in autophagy as a common denominator in most neurodegenerative conditions. Progressive functional decline in the autophagy-lysosomal pathway (ALP) occurs with age, and the consequent impairment in protein processing capacity has been associated with a higher risk of neurodegeneration. Defects in cathepsin D (CD) processing and α-synuclein degradation causing its accumulation in lysosomes are particularly relevant for the development of Parkinson's disease (PD). However, the mechanism by which alterations in CD maturation and α-synuclein degradation leads to autophagy defects in PD neurons is still uncertain. Here we demonstrate that MPR300 shuttling between endosomes and the trans Golgi network is altered in α-synuclein overexpressing neurons. Consequently, CD is not correctly trafficked to lysosomes and cannot be processed to generate its mature active form, leading to a reduced CD-mediated α-synuclein degradation and α-synuclein accumulation in neurons. MPR300 is downregulated in brain from α-synuclein overexpressing animal models and in PD patients with early diagnosis. These data indicate MPR300 as a potential biomarker for PD.

General information
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Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
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Volume: 11
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Martensitbildung in Fe-basierten Legierungen während der Erwärmung von Stickstoff-Siedetemperatur

The austenite-to-martensite transformation at temperatures below room temperature was investigated in situ by magnetometry in Fe-N, Fe-Cr-C and Fe-Cr-Ni based alloys. After quenching to room temperature, samples were immersed in boiling nitrogen and martensite formation was followed during subsequent heating to room temperature. Different tests were performed with heating rates ranging from 0.5 K/min to 10 K/min. For comparison a sample was up-quenched in water to verify whether martensite formation can be suppressed at high heating rates. Thermally activated formation of martensite during heating was convincingly demonstrated for all investigated materials by showing heating rate dependent transformation kinetics. Moreover, magnetometry showed that
the heating rate influences the fraction of martensite formed during the thermal treatment. The activation energy for thermally activated martensite formation as quantified by a Kissinger-like method lies in the range 11-18 kJ/mol and increases with the total fraction of interstitials in the alloy.

Material transfer in Pulsed Laser Deposition of the solar cell materials Cu$_2$SnS$_3$ and Cu$_2$ZnSnS$_4$.

Material transfer in Pulsed Laser Deposition of the solar cell materials Cu$_2$SnS$_3$ and Cu$_2$ZnSnS$_4$. 

General information
State: Published
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Number of pages: 1
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Event: Abstract from Annual Meeting of the Danish Physical Society, Middelfart, Denmark.
Main Research Area: Technical/natural sciences
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Relations
Activities:
Annual Meeting of the Danish Physical Society
Matrix metalloprotease-sensitive doxorubicin-loaded liposomes for enhanced anticancer activity.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Copenhagen
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Publication date: 2016
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Mechanisms of protein misfolding: Novel therapeutic approaches to protein-misfolding diseases

In protein misfolding, protein molecule acquires wrong tertiary structure, thereby induces protein misfolding diseases. Protein misfolding can occur through various mechanisms. For instance, changes in environmental conditions, oxidative stress, dominant negative mutations, error in post-translational modifications, increase in degradation rate and trafficking error. All of these factors cause protein misfolding thereby leading to diseases conditions. Both in vitro and in vivo observations suggest that partially unfolded or misfolded intermediates are particularly prone to aggregation. These partially misfolded intermediates aggregate via the interaction with the complementary intermediates and consequently enhance oligomers formation that grows into fibrils and proto-fibrils. The amyloid fibrils for example, accumulate in the brain and central nervous system (CNS) as amyloid deposits in the Parkinson’s disease (PD), Alzheimer’s disease (AD), Prion disease and Amylo lateral Sclerosis (ALS). Furthermore, tau protein shows intrinsically disorder conformation; therefore its interaction with microtubule is impaired and this protein undergoes aggregation. This is also underlying cause of Alzheimers and other neurodegenerative diseases. Treatment of such misfolding maladies is considered as one of the most important challenges of the 21st century. Currently, several treatments strategies have been and are being discovered. These therapeutic interventions partly reversed or prevented the pathological state. More recently, a new approach was discovered, which employs nanobodies that targets multisteps in fibril formation pathway that may possibly completely cure these misfolding diseases. Keeping the above views in mind in the current review, we have comprehensively discussed the different mechanisms underlying protein misfolding thereby leading to diseases conditions and their therapeutic interventions.

General information
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Main Research Area: Technical/natural sciences

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Web of Science (2017): Indexed Yes
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Scopus rating (2016): CiteScore 1.58
Web of Science (2016): Indexed yes
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Meso-Molding Three-Dimensional Macroporous Perovskites: A New Approach to Generate High-Performance Nanohybrid Catalysts

Newly designed 3D highly ordered macro/mesoporous multifunctional La$_{1-x}$Ce$_x$CoO$_3$ nanohybrid frameworks with a 2D hexagonal mesostructure were fabricated via facile meso-molding in a three-dimensionally macroporous perovskite (MTMP) route. The nanohybrid framework exhibited excellent catalytic activity for methane combustion, which derived from the MTMP providing a larger surface area and pore volume, uniform pore sizes, higher accessible surface oxygen concentration, better low-temperature reducibility, and a unique nanovoid 3D structure.

General information
State: Published
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Scopus rating (2017): SJR 2.784 SNIP 1.543
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 7.6 SJR 2.561 SNIP 1.536
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Mesoscopic current transport in two-dimensional materials with grain boundaries: Four-point probe resistance and Hall effect

We have studied the behavior of micro four-point probe (M4PP) measurements on two-dimensional (2D) sheets composed of grains of varying size and grain boundary resistivity by Monte Carlo based finite element (FE) modelling. The 2D sheet of the FE model was constructed using Voronoi tessellation to emulate a polycrystalline sheet, and a square sample was cut from the tessellated surface. Four-point resistances and Hall effect signals were calculated for a probe placed in the center of the square sample as a function of grain density \( n \) and grain boundary resistivity \( \rho_{GB} \). We find that the dual configuration sheet resistance as well as the resistance measured between opposing edges of the square sample have a simple unique dependency on the dimension-less parameter \( \sqrt{n\rho_{GB}G_0} \), where \( G_0 \) is the sheet conductance of a grain. The value of the ratio \( R_A/R_B \) between resistances measured in A- and B-configurations depends on the dimensionality of the current transport (i.e., one- or two-dimensional). At low grain density or low grain boundary resistivity, two-dimensional transport is observed. In contrast, at moderate grain density and high grain resistivity, one-dimensional transport is seen. Ultimately, this affects how measurements on defective systems should be interpreted in order to extract relevant sample parameters. The Hall effect response in all M4PP configurations was only significant for moderate grain densities and fairly large grain boundary resistivity.

General information
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Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 1.72 SJR 0.906 SNIP 0.977
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.821 SNIP 0.996 CiteScore 1.57
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.039 SNIP 1.197 CiteScore 2.04
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
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Web of Science (2013): Indexed yes
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Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
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Web of Science (2009): Indexed yes
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Scopus rating (2008): SJR 1.644 SNIP 1.326
Web of Science (2008): Indexed yes
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Scopus rating (2006): SJR 1.944 SNIP 1.667
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Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.078 SNIP 1.532
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 2.184 SNIP 1.7
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 2.147 SNIP 1.554
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 2.009 SNIP 1.53
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.973 SNIP 1.486
Meta-analysis of transcriptomic responses as a means to identify pulmonary disease outcomes for engineered nanomaterials

Background: The increasing use of engineered nanomaterials (ENMs) of varying physical and chemical characteristics poses a great challenge for screening and assessing the potential pathology induced by these materials, necessitating novel toxicological approaches. Toxicogenomics measures changes in mRNA levels in cells and tissues following exposure to toxic substances. The resulting information on altered gene expression profiles, associated pathways, and the doses at which these changes occur, are used to identify the underlying mechanisms of toxicity and to predict disease outcomes. We evaluated the applicability of toxicogenomics data in identifying potential lung-specific (genomic datasets are currently available from experiments where mice have been exposed to various ENMs through this common route of exposure) disease outcomes following exposure to ENMs.

Methods: Seven toxicogenomics studies describing mouse pulmonary responses over time following intra-tracheal exposure to increasing doses of carbon nanotubes (CNTs), carbon black, and titanium dioxide (TiO2) nanoparticles of varying properties were examined to understand underlying mechanisms of toxicity. mRNA profiles from these studies were compared to the publicly available datasets of 15 other mouse models of lung injury/diseases induced by various agents including bleomycin, ovalbumin, TNF alpha, lipopolysaccharide, bacterial infection, and welding fumes to delineate the implications of ENM-perturbed biological processes to disease pathogenesis in lungs.

Results: The meta-analysis revealed two distinct clusters—one driven by TiO2 and the other by CNTs. Unsupervised clustering of the genes showing significant expression changes revealed that CNT response clustered with bleomycin injury and bacterial infection models, both of which are known to induce lung fibrosis, in a post-exposure-time dependent manner, irrespective of the CNT's physical-chemical properties. TiO2 samples clustered separately from CNTs and disease models.

Conclusions: These results indicate that in the absence of apical toxicity data, a tiered strategy beginning with short term, in vivo tissue transcriptomics profiling can effectively and efficiently screen new ENMs that have a higher probability of inducing pulmonary pathogenesis.
Microcontainers - an oral drug delivery system for poorly soluble drugs

In oral delivery, it can sometimes be necessary to employ drug delivery systems to achieve targeted delivery to the intestine. Microcontainers are polymeric, cylindrical devices in the micrometer size range (Figure 1), and are suggested as a promising oral drug delivery system [1],[2]. The purpose of these studies was to fabricate microcontainers in either SU-8 or biodegradable poly-L-lactic acid (PLLA), and fill the microcontainers with poorly soluble drugs. Furthermore, the application of the microcontainers as an oral drug delivery system was investigated in terms of release, in situ intestinal perfusion and oral bioavailability. SU-8 microcontainers were fabricated using lithography resulting in microcontainers with an inner diameter of 220 μm. The PLLA microcontainers were prepared by hot embossing with inner diameter of 240 μm (Figure 1). In terms of drug filling, the SU-8 microcontainers were filled with polyvinylpyrrolidone (PVP) by inkjet printing followed by supercritical CO2 impregnation of ketoprofen into the PVP matrix. As an alternative filling method, the powder of amorphous sodium salt of furosemide, (ASSF) was filled into the SU-8 microcontainers. The PLLA microcontainers were filled with drug formulation by embossing the microcontainers into a polycaprolactone (PCL) and furosemide (4:1 w/w) layer. For the ASSF-filled microcontainers, an enteric-resistant lid of Eudragit L100 was spray coated onto the cavity of the microcontainers. From coated ASSF-filled microcontainers, a fast release in simulated intestinal medium at pH 6.5 was observed. In situ intestinal perfusions were performed in rats of the Eudragit-coated ASSF-filled microcontainers and compared to a furosemide solution. At the end of the study, the small intestine was harvested from the rat and imaged under a light microscope. The absorption rate constant of ASSF was 1.5 fold higher, when ASSF was confined in the microcontainers compared to a furosemide solution. Micrographs of the small intestine after the perfusion showed that the microcontainers were engulfed by the intestinal mucus. For the in vivo studies, the rats were dosed orally with capsules containing ASSF-filled microcontainers coated with Eudragit L100. As control, capsules were filled with the powder of ASSF and the capsules were coated with Eudragit L100. The oral bioavailability study showed that the relative oral bioavailability of ASSF in microcontainers is 220±43% when compared to drug-filled capsules coated with Eudragit.
Microcontainers - an oral drug delivery system for poorly soluble drugs

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Microcontainers as an oral drug delivery system

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Microcontainers as an Oral Drug Delivery System

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, University of Copenhagen
Publication date: 2016
Microcontainers as effective drug delivery vehicles: advances in the drug loading

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Technical University of Denmark
Authors: Marizza, P. (Intern), Leonardi, L. (Ekstern), Mazzoni, C. (Intern), Tentor, F. (Intern), Petersen, R. S. (Intern), Abid, Z. (Intern), Boisen, A. (Intern)
Publication date: 2016
Event: Abstract from 11th Central European Symposium on Pharmaceutical Technology, Belgrade, Serbia.
Main Research Area: Technical/natural sciences
Electronic versions:
Chiara_Mazzoni_2.pdf

Microcontainers for Intestinal Drug Delivery
Among all the drug administration routes, the oral one is the most preferred by the patients being less invasive, faster and easier. Oral drug delivery systems designed to target the intestine are produced by powder technology and capsule formulations. Those systems including micro- and nano-particulate systems (i.e. vesicles, polymer nanoparticles, dendrimers etc.) suffer the non-unidirectional release of the drug to the epithelium of the intestine, which entails an inevitable loss in the lumen and, therefore, the reduction of the drug delivered to the intestinal epithelium. A new promising approach focuses on reservoir based microdevices serving as carriers for poorly soluble drugs, hereby called microcontainers (1). Microcontainers have a cylindrical geometry and provide a unidirectional release due to their design meanwhile protecting the drug formulation from the low gastric pH and the enzymatic degradation. Here, we present the preparation of microcontainers with enteric coating (2) efficiently loaded with drug and able to target the intestine as a multi-particulate system.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Tentor, F. (Intern), Mazzoni, C. (Intern), Keller, S. S. (Intern), Marizza, P. (Intern), Boisen, A. (Intern)
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Main Research Area: Technical/natural sciences
Electronic versions:
Fabio_Tentor.pdf

Relations
Activities:
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Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Micro fluidic System for Culturing and Monitoring of Neuronal Cells and Tissue
The aim of this Ph.D. project was to combine experience within cell and tissue culturing, electrochemistry and microfabrication in order to develop an in vivo-like fluidic culturing platform, challenging the traditional culturing methods. The first goal was to develop a fluidic system for culturing of brain tissue. The second goal was to develop a sensor
system with the potential for incorporation into both conventional culture systems and fluidic culturing systems. The third and final goal of this project was to develop a system for culturing of neuronal cells with the possibility of incorporating the developed sensor system. The project was conducted in collaboration with researchers at KU to ensure that the end product is actually desired by the community. 

This thesis demonstrates some of the work carried out during the course of this Ph.D. project. First it describes culturing of primary neuronal cells on a Peptide Nano Wires (PNW) modified substrate aiming to bring conventional neuronal cultures closer to mimic the in vivo situation. The work describes both the fabrication of the culture substrates and results comparing the performance of PNW cultured neurons and conventional cultures. Tests show that the function of neurons cultured on PNWs lies closer to neurons in vivo than neurons cultured on conventional plastic substrates. 

The second part of the thesis describes a fluidic system for culturing of brain slices. It describes the fabrication and use of the system as well as results on culturing of hippocampal tissue slices. We found that the tissues cultured in the microfluidic system were of similar or better quality compared to tissues cultured conventionally. 

The third part of the thesis is about the development, characterisation and test of a membrane based sensor system. As the membranes are used for culturing, the introduction of electrodes on these will allow for the real time measurement of relevant cell/tissue products during culturing. 

The last part of the thesis is about, i.e. the integration of the membrane based sensors with the fluidic system, in a way compatible with mass production. The last part of this thesis also includes perspectives on how to expand the latest designed device to facilitate culturing of tissue and co-culturing of cells.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems
Authors: Bakmand, T. (Intern), Dimaki, M. (Intern), Svendsen, W. E. (Intern), Waagepetersen, H. S. (Ekstern)
Number of pages: 110
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Original language: English
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Micro fluidic System for Culturing and Monitoring of Neuronal Cells and Tissue
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Micromechanical Pyrolytic Carbon String Resonators
General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Technical University of Denmark
Authors: Kurek, M. (Intern), Larsen, F. K. (Ekstern), Larsen, P. E. (Intern), Schmid, S. (Intern), Boisen, A. (Intern), Keller, S. S. (Intern)
Number of pages: 2
Publication date: 2016
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Micromechanical_Pyrolytic_Carbon_String_Resonators.pdf
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Source-ID: 126456729
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Micro/Nano-Structured Flexible Foils for Anti-Counterfeiting Purposes
Up to date there have been found many ways of producing samples with functional nano-pattering, however for mass production of such samples the method of fabrication of the surface structure must be fast and cheap. A recently developed method suggests using extrusion coating of polymer materials in a roll-to-roll process, where the functional micro-/nano- surface structures are imprinted directly onto the surface of a polymer foil. This new technology can both answer the requirement for being fast and cheap. The aim of this project is implementation of the technology for mass production and it is carried out in collaboration between technical University of Denmark and Danapak Flexibles A/S. In a roll to roll extrusion coating a molten polymer film is extruded through a flat nozzle, then stretched in air, and finally laminated onto a carrier foil. The lamination process takes place as the melt curtain is squeezed between a structured cooling roller and a rubber counter roller. A force is exerted on the compliant counter roller to form a so-called nip region
where the molten polymer solidifies and adheres to the carrier foil. The extrusion coating process is fast, mainly due to the fact that the polymer is molten to begin with, and cools rapidly by contact with the cooling roller. Previously a large area replication at high throughput of patterns both on micrometer- and nanometer scale in thermoplastic foils using standard industrial extrusion coating equipment and standard thermoplastic polymers has been demonstrated. The focus of this study lies on the reproduction of the previous results for nano- or micro-structures and implementation of this technology for mass production of such patterned foils for the use in packaging. An interesting application is production of holograms with build in anti-counterfeiting designs on micro- or nanoscale.
Modeling of plates with multiple anisotropic layers and residual stress

Usually the analytical approach for modeling of plates uses the single layer plate equation to obtain the deflection and does not take anisotropy and residual stress into account. Based on the stress–strain relation of each layer and balancing stress resultants and bending moments, a general multilayered anisotropic plate equation is developed for plates with an arbitrary number of layers. The exact deflection profile is calculated for a circular clamped plate of anisotropic materials with residual bi-axial stress. From the deflection shape the critical stress for buckling is calculated and by using the Rayleigh–Ritz method the natural frequency is estimated. Using the Galerkin method, an approximate deflection shape is calculated for a rectangular plate, and for a square plate the expression can be simplified drastically. To support the results, the model has been compared to a FEM model, and an excellent agreement between the two models is seen with a relative difference of less than 2% for all calculations. The model was also used to extract the cell capacitance, the parasitic capacitance and the residual stress of a pressure sensor composed of a multilayered plate of silicon and silicon oxide. The extracted values were in good agreement with the expected and it showed that the behavior of devices with a plate could easily be predicted with a low uncertainty.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Silicon Microtechnology
Authors: Engholm, M. (Intern), Pedersen, T. (Intern), Thomsen, E. V. (Intern)
Number of pages: 10
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Web of Science (2018): Indexed yes
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BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.826 SNIP 1.553 CiteScore 2.73
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.866 SNIP 1.771 CiteScore 2.41
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.819 SNIP 1.762 CiteScore 2.53
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.91 SNIP 2.113 CiteScore 2.34
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.909 SNIP 2.103 CiteScore 2.5
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.11 SNIP 1.85
Modelling the deformation of nickel foil during manufacturing of nanostructures on injection moulding tool inserts

In the present work, a manufacturing process for transferring nanostructures from a glass wafer to a double-curved insert for injection moulding is demonstrated. A nanostructure consisting of sinusoidal cross-gratings with a period of 426 nm is successfully transferred to hemispheres on an aluminium substrate with three different radii; 500 μm, 1000 μm and 2000 μm, respectively. The nanoimprint is performed using a 50 μm thick nickel foil, manufactured using electroforming. During the imprinting process, the nickel foil is stretched due to the curved surface of the aluminium substrate. Experimentally, it is possible to address this stretch by counting the periods of the cross-gratings via SEM characterization. A model for the deformation of the nickel foil during nanoimprint is developed, utilizing non-linear material and geometrical behaviour. Good agreement between measured and numerically calculated stretch ratios on the surface of the deformed nickel foil is found, and it is shown, that from the model it is also possible to predict the geometrical extend of the nanostructured area on the curved surfaces.
This paper presents a new manufacturing process for transferring nanostructures from a glass wafer to a curved aluminium insert for polymer injection moulding. A nanostructure consisting of sinusoidal cross-gratings with a period of 426 nm is successfully transferred to hemispheres with different radii via an embossing process. The embossing is done into a glass-like resist called HSQ, using a 50 μm thick nickel foil, manufactured with electroforming. During the imprinting process the nickel foil is stretched due to the curved surface of the aluminium substrate and it is experimentally possible to characterize this stretch by counting the periods of the cross-gratings via SEM characterization. A numerical model for simulating the deformation of the nickel foil during nanoimprint is also developed, utilizing non-linear material and geometrical behaviour. Good agreement between measured and numerically calculated stretch ratios on the surface of the
deformed nickel foil is shown, and from the model it is also possible to predict the limiting boundary of the nanostructures on the curved surfaces, with decreasing radii.
Monitoring intra- and extracellular redox capacity of intact barley aleurone layers responding to phytohormones

Redox regulation is important for numerous processes in plant cells including abiotic stress, pathogen defence, tissue development, seed germination and programmed cell death. However, there are few methods allowing redox homeostasis to be addressed in whole plant cells, providing insight into the intact in vivo environment. An electrochemical redox assay that applies the menadione-ferricyanide double mediator is used to assess changes in the intracellular and extracellular redox environment in living aleurone layers of barley (Hordeum vulgare cv. Himalaya) grains, which respond to the phytohormones gibberellic acid and abscisic acid. Gibberellic acid is shown to elicit a mobilisation of electrons as detected by an increase in the reducing capacity of the aleurone layers. By taking advantage of the membrane-permeable menadione/menadiol redox pair to probe the membrane-impermeable ferricyanide/ferrocyanide redox pair, the mobilisation of electrons was dissected into an intracellular and an extracellular, plasma membrane-associated component. The intracellular and extracellular increases in reducing capacity were both suppressed when the aleurone layers were incubated with abscisic acid. By probing redox levels in intact plant tissue, the method provides a complementary approach to assays of reactive oxygen species and redox-related enzyme activities in tissue extracts.

General information
State: Published
Organisations: Agricultural and Environmental Proteomics, Department of Systems Biology, Department of Micro- and Nanotechnology, Nanoprobes, Bioanalytics, Fluidic Array Systems and Technology
Authors: Mark, C. (Intern), Zor, K. (Intern), Heiskanen, A. (Intern), Dufva, M. (Intern), Emnéus, J. (Intern), Finnie, C. (Intern)
Pages: 1-8
Publication date: 2016
Main Research Area: Technical/natural sciences

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Web of Science (2018): Indexed yes
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Scopus rating (2017): SNIP 0.649 SJR 0.633
Web of Science (2017): Indexed Yes
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Scopus rating (2016): CiteScore 2.34 SJR 0.719 SNIP 0.743
Multi-electrode probe geometry optimization for characterization of magnetic tunnel junction stacks

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Silicon Microtechnology, Experimental Surface and Nanomaterials Physics, Nanocarbon
Authors: Cagliani, A. (Intern), Kjær, D. (Intern), Østerberg, F. W. (Intern), Hansen, O. (Intern), Nielsen, P. F. (Intern), Petersen, D. H. (Intern)
Multi-electrode probe optimization for characterization of magnetic tunnel junction stacks

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Capres A/S
Authors: Cagliani, A. (Intern), Kjær, D. (Intern), Østerberg, F. W. (Intern), Hansen, O. (Intern), Nielsen, P. F. (Ekstern), Petersen, D. H. (Intern)
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Multimaterial hydrogel with widely tunable elasticity by selective photopolymerization of PEG diacrylate and epoxy monomers

General information
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Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Polymer Microsystems for Cell Processing
Authors: Larsen, E. K. U. (Intern), Larsen, N. B. (Intern), Almdal, K. (Intern)
Pages: 1195–1201
Publication date: 2016
Main Research Area: Technical/natural sciences

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Journal: Journal of Polymer Science. Part B, Polymer Physics
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.88 SJR 0.837
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.12 SJR 1.067 SNIP 0.97
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.235 SNIP 1.117 CiteScore 3.4
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.503 SNIP 1.412 CiteScore 3.91
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.185 SNIP 1.3 CiteScore 3
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Multiplexed Dosing Assays by Digitally Definable Hydrogel Volumes

Stable and low-cost multiplexed drug sensitivity assays using small volumes of cells or tissue are in demand for personalized medicine, including patientspecific combination chemotherapy. Spatially defined projected light photopolymerization of hydrogels with embedded active compounds is introduced as a flexible and cost-efficient method for producing multiplexed dosing assays. The high spatial resolution of light projector technology defines multiple compound doses by the volume of individual compound-embedded hydrogel segments. Quantitative dosing of multiple proteins with a dynamic range of 1–2 orders of magnitude is demonstrated using fluorescently labeled albumins. The hydrogel matrix results from photopolymerization of low-cost poly(ethylene glycol) diacrylates (PEGDA), and tuning of the PEGDA composition enables fast complete dosing of all tested species. Dosing of hydrophilic and hydrophobic compounds is demonstrated using two first-line chemotherapy regimens combining oxaliplatin, SN-38, 5-fluorouracil, and folic acid, with each compound being dosed from a separate light-defined hydrogel segment. Cytotoxicity studies using a colorectal cancer cell line show equivalent effects of dissolved and released compounds. Further control of the dosing process is demonstrated by liposomal encapsulation of oxaliplatin, stable embedding of the liposomes in hydrogels for more than 3 months, and heat-triggered complete release of the loaded oxaliplatin.
Multi-scale magnetic nanoparticle based optomagnetic bioassay for sensitive DNA and bacteria detection

Benefiting from their rapid readout, highly flexible devices and low-cost portable systems, optomagnetic biosensors have drawn increased attention in recent years as bioassay technologies for small molecules, biomarkers, DNA, and bacteria. Herein, an optomagnetic bioassay strategy suitable for point-of-care diagnostics, utilizing functionalized magnetic nanoparticles (100 nm) with Brownian relaxation behavior is optimized in order to obtain higher detection sensitivity for DNA molecules and bacteria. Presence of target DNA sequences or bacteria changes the dynamic behavior of the magnetic nanoparticles (binding to the target) and thus the optomagnetic response of the sample, which is measured by an optomagnetic setup including a 405 nm laser and a photodetector. The limit of detection is mainly set by the lowest measurable concentration of magnetic nanoparticles. Herein, as new results compared to previous work, we systematically optimize the concentration of 100 nm magnetic nanoparticles to increase the assay sensitivity and lower the limit of detection. To enable biple detection, we perform this optimization in the presence of larger 250 nm magnetic nanoparticles that do not interact with the target. We show that the optimization and lowering of the 100 nm magnetic nanoparticle concentration result in a limit of detection of 780 fM of DNA coils formed by rolling circle amplification (size of about 1 μm) and 10^5 CFU per mL Salmonella (for immunoassay). These values are 15 times lower than those reported previously for this readout principle. Finally, we show that the 250 nm magnetic nanoparticles can serve as a second detection label for qualitative biple detection of DNA coils formed by rolling circle amplification from V. cholerae and E. coli DNA coils using 100 nm and 250 nm magnetic detection nanoparticles, respectively.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Uppsala University
Authors: Tian, B. (Ekstern), Zardán Gómez De La Torre, T. (Ekstern), Donolato, M. (Intern), Hansen, M. F. (Intern), Svedlindh, P. (Ekstern), Strömberg, M. (Ekstern)
Number of pages: 8
Pages: 5009-5016
Publication date: 2016
Main Research Area: Technical/natural sciences
Lung deposition of multi-walled carbon nanotubes (MWCNT) induces pulmonary toxicity. Commercial MWCNT vary greatly in physicochemical properties and consequently in biological effects. To identify determinants of MWCNT-induced toxicity, we analyzed the effects of pulmonary exposure to 10 commercial MWCNT (supplied in three groups of different dimensions, with one pristine and two/three surface modified in each group). We characterized morphology, chemical composition, surface area and functionalization levels. MWCNT were deposited in lungs of female C57BL/6J mice by intratracheal instillation of 0, 6, 18 or 54g/mouse. Pulmonary inflammation (neutrophil influx in bronchoalveolar lavage (BAL)) and genotoxicity were determined on day 1, 28 or 92. Histopathology of the lungs was performed on day 28 and 92. All MWCNT induced similar histological changes. Lymphocytic aggregates were detected for all MWCNT on day 28 and 92. Using adjusted, multiple regression analyses, inflammation and genotoxicity were related to dose, time and physicochemical properties. The specific surface area (BET) was identified as a positive predictor of pulmonary inflammation on all post-exposure days. In addition, length significantly predicted pulmonary inflammation, whereas surface oxidation (-OH and -COOH) was predictor of lowered inflammation on day 28. BET surface area, and therefore diameter, significantly predicted genotoxicity in BAL fluid cells and lung tissue such that lower BET surface area or correspondingly larger diameter was associated with increased genotoxicity. This study provides information on possible
toxicity-driving physicochemical properties of MWCNT. The results may contribute to safe-by-design manufacturing of MWCNT, thereby minimizing adverse effects.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment, National Institute of Occupational Health, Finnish Institute of Occupational Health
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Web of Science (2016): Indexed yes
Scopus rating (2016): CiteScore 5.8
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 7.14
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.92
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.39
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 6.49
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 4.77
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Web of Science (2007): Indexed yes
Original language: English
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Publication: Research - peer-review › Journal article – Annual report year: 2016
Nanomechanical IR spectroscopy for fast analysis of liquid-dispersed engineered nanomaterials

The proliferated use of engineered nanomaterials (ENMs), e.g. in nanomedicine, calls for novel techniques allowing for fast and sensitive analysis of minute samples. Here we present nanomechanical IR spectroscopy (NAM-IR) for chemical analysis of picograms of ENMs. ENMs are nebulized directly from dispersion and efficiently collected on nanomechanical string resonators through a non-diffusion limited sampling method. Even very small amounts of sample can convert absorbed IR light into a measurable frequency detuning of the string through photothermal heating. An IR absorption spectrum is thus readily obtained by recording this detuning of the resonator over a range of IR wavelengths. Results recorded using NAM-IR agree well with corresponding results obtained through ATR-FTIR, and remarkably, measurement including sample preparation takes only a few minutes, compared to ~2 days sample preparation for ATR-FTIR. Resonator dimensions play an important role in NAM-IR, a relationship which will be elaborated here.
Nanomechanical Pyrolytic Carbon Resonators: Novel Fabrication Method and Characterization of Mechanical Properties

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Technical University of Denmark
Authors: Kurek, M. (Intern), Larsen, F. K. (Ekstern), Larsen, P. E. (Intern), Schmid, S. (Intern), Boisen, A. (Intern), Keller, S. S. (Intern)
Number of pages: 11
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Main Research Area: Technical/natural sciences

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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.647 SNIP 1.643 CiteScore 2.21
Nanomedicines for renal disease: current status and future applications

Treatment and management of kidney disease currently presents an enormous global burden, and the application of nanotechnology principles to renal disease therapy, although still at an early stage, has profound transformative potential. The increasing translation of nanomedicines to the clinic, alongside research efforts in tissue regeneration and organ-on-a-chip investigations, are likely to provide novel solutions to treat kidney diseases. Our understanding of renal anatomy and of how the biological and physico-chemical properties of nanomedicines (the combination of a nanocarrier and a drug) influence their interactions with renal tissues has improved dramatically. Tailoring of nanomedicines in terms of kidney retention and binding to key membranes and cell populations associated with renal diseases is now possible and greatly enhances their localization, tolerability, and efficacy. This Review outlines nanomedicine characteristics central to improved targeting of renal cells and highlights the prospects, challenges, and opportunities of nanotechnology-mediated therapies for renal diseases.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Harvard Medical School, Icahn School of Medicine at Mount Sinai (ISMMS)
We report a facile synthesis of a novel cobalt oxide (Co$_3$O$_4$) hierarchical nanostructure, in which crystalline core-amorphous shell Co$_3$O$_4$ nanoparticles with a bimodal size distribution are uniformly dispersed on ultrathin Co$_3$O$_4$ nanosheets. When tested as anode materials for lithium ion batteries, the as-prepared Co$_3$O$_4$ hierarchical electrodes delivered high lithium storage properties comparing to the other Co$_3$O$_4$ nanostructures, including a high reversible capacity of 1053.1 mAh$^{-1}$ after 50 cycles at a current density of 0.2C (1 C = 890 mAh$^{-1}$), good cycling stability and rate capability.
Nano-risk Science: application of toxicogenomics in an adverse outcome pathway framework for risk assessment of multi-walled carbon nanotubes

Background: A diverse class of engineered nanomaterials (ENMs) exhibiting a wide array of physical-chemical properties that are associated with toxicological effects in experimental animals is in commercial use. However, an integrated framework for human health risk assessment (HHRA) of ENMs has yet to be established. Rodent 2-year cancer bioassays, clinical chemistry, and histopathological endpoints are still considered the ‘gold standard’ for detecting substance-induced toxicity in animal models. However, the use of data derived from alternative toxicological tools, such as genome-wide expression profiling and in vitro high-throughput assays, are gaining acceptance by the regulatory community for hazard identification and for understanding the underlying mode-of-action. Here, we conducted a case study to evaluate the application of global gene expression data in deriving pathway-based points of departure (PODs) for multi-walled carbon nanotube (MWCNT)-induced lung fibrosis, a non-cancer endpoint of regulatory importance.

Methods: Gene expression profiles from the lungs of mice exposed to three individual MWCNTs with different physical-chemical properties were used within the framework of an adverse outcome pathway (AOP) for lung fibrosis to identify key biological events linking MWCNT exposure to lung fibrosis. Significantly perturbed pathways were categorized along the
key events described in the AOP. Benchmark doses (BMDs) were calculated for each perturbed pathway and were used to derive transcriptional BMDs for each MWCNT.

Results: Similar biological pathways were perturbed by the different MWCNT types across the doses and post-exposure time points studied. The pathway BMD values showed a time-dependent trend, with lower BMDs for pathways perturbed at the earlier post-exposure time points (24 h, 3d). The transcriptional BMDs were compared to the apical BMDs derived by the National Institute for Occupational Safety and Health (NIOSH) using alveolar septal thickness and fibrotic lesions endpoints. We found that regardless of the type of MWCNT, the BMD values for pathways associated with fibrosis were 14.0-30.4 μg/mouse, which are comparable to the BMDs derived by NIOSH for MWCNT-induced lung fibrotic lesions (21.0-27.1 μg/mouse).

Conclusions: The results demonstrate that transcriptomic data can be used to as an effective mechanism-based method to derive acceptable levels of exposure to nanomaterials in product development when epidemiological data are unavailable.
The use of nanoscale zero-valent iron (nZVI) has quickly become a leading research material for the treatment of typically hard to degrade contaminants found in groundwater. These contaminants include antibiotics, pesticides, halogenated organics, heavy metals, among others. However, the effectiveness of nZVI has its limitations, due to its high reactivity and subsequent loss of degradative ability. Therefore, nZVI must be stabilized in a matrix allowing for the maintaining of reactivity, as well as protection from the effects of the surrounding environment.

By employing a nanoporous polymeric network already previously proven to stabilize nZVI and a long-standing water treatment material, activated carbon; we have developed an advanced material that allows for the not only stabilization of nZVI, but also the improved degradation of various water contaminants. This was done by performing a series of surface modification techniques to the surface of the activated carbon, then physically grafting the covalent organic polymer to the carbon in a shell-like manner, and ultimately synthesizing nZVI in situ within the pores of both the activated carbon and the polymeric network. Not only does this enhanced version of activated carbon utilize the outstanding adsorptive properties of both activated carbon and the polymeric network, but it also employs the degradation capability of nZVI. In this way, a new breed of materials is being developed, working in a synergistic manner for the purpose of the remediation of contaminants found in the groundwater.

We confirmed the existence of the polymeric shell with a variety of chemical characterization techniques; including Fourier transform infrared spectroscopy (FTIR), elemental analysis, X-ray photoelectron spectroscopy (XPS), transmission electron microscopy (TEM), and scanning electron microscopy (SEM). We also monitored the degradation and/or adsorption of various contaminants (e.g. chlorinated organics like trichloroethylene and trichloroethane, and heavy metals like cadmium and nickel) to produce the kinetics of the interactions.
Nanostructuring of Solar Cell Surfaces

Solar energy is by far the most abundant renewable energy source available, but the levelized cost of solar energy is still not competitive with that of fossil fuels. Therefore there is a need to improve the power conversion efficiency of solar cells without adding to the production cost.

The main objective of this PhD thesis is to develop nanostructured silicon (Si) solar cells with higher power conversion efficiency using only scalable and cost-efficient production methods. The nanostructures, known as 'black silicon', are fabricated by single-step, maskless reactive ion etching and used as front texturing of different Si solar cells. Theoretically the nanostructure topology may be described as a graded refractive index in a mean-field approximation between air and Si. The optical properties of the developed black Si were simulated and experimentally measured. Total AM1.5G-weighted average reflectance well below 1% was measured for different crystalline grades of Si. Furthermore, the reflectance of RIE-textured Si remains below that of KOH-textured Si at all incident angles below 70°. RIE- and conventionally textured, screen-printed Si solar cells were fabricated on 156x156 mm² CZ Si wafers and characterized for comparison. Power conversion efficiency of 16.5% was obtained for this batch of RIE-textured Si solar cells. The efficiency of the KOH-textured reference cell was 17.8%. Quantum Efficiency measurements and carrier loss analysis show that the lower efficiency of the RIE-textured cells is primarily due to increased emitter and surface recombination. The large-area screen-printed solar cells were furthermore characterized at varying incident angles. The angle-dependent analysis shows that RIE-textured cells have a higher normalized power output averaged over the range of incident angles between 0 and 90°. This result indicates the potential of improved cell performance and higher output power at diffuse light conditions and during daily and yearly operation. A second batch of RIE-textured solar cells with laser-doped selective emitters (LDSE) was fabricated. A power conversion efficiency of 18.1% and a fill factor of 80.1% were obtained by laser doping and subsequent Ni/Cu plating in combination with RIE-texturing. This result shows the potential of improved efficiency of RIE-textured compared to conventionally textured cells, especially when laser doping on black Si is combined with improved surface passivation schemes such as atomic layer deposition (ALD) of Al₂O₃. ALD Al₂O₃ passivation on black Si yields surface recombination velocity (SRV) below 80 cm/s and implied open-circuit voltage (iVOC) of 680 mV. Surface recombination velocity of 20 cm/s and implied open-circuit voltage of 695 mV is obtained for black Si passivated by doped poly-Si and a tunnel oxide.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Experimental Surface and Nanomaterials Physics, Nanoprobes
Authors: Davidsen, R. S. (Intern), Hansen, O. (Intern), Boisen, A. (Intern), Schmidt, M. S. (Intern)
Number of pages: 236
Publication date: 2016

Nanotextured surfaces with enhanced optical and thermodynamic properties fabricated by maskless reactive ion etching methods

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering
Authors: Taboryski, R. J. (Intern)
Publication date: 2016
Event: Abstract from 3rd International Conference on Self Assembly and Molecular Electronics, Aalborg, Denmark.
Main Research Area: Technical/natural sciences
Electronic versions:
SAME2016_Abstract_Taboryski_final.pdf
Source: PublicationPreSubmission
Source-ID: 127743574
Publication: Research › Conference abstract for conference – Annual report year: 2016
Nematic effects and strain coupling in entangled polymer melts under strong flow

We use small-angle neutron scattering (SANS) to study labeled short chains with and without the influence of an entangled and highly stretched surrounding environment of longer chains. We find unequivocal evidence of nematic effects as the blend chains in steady state flow are stretched a factor ~1.5 more from the presence of the long chain nematic field. In the pure melt we confirm that the nonaffine mean-field result \( v = 0.5 \) for the strain coupling is still valid for very fast flows, while in the nematic system our analysis predicts an increased coupling constant. We provide a structural explanation for the two first regimes of the nonlinear relaxation, particularly a transition regime where the long chains are relaxing in a sea of reptating short chains.
New technologies for DNA analysis: a review of the READNA Project

The REvolutionary Approaches and Devices for Nucleic Acid analysis (READNA) project received funding from the European Commission for 4 1/2 years. The objectives of the project revolved around technological developments in nucleic acid analysis. The project partners have discovered, created and developed a huge body of insights into nucleic acid analysis, ranging from improvements and implementation of current technologies to the most promising sequencing technologies that constitute a 3rd and 4th generation of sequencing methods with nanopores and in situ sequencing, respectively.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Stochastic Systems and Signals, Centre National de Génotypage, University of Oxford, Comprehensive Biomarker Center GmbH, Damietta University, Clarendon Laboratory, Uppsala University, Christian Albrechts University, Olink AB, University of Leicester, Chalmers University of Technology, Universitat Pompeu Fabra, Stockholm University, Max Planck Institute for Molecular Genetics, FlexGen BV, CEA Saclay, Oxford Nanopore Technologies, Lund University, Philips Research, PHOTONIS France S.A.S., Thermo Fisher Scientific, Delft University of Technology, University of Southampton, University of Gothenburg

Number of pages: 20
Pages: 311-330
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: New Biotechnology
Volume: 33
Issue number: 3
ISSN (Print): 1871-6784
Ratings:
BFI (2018): BFI-level 1
Noble metal nanoparticle-functionalized ZnO nanoflowers for photocatalytic degradation of RhB dye and electrochemical sensing of hydrogen peroxide

Flower-like hierarchical Zinc oxide nanostructures synthesized by co-precipitation method have been hydrothermally functionalized with 8 nm Au NPs and 15 nm Ag nanoparticles. The photocatalytic and electrochemical performance of these structures are investigated. XPS studies show that the composite exhibits a strong interaction between noble metal nanoparticles (NPs) and Zinc oxide nanoflowers. The PL spectra exhibit UV emission arising due to near band edge transition and show that the reduced PL intensities of Au–ZnO and Ag–ZnO composites are responsible for improved photocatalytic activity arising due to increase in defects. Moreover, the presence of Au NPs on ZnO surface remarkably enhances photocatalytic activity as compared to Ag–ZnO and pure ZnO due to the higher catalytic activity and stability of Au NPs. On the other hand, Ag–ZnO-modified glassy carbon electrode shows good amperometric response to hydrogen peroxide (H₂O₂), with linear range from 1 to 20 μM, and detection limit of 2.5 μM.
(S/N = 3). The sensor shows high and reproducible sensitivity of 50.8 μA cm⁻² μM⁻¹ with a fast response less than 3 s and good stability as compared to pure ZnO and Au–ZnO-based sensors. All these results show that noble metal NPs functionalized ZnO base nanocomposites exhibit great prospects for developing efficient non-enzymatic biosensor and environmental remediators.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Pakistan Institute of Nuclear Science and Technology, University of the Punjab
Authors: Hussain, M. (Ekstern), Sun, H. (Intern), Karim, S. (Ekstern), Nisar, A. (Ekstern), Khan, M. (Ekstern), ul Haq, A. (Ekstern), Iqbal, M. (Ekstern), Ahmad, M. (Ekstern)
Number of pages: 14
Pages: 1-14
Publication date: 2016
Main Research Area: Technical/natural sciences

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Volume: 18
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- BFI (2018): BFI-level 1
- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 1
- Scopus rating (2017): SNIP 0.603 SJR 0.528
- Web of Science (2017): Indexed yes
- BFI (2016): BFI-level 1
- Scopus rating (2016): CiteScore 1.74 SJR 0.496 SNIP 0.557
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 1
- Scopus rating (2015): SJR 0.568 SNIP 0.696 CiteScore 1.97
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 1
- Scopus rating (2014): SJR 0.672 SNIP 0.861 CiteScore 2.17
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 1
- Scopus rating (2013): SJR 0.753 SNIP 1.01 CiteScore 2.54
- ISI indexed (2013): ISI indexed yes
- BFI (2012): BFI-level 1
- Scopus rating (2012): SJR 0.855 SNIP 1.024 CiteScore 2.56
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 1
- Scopus rating (2011): SJR 1.092 SNIP 1.437 CiteScore 3.52
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 1
- Scopus rating (2010): SJR 0.974 SNIP 1.242
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 1
- Scopus rating (2009): SJR 0.979 SNIP 1.055
- Web of Science (2009): Indexed yes
- BFI (2008): BFI-level 1
- Scopus rating (2008): SJR 0.991 SNIP 1.124
- Scopus rating (2007): SJR 0.882 SNIP 1.089
- Scopus rating (2006): SJR 0.869 SNIP 1.267
No cytotoxicity or genotoxicity of graphene and graphene oxide in murine lung epithelial FE1 cells in vitro

Graphene and graphene oxide receive much attention these years, because they add attractive properties to a wide range of applications and products. Several studies have shown toxicological effects of other carbon-based nanomaterials such as carbon black nanoparticles and carbon nanotubes in vitro and in vivo. Here, we report in-depth physicochemical characterization of three commercial graphene materials, one graphene oxide (GO) and two reduced graphene oxides (rGO) and assess cytotoxicity and genotoxicity in the murine lung epithelial cell line FE1. The studied GO and rGO mainly consisted of 2–3 graphene layers with lateral sizes of 1–2 µm. GO had almost equimolar content of C, O, and H while the two rGO materials had lower contents of oxygen with C/O and C/H ratios of 8 and 12.8, respectively. All materials had low levels of endotoxin and low levels of inorganic impurities, which were mainly sulphur, manganese, and silicon. GO generated more ROS than the two rGO materials, but none of the graphene materials influenced cytotoxicity in terms of cell viability and cell proliferation after 24 hr. Furthermore, no genotoxicity was observed using the alkaline comet assay following 3 or 24 hr of exposure. We demonstrate that chemically pure, few-layered GO and rGO with comparable lateral size (> 1 µm) do not induce significant cytotoxicity or genotoxicity in FE1 cells at relatively high doses (5–200 µg/ml).


General information
State: Published
Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment, Graphenea S.A., Grenoble-Alpes University
Number of pages: 14
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Publication date: 2016
Main Research Area: Technical/natural sciences

Publication Information
Journal: Environmental and Molecular Mutagenesis
Volume: 57
Issue number: 6
ISSN (Print): 0893-6692
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.858 SJR 1.119
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.49 SJR 1.51 SNIP 0.987
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.339 SNIP 0.914 CiteScore 3.01
Web of Science (2015): Indexed yes
Nonclassical effects in plasmonics: an energy perspective to quantify nonclassical effects

Plasmons are commonly interpreted with classical electrodynamics, while nonclassical effects may influence the dynamics of plasmon resonances as the plasmon confinement approaches the few-nanometer scale. However, an unambiguous approach to quantify the degree of nonclassical dynamics remains. We propose a nonclassical-impact parameter (NCI) to characterize the degree of nonclassical effects from an energy perspective, i.e., which fraction of the total electromagnetic energy is attributed to classical electrodynamic terms and which fraction is correspondingly to be assigned to nonclassical degrees of freedom? We show that the NCI relates directly to two fundamental parameters of plasmon resonances: the loss function and the quality factor. Guided by the NCI, we discuss the nonclassical effects of plasmon waveguiding modes of metallic slab waveguides, and highlight the general features of the nonclassical effects at different microscopic levels by contrasting the numerical results from the semiclassical hydrodynamic Drude model (HDM) and the microscopic random-phase approximation (RPA). The formal relation between the HDM and the RPA is also established for metals by exploring the limit of an infinite work function.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Photonics Engineering, Structured Electromagnetic Materials, Department of Micro- and Nanotechnology
Authors: Yan, W. (Intern), Mortensen, N. A. (Intern)
Publication date: 2016
Non-destructive integration of graphene for organic light emitting devices

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, Department of Photonics Engineering, Ultrafast Infrared and Terahertz Science
Authors: Whelan, P. R. (Intern), Booth, T. (Intern), Jepsen, P. U. (Intern), Bøggild, P. (Intern)
Number of pages: 1
Publication date: 2016
Main Research Area: Technical/natural sciences
Links: http://www.sustain.dtu.dk/

Bibliographical note
Sustain Abstract M-8
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Nonlinear optomechanical measurement of mechanical motion
Precision measurement of nonlinear observables is an important goal in all facets of quantum optics. This allows measurement-based non-classical state preparation, which has been applied to great success in various physical systems, and provides a route for quantum information processing with otherwise linear interactions. In cavity optomechanics much progress has been made using linear interactions and measurement, but observation of nonlinear mechanical degrees-of-freedom remains outstanding. Here we report the observation of displacement-squared thermal motion of a micro-mechanical resonator by exploiting the intrinsic nonlinearity of the radiation-pressure interaction. Using this measurement we generate bimodal mechanical states of motion with separations and feature sizes well below 100 pm. Future improvements to this approach will allow the preparation of quantum superposition states, which can be used to experimentally explore collapse models of the wavefunction and the potential for mechanical-resonator-based quantum information and metrology applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Technical University of Denmark, University of Queensland
Authors: Brawley, G. (Ekstern), Vanner, M. R. (Ekstern), Larsen, P. E. (Intern), Schmid, S. (Intern), Boisen, A. (Intern), Bowen, W. (Ekstern)
Number of pages: 7
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Main Research Area: Technical/natural sciences

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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 2.912 SJR 6.582
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 11.8 SJR 6.414 SNIP 2.855
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 6.287 SNIP 2.86 CiteScore 11.23
Non-resonant dynamic stark control of vibrational motion with optimized laser pulses

The term dynamic Stark control (DSC) has been used to describe methods of quantum control related to the dynamic Stark effect, i.e., a time-dependent distortion of energy levels. Here, we employ analytical models that present clear and concise interpretations of the principles behind DSC. Within a linearly forced harmonic oscillator model of vibrational excitation, we show how the vibrational amplitude is related to the pulse envelope, and independent of the carrier frequency of the laser pulse, in the DSC regime. Furthermore, we shed light on the DSC regarding the construction of optimal pulse envelopes - from a time-domain as well as a frequency-domain perspective. Finally, in a numerical study beyond the linearly forced harmonic oscillator model, we show that a pulse envelope can be constructed such that a vibrational excitation into a specific excited vibrational eigenstate is accomplished. The pulse envelope is constructed such that high intensities are avoided in order to eliminate the process of ionization.

General information
State: Published
Organisations: Department of Chemistry, Department of Micro- and Nanotechnology
Authors: Thomas, E. F. (Intern), Henriksen, N. E. (Intern)
Number of pages: 10
Publication date: 2016
Main Research Area: Technical/natural sciences

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Journal: Journal of Chemical Physics
Volume: 144
Article number: 244307
ISSN (Print): 0021-9606
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 0.926 SJR 1.252
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.13 SJR 1.486 SNIP 0.964
Web of Science (2016): Indexed yes
Novel micro-reactor flow cell for investigation of model catalysts using in situ grazing-incidence X-ray scattering

The design, fabrication and performance of a novel and highly sensitive micro-reactor device for performing in situ grazing-incidence X-ray scattering experiments of model catalyst systems is presented. The design of the reaction chamber, etched in silicon on insulator (SOI), permits grazing-incidence small-angle X-ray scattering (GISAXS) in transmission through 10 µm-thick entrance and exit windows by using micro-focused beams. An additional thinning of the Pyrex glass reactor lid allows simultaneous acquisition of the grazing-incidence wide-angle X-ray scattering (GIWAXS). In situ experiments at synchrotron facilities are performed utilizing the micro-reactor and a designed transportable gas feed and analysis system. The feasibility of simultaneous in situ GISAXS/GIWAXS experiments in the novel micro-reactor flow cell was confirmed with CO oxidation over mass-selected Ru nanoparticles.

General information
State: Published
Organisations: Department of Physics, Neutrons and X-rays for Materials Physics, Center for Individual Nanoparticle Functionality, Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Energy Conversion and Storage, Imaging and Structural Analysis, Experimental Surface and Nanomaterials Physics, Paul Scherrer Institut
Number of pages: 9
Pages: 455-463
Publication date: 2016
Main Research Area: Technical/natural sciences

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Journal: Journal of Synchrotron Radiation
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.431 SJR 1.65
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.86 SJR 1.521 SNIP 1.491
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.146 SNIP 1.301 CiteScore 2.45
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.317 SNIP 1.477 CiteScore 2.58
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.476 SNIP 1.676 CiteScore 2.91
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.465 SNIP 1.261 CiteScore 2.36
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.736 SNIP 1.403 CiteScore 2.45
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.629 SNIP 1.466
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.507 SNIP 1.386
Web of Science (2009): Indexed yes
On-chip RF-to-optical transducer

Recent advances in the fabrication of nano- and micromechanical elements enable the realization of high-quality mechanical resonators with masses so small that the forces from optical photons can have a significant impact on their motion. This facilitates a strong interaction between mechanical motion and light, or phonons and photons. This interaction is the cornerstone of the field of optomechanics and allows, for example, for ultrasensitive detection and manipulation of mechanical motion using laser light. Remarkably, today these techniques can be extended into the quantum regime, in which fundamental fluctuations of light and mechanics govern the system's behavior. Micromechanical elements can also interact strongly with other physical systems, which is the central aspect of many micro-electro-mechanical based sensors. Micromechanical elements can therefore act as a bridge between these diverse systems, plus technologies that utilize them, and the mature toolbox of optical techniques that routinely operates at the quantum limit.

In a previous work [1], we demonstrated such a bridge by realizing simultaneous coupling between an electronic LC circuit and a quantum-noise limited optical interferometer. The coupling was mediated by a mechanical oscillator forming a mechanically compliant capacitor biased with a DC voltage. The latter enhances the electromechanical interaction all the way to the strong coupling regime. That scheme allowed optical detection of electronic signals with effective noise temperatures far below the actual temperature of the mechanical element. On-chip integration of the electrical, mechanical and optical elements is necessary for an implementation of the transduction scheme that is viable for commercial applications. Reliable assembly of a strongly coupled electromechanical device, and inclusion of an optical cavity for enhanced optical readout, are key features of the new platform. Both can be achieved with standard cleanroom fabrication techniques. We will furthermore present ongoing work to couple our transducer to an RF or microwave antenna, for low-noise detection of electromagnetic signals, including sensitive measurements of magnetic fields in an MRI detector.

Suppression of thermomechanical noise is a key feature of electro-optomechanical transducers, and, more generally, hybrid systems involving mechanical degrees of freedom. We have shown that engineering of the phononic density of states allows improved isolation of the relevant mechanical modes from their thermal bath [2], enabling coherence times sufficient to realize quantum-coherent optomechanical coupling. This proves the potential of the employed platform for complex transducers all the way into the quantum regime.
One-pot hydrothermal synthesis of hollow Fe$_3$O$_4$ microspheres assembled with nanoparticles for lithium-ion battery anodes

Hollow Fe$_3$O$_4$ microspheres assembled with nanoparticles were successfully synthesized without the addition of any templates or subsequent treatments. When used as the anode materials for lithium-ion battery (LIB), the products showed good lithium storage properties, demonstrating their promising applications for advanced LIB.
One-step Maskless Fabrication and Optical Characterization of Silicon Surfaces with Antireflective Properties and a White Color Appearance

We report a simple one-step maskless fabrication of inverted pyramids on silicon wafers by reactive ion etching. The fabricated surface structures exhibit excellent anti-reflective properties: The total reflectance of the nano inverted pyramids fabricated by our method can be as low as 12% without any anti-reflective layers, and down to only 0.33% with a silicon nitride coating. The results from angle resolved scattering measurements indicate that the existence of triple reflections is responsible for the reduced reflectance. The surfaces with the nano inverted pyramids also exhibit a distinct milky white color.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Danish Fundamental Metrology
Authors: Sun, L. (Intern), Feidenhansl', N. A. (Intern), Telecka, A. (Intern), Taboryski, R. J. (Intern)
Number of pages: 6
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Main Research Area: Technical/natural sciences

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Journal: Scientific Reports
Volume: 6
Article number: 35183
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.245 SJR 1.533
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.63 SJR 1.692 SNIP 1.354
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.034 SNIP 1.597 CiteScore 5.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.163 SNIP 1.554 CiteScore 4.75
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.998 SNIP 1.57 CiteScore 4.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.531 SNIP 0.962 CiteScore 2.44
ISI indexed (2012): ISI indexed yes
On performance limitations and property correlations of Al-doped ZnO deposited by radio-frequency sputtering: Paper

The electrical properties of RF-sputtered Al-doped ZnO are often spatially inhomogeneous and strongly dependent on deposition parameters. In this work, we study the mechanisms that limit the minimum resistivity achievable under different deposition regimes. In a low- and intermediate-pressure regime, we find a generalized dependence of the electrical properties, grain size, texture, and Al content on compressive stress, regardless of sputtering pressure or position on the substrate. In a high-pressure regime, a porous microstructure limits the achievable resistivity and causes it to increase over time as well. The primary cause of inhomogeneity in the electrical properties is identified as energetic particle bombardment. Inhomogeneity in oxygen content is also observed, but its effect on the electrical properties is small and limited to the carrier mobility.
On The Role of Wetting, Structure Width, and Flow Characteristics in Polymer Replication on Micro- and Nanoscale

The replication of functional polymeric micro- and nanostructures requires a deep understanding of material and process interrelations. In this investigation the dewetting potential of a polymer is proposed as a simple rationale for estimation of the replicability of functional micro- and nanostructures by injection molding. The dewetting potential of a polymer is determined by integrating the spreading coefficient over the range from melt temperature to no-flow temperature. From all polymers tested, the lowest dewetting potential is calculated for PP and the highest for polymethylmethacrylate. The dewetting potential correlates well with the replicated height of four different structures covering both the micro- and the nanorange on two different surfaces (brass and fluorocarbon modified nickel) and polymers with different spreading coefficients. It is clearly shown that a lower dewetting potential of a polymer leads to a better replication accuracy. Additionally a parabolic relationship is demonstrated between filled height and structure width.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, University of Applied Sciences and Arts Northwestern Switzerland, Technical University of Dortmund, Paul Scherrer Institut
Optical Characterization of Nanostructured Surfaces

Micro- and nanostructured surfaces are interesting due to the unique properties they add to the bulk material. One example is structural colors, where the interaction between surface structures and visible light produce bright color effects without the use of paints or dyes. Several research groups are investigating the manufacturing of these structures using established high-volume polymer fabrication methods, such as injection molding and roll-to-roll manufacturing. These methods are interesting as they can ease the industrial uptake of nanopatterning technology. However, for a successful industrial implementation, a range of complementing characterization methods is needed to perform high-speed quality control of the nanostructures.

This thesis concerns the development of a new method for fast in-line characterization of periodic nanostructures. The focus is on optical scatterometry, which uses inverse modeling to evaluate the dimensions of subwavelength gratings, by correlating the reflected light measured from the structures with a database of simulations. A new method is developed and termed color scatterometry, since compared to typical spectroscopic scatterometry, which evaluates the full reflection spectrum; the new method only evaluates the color of the reflected light using a standard RGB color camera. Color scatterometry provides the combined advantages of spectroscopic scatterometry, which provides fast evaluations, and imaging scatterometry that provides an overview image from which small regions can be analyzed independently. With color scatterometry, a single exposure with the camera is sufficient to evaluate the grating profile for thousands of individual regions spanning a millimeter-sized area. The accuracy of color scatterometry is evaluated on injection molded polymer line gratings, with trapezoidal profiles approximately ~200 nm high and with periods between 600 nm and 5000 nm. The heights and filling factors are determined with an accuracy of ~8 %, while the sidewall slopes have larger uncertainties due to a lower influence on the reflected light.

The thesis also evaluates the use of angular scatterometry for characterization of nanoscale surface roughness. This study is motivated by the need for highly polished surfaces for the production of master molds in injection molding and roll-to-roll manufacturing. Three characterization instruments are compared: a confocal optical profiler, a high-resolution laboratory scatterometer, and a simple commercial scatterometer designed for in-machine measurements. The study is focused on characterizing the commercial scatterometer, to support the implementation of in-situ roughness evaluation during polishing processes. We present an algorithm for expanding the length scale of evaluated surface structures, and a method for converting the standard output parameter, “Aq”, to the more widely used root-mean-square roughness parameter (Rq). The study also includes a detailed analysis of the range of spatial surface wavelengths correctly evaluated by each instrument, and a small study of the implications if the sample surface is covered with an interface layer, e.g. a thin liquid film.

For roughness evaluation on hard-to-reach surfaces, the thesis includes a study of surface replication using the thermosetting polymer PDMS.
Optical sensors from electrohydrodynamic jetted polymer fiber resonators

Electrohydrodynamic jetting is used to manufacture dye-doped polymer fiber resonators. We present comb-like laser emission from different polymer/dye combinations and report the use of these structures as sensitive detection of ethanol and methanol.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, National Food Institute, Research Group for Nano-Bio Science, Center for Nanostructured Graphene, Karlsruhe Institute of Technology KIT
Authors: Laye, F. (Ekstern), Kraemmer, S. (Ekstern), Castillo, A. (Ekstern), Friedrich, F. (Ekstern), Vannahme, C. (Intern), Smith, C. (Intern), Mendes, A. C. L. (Intern), Chronakis, I. S. (Intern), Kristensen, A. (Intern), Lahann, J. (Ekstern), Kalt, H. (Ekstern)
Number of pages: 2
Publication date: 2016
Event: Abstract from APS March Meeting 2016, Baltimore, MD, United States.
Main Research Area: Technical/natural sciences

Optical tweezers theory near a flat surface: a pertubative method

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Universidade Federal do Rio de Janeiro
Authors: Flyvbjerg, H. (Intern), Dutra, R. D. S. (Intern), Neto, P. A. M. (Ekstern), Nussenzveig, H. M. (Ekstern)
Number of pages: 1
Publication date: 2016
Event: Abstract from APS March Meeting 2016, Baltimore, MD, United States.
Main Research Area: Technical/natural sciences
Optical two-beam trap in a polymer microfluidic chip

An optical two-beam trap, composed from two counter propagating laser beams, is an interesting setup due to the ability of the system to trap, hold, and stretch soft biological objects like vesicles or single cells. Because of this functionality, the system was also named "the optical stretcher" by Jochen Guck, Josep Käs and co-workers some 15 years ago. In a favorable setup, the two opposing laser beams meet with equal intensities in the middle of a fluidic channel in which cells may flow past, be trapped, stretched, and allowed to move on, giving the promise of a high throughput device. Yet, single beam optical traps, aka optical tweezers, by far outnumber the existing optical stretchers in research labs throughout the world. The ability to easily construct an optical stretcher setup in a low-cost material would possibly imply more frequent use of the optical stretching technique. Here, we will outline the design, the production procedures, and results obtained in a fiber-based experimental setup built within an injection molded microfluidic polymer chip. The microfluidic chip is constructed with a three layer technology in which we ensure both horizontal and vertical focusing of the cells we wish to trap, thereby preventing too many cells to flow below the line of focus of the two counter propagating laser beams that are positioned perpendicular to the direction of flow of the cells. Results will be compared to that from other designs from previous work in the group.

General information
State: Published
Organisations: Department of Physics, Biophysics and Fluids, Department of Micro- and Nanotechnology, Optofluidics, Nanoprobes, NIL Technology ApS
Authors: Palanco, M. E. (Intern), Catak, D. (Intern), Marie, R. (Intern), Matteucci, M. (Intern), Bilenberg, B. (Ekstern), Kristensen, A. (Intern), Berg-Sørensen, K. (Intern)
Number of pages: 10
Publication date: 2016

Host publication information
Title of host publication: Proceedings of SPIE 9922, Optical Trapping and Optical Micromanipulation XIII
Volume: 9922
Publisher: SPIE - International Society for Optical Engineering
Series: SPIE - International Society for Optical Engineering. Proceedings
Volume: 9922
ISSN: 0277-786X
Main Research Area: Technical/natural sciences
Optical trapping, Fiber-based optical trap, Polymer injection molding, Hydrodynamic focusing
Electronic versions:
Palanco_2016_optical_two_beam_trap_in_a_polymer_microfluidic_chip_SPIE_992213_2.pdf
DOIs:
10.1117/12.2236465
Source: FindIt
Source-ID: 2349370130
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

Optimization of Synthesis Condition for Nanoscale Zero Valent Iron Immobilization on Granular Activated Carbon
Nanoscale zero valent iron (nZVI) has been intensively studied for the treatment of a plethora of pollutants through reductive reaction, however, the nano size should be of concern when nZVI is considered for water treatment, due to difficulties in recovery. The loss of nZVI causes not only economical loss, but also potential risk to human health and environment. Thus, the immobilization onto coarse or structured support is essential. In this study, two representative processes for nZVI immobilization on granular activated carbon (GAC) were evaluated, and optimized conditions for synthesizing Fe/GAC composite were suggested. Both total iron content and Fe⁰ content can be significantly affected by preparation processes, therefore, it was important to avoid oxidation during preparation to achieve higher reduction capacity. Synthesis conditions such as reduction time and existence of intermediate drying step were investigated to improve Fe⁰ content of Fe/GAC composites. The optimal condition was two hours of NaBH4 reduction without intermediate drying process. The prepared Fe/GAC composite showed synergistic effect of the adsorption capability of the GAC and the degradation capability of the nZVI, which make this composite a very effective material for environmental remediation.

General information
Optimized SU-8 pyrolysis for fabrication of pyrolytic carbon microelectrodes

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon
Publication date: 2016
Event: Abstract from 42nd International conference on Micro and Nano Engineering, Vienna, Austria.
Main Research Area: Technical/natural sciences
Electronic versions:
AbstractMNE_final.pdf
Source: PublicationPreSubmission
Source-ID: 127227764
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Optimizing experimental parameters for tracking of diffusing particles
We describe how a single-particle tracking experiment should be designed in order for its recorded trajectories to contain the most information about a tracked particle's diffusion coefficient. The precision of estimators for the diffusion coefficient is affected by motion blur, limited photon statistics, and the length of recorded time series. We demonstrate for a particle undergoing free diffusion that precision is negligibly affected by motion blur in typical experiments, while optimizing photon counts and the number of recorded frames is the key to precision. Building on these results, we describe for a wide range of experimental scenarios how to choose experimental parameters in order to optimize the precision. Generally, one should choose quantity over quality: experiments should be designed to maximize the number of frames recorded in a time series, even if this means lower information content in individual frames.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Authors: Vestergaard, C. L. (Intern)
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Physical Review E
Volume: 94
Issue number: 2
Article number: 022401
ISSN (Print): 2470-0045
Optomagnetic biosensor system for DNA and bacteria detection based on rolling circle amplification and immunomagnetic strategies

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Uppsala University
Authors: Tian, B. (Ekstern), de la Torre, T. Z. G. (Ekstern), Donolato, M. (Intern), Hansen, M. F. (Intern), Svedlindh, P. (Ekstern), Strömberg, M. (Ekstern)
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions:
Bo_Tian_et_al_Biosensors_2016_Abstract.pdf
Source: PublicationPreSubmission
Source-ID: 127607182
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Optomagnetic studies of ph-switchable nanoparticle agglutination via triplex dna formation
Polypurine-polypyrimidine sequences found in eukaryotic genomes can fold into a triple-helical structure if the sequences exhibit mirror symmetry [1]. They have been shown to stop DNA replication in vitro and in cell cultures and play a significant role in genetic regulation. New methods are needed to investigate switching behavior of triplex DNA complexes under controlled conditions.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Ruhr-University Bochum
Authors: Minero, G. K. A. (Intern), Fock, J. (Intern), McCaskill, J. (Ekstern), Hansen, M. F. (Intern)
Number of pages: 2
Publication date: 2016
Host publication information
Title of host publication: Proceedings of Microtas 2016
Main Research Area: Technical/natural sciences
Conference: 20th International Conference on Miniaturized Systems for Chemistry and Life Sciences, Dublin, Ireland, 09/10/2016 - 09/10/2016
DNA triplex, Nanoparticle, Biosensor, pH
Electronic versions:
Minero_TAS_proceedings.pdf
Source: PublicationPreSubmission
Source-ID: 127018523
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2016

Optomagnetic studies of triplex dna nanoswitches

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Ruhr-Universität Bochum
Authors: Minero, G. K. A. (Intern), Fock, J. (Intern), McCaskill, J. S. (Ekstern), Hansen, M. F. (Intern)
Number of pages: 1
Publication date: 2016
Host publication information
Title of host publication: DNA22 Conference: Book of Abstracts
Main Research Area: Technical/natural sciences
Conference: 22nd International Conference on DNA Computing and Molecular Programming, Munich, Germany, 04/09/2016 - 04/09/2016
DNA triplex, Nanoparticle, Biosensor, pH
Electronic versions:
Final_Abstract_for_DNA_22.pdf
Source: PublicationPreSubmission
Source-ID: 125882800
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2016
Orientation of Pterin-6-Carboxylic Acid on Gold Capped Silicon Nanopillars Platforms: Surface Enhanced Raman Spectroscopy and Density Functional Theory Studies

The orientation of pterin-6-carboxylic acid on gold nanopillars was investigated by surface enhanced Raman spectroscopy and density functional theory methods. The experimentally vibrations from pterin-6-COOH free and attached to the Au surface display vibration features indicating chemical interaction of the pterin with the metal surface. The spectral feature evidenced that the pterin would adsorb on gold surface with a "lying down" configuration through the high intensity vibration of NH scissoring and rocking OH modes. The orientation study of pterins on gold nanopillars presented herein is believed to lead to new applications in biosensing field for detecting pterins of physiological importance.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Universidad Industrial de Santander, Universidad Santo Tomas, Bogota
Authors: Castillo, J. J. (Ekstern), Rozo, C. E. (Ekstern), Bertel, L. (Ekstern), Rindzevicius, T. (Intern), Mendez-Sanchez, S. C. (Ekstern), Martinez Ortega, F. (Ekstern), Boisen, A. (Intern)
Number of pages: 7
Pages: 971-977
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of the Brazilian Chemical Society
Volume: 27
Issue number: 5
ISSN (Print): 0103-5053
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.597 SJR 0.357
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.21 SJR 0.363 SNIP 0.57
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.334 SNIP 0.538 CiteScore 1.21
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.383 SNIP 0.703 CiteScore 1.25
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.398 SNIP 0.655 CiteScore 1.27
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.465 SNIP 0.717 CiteScore 1.4
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.438 SNIP 0.624 CiteScore 1.33
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.437 SNIP 0.748
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.406 SNIP 0.751
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.381 SNIP 0.72
Scopus rating (2007): SJR 0.406 SNIP 0.806
Scopus rating (2006): SJR 0.406 SNIP 0.723
Scopus rating (2005): SJR 0.377 SNIP 0.721
Scopus rating (2004): SJR 0.352 SNIP 0.728
Scopus rating (2003): SJR 0.316 SNIP 0.633
Scopus rating (2002): SJR 0.459 SNIP 0.602
Scopus rating (2001): SJR 0.266 SNIP 0.535
Scopus rating (2000): SJR 0.273 SNIP 0.394
Pair correlation analysis of Fixed Photoactivatable Analysis of Live PALM applied on the Water Channel Aquaporin -3

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Aarhus University, US National Institute of Health
Authors: Arnspang, E. (Ekstern), Sengupta, P. (Ekstern), Jensen, H. (Ekstern), Hahn, U. (Ekstern), Andersen, I. (Ekstern), Jensen, E. (Ekstern), Mortensen, K. (Intern), Lippincott-Schwartz, J. (Ekstern), Nejsum, L. (Ekstern)
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions:
abstract_ASCB_2016_4_.pdf
Source: PublicationPreSubmission
Source-ID: 140693168
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2017

Pair correlation analysis of Fixed Photoactivatable Localization Microscopy (PALM) and Powerspectral Analysis of Live PALM applied on the Water Channel Aquaporin-3

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, University of Southern Denmark, National Institutes of Health, Aarhus University
Number of pages: 2
Publication date: 2016
Main Research Area: Technical/natural sciences
Publication information
Journal: Molecular Biology of the Cell
Volume: 27
Issue number: 25
Article number: P1665
ISSN (Print): 1059-1524
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.942 SJR 2.935
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.65 SJR 2.922 SNIP 0.951
BFI (2015): BFI-level 1
Scopus rating (2015): SNIP 1.097 SJR 3.639 CiteScore 4.03
BFI (2014): BFI-level 1
Scopus rating (2014): SNIP 1.139 SJR 3.692 CiteScore 4.33
BFI (2013): BFI-level 2
Scopus rating (2013): SNIP 1.209 SJR 4.065 CiteScore 4.57
Perforated SiN membrane resonators for nanomechanical IR spectroscopy poster

Constant progress in micro- and nanofabrication provides a great opportunity in development of micro- and nanomechanical resonoatorthat can be used for sensing purposes. These sensors usually consist of singly-clamped cantilever beams, doubly-clamped bridges omembranes that exhibit resonant behavior. The principle of operation is based on the monitoring of the resonance frequency shift dueto various external factors such as change of temperature. It has been shown that photothermal infrared (IR) spectroscopy based onnanomechanical silicon nitride (SiN) string resonators (NAM-IR) enables the exceptionally fast chemical analysis of pictograms of analytedirectly from liquid solution in only a few minutes [1]. However in this technique the coupling of the IR laser beam to the nanometerwidestring resonators is difficult and inefficient. Therefore perforated SiN membranes with thickness of 100 nm, lateral dimension of1×1 mm² and 2 µm perforation grid pitch were used instead of strings which makes the IR beam alignment significantly simpler whilemaintaining similar sampling efficiency and photothermal IR absorption sensitivity.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Technical University of Denmark
Authors: Kurek, M. (Intern), Carnoy, M. (Ekstern), Boisen, A. (Intern), Schmid, S. (Intern)
Number of pages: 1
Publication date: 2016
Event: Poster session presented at 42nd International conference on Micro and Nano Engineering, Vienna, Austria.
Main Research Area: Technical/natural sciences
Electronic versions:
Perforated_SiN_membrane_resonators_for_nanomechanical_IR_spectroscopy_poster.pdf
Source: PublicationPreSubmission
Source-ID: 126456873
Publication: Research - peer-review › Journal article – Annual report year: 2017
Phosphorous Doping of Nanostructured Crystalline Silicon

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Technical University of Denmark, Pierre and Marie Curie University - University of Paris VI
Authors: Plakhotnyuk, M. (Intern), Davidsen, R. S. (Intern), Steckel, A. (Ekstern), Dodu, A. (Ekstern), Hansen, O. (Intern)
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions:
PVSEC_26_Doping_effect_on_bSi.pdf

Relations
Projects:
Phosphorous Doping of Nanostructured Crystalline Silicon
Source: Publication PreSubmission
Source-ID: 127784543
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Phosphorous Doping of Nanostructured Crystalline Silicon
Nano-textured silicon, known as black silicon (bSi), is attractive with excellent photon trapping properties. bSi can be produced using simple one-step fabrication reactive ion etching (RIE) technique. However, in order to use bSi in photovoltaics doping process should be developed. Due to high surface aspect ration (22.25) of bSi to planar surface doping concentration might be slightly higher than on planar surfaces. Therefore, we conducted a study and present recent results of doping of bSi and compared their properties to planar Si. We doped planar, KOH-etched random pyramid and bSi surfaces with phosphorous (POCl3) in the temperature range 850-1000°C for 15 and 20 min, respectively. Sheet resistance measurements show slight differences in doping density between planar, KOH pyramidal and bSi structures. bSi samples have lower sheet resistance, pointing to higher doping density presumably due to the higher surface area. These results can be used to optimize doping processes for industrial application of bSi solar cells.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Technical University of Denmark, Pierre and Marie Curie University - University of Paris VI
Authors: Plakhotnyuk, M. (Intern), Davidsen, R. S. (Intern), Steckel, A. (Ekstern), Dodu, A. (Ekstern), Hansen, O. (Intern)
Number of pages: 1
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions:
Poster_PVSEC26_M_Plakhotnyuk_final.pdf

Relations
Activities:
26th International Photovoltaic Science and Engineering Conference
Projects:
Phosphorous Doping of Nanostructured Crystalline Silicon
Publication: Research - peer-review › Poster – Annual report year: 2017

Photocatalytic Nanostructuring of Graphene Guided by Block Copolymer Self-Assembly
Nanostructured graphene exhibits many intriguing properties. For example, precisely controlled graphene nanomeshes can be applied in electronic, photonic, or sensing devices. However, fabrication of nanopatterned graphene with periodic superlattice remains a challenge. In this work, periodic graphene nanomesh was fabricated by photocatalysis of single-layer graphene suspended on top of TiO2-covered nanopillars, which were produced by combining block copolymer nanolithography with atomic layer deposition. Graphene nanoribbons were also prepared by the same method applied to a line-forming block copolymer template. This mask-free and nonchemical/nonplasma route offers an exciting platform for nanopatterning of graphene and other UV-transparent materials for device engineering.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Self-Organized Nanoporous Materials, Amphiphilic Polymers in Biological Sensing
Photonic crystal Fano structures and their application to ultrafast switching and lasers

We present investigations on photonic-crystal Fano structures based on a cavitywaveguide configuration. We show that the use of Fano resonance can enable great improvements in high-speed low-energy all-optical switching and realizing ultra-fast nanolasers.

General information
State: Published
Organisations: Department of Photonics Engineering, Nanophotonics Theory and Signal Processing, High-Speed Optical Communication, Nanophotonic Devices, Department of Micro- and Nanotechnology
Planar Hall effect bridge sensors with NiFe/Cu/IrMn stack optimized for self-field magnetic bead detection

The stack composition in trilayer Planar Hall effect bridge sensors is investigated experimentally to identify the optimal stack for magnetic bead detection using the sensor self-field. The sensors were fabricated using exchange-biased stacks Ni$_{80}$Fe$_{20}$(tFM)/Cu(tCu)/Ir$_{80}$Mn$_{20}$(10 nm) with t$_{FM}$ = 10, 20, and 30 nm, and 0 ≤ t$_{Cu}$ ≤ 0.6 nm. The sensors were characterized by magnetic hysteresis measurements, by measurements of the sensor response vs. applied field, and by measurements of the sensor response to a suspension of magnetic beads magnetized by the sensor self-field due to the sensor bias current. The exchange bias field was found to decay exponentially with t$_{Cu}$ and inversely with t$_{FM}$. The reduced exchange field for larger values of t$_{FM}$ and t$_{Cu}$ resulted in higher sensitivities to both magnetic fields and magnetic beads. We argue that the maximum magnetic bead signal is limited by Joule heating of the sensors and, thus, that the magnetic stacks should be compared at constant power consumption. For a fixed sensor geometry, the figure of merit for this comparison is the magnetic field sensitivity normalized by the sensor bias voltage. In this regard, we found that sensors with t$_{FM}$ = 20 nm or 30 nm outperformed those with t$_{FM}$ = 10 nm by a factor of approximately two, because the latter have a reduced AMR ratio. Further, the optimum layer thicknesses, t$_{Cu}$ = 0.6 nm and t$_{FM}$ = 20-30 nm, gave a 90% higher signal compared to the corresponding sensors with t$_{Cu}$ = 0 nm.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems
Authors: Henriksen, A. D. (Intern), Rizzi, G. (Intern), Hansen, M. F. (Intern)
Number of pages: 8
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Applied Physics
Volume: 119
Issue number: 9
Article number: 093910
ISSN (Print): 0021-8979
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.953 SJR 0.739
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.72 SJR 0.906 SNIP 0.977
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.821 SNIP 0.996 CiteScore 1.57
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Planar Hall effect bridges for magnetic field sensing and biosensing

General information
Plasma diagnostics during magnetron sputtering of aluminum doped zinc oxide

Plasma parameters during magnetron sputtering of aluminum-doped zinc oxide are investigated with optical emission spectroscopy, electrostatic probes and mass spectrometry with the aim of understanding the role of negative ions of oxygen during the film growth and improving the uniformity of the film resistivity over the deposition area.

General information

State: Published
Organisations: Department of Energy Conversion and Storage, Department of Micro- and Nanotechnology, Silicon Microtechnology, Electrofunctional materials
Authors: Stamate, E. (Intern), Crovetto, A. (Intern), Sanna, S. (Intern)
Pages: 327-328
Publication date: 2016

Host publication information

Title of host publication: Proceedings of 23rd Europhysics Conference on Atomic and Molecular Physics of Ionized Gases (ESCAMPIG XXIII)
Publisher: European Physical Society
Main Research Area: Technical/natural sciences
Conference: 23rd Europhysics Conference on Atomic and Molecular Physics of Ionized Gases, Bratislava, Slovakia, 12/07/2016 - 12/07/2016

Plasma wave instabilities in nonequilibrium graphene

We study two-stream instabilities in a nonequilibrium system in which a stream of electrons is injected into doped graphene. As with equivalent nonequilibrium parabolic band systems, we find that the graphene systems can support unstable charge-density waves whose amplitudes grow with time. We determine the range of wave vectors $q$ that are unstable, and their growth rates. We find no instability for waves with wave vectors parallel or perpendicular to the direction of the injected carriers. We find that, within the small-wave-vector approximation, the angle between $q$ and the direction of the injected electrons that maximizes the growth rate increases with increasing $|q|$. We compare the range and strength of the instability in graphene to that of two- and three-dimensional parabolic band systems.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Nanostructured Graphene, Theoretical Nanotechnology, University of Akron
Authors: Aryal, C. M. (Ekstern), Hu, B. Y. (Ekstern), Jauho, A. (Intern)
Number of pages: 9
Publication date: 2016
Main Research Area: Technical/natural sciences
Plasmonic Colors: Toward Mass Production of Metasurfaces

Plasmonic metasurface coloration has attracted considerable attention in recent years due to its industrial potential. So far, demonstrations have been limited to small patterned areas fabricated using expensive techniques with limited scalability.
This study elevates the technology beyond the common size and volume limitations of nanofabrication and demonstrates aluminum-coated polymer-based colored metasurfaces of square-centimeter size by embossing, injection molding, roll-to-roll printing, and film insert molding. Different techniques are compared and the requirements and bottlenecks in terms of master fabrication, replication, metallization, and protection coating for large-scale production of sub-wavelength metasurfaces are discussed. Most notably, it is demonstrated that plasmonic metasurface colors are compatible with film insert molding. The results indicate a promising future for plasmonic colors as a viable alternative for decorating mass-produced polymer parts.

Plasmonic colour generation
Plasmonic colours are structural colours that emerge from resonant interactions between light and metallic nanostructures. The engineering of plasmonic colours is a promising, rapidly emerging research field that could have a large technological impact. We highlight basic properties of plasmonic colours and recent nanofabrication developments, comparing technology-performance indicators for traditional and nanophotonic colour technologies. The structures of interest include diffraction gratings, nanoaperture arrays, thin films, and multilayers and structures that support Mie resonances and whispering-gallery modes. We discuss plasmonic colour nanotechnology based on localized surface plasmon resonances, such as gap plasmons and hybridized disk–hole plasmons, which allow for colour printing with sub-diffraction resolution. We also address a range of fabrication approaches that enable large-area printing and nanoscale lithography compatible with complementary metal-oxide semiconductor technologies, including nanoimprint lithography and self-assembly. Finally, we review recent developments in dynamically reconfigurable plasmonic colours and in the laser-induced post-processing of plasmonic colour surfaces.
Plasmonic colour laser printing

Colour generation by plasmonic nanostructures and metasurfaces has several advantages over dye technology: reduced pixel area, sub-wavelength resolution and the production of bright and non-fading colours. However, plasmonic colour patterns need to be pre-designed and printed either by e-beam lithography (EBL) or focused ion beam (FIB), both expensive and not scalable processes that are not suitable for post-processing customization. Here we show a method of colour printing on nanoimprinted plasmonic metasurfaces using laser post-writing. Laser pulses induce transient local heat generation that leads to melting and reshaping of the imprinted nanostructures. Depending on the laser pulse energy density, different surface morphologies that support different plasmonic resonances leading to different colour appearances can be created. Using this technique we can print all primary colours with a speed of 1 ns per pixel, resolution up to 127,000 dots per inch (DPI) and power consumption down to 0.3 nJ per pixel.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Authors: Zhu, X. (Intern), Vannahme, C. (Intern), Hejlund-Nielsen, E. (Intern), Mortensen, N. A. (Intern), Kristensen, A. (Intern)
Number of pages: 5
Pages: 325-329
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information

Journal: Nature Nanotechnology
Volume: 11
Issue number: 4
ISSN (Print): 1748-3387
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 8.171 SJR 20.612
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 21.85 SJR 18.916 SNIP 7.649
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 18.842 SNIP 8.019 CiteScore 22.1
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 17.177 SNIP 8.047 CiteScore 21.76
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 16.688 SNIP 7.784 CiteScore 21.94
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 15.706 SNIP 7.569 CiteScore 17.55
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Plasmonic laser printing for functional metasurfaces

Recently, we show a method of color printing on nanoimprinted plasmonic metasurfaces using laser post-writing. Laser pulses induce transient local heat generation that leads to melting and reshaping of the imprinted nanostructures [1]. Depending on the laser pulse energy density, different surface morphologies that support different plasmonic resonances can be created. This technology creates a laser printer capable of producing color images with a resolution up to 127,000 DPI. With tailored trains of laser pulses, multiple optical states are flatiron onto the metasurface film with a nanoscale controlling. Thus, this diffraction-limited-resolution optical writing process can be further used to demonstrate a variety of applications in addition to large-area structural color printing. Multi-focus Fresnel zone plates with subwavelength focus, and more meta-surfaces different functions, such as spectroscope filters, Raman substrates and biosensors are also applicable.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Authors: Zhu, X. (Intern), Carstensen, M. S. (Intern), Vannahme, C. (Intern), Højlund-Nielsen, E. (Intern), Mortensen, N. A. (Intern), Kristensen, A. (Intern)
Number of pages: 1
Pages: 752-752
Publication date: 2016

Host publication information
Title of host publication: 2016 Progress In Electromagnetic Research Symposium (PIERS)
Publisher: IEEE
ISBN (Print): 978-1-5090-6094-8
ISBN (Electronic): 978-1-5090-6093-1
Main Research Area: Technical/natural sciences
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Plasmonic laser printing for ink-free color decoration

Here we show a method of color printing on nanoimprinted plasmonic metasurfaces [1] using laser post-writing. Laser pulses induce transient local heat generation that leads to melting and reshaping of the imprinted nanostructures [2]. This leads to melting and reshaping of the imprinted 20nm Al structures embedded in plastics. Depending on the laser pulse
energy density, different surface morphologies that support different plasmonic resonances leading to different color appearances can be created. Color printing by this technology has several advantages over dye technology: ink/toner-free, sub-wavelength resolution and the production of bright and non-fading colors. This technology creates a laser printer capable of producing images with a resolution of 127,000 DPI. It will be possible to save data invisible to the naked eye. This includes serial numbers or bar codes of products and other information. It can also be used on a larger scale to personify products such as mobile phones with unique decorations, names, etc.. This laser technology may create environmentally sound color printing solutions and simplify the production for consumer products.

General information
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Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Authors: Zhu, X. (Intern), Vannahme, C. (Intern), Højlund-Nielsen, E. (Intern), Mortensen, N. A. (Intern), Kristensen, A. (Intern)
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Plasmonic nanopillar structures for surface-enhanced raman scattering applications
Noble metal nanostructures support localized surface plasmon (LSPR) resonances that depend on their dimensions, shapes and compositions. Particle LSPR's can be used to spatially confine the incident light and produce enormous electromagnetic (EM) field enhancement spots, i.e. hot spots. Hot spots have been utilized in surfaceenhanced Raman spectroscopy (SERS) for biological and chemical sensing. We present Au nanopillar (NP) SERS structures that are excellent for molecular detection. The NP structures can be fabricated using a simple two-step process. We analyze NP optical properties experimentally and theoretically. Simulations show that that a single Agcoated NP supports two LSPR modes, i.e. the particle mode and the Ag cap resonant cavity mode. The Ag cap resonant cavity mode contributes most to the enhancement of the Raman scattering signal. The electric field distribution calculations show that the EM hot spots are located at the bottom of the Ag cap which is important observation for practical SERS sensing. Reproducible and repeatable SERS signal intensities can be obtained across large surface areas (>mm²). Application examples include detection of TAMRA-labeled vasopressin and cyanide (KCN).

General information
State: Published
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2016
Polymeric microcontainers improve oral bioavailability of furosemide

Microcontainers with an inner diameter of 223μm are fabricated using the polymer SU-8, and evaluated in vitro, in situ and in vivo for their application as an advanced oral drug delivery system for the poorly water soluble drug furosemide. An amorphous sodium salt of furosemide (ASSF) is filled into the microcontainers followed by applying a lid using Eudragit L100. It is possible to control the drug release in vitro, and in vitro absorption studies show that the microcontainers are not a hindrance for absorption of ASSF. In situ perfusion studies in rats are performed with ASSF-filled microcontainers coated with Eudragit and compared to a furosemide solution. The absorption rate constant of ASSF confined in microcontainers is found to be significantly different from the solution, and by light microscopy, it is observed that the microcontainers are engulfed by the intestinal mucus. An oral bioavailability study in rats is performed with ASSF confined in microcontainers coated with Eudragit and a control group with ASSF in Eudragit-coated capsules. A relative bioavailability of 220% for the ASSF in microcontainers compared to ASSF in capsules is found. These studies indicate that the microcontainers could serve as a promising oral drug delivery system.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, University of Valencia, University of Copenhagen
Authors: Nielsen, L. H. (Intern), Melero, A. (Ekstern), Keller, S. S. (Intern), Jacobsen, J. (Ekstern), Garrigues, T. (Ekstern), Rades, T. (Ekstern), Müllertz, A. (Ekstern), Boisen, A. (Intern)
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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.298 SNIP 1.45 CiteScore 4.2
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Scopus rating (2013): SJR 1.377 SNIP 1.605 CiteScore 4.17
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Scopus rating (2012): SJR 1.552 SNIP 1.637 CiteScore 4.1
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BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.493 SNIP 1.619 CiteScore 4.01
ISI indexed (2011): ISI indexed yes
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Polymeric pH nanosensor with extended measurement range bearing octaarginine as cell penetrating peptide

A synthetic peptide octaarginine which mimics human immunodeficiency virus-1, Tat protein is used as cell penetrating moiety for new pH nanosensors which demonstrate enhanced cellular uptake and expanded measurement range from pH 3.9 to pH 7.3 by simultaneously incorporating two complemental pH-sensitive fluorophores in a same nanoparticle. The authors believe that this triple fluorescent pH sensor provides a new tool to pH measurements that can have application in cellular uptake mechanism study and new nanomedicine design.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Southern Denmark, Hubei University of Technology
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Number of pages: 5
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Publication date: 2016
Main Research Area: Technical/natural sciences
Polymer Optical Fiber Compound Parabolic Concentrator fiber tip based glucose sensor: In-Vitro Testing

We present in-vitro sensing of glucose using a newly developed efficient optical fiber glucose sensor based on a Compound Parabolic Concentrator (CPC) tipped polymer optical fiber (POF). A batch of 9 CPC tipped POF sensors with a 35 mm fiber length is shown to have an enhanced fluorescence pickup efficiency with an average increment factor of 1.7 as compared to standard POF sensors with a plane cut fiber tip. Invitro measurements for two glucose concentrations (40 and 400 mg/dL) confirm that the CPC tipped sensors efficiently can detect both glucose concentrations. It sets the footnote at the bottom of this column.
Poly(vinylpyrrolidone) as dispersing agent for cerium-gadolinium oxide (CGO) suspensions

The behaviour of selected poly(vinylpyrrolidone) grades to act as dispersant for ethanol-based ceriumgadolinium oxide suspensions was investigated and related to the molecular weight characteristics. The number, weight, and z-average molecular weights $M_n$, $M_w$, and $M_z$ were determined by gel permeation chromatography and then used in a numerical method to evaluate the viscosity average molecular weight ($M_v$) via an empirically modified Mark–Houwink–Sakurada (MHS) equation. The MHS equation parameters ($a$ and $K$) and the polydispersity correction factor ($q_{\text{MHS}}$) were also evaluated. Three grades with different molecular weight features were selected and further studied as dispersants by means of rheology. Despite the differences, only slight shifts in the amount of polymer required for achieving fully stabilized dispersions were observed, whereas comparable packing properties were obtained. This was explained as an effect of the polydispersity, expressed as $q_{\text{MHS}}$.
Main Research Area: Technical/natural sciences

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Scopus rating (2016): CiteScore 2.49 SJR 0.769 SNIP 1.072
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Scopus rating (2015): SJR 0.792 SNIP 1.059 CiteScore 2.36
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Scopus rating (2014): SJR 0.963 SNIP 1.388 CiteScore 2.54
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.926 SNIP 1.451 CiteScore 2.36
ISI indexed (2013): ISI indexed yes
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Scopus rating (2012): SJR 0.988 SNIP 1.383 CiteScore 2.2
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.935 SNIP 1.377 CiteScore 2.05
ISI indexed (2011): ISI indexed yes
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BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.957 SNIP 1.091
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.844 SNIP 0.956
Web of Science (2009): Indexed yes
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Scopus rating (2008): SJR 0.68 SNIP 0.773
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.622 SNIP 0.868
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.549 SNIP 0.798
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.561 SNIP 0.879
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.587 SNIP 0.986
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.695 SNIP 1.045
Scopus rating (2002): SJR 0.627 SNIP 0.877
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.734 SNIP 1.015
Prediction of wastewater quality using amperometric bioelectronic tongues

Wastewater samples from a Swedish chemi-thermo-mechanical pulp (CTMP) mill collected at different purification stages in a wastewater treatment plant (WWTP) were analyzed with an amperometric enzyme-based biosensor array in a flow-injection system. In order to resolve the complex composition of the wastewater, the array consists of several sensing elements which yield a multidimensional response. We used principal component analysis (PCA) to decompose the array's responses, and found that wastewater with different degrees of pollution can be differentiated. With the help of partial least squares regression (PLS-R), we could link the sensor responses to the Microtox (R) toxicity parameter, as well as to global organic pollution parameters (COD, BOD, and TOC). From investigating the influences of individual sensors in the array, it was found that the best models were in most cases obtained when all sensors in the array were included in the PLS-R model. We find that fast simultaneous determination of several global environmental parameters characterizing wastewaters is possible with this kind of biosensor array, in particular because of the link between the sensor responses and the biological effect onto the ecosystem into which the wastewater would be released. In conjunction with multivariate data analysis tools, there is strong potential to reduce the total time until a result is yielded from days to a few minutes. (C) 2015 Elsevier B.V. All rights reserved.
Propagation of Channel Plasmons at the Visible Regime in Aluminum V-Groove Waveguides
Aluminum plasmonics is emerging as a promising platform in particular for the ultraviolet-blue spectral band. We present the experimental results of propagating channel plasmon-polaritons (CPP) waves in aluminum coated V-shaped waveguides at the short visible wavelength regime. The V-grooves are fabricated by a process involving UV-photolithography, crystallographic silicon etching, and metal deposition. Polarization measurements of coupling demonstrate a preference to the TM-aligned mode, as predicted in simulations.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials, Hebrew University of Jerusalem
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Number of pages: 8
Pages: 2150-2157
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Main Research Area: Technical/natural sciences
Protection of Si photocathode using TiO₂ deposited by high power impulse magnetron sputtering for H₂ evolution in alkaline media

Si is an excellent absorber material for use in photoelectrochemical (PEC) hydrogen production. Only a few studies have been done using Si in alkaline electrolyte for hydrogen evolution due to its poor chemical stability in high pH electrolyte, indicating that a chemically stable protection layer is essential. Here we investigate thin TiO₂ films deposited by high power impulse magnetron sputtering (HiPIMS) as a protection layer for a p-type silicon photocathode for photoelectrochemical H₂ evolution in a high pH electrolyte. The X-ray reflectometry analysis reveals that the HiPIMS process provides improved film density for TiO₂ films (4.15 g/cm³), and consequently results in a significantly less corroded Si surface. The Si photocathode protected by the HiPIMS grown TiO₂ film along with Pt as co-catalyst produced a photocurrent onset potential of ~0.5 V vs. RHE in 1 M KOH and showed a 4% decay over 24 h in KOH. In contrast, the sample with the TiO₂ deposited using conventional DC sputtering technique of similar thickness shows 20% loss in photocurrent for the same time interval. Considering the fact that the experiments were carried out not in the cleanroom, much less corrosion loss can be obtained if done in dust-free condition. Hence, these results suggest the HiPIMS technique as an improved approach for the protection of photoelectrodes, which are unstable in alkaline solution.

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Organisations: Department of Physics, Experimental Surface and Nanomaterials Physics, Department of Micro- and Nanotechnology, Silicon Microtechnology, University of Iceland
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Protective coatings based on 2D-materials

Corrosion has a major impact on the world economy. Barrier coatings is one of the most widely applied strategies to reduce the degradation of materials, however, every coating technology has its drawbacks. Graphene has the potential of creating the ideal coating, being atomically thin and, when in perfect condition, impermeable to most molecules. However, it has recently been demonstrated that graphene can promote galvanic corrosion and may actually increase the corrosion rate in the long term.

The aim of this thesis is to individuate, develop and demonstrate solutions based on 2Dmaterials, that can deliver viable coatings technologies circumventing the drawback demonstrated for graphene coatings. The focus is twofold, with a solution that focuses on multi-layer coatings, wherein the drawback of graphene is circumvented by diffusion limitations. Here it will be shown that such solutions are viable in pH neutral environments, however, a new issue with graphene coatings is encountered in strong acidic environments. Another focus is on "white graphene", another 2D-material that shares many of its properties with graphene, but without some of the fundamental limitations.

Through the development and investigations of 2D-coatings technologies, testing methods and synthesis four patents applications have been submitted, making a substantial platform for further development of 2D-based barrier coatings.

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Organisations: Department of Micro- and Nanotechnology, Nanocarbon
Authors: Stoot, A. C. (Intern), Bøggild, P. (Intern), Camilli, L. (Intern)
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Pseudomagnetic fields and triaxial strain in graphene

Pseudomagnetic fields, which can result from nonuniform strain distributions, have received much attention in graphene systems due to the possibility of mimicking real magnetic fields with magnitudes of greater than 100 T. We examine systems with such strains confined to finite regions ("pseudomagnetic dots") and provide a transparent explanation for the characteristic sublattice polarization occurring in the presence of a pseudomagnetic field. In particular, we focus on a triaxial strain leading to a constant field in the central region of the dot. This field causes the formation of pseudo-Landau levels, where the zeroth order level shows significant differences compared to the corresponding level in a real magnetic field. Analytic arguments based on the Dirac model are employed to predict the sublattice and valley dependencies of the density of states in these systems. Numerical tight-binding calculations of single pseudomagnetic dots in extended graphene sheets confirm these predictions, and are also used to study the effect of rotating the strain direction with respect to the underlying graphene lattice, and varying the size of the pseudomagnetic dot.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Nanostructured Graphene, Structured Electromagnetic Materials, Theoretical Nanotechnology
Authors: Settnes, M. (Intern), Power, S. (Intern), Jauho, A. (Intern)
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Organisations: Department of Photonics Engineering, Photovoltaic Materials and Systems, DTU Danchip, Department of Physics, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology, Department of Micro- and Nanotechnology, Department of Energy Conversion and Storage, Electrofunctional materials
Authors: Schou, J. (Intern), Cazzaniga, A. C. (Intern), Canulescu, S. (Intern), Ettlinger, R. B. (Intern), Crovetto, A. (Intern), Engberg, S. L. J. (Intern), Hansen, Ø. (Intern), Pryds, N. (Intern)
Number of pages: 1
Publication date: 2016
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Main Research Area: Technical/natural sciences
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Pyrolytic 3D Carbon Microelectrodes for Electrochemistry
This work presents the fabrication and characterization of multi-layered three-dimensional (3D) pyrolysed carbon microelectrodes for electrochemical applications. For this purpose, an optimized UV photolithography and pyrolysis process with the negative tone photosresist SU-8 has been developed. The fabricated three electrode electrochemical cell is characterized with cyclic voltammetry (CV) using the standard potassium ferri-ferrocyanide redox probe. Carbon materials have several attractive characteristics as microelectrodes for electrochemical applications, such as wide potential window, good electrochemical activity, chemical stability, and ease in surface functionalization [1]. The most common carbon microfabrication techniques (e.g. screen printing) produce two-dimensional (2D) electrodes, which limit the detection sensitivity. Hence several 3D microfabrication techniques have been explored in recent years amongst which the SU-8 photolithography and pyrolysis process plays a critical role in fabricating suspended layer. This process enables fabrication of 2D and 3D electrodes with possibility for tailoring ad-hoc designs and unique sensitivities for specific applications. Due to this, pyrolysed carbon is becoming increasingly attractive for numerous applications, such as novel sensors and scaffolds for cell analysis [3]. However fabrication of a conducting 3D microstructure with feature sizes in the micron-range still remains a challenge. In this work an optimized UV photolithography and pyrolysis process for SU-8 based on highly controlled exposure dose and modified baking time is presented to obtain multi-layered 3D carbon microelectrodes for electrochemistry (figure 1.A). SU-8 2005 (5.6µm) is spin coated on a Si/SiO2 wafer, soft baked (SB) at 50C for 30min followed by UV exposure (E1 – 210mJ cm-2) and post exposure bake (PEB) at 50C for 1h (figure 1.A.a). A second thick layer of SU-8 2075 (76µm) is spin coated, SB at 50C for 6h and UV exposed (E2 – 149mJ cm-2) (figure 1.A.b). A second partial exposure E3 – 28mJ cm-2 is performed to obtain a suspended layer followed by a PEB at 50C for 8h (figure 1.A.c). The partial exposure dose at wavelength 365nm and the low temperature (50C) baking steps plays a critical role in fabricating suspended layer. Non cross-linked SU-8 is developed in propylene glycol monomethyl ether acetate (PGMEA) for 30min (figure 1.A.d). The obtained SU-8 polymer templates are then pyrolysed at 900C for 1h in an N2 environment to obtain suspended 3D pyrolysed carbon microelectrodes (figure.1.A.e). By sequentially repeating the steps shown in figure 1.A. a, b, c and d followed by a final development step, a multi-layered polymer template can be obtained which can be pyrolysed to produce 3D carbon microelectrodes (figure 1.A.f). The height of the singe carbon layer (figure 1.A.e) is 21.10µm which includes a suspended layer of 2.25µm. The diameter of circles in the suspended layer is 11.50µm. The small carbon microstructures are shown in figure 1.B with structures of 4µm (mesh) and 18µm (mesh boundaries). Depending on the desired application, different 3D carbon microelectrodes can be fabricated (figure 1.B). Figure 1.C shows the electrochemical characterization of a three electrodes system, comparing planar and 3D carbon working electrodes. The cyclic voltammograms performed in 10mM ferri-ferrocyanide show higher peak current (2 folds higher) for the 3D microelectrodes compared to the 2D ones (figure 1.C). The 3D microelectrodes potentially increase the overall sensitivity in amperometric monitoring of cell response due to the increase surface area and enhanced interaction with cells [3]. Reference: [1] R. L. McCreery, “Advanced carbon electrode materials for molecular electrochemistry,” Chem. Rev., vol. 108, no. 7, pp. 2646–2687, 2008. [2] R. Martinez-Duarte, “SU-8 Photolithography as a Toolbox for Carbon MEMS,” Micromachines, vol. 5, no. 3, pp. 766–782, 2014. [3] L. Amato, A. Heiskanen, C. Caviglia, F. Shah, K. Zéor, M. Skolimowski, M. Madou, L. Gammelgaard, R. Hansen, E. G. Seiz, M. Ramos, T. R. Moreno, A. Martéóínez-Serrano, S. S. Keller, and J. Emnéóíéus, “Pyrolysed 3D-Carbon Scaffolds Induce Spontaneous Differentiation of Human Neural Stem Cells and Facilitate Real-Time Dopamine Detection,” Adv. Funct. Mater., vol. 24, no. 44, pp. 7042–7052, 2014. [Figure]
Pyrolytic 3D Carbon Microelectrodes for Electrochemistry

This work presents the fabrication and characterization of suspended three-dimensional (3D) pyrolytic carbon microelectrodes for electrochemical applications. For this purpose, an optimized process with multiple steps of UV photolithography with the negative tone photoresist SU-8 followed by pyrolysis at 900°C for 1h was developed. With this process, microelectrode chips with a three electrode configuration were fabricated and characterized with cyclic voltammetry (CV) using a 10mM potassium ferri-ferrocyanide redox probe in a custom made batch system with magnetic clamping. The 3D pyrolytic carbon microelectrodes displayed twice the higher peak current compared to 2D.
Pyrolytic carbon electrode for dopamine detection from cells

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Bioanalytics, Center for Nanostructured Graphene, Optofluidics, Polymer Microsystems for Cell Processing
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Publication date: 2016
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Pyrolytic carbon microelectrodes for impedance based cell sensing

Electrically conductive glass-like carbon structures can be obtained from a polymer template through a pyrolysis process. These structures can be used as electrodes for bio sensing applications such as electrochemical evaluation of cell adhesion and proliferation. This study focuses on the optimization of two dimensional (2D) pyrolytic carbon microelectrodes with the carbon MEMS (C-MEMS) process using the negative epoxy photoresist SU-8. Different electrochemical microchips with carbon working (WE) and counter electrode (CE) were fabricated. More specifically, pyrolysis process was optimized to decrease the resistivity of the resulting carbon material and improve the performance in cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). Finally, EIS was used to monitor adhesion and proliferation of HeLa cells.

**General information**

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Pyrolytic carbon microelectrodes for impedance based cell sensing

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Quantum optical effective-medium theory and transformation quantum optics for metamaterials

While typically designed to manipulate classical light, metamaterials have many potential applications for quantum optics as well. We argue why a quantum optical effective-medium theory is needed. We present such a theory for layered metamaterials that is valid for light propagation in all spatial directions, thereby generalizing earlier work for one-dimensional propagation. In contrast to classical effective-medium theory there is an additional effective parameter that describes quantum noise. Our results for metamaterials are based on a rather general Lagrangian theory for the quantum electrodynamics of media with both loss and gain. In the second part of this paper, we present a new application of transformation optics whereby local spontaneous-emission rates of quantum emitters can be designed. This follows from an analysis how electromagnetic Green functions transform under coordinate transformations. Spontaneous-emission rates can be either enhanced or suppressed using invisibility cloaks or gradient index lenses. Furthermore, the anisotropic material pro file of the cloak enables the directional control of spontaneous emission.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Photonics Engineering, Structured Electromagnetic Materials, Department of Micro- and Nanotechnology, Shahrekord University
Authors: Wubs, M. (Intern), Amooghorban, E. (Ekstern), Zhang, J. (Intern), Mortensen, N. A. (Intern)
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

Quantum transport in graphene in presence of strain-induced pseudo-Landau levels
We report on mesoscopic transport fingerprints in disordered graphene caused by strain-field induced pseudomagnetic Landau levels (pLLs). Efficient numerical real space calculations of the Kubo formula are performed for an ordered network of nanobubbles in graphene, creating pseudomagnetic fields up to several hundreds of Tesla, values inaccessible by real magnetic fields. Strain-induced pLLs yield enhanced scattering effects across the energy spectrum resulting in lower mean free path and enhanced localization effects. In the vicinity of the zeroth order pLL, we demonstrate an anomalous transport regime, where the mean free paths increases with disorder. We attribute this puzzling behavior to the low-energy sub-lattice polarization induced by the zeroth order pLL, which is unique to pseudomagnetic fields preserving time-reversal symmetry. These results, combined with the experimental feasibility of reversible deformation fields, open the way to tailor a metal-insulator transition driven by pseudomagnetic fields.

General information
State: Published
Organisations: Department of Photonics Engineering, Center for Nanostructured Graphene, Structured Electromagnetic Materials, Department of Micro- and Nanotechnology, Theoretical Nanotechnology, Barcelona Institute of Science and Technology
Authors: Settnes, M. (Intern), Leconte, N. (Ekstern), Barrios-Vargas, J. E. (Ekstern), Jauho, A. (Intern), Roche, S. (Ekstern)
Raman Spectroscopic probing of plant material using SERS

General information
State: Published
Organisations: Department of Physics, Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology, Biophysics and Fluids
Authors: Palanco, M. E. (Intern), Mogensen, K. B. (Intern), Kneipp, K. (Intern)
Number of pages: 6
Pages: 156–161
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Raman Spectroscopy
Volume: 47
Issue number: 2
ISSN (Print): 0377-0486
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.05 SJR 0.888
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.71 SJR 0.926 SNIP 1.115
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 4.602 SNIP 1.009 CiteScore 5.89
BFI (2014): BFI-level 1
BFI (2013): BFI-level 1
ISI indexed (2013): ISI indexed no
Original language: English
Electronic versions:
pesel_1607.07300.pdf
DOIs:
10.1088/2053-1583/3/3/034005
Source: Findit
Source-ID: 2342560234
Publication: Research - peer-review » Journal article – Annual report year: 2016
Rapid Newcastle Disease Virus Detection Based on Loop-Mediated Isothermal Amplification and Optomagnetic Readout

Rapid and sensitive diagnostic methods based on isothermal amplification are ideal substitutes for PCR in out-of-lab settings. However, there are bottlenecks in terms of establishing low-cost and user-friendly readout methods for isothermal amplification schemes. Combining the high amplification efficiency of loop-mediated isothermal amplification (LAMP) with an optomagnetic nanoparticle-based readout system, we demonstrate ultrasensitive and rapid detection of Newcastle disease virus RNA. Biotinylated amplicons of LAMP and reverse transcription LAMP (RT-LAMP) bind to streptavidin-coated magnetic nanoparticles (MNPs) resulting in a dramatical increase in the hydrodynamic size of the MNPs. This increase was measured by an optomagnetic readout system and provided quantitative information on the amount of LAMP target sequence. Our assay resulted in a limit of detection of 10 aM of target sequence with a total assay time of 30 min. The assay has also been tested on clinical samples (vaccine and tissue specimens) with a performance comparable to real-time RT-PCR. By changing the LAMP primers, this strategy can serve as a general method for the detection of other DNA/RNA targets with high specificity and sensitivity.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Uppsala University, Central Agricultural Office
Rapid Voltammetric Measurements at Conducting Polymer Microelectrodes Using Ultralow-Capacitance Poly(3,4-ethylenedioxythiophene):Tosylate

We use a vapor-phase synthesis to generate conducting polymer films with low apparent capacitance and high conductance enabling rapid electrochemical measurements. Specifically, oxidative chemical vapor deposition was used to create thin films of poly(3,4-ethylenedioxythiophene):tosylate (PEDOT:tosylate). These films had a conductance of 17.1 ± 1.7 S/cm. Furthermore, they had an apparent capacitance of 197 ± 14 μF/cm², which is an order of magnitude lower than current commercially available and previously reported PEDOT. Using a multistage photolithography process, these films were patterned into PEDOT:tosylate microelectrodes and were used to perform fast-scan cyclic voltammetry (FSCV) measurements. Using a scan rate of 100 V/s, we measured ferrocene carboxylic acid and dopamine by FSCV. In contrast to carbon-fiber microelectrodes, the reduction peak showed higher sensitivity when compared to the oxidation peak. The adsorption characteristics of dopamine at the polymer electrode were fit to a Langmuir isotherm. The low apparent capacitance and the microlithographic processes for electrode design make PEDOT:tosylate an attractive material for future applications as an implantable biosensor for FSCV measurements. Additionally, the integration of PEDOT:tosylate electrodes on plastic substrates enables new electrochemical measurements at this polymer using FSCV.
Recognizing nitrogen dopant atoms in graphene using atomic force microscopy

Doping graphene by heteroatoms such as nitrogen presents an attractive route to control the position of the Fermi level in the material. We prepared N-doped graphene on Cu(111) and Ir(111) surfaces via chemical vapor deposition of two different molecules. Using scanning tunneling microscopy images as a benchmark, we show that the position of the dopant atoms can be determined using atomic force microscopy. Specifically, the frequency shift-distance curves $\Delta f(z)$ acquired above a N atom are significantly different from the curves measured over a C atom. Similar behavior was found for N-doped graphene on Cu(111) and Ir(111). The results are corroborated by density functional theory calculations employing a van der Waals functional.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Utrecht University
Authors: van der Heijden, N. J. (Ekstern), Smith, D. (Ekstern), Calogero, G. (Intern), Koster, R. S. (Ekstern), Vanmaekelbergh, D. (Ekstern), van Huis, M. A. (Ekstern), Swart, I. (Ekstern)
Number of pages: 9
Solid surface structure, Doping and implantation of impurities, Chemical vapour deposition, Density functional theory, local density approximation (condensed matter electronic structure), Preparation of graphene and graphene-related materials, intercalation compounds, and diamond, Electronic structure of graphene and graphene-related materials (thin films, low
dimensional and nanoscale structures), atomic force microscopy, chemical vapour deposition, density functional theory, doping, Fermi level, graphene, nitrogen, scanning tunnelling microscopy, van der Waals functional, frequency shift–distance curves, benchmark, scanning tunneling microscopy images, chemical vapor deposition, N-doped graphene, heteroatoms, nitrogen dopant atoms

Electronic versions:
Recognizing_nitrogen.pdf
DOIs:
10.1103/PhysRevB.93.245430
Source: FindIt
Source-ID: 2306167499
Publication: Research - peer-review › Journal article – Annual report year: 2016

Redox-Sensitive liposomes for glioblastoma treatment.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces
Authors: Lund, M. A. (Intern), Bak, M. (Intern), Kamaly, N. (Intern), Andresen, T. L. (Intern)
Publication date: 2016
Event: Poster session presented at 19th International Symposium on Signal Transduction at the Blood-Brain Barriers, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
Electronic versions:
Poster_Redox_sensitive_liposomes_1.pdf
Source: PublicationPreSubmission
Source-ID: 127726497
Publication: Research - peer-review › Poster – Annual report year: 2016

Redox-Sensitive liposomes for glioblastoma treatment.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces
Authors: Lund, M. A. (Intern), Bak, M. (Intern), Kamaly, N. (Intern), Andresen, T. L. (Intern)
Publication date: 2016
Event: Abstract from 19th International Symposium on Signal Transduction at the Blood-Brain Barriers, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
Electronic versions:
Abstract_MetteLund.pdf
Source: PublicationPreSubmission
Source-ID: 127758971
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Replication of nanopits and nanopillars by roll-to-roll extrusion coating using a structured cooling roll
This paper investigates a novel, very high throughput, roll-to-roll (R2R) process for nanostructuring of polymer foils, called R2R extrusion coating. It has the potential to accelerate the integration of nanostructured materials in consumer products for a variety of applications, including optical, technical, and functional surfaces and devices. In roll-to-roll extrusion coating, a molten polymer film is extruded through a flat die forming a melt curtain, and then laminated onto a carrier foil. The lamination occurs as the melt curtain is pressed between a cooling roller and a counter roller. By mounting a nanostructured metal shim on the surface of the cooling roller, the relief structure from the shim can be replicated onto a thermoplastic foil. Among the benefits of P oil, the process are availability of a wide range of commercial extruders, off-the-shelf extrusion grade polymers, functional additives, polymeric materials with good diffusion barrier properties, and the overall maturity of the technology [S. H. Ahn and L. J. Guo, Adv. Mater. 20, 2044 (2008)]. In this article, the authors demonstrate replication of nanopits and nanopillars with diameters between 40 and 120 nm and depth/height of 100 nm. The best replication was achieved in polypropylene, by running at high roller line-speed of 60 m/min, and high cooling roller temperature of 70°C. Replication in other common polymers like polyethylene and polystyrene was not possible for the parameter range used for the investigation.

General information
State: Published
Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Inmold A/S
Revisiting the IFN-γ release assay: Whole blood or PBMC cultures? - And other factors of influence

The interferon-γ release assay (IGRA) is a widely used test for the presence of a cell-mediated immune (CMI) response in vitro. This measure is used to test for infection with intracellular pathogens or for validating vaccine efficacy, and it is a widely used test for both human as well as cattle. However, there is no consensus whether to use whole blood cultures or purified PBMCs for the assay, and both cell populations are being used and results compared. Therefore the aim of this study was to compare different culture settings using immune cells from previously vaccinated calves, and to shed light on external factors that could influence the read out in terms of IFN-γ levels. It was found that optimal culture conditions varied between individual animals; when polyclonally activated, cells from whole blood cultures were most responsive, but when activated specifically, the optimal cell concentration/population varied with whole blood, 10 x 106 cells/ml PBMC and 5 x 106 cells/ml PBMC being the highest performing conditions. A further investigation of the distribution of cell populations in PBMCs compared to whole blood was conducted, and a significant (p < 0.001) decrease in the percentage of CD3+ T lymphocytes within the PBMCs was found. More specifically, this reduction was due to a significant (p < 0.01) decrease in the percentage of γδ+ T lymphocytes. Thus measuring immune responses on purified PBMCs might not give a physiologically relevant output. Additionally, it was tested if the choice of incubation plate would interfere with the level of secreted IFN-γ in whole blood cultures from five calves. Six plates (a–f) were tested and no significant difference in absolute levels of IFN-γ was detected in the six plates when cells were polyclonally and specifically activated. However, we observed a significant (p < 0.05) higher background level in a flat-bottom plate from Corning® (cat# 3595) (plate d) compared to two different flat-bottom plates from Corning® (cat# 3596) (plate b) and Nunc™ (cat# 167008) (plate a).

Furthermore 4 out of 5 calves had maximum specific IFN-γ expression on plate b, and the relative-to-maximum level on this plate was significant (p < 0.05) compared to plate a. Altogether these findings highlight the potential weaknesses of the IFN-γ release assay in terms of the many variables that can influence the results, including the cell culture population, the concentration of cells being cultured, and the plastic ware used for the in vitro culture. These findings stress the importance of documenting the precise assay conditions when publishing results of in vitro IFN-γ release assays.

General information
State: Published
Organisations: National Veterinary Institute, Section for Immunology and Vaccinology, Department of Micro- and Nanotechnology, Bioanalytics, BioLabChip
Authors: Hartmann, S. B. (Intern), Emnéus, J. (Intern), Wolff, A. (Intern), Jungersen, G. (Intern)
Pages: 24-31
Publication date: 2016
Main Research Area: Technical/natural sciences

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Journal: Journal of Immunological Methods
Volume: 434
ISSN (Print): 0022-1759
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.715 SJR 1.289
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.92 SJR 1.089 SNIP 0.65
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.064 SNIP 0.739 CiteScore 2.07
Robust band gap and half-metallicity in graphene with triangular perforations

Ideal graphene antidot lattices are predicted to show promising band gap behavior (i.e., $E_G \approx 500$ meV) under carefully specified conditions. However, for the structures studied so far this behavior is critically dependent on superlattice geometry and is not robust against experimentally realistic disorders. Here we study a rectangular array of triangular antidots with zigzag edge geometries and show that their band gap behavior qualitatively differs from the standard behavior which is exhibited, e.g., by rectangular arrays of armchair-edged triangles. In the spin unpolarized case, zigzag-edged antidots give rise to large band gaps compared to armchair-edged antidots, irrespective of the rules which govern the existence of gaps in armchair-edged antidot lattices. In addition the zigzag-edged antidots appear more robust than armchair-edged antidots in the presence of geometrical disorder. The inclusion of spin polarization within a mean-field Hubbard approach gives rise to a large overall magnetic moment at each antidot due to the sublattice imbalance imposed by the triangular geometry. Half-metallic behavior arises from the formation of spin-split dispersive states near the Fermi energy, reducing the band gaps compared to the unpolarized case. This behavior is also found to be robust in the presence of disorder. Our results highlight the possibilities of using triangular perforations in graphene to open electronic band gaps in systems with experimentally realistic levels of disorder, and furthermore, of exploiting the strong spin dependence of the system for spintronic applications.
Robustness of the far-field response of nonlocal plasmonic ensembles

Contrary to classical predictions, the optical response of few-nm plasmonic particles depends on particle size due to effects such as nonlocality and electron spill-out. Ensembles of such nanoparticles are therefore expected to exhibit a nonclassical inhomogeneous spectral broadening due to size distribution. For a normal distribution of free-electron nanoparticles, and within the simple nonlocal hydrodynamic Drude model, both the nonlocal blueshift and the plasmon linewidth are shown to be considerably affected by ensemble averaging. Size-variance effects tend however to conceal nonlocality to a lesser extent when the homogeneous size-dependent broadening of individual nanoparticles is taken into account, either through a local size-dependent damping model or through the Generalized Nonlocal Optical Response theory. The role of ensemble averaging is further explored in realistic distributions of isolated or weakly-interacting noble-metal nanoparticles, as encountered in experiments, while an analytical expression to evaluate the importance of inhomogeneous broadening through measurable quantities is developed. Our findings are independent of the specific nonclassical theory used, thus providing important insight into a large range of experiments on nanoscale and quantum plasmonics.

General information
State: Published
Organisations: Department of Photonics Engineering, Structured Electromagnetic Materials, Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, University of California
Authors: Tserkezis, C. (Intern), Maack, J. R. (Intern), Liu, Z. (Ekstern), Wubs, M. (Intern), Mortensen, N. A. (Intern)
Number of pages: 8
Publication date: 2016
Main Research Area: Technical/natural sciences

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Journal: Scientific Reports
Volume: 6
Article number: 28441
ISSN (Print): 2045-2322
Ratings:
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.245 SJR 1.533
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.63 SJR 1.692 SNIP 1.354
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.034 SNIP 1.597 CiteScore 5.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.163 SNIP 1.554 CiteScore 4.75
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.998 SNIP 1.57 CiteScore 4.06
Roll-to-roll extrusion coating process for high-speed replication of micron-sized periodic patterns

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Danapak Flexibles A/S
Authors: Okulova, N. (Intern), Christensen, L. (Ekstern), Johansen, P. (Ekstern), Taboryski, R. J. (Intern)
Publication date: 2016
Event: Abstract from 42nd International conference on Micro and Nano Engineering, Vienna, Austria.
Main Research Area: Technical/natural sciences
Electronic versions:
Tserkezis_C_et_al_Sci_Rep_6_28441_2016_.pdf
DOIs:
10.1038/srep28441
Source: FindIt
Source-ID: 2291789102
Publication: Research - peer-review › Journal article – Annual report year: 2016

Sculpturing Surfaces with Cartan Ribbons
Using the concepts of Cartan development and rolling from differential geometry we develop a method for sculpturing any surface with the use of Cartan ribbons.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Department of Micro- and Nanotechnology, Theoretical Biophysics
Authors: Raffaelli, M. (Intern), Bohr, J. (Intern), Markvorsen, S. (Intern)
Pages: 457-460
Publication date: 2016
Event: Bridges 2016, Jyväskylä, Finland, 09/08/2016 - 09/08/2016
Main Research Area: Technical/natural sciences
Electronic versions:
Bridges_2016_paper_119_Annotated.pdf
bridges2016_457.pdf
Links:
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

Search for a metallic dangling-bond wire on n-doped H-passivated semiconductor surfaces
We have theoretically investigated the electronic properties of neutral and n-doped dangling bond (DB) quasi-one-dimensional structures (lines) in the Si(001):H and Ge(001):H substrates with the aim of identifying atomic-scale
interconnects exhibiting metallic conduction for use in on-surface circuitry. Whether neutral or doped, DB lines are prone
to suffer geometrical distortions or have magnetic ground states that render them semiconducting. However, from our
study we have identified one exception - a dimer row fully stripped of hydrogen passivation. Such a DB-dimer line shows
an electronic band structure which is remarkably insensitive to the doping level, and thus, it is possible to manipulate the
position of the Fermi level, moving it away from the gap. Transport calculations demonstrate that the metallic conduction in
the DB-dimer line can survive thermally induced disorder but is more sensitive to imperfect patterning. In conclusion, the
DB-dimer line shows remarkable stability to doping and could serve as a one-dimensional metallic conductor on n-doped
samples.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Nanostructured Graphene, Theoretical
Nanoelectronics, Centro de Física de Materiales, Donostia International Physics Center (DIPC)
Authors: Engelund, M. (Ekstern), Papior, N. R. (Intern), Brandimarte, P. (Ekstern), Frederiksen, T. (Ekstern), Garcia-
Lekue, A. (Ekstern), Sánchez-Portal, D. (Ekstern)
Number of pages: 7
Pages: 20303-20309
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Physical Chemistry C
Volume: 120
Issue number: 36
ISSN (Print): 1932-7447
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 2.135 SNIP 1.147
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.48 SJR 1.964 SNIP 1.195
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.886 SNIP 1.26 CiteScore 4.68
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.032 SNIP 1.447 CiteScore 5.08
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.143 SNIP 1.445 CiteScore 5.14
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.529 SNIP 1.461 CiteScore 4.98
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.339 SNIP 1.465 CiteScore 4.92
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 2.462 SNIP 1.362
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 2.158 SNIP 1.427
Web of Science (2009): Indexed yes
Selective heavy metal capture from contaminated water

State: Published
Organisations: Department of Environmental Engineering, Water Technologies, Department of Micro- and Nanotechnology, Surface Engineering, Korea Advanced Institute of Science & Technology, Seoul National University
Authors: Ko, D. (Intern), Lee, J. (Ekstern), Jakobsen, M. H. (Intern), Hwang, Y. (Ekstern), Yavuz, C. T. (Ekstern), Andersen, H. R. (Intern)
Number of pages: 1
Publication date: 2016
Event: Poster session presented at 9th Europe-Korea Conference on Science and Technology (EKC2016), Berlin, Germany.
Main Research Area: Technical/natural sciences
Electronic versions: EKC_presentation.pdf
Source: PublicationPreSubmission
Source-ID: 126887185
Publication: Research - peer-review › Poster – Annual report year: 2016

Semiconductor band alignment from first principles: a new nonequilibrium Green's function method applied to the CZTSe/CdS interface for photovoltaics

In this paper we present a method to obtain the band offset of semiconductor heterointerfaces from Density Functional Theory together with the nonequilibrium Green's function method. Band alignment and detailed properties of the interface between Cu2ZnSnSe4 and CdS are extracted directly from first principles simulations. The interface is important for photovoltaics applications where in particular the band offsets are important for efficiency. The band bending pose a problem for accurate atomistic simulations of band offsets due to its long range. Here we investigate two different methods for dealing with band bending directly. One involves doping the materials to induce a shorter screening length. The other method is to apply a voltage bias across the interface to correct for the band bending. The calculated band offsets agree well with previous experimental and theoretical studies and, interestingly, the offset is seen to depend on whether or not the interface is under flat-band conditions.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Center for Nanostructured Graphene, Silicon Microtechnology, QuantumWise A/S
Authors: Palsgaard, M. L. N. (Intern), Crovetto, A. (Intern), Gunst, T. (Intern), Markussen, T. (Ekstern), Hansen, O. (Intern), Stokbro, K. (Ekstern), Brandbyge, M. (Intern)
Number of pages: 4
Pages: 377-380
Publication date: 2016
Sensor Systems with Magnetic and Optomagnetic Readout of Rolling Circle Amplification Products

We are developing robust biosensors for homogeneous detection of rolling circle amplification (RCA) products with magnetic and/or optomagnetic readouts based on surface-functionalized magnetic nanoparticles. Binding of RCA amplicons to nanoparticles modifies their ability to rotate in response to an applied oscillating magnetic field. As a result, magnetic or optical measurements of these changes in the rotational response of nanoparticles vs. frequency of the magnetic field can be used to quantitate the number of amplicons, and, hence, the concentration of target nucleic acid analytes. After describing the basic principles of this approach, we present the current status of the development of compact and portable sensing devices used to measure the dynamic response of magnetic particle suspensions. Then, we give examples and results of different RCA detection strategies designed by us, and we also outline future directions for this innovative diagnostic approach.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Uppsala University
Authors: Hansen, M. F. (Intern), Donolato, M. (Intern), Fock, J. (Intern), Strömberg, M. (Ekstern), Strømme, M. (Ekstern), Svedlindh, P. (Ekstern)
Pages: 123-128
Publication date: 2016

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Title of host publication: Rolling Circle Amplification (RCA) : Toward New Clinical Diagnostics and Therapeutics
Publisher: Springer
Editor: Demidov, V. V.
Edition: 1
ISBN (Print): 978-3-319-42224-4
ISBN (Electronic): 978-3-319-42226-8
Main Research Area: Technical/natural sciences
Source: PublicationPreSubmission
Source-ID: 127522731
Publication: Research - peer-review › Book chapter – Annual report year: 2016

SERS detection of pneumonia in breath of children with cystic fibrosis
Cystic fibrosis (CF) is the most frequently inherited disease in the Western world, and also the one with the highest morbidity and mortality. The main reason is chronic lung infections caused by the pathogenic bacterium Pseudomonas aeruginosa, which is well-adapted to the thick and dehydrated mucous in the CF airways. Established methods to detect P. aeruginosa in young CF children are invasive and lack sensitivity, which is why novel approaches are being investigated. P. aeruginosa emits hydrogen cyanide (HCN) gas, which can possibly be used as a biomarker for early P. aeruginosa colonisation, if it can be detected in the breath. It was investigated if a nanopillar substrate for surface-enhanced Raman spectroscopy (SERS), developed in the Nanoprobes group, could be optimised for gas phase detection of HCN. The project consisted of 3 steps, of which the first was to establish a chemical method to detect cyanide on the substrate in relevant concentrations, preferably in gas. Step I was split up into two parts; one for HCN detection in the gas phase, and one for detection of potassium cyanide (KCN) in serial dilutions to reach sufficiently low CN concentrations and verify the limit of detection. Once this was done, Step II was to measure HCN(g) from emissions of P. aeruginosa; first from the established reference strain, the wild type PAO1. Secondly, it was relevant to study clinical P. aeruginosa strains, isolated for the first time from CF children (the wild type-like strains), and then compare to SERS measurements on later strains, isolated from the same patients after their infection became chronic and the P. aeruginosa had mutated in the lasR gene, which is essential to HCN production. Step III was a clinical trial, where children with CF would blow into a bag containing the SERS substrate, which was then measured, to see if HCN was detected when a new P. aeruginosa colonisation occurred; and data was correlated to culturing of sputum from the patient’s lungs.

The SERS substrate was optimised, and setups were developed for HCN(g) detection, for SERS detection of HCN from
bacterial volatiles, and for collection and SERS substrate exposure to human breath. Five ppm HCN was successfully detected in gas phase, and KCN was detected down to 10-6 M. HCN detection was demonstrated from cultures of P. aeruginosa wild types, starting from the end of exponential / beginning of stationary growth phase. HCN was also detected from lasR mutated clinical P. aeruginosa strains isolated from the airways of children with CF, when the mutation was located at the 5' terminal (downstream) of the gene. P. aeruginosa isolates with a mutation at the 3' terminal of the lasR gene (upstream) did not emit detectable HCN. Application for ethics’ committee was submitted and permission granted to conduct a 4 months’ clinical pilot study at Rigshospitalet, including 50 CF patients aged 5-17 years and 19 age-matched control subjects. One CF patient had a new P. aeruginosa lung colonisation during the trial, and it was probably detected on the SERS substrate, which had an increased HCN signal compared to the patient’s other visits. Additional cases of increased SERS cyanide signal were seen in the breath of some of the children, and it was speculated if they could come from prolonged exposure time or from children being exposed to passive smoking at home. The SERS substrate has a background peak in the Raman spectrum, which needs to be addressed, because it is located very close to the cyanide peak.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Novo Nordisk AS
Authors: Lauridsen, R. K. (Intern), Boisen, A. (Intern), Rindzevicius, T. (Intern), Molin, S. (Ekstern)
Number of pages: 160
Publication date: 2016

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Publisher: DTU Nanotech
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions: Untitled.pdf

Relations
Projects:
SERS detection of pneumonia in breath of children with cystic fibrosis
Source: PublicationPreSubmission
Source-ID: 128539546
Publication: Research › Ph.D. thesis – Annual report year: 2017

Simultaneous all-channel OTDM demultiplexing based on complete optical Fourier transformation
We demonstrate simultaneous OTDM demultiplexing of all 16-channels for 160-Gbit/s DPSK and 320-Gbit/s DQPSK signals based on complete OFT. Furthermore, numerical simulations show promising results for extending the proposed technique to spectrally efficient Nyquist-OTDM.

General information
State: Published
Organisations: Department of Photonics Engineering, High-Speed Optical Communication, Centre of Excellence for Silicon Photonics for Optical Communications, National Space Institute, Department of Micro- and Nanotechnology
Authors: Guan, P. (Intern), Lilieholm, M. (Intern), Røge, K. M. (Intern), Morioka, T. (Intern), Oxenløwe, L. K. (Intern)
Number of pages: 3
Publication date: 2016

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ISBN (Electronic): 9781509021475
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Conference: 21st OptoElectronics and Communications Conference, Niigata, Japan, 03/07/2016 - 03/07/2016
Optical Fourier transformation, Optical signal processing, Optical demultiplexing
Electronic versions: OECC2016.pdf
Source: FindIt
Source-ID: 2347975262
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

Size-Resolved Characterization of Particles and Fibers Released during Abrasion of Fiber-Reinforced Composite in a Workplace Influenced by Ambient Background Sources
We demonstrate the use of high-to low-resolution microscopy and particle chemical analysis during normal vacuum and cryo-conditions to identify the nature and relative abundances of process-generated particles and fibers from sanding of a glass and carbon fiber epoxy layer-composite in a workplace influenced by both indoor and ambient background sources. The study suggests that a proper exposure characterization requires multiple techniques covering wide size ranges to reach a conclusion. Besides a rise in number concentration due to release of particles during the sanding, a significant contribution of ambient particles to the background in the production facility was observed in the sub-micron size range. Fibers are posing a dominant exposure risk in the micron size range, with carbon fibers dominating in count.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, National Research Center for Working Environment
Number of pages: 14
Pages: 11-24
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Aerosol and Air Quality Research
Volume: 16
Issue number: 1
ISSN (Print): 1680-8584

Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): SNIP 0.89 SJR 0.928
Web of Science (2017): Indexed Yes
Scopus rating (2016): CiteScore 2.81 SJR 0.95 SNIP 1.159
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 1.002 SNIP 1.124 CiteScore 2.68
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 0.86 SNIP 1.12 CiteScore 2.22
Scopus rating (2013): SJR 1.014 SNIP 1.376 CiteScore 2.84
Scopus rating (2012): SJR 1.05 SNIP 1.394 CiteScore 3.21
Scopus rating (2011): SJR 0.852 SNIP 1.19 CiteScore 2.55
Scopus rating (2010): SJR 0.635 SNIP 0.911
Scopus rating (2009): SJR 0.366 SNIP 0.592
Original language: English
Fiber mats, Particle identification, Epoxy, Production emission, HR-TEM

Electronic versions:
Size_Resolved_Characterization.pdf
DOIs:
10.4209/aaqr.2015.05.0295
Source: FindIt
Source-ID: 2280639263
Publication: Research - peer-review › Journal article – Annual report year: 2016

Smartphone-based biosensing platform evolution: implementation of electrochemical analysis capabilities
Lab-on-Chip technologies offer great opportunities for the democratization of in-vitro medical diagnostics to the consumer-market. Despite the limitations set by the strict instrumentation and control requirements of certain families of these devices, new solutions are emerging. Smartphones now routinely demonstrate their potential as an interface of choice for operating complex, instrumented Lab-on-Chips. The sporadic nature of home-based in-vitro medical diagnostics testing calls for the development of systems capable of evolving with new applications or new technologies for Lab-on-Chip devices. We present in this work how we evolved the first generation of a smartphone/Lab-on-Chip platform designed for evolvability. We demonstrate how reengineering efforts can be confined to the mobile-software layer and illustrate some of the benefits of building evolvable systems. We implement electrochemical capabilities on our platform prototype and carry out cyclic voltammetry to measure dopamine concentrations over several orders of magnitude.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems, Department of Electrical Engineering, Department of Applied Mathematics and Computer Science , Embedded Systems Engineering
Spatial characterization of nanotextured surfaces by visual color imaging

We present a method using an ordinary color camera to characterize nanostructures from the visual color of the structures. The method provides a macroscopic overview image from which micrometer-sized regions can be analyzed independently, thereby revealing long-range spatial variations of the structures. The method is tested on injection-molded polymer line gratings, and the height and filling factor are determined with confidence intervals similar to more advanced imaging scatterometry setups.
Spatial dispersion in two-dimensional plasmonic crystals: Large blueshifts promoted by diffraction anomalies

We develop a methodology to incorporate nonlocal optical response of the free electron gas due to quantum-interaction effects in metal components of periodic two-dimensional plasmonic crystals and study the impact of spatial dispersion on promising building blocks for photonic circuits. Within the framework of the hydrodynamic model, we observe significant changes with respect to the commonly employed local-response approximation, but also in comparison with homogeneous metal films where nonlocal effects have previously been considered. Notable are the emergence of a contribution from nonlocality at normal incidence and the surprisingly large structural parameters at which finite blueshifts are observable, which we attribute to diffraction that offers nonvanishing in-plane wave vector components and increases the penetration depth of longitudinal (nonlocal) modes.

General information

State: Published
Organisations: Structured Electromagnetic Materials, Department of Photonics Engineering, Department of Micro- and Nanotechnology, Center for Nanostructured Graphene
**Collective excitations (surface states), Optical properties of metals and metallic alloys (thin films, low-dimensional and nanoscale structures), Thin film growth, structure, and epitaxy, metallic thin films, plasmonics, spectral line shift, diffraction anomalies, nonlocal optical response, free electron gas, quantum-interaction effect, metal components, periodic two-dimensional plasmonic crystals, spatial dispersion, photonic circuits, hydrodynamic model, local-response approximation, homogeneous metal films, structural parameters, finite blueshifts, in-plane wave vector components, penetration depth, longitudinal modes**

Electronic versions:
- PhysRevB.94.165410.pdf
- DOIs: 10.1103/PhysRevB.94.165410
- Source: FindIt
- Source-ID: 2347367798
- Publication: Research - peer-review › Journal article – Annual report year: 2016

**sPLA₂ sensitive fluid phase liposomes induce severe toxicity in murine cancer model**

**General information**
- State: Published
- Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Copenhagen
- Authors: Østrem, R. G. (Intern), Nielsen, O. L. (Ekstern), Hansen, A. E. (Ekstern), Andresen, T. L. (Intern)
- Publication date: 2016
- Main Research Area: Technical/natural sciences
- Electronic versions:
- Poster_CLINAM_Ragnhild_3.pdf
- Source: PublicationPreSubmission
- Source-ID: 127726432
- Publication: Research - peer-review › Poster – Annual report year: 2016

**Spray Drying of Cubosomes for Oral Vaccine Delivery**

**General information**
- State: Published
- Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Technical University of Denmark, University of Copenhagen
- Publication date: 2016
- Event: Poster session presented at 2016 AAPS Annual Meeting and Exposition, Denver, CO, United States.
- Main Research Area: Technical/natural sciences
- Electronic versions:
- poster_v4.pdf
- Source: PublicationPreSubmission
- Source-ID: 127315890
- Publication: Research - peer-review › Poster – Annual report year: 2016

**Starch Granule Re-Structuring by Starch Branching Enzyme and Glucan Water Dikinase Modulation Affects Caryopsis Physiology and Metabolism**

Starch is of fundamental importance for plant development and reproduction and its optimized molecular assembly is potentially necessary for correct starch metabolism. Re-structuring of starch granules in-planta can therefore potentially affect plant metabolism. Modulation of granule micro-structure was achieved by decreasing starch branching and increasing starch-bound phosphate content in the barley caryopsis starch by RNAi suppression of all three Starch Branching Enzyme (SBE) isoforms or overexpression of potato Glucan Water Dikinase (GWD). The resulting lines displayed Amylose-Only (AO) and Hyper-Phosphorylated (HP) starch chemotypes, respectively. We studied the influence of these alterations on primary metabolism, grain composition, starch structural features and starch granule morphology over caryopsis development at 10, 20 and 30 days after pollination (DAP) and at grain maturity. While HP showed relatively little effect, AO showed significant reduction in starch accumulation with re-direction to protein and β-glucan (BG) accumulation. Metabolite profiling indicated significantly higher sugar accumulation in AO, with re-partitioning of carbon to accumulate amino acids, and interestingly it also had high levels of some important stress-related metabolites and potentially protective metabolites, possibly to elude deleterious effects. Investigations on starch molecular structure revealed significant increase in starch phosphate and amylose content in HP and AO respectively with obvious differences in starch granule morphology at maturity. The results demonstrate that decreasing the storage starch branching resulted in metabolic adjustments and re-directions, tuning to evade deleterious effects on caryopsis physiology and plant
performance while only little effect was evident by increasing starch-bound phosphate as a result of overexpressing GWD.
Static thermo-optic instability in double-pass fiber amplifiers

A coupled-mode formalism, earlier used to describe transverse mode instabilities in single-pass optical fiber amplifiers, is extended to the case of double-pass amplifiers. Contrary to the single-pass case, it is shown that the thermo-optic nonlinearity can couple light at the same frequency between the LP01 and LP11 modes, leading to a static deformation of the output beam profile. This novel phenomenon is caused by the interaction of light propagating in either direction with thermo-optic index perturbations caused by light propagating in the opposite direction. The threshold power for the static deformation is found to be several times lower than what is typically found for the dynamic modal instabilities observed in single-pass amplifiers. (C) 2016 Optical Society of America
Stereolithography-based 3D printing of micro-channels for vascularized hydrogels

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Microsystems for Cell Processing, Technical University of Denmark
Authors: Zhang, R. (Intern), Juul, M. H. (Ekstern), Larsen, N. B. (Intern)
Number of pages: 1
Publication date: 2016
Event: Abstract from 10th World Biomaterials Congress, Montreal, Canada.
Main Research Area: Technical/natural sciences
Electronic versions:

**Frontiers_Stereolithography_based_3D_printing_of_micro_channels_for_vascularized_hydrogels.pdf**
Source: PublicationPreSubmission
Source-ID: 125156118
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016
Stress relaxation of bi-disperse polystyrene melts: Exploring the interactions between long and short chains in non-linear rheology

We present start-up of uniaxial extension followed by stress relaxation experiments of a bi-disperse 50% by weight blend of 95k and 545k molecular weight polystyrene. We also show, for comparison, stress relaxation measurements of the polystyrene melts with molecular weight 95k and 545k, which are the components of the bi-disperse melt. The measurements show three separated relaxation regimes: a fast regime, a transition regime, and a slow regime. In the fast regime, the orientation of the long chains is frozen and the stress relaxation is due to stretch relaxation of the short chains primarily. Conversely, in the slow regime, the long chains have retracted and undergo relaxation of orientation in fully relaxed short chains.

General information
State: Published
Organisations: Department of Chemical and Biochemical Engineering, The Danish Polymer Centre, Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Drexel University
Authors: Hengeller, L. (Intern), Huang, Q. (Intern), Dorokhin, A. (Intern), Alvarez, N. J. (Ekstern), Almdal, K. (Intern), Hassager, O. (Intern)
Pages: 303-314
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Rheologica Acta
Volume: 55
Issue number: 4
ISSN (Print): 0035-4511
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.063 SJR 0.704
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.9 SJR 0.634 SNIP 1.026
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.876 SNIP 1.272 CiteScore 2.09
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.725 SNIP 1.181 CiteScore 1.72
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.877 SNIP 1.38 CiteScore 2.09
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.898 SNIP 1.36 CiteScore 1.8
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.292 SNIP 1.397 CiteScore 2.22
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.267 SNIP 1.302
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.005 SNIP 1.227
Web of Science (2009): Indexed yes
Substrate tolerant direct block copolymer nanolithography

Block copolymer (BC) self-assembly constitutes a powerful platform for nanolithography. However, there is a need for a general approach to BC lithography that critically considers all the steps from substrate preparation to the final pattern transfer. We present a procedure that significantly simplifies the main stream BC lithography process, showing a broad substrate tolerance and allowing for efficient pattern transfer over wafer scale. PDMS-rich poly(styrene-b-dimethylsiloxane) (PS-b-PDMS) copolymers are directly applied on substrates including polymers, silicon and graphene. A single oxygen plasma treatment enables formation of the oxidized PDMS hard mask, PS block removal and polymer or graphene substrate patterning.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Self-Organized Nanoporous Materials, Center for Nanostructured Graphene
Authors: Li, T. (Intern), Wang, Z. (Intern), Schulte, L. (Intern), Ndoni, S. (Intern)
Number of pages: 5
Pages: 136-140
Publication date: 2016
Main Research Area: Technical/natural sciences
The hypoxia PET tracer $^{64}$Cu-diacetyl-bis(N$^{4}$-methylthiosemicarbazone) (64Cu-ATSM) has shown promising results in clinical studies. However, concerns have been raised with regard to the possible effect of copper metabolism and free copper on tumor uptake and thereby the robustness of 64Cu-ATSM as a hypoxia marker. In this study, accumulation and distribution of $^{64}$Cu-ATSM and $^{64}$CuCl2 in tumor tissue were compared with partial pressure of oxygen (pO2) probe measurements. Methods: One-hour dynamic PET scans were performed on nude mice bearing subcutaneous human head and neck tumors (FaDu) and human colorectal tumors (HT29) after administration of either $^{64}$Cu-ATSM or $^{64}$CuCl2. Subsequently, tracks were generated and track markers were positioned in tumors to allow for registration of their exact location on the high-resolution CT scan. After completion of the CT scan, pO2 probe measurements were performed along each track. PET and CT images were coregistered and ROIs drawn on the basis of the location of track markers and pO2 probe measurement depth. A linear mixed model for repeated measures was applied for the comparison of PET tracer uptake to corresponding pO2 values. Results: Comparable uptake of $^{64}$Cu-ATSM and $^{64}$CuCl2 was found in the kidney, muscle, and liver of all animals, but $^{64}$CuCl2 showed a higher uptake 10–60 min after injection in both tumor models. Significant differences were also found for both tumor-to-muscle and tumor-to-liver ratios. The intratumoral distribution of $^{64}$Cu-ATSM, but not $^{64}$CuCl2, showed a significant negative relationship with pO2 measurements in FaDu tumors. However, this relationship was not found in HT29 tumors. Conclusion: $^{64}$Cu-ATSM and $^{64}$CuCl2 displayed different uptake in tumors. In human head and neck xenografts, $^{64}$Cu-ATSM but not $^{64}$CuCl2 reflected pO2 measurements, indicating that $^{64}$Cu-ATSM is a hypoxia-specific marker in this tumor type. However, data from colorectal cancer xenografts indicated that $^{64}$Cu-ATSM may not be a hypoxia marker in all tumor types.
The present study is aimed to enhance the oral bioavailability of ketoprofen by inserting it into the matrix of poly(vinylpyrrolidone) (PVP) K10 spatially confined into microcontainers, by means of supercritical CO2-aided impregnation. Microcontainers are cylindrical reservoirs, with typical sizes in the micrometer range, with a cavity open on one side, where the drug formulation is loaded. Differently to traditional tablets, microcontainers have a higher surface area...
per unit volume, and release the drug only in one direction. This design is meant to enhance the absorption of problematic
drugs, like those with poor solubility in water. In a previous study we introduced a novel technique for drug loading of
microcontainers, based on inkjet printing and supercritical impregnation (SCI). We showed that SCI produces accurate
and reproducible drug loading for large arrays of microcontainers. In the attempt of enhancing the throughput of the loading
methods, we propose the replacement of polymer inkjet printing with an easier manual compression of the PVP powder
into the microcontainers. As the second step, the polymer powder-filled microcontainers were submitted to SCI. The
separate role of different impregnation parameters (temperature, pressure, time, drug concentration in the supercritical
phase) was elucidated with respect to the loading capacity. The microcontainer filling was observed by means of optical
microimaging, X-ray microtomography and scanning electron microscopy. The physical state of the drug was
investigated by means of Raman spectroscopy and compared with selected representative PVP-ketoprofen
physical mixtures. Finally, the drug loading was estimated by means of in vitro dissolution tests. The characterization study
shows that the present loading method is a valuable alternative to the one previously described. The drug loading can be
controlled with high accuracy and reproducibility and the impregnated drug is in amorphous state. These results
demonstrate that SCI can be used as a high-throughput loading technique for microfabricated devices for oral drug
delivery.

**General information**

**State:** Published  
**Organisations:** Department of Micro- and Nanotechnology, Nanoprobes, Biomaterial Microsystems, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, University of Trieste, University of Cambridge  
**Authors:** Marizza, P. (Intern), Pontoni, L. (Ekstern), Rindzevicius, T. (Intern), Alopaeus, J. (Ekstern), Su, K. (Ekstern), Zeitler, J. (Ekstern), Keller, S. S. (Intern), Kikic, I. (Ekstern), Moneghini, M. (Ekstern), De Zordi, N. (Ekstern), Solinas, D. (Ekstern), Cortesi, A. (Ekstern), Boisen, A. (Intern)  
**Pages:** 145-152  
**Publication date:** 2016  
**Main Research Area:** Technical/natural sciences

**Publication information**

**Journal:** Journal of Supercritical Fluids  
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**Ratings:**  
BFI (2018): BFI-level 2  
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Scopus rating (2017): SNIP 1.282 SJR 1.015  
Web of Science (2017): Indexed Yes  
BFI (2016): BFI-level 2  
Scopus rating (2016): CiteScore 3.01 SJR 0.982 SNIP 1.278  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 1  
Scopus rating (2015): SJR 0.904 SNIP 1.195 CiteScore 2.71  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 1  
Scopus rating (2014): SJR 1.128 SNIP 1.461 CiteScore 2.89  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 1  
Scopus rating (2013): SJR 1.099 SNIP 1.5 CiteScore 3.18  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 1  
Scopus rating (2012): SJR 1.337 SNIP 1.666 CiteScore 3.38  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 1  
Scopus rating (2011): SJR 1.049 SNIP 1.476 CiteScore 3.03  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 1
Superhydrophobic Properties of Nanotextured Polypropylene Foils Fabricated by Roll-to-Roll Extrusion Coating

We demonstrate the use of roll-to-roll extrusion coating (R2R-EC) for fabrication of nanopatterned polypropylene (PP) foils with strong antiwetting properties. The antiwetting nanopattern is originated from textured surfaces fabricated on silicon wafers by a single-step method of reactive ion etching with different processing gas flow rates. We provide a systematic study of the wetting properties for the fabricated surfaces and show that a controlled texture stretching effect in the R2R-EC process is instrumental to yield the superhydrophobic surfaces with water contact angles approaching 160° and droplet roll-off angles below 10°.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Physics, Risø National Laboratory for Sustainable Energy, Inmold A/S
Authors: Telecka, A. (Intern), Murthy, S. (Intern), Sun, L. (Intern), Pranov, H. (Ekstern), Taboryski, R. J. (Intern)
Pages: 1034-1038
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication Information
Journal: ACS Macro Letters
Volume: 5
Issue number: 9
ISSN (Print): 2161-1653
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.349 SJR 2.486
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 6.03 SJR 2.763 SNIP 1.298
Superhydrophobic Properties of Nanotextured Polypropylene Foils Fabricated by Roll-to-Roll Extrusion Coating

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Department of Photonics Engineering
Authors: Telecka, A. (Intern), Murthy, S. (Intern), Taboryski, R. J. (Intern)
Number of pages: 1
Publication date: 2016
Main Research Area: Technical/natural sciences
Links:
http://www.sustain.dtu.dk/

Bibliographical note
Sustain Abstract P-8
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Supramolecular hair dyes: a new application of cocrystallization
The manuscript presents the first report of hair dyes of various colors formed by cocrystallization. Unlike the most popular oxidative hair dye (OHD) products, these dyes are NH₃ free and do not require H₂O₂ as a color developer. The importance of these new hair dyes products is further enhanced by recent reports which indicate that some of the OHDs may be carcinogenic.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Strathclyde
Authors: Delori, A. (Ekstern), Urquhart, A. (Intern), Oswald, I. D. H. (Ekstern)
Number of pages: 5
Pages: 5360-5364
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: CrystEngComm
Volume: 18
Issue number: 28
ISSN (Print): 1466-8033
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.823 SJR 0.998
Surface-enhanced Raman spectroscopic study of DNA and 6-mercapto-1-hexanol interactions using large area mapping

The emergence of 2D SERS substrates with large areas of hot spots has enabled data to be gathered at large scale. This work presents a statistical tool for analysing large amounts of SERS data by utilizing a peak-fitting model in a specific spectral range. By analysing the distributions of Raman intensities and peak positions it is possible to directly inspect the interplay between DNA and 6-mercapto-1-hexanol on gold covered nanopillars. It is demonstrated that optimised functionalization parameters can be extracted from the Raman spectra directly. Using the peak-fitting approach it is possible to avoid miss-interpretation of intensity histograms, where contamination might contribute with an enhanced background and not a peak.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Applied Mathematics and Computer Science, Cognitive Systems, Nanoprobes, Copenhagen Center for Health Technology, Surface Engineering, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Frøhling, K. B. (Intern), Alstrøm, T. S. (Intern), Bache, M. (Intern), Schmidt, M. S. (Intern), Schmidt, M. N. (Intern), Larsen, J. (Intern), Jakobsen, M. H. (Intern), Boisen, A. (Intern)
Pages: 331-336
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Vibrational Spectroscopy
Volume: 86
ISSN (Print): 0924-2031
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.88
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.1
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.68
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.72
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.8
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
BFI (2009): BFI-level 1
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Web of Science (2008): Indexed yes
Web of Science (2007): Indexed yes
Web of Science (2006): Indexed yes
Web of Science (2005): Indexed yes
Web of Science (2004): Indexed yes
Web of Science (2003): Indexed yes
Web of Science (2002): Indexed yes
Web of Science (2001): Indexed yes
Web of Science (2000): Indexed yes
Original language: English
SERS, Area mapping, DNA, 6-mercapto-1-hexanol, Thiol, Gold, Peak-fitting
DOIs:
10.1016/j.vibspec.2016.08.005
Surface Enhanced Raman Spectroscopy detection of p-coumaric acid from cell supernatant using gold-capped silicon nanopillar substrates

A standard protocol for analysis of microbial factories requires the screening of several populations in order to find the best performing ones. This is done with standard analytical methods (e.g. HPLC) with an expensive and time-consuming process. Surface Enhanced Raman Spectroscopy (SERS) is a highly sensitive spectroscopic technique which only requires drying a small volume of solution on an active substrate, with an analysis time of few minutes. Here we demonstrate the use of SERS to discriminate between two different bacterial populations based on detection of p-coumaric acid (pHCA) in cell supernatant. pHCA is a valuable secondary metabolite of genetically modified E. coli[1]. It is produced through deamination of tyrosine, and it has strong Raman and SERS activity[2],[3]. Gold capped silicon nanopillars were used as sensing substrates[4]. At first, they were successfully used to detect pHCA spiked in culture medium, in the same concentration range \(10^{-4} - 10^{-5} \text{ M}\) commonly found in cell supernatant. For supernatant analysis, triplicate cultures of FjTAL modified (P strains) and control (C strains) E.coli strains were carried out according to the methods described by[5] and shown in Fig.1. Samples of cell supernatant were extracted from each culture at 0, 3, 24 and 48 h post seeding and their pHCA content was measured with HPLC[5]. For SERS analysis, aliquots of supernatant were diluted 10-fold with MilliQ water, and 1 µL droplets were dried on the SERS substrates. A MatLab analysis was performed to extract the height of the significant peak at 1169 cm\(^{-1}\), with the results shown in Fig.2. The amplitude of the peak shows a different trend for P and C strains. A similar trend is obtained from HPLC. These promising results open up new possibilities for the use of SERS for high-throughput and automated evaluation of bacterial factories, allowing parallel analysis and discrimination of different strains.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Novo Nordisk Foundation Center for Biosustainability, Bacterial Cell Factory Optimization, Research Groups
Publication date: 2016
Main Research Area: Technical/natural sciences
Source: PublicationPreSubmission
Source-ID: 127154620
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Surface Enhanced Raman Spectroscopy detection of p-coumaric acid from cell supernatant using gold-capped silicon nanopillar substrates

The purpose of the project is to use Surface Enhanced Raman Spectroscopy (SERS) to discriminate between two different bacterial populations, based on their p-coumaric acid (pHCA) production. The pHCA concentration is measured in a droplet of diluted supernatant dried on SERS substrates, using a Raman microscope. By analyzing the SERS signal of pHCA from the supernatant, considering the peak height at the characteristic frequency (1169 cm\(^{-1}\)) it is possible to distinguish between a producing and control strain, as also confirmed by HPLC analysis.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Novo Nordisk Foundation Center for Biosustainability, Bacterial Cell Factory Optimization, Research Groups
Number of pages: 1
Publication date: 2016
Main Research Area: Technical/natural sciences
Electronic versions: bios2016_poster_v1_KZ_LM.pdf
Publication: Research - peer-review › Poster – Annual report year: 2016

Surface modification does not influence the genotoxic and inflammatory effects of TiO\(_2\) nanoparticles after pulmonary exposure by instillation in mice

The influence of surface charge of nanomaterials on toxicological effects is not yet fully understood. We investigated the inflammatory response, the acute phase response and the genotoxic effect of two different titanium dioxide nanoparticles (TiO\(_2\) NPs) following a single intratracheal instillation. NRCWE-001 was unmodified rutile TiO\(_2\) with endogenous negative surface charge, whereas NRCWE-002 was surface modified to be positively charged. C57BL/6J BomTac mice received 18, 54 and 162 µg/mouse and were humanely killed 1, 3 and 28 days post-exposure. Vehicle controls were tested alongside for comparison. The cellular composition and protein concentration were determined in bronchoalveolar lavage
The BAL (BAL) fluid as markers for an inflammatory response. Pulmonary and systemic genotoxicity was analysed by the alkaline comet assay as DNA strand breaks in BAL cells, lung and liver tissue. The pulmonary and hepatic acute phase response was analysed by Saa3 mRNA levels in lung tissue or Saa1 mRNA levels in liver tissue by real-time quantitative polymerase chain reaction. Instillation of NRCWE-001 and -002 both induced a dose-dependent neutrophil influx into the lung lining fluid and Saa3 mRNA levels in lung tissue at all assessed time points. There was no statistically significant difference between NRCWE-001 and NRCWE-002. Exposure to both TiO$_2$ NPs induced increased levels of DNA strand breaks in lung tissue at all doses 1 and 28 days post-exposure and NRCWE-002 at the low and middle dose 3 days post-exposure. The DNA strand break levels were statistically significantly different for NRCWE-001 and -002 for liver and for BAL cells, but no consistent pattern was observed. In conclusion, functionalisation of reactive negatively charged rutile TiO$_2$ to positively charged did not consistently influence pulmonary toxicity of the studied TiO$_2$ NPs.
Symmetry-selected spin-split hybrid states in C-60/ferromagnetic interfaces

The understanding of orbital hybridization and spin polarization at the organic-ferromagnetic interface is essential in the search for efficient hybrid spintronic devices. Here, using first-principles calculations, we report a systematic study of spin-split hybrid states of C60 deposited on various ferromagnetic surfaces: bcc-Cr(001), bcc-Fe(001), bcc-Co(001), fcc-Co(001), and hcp-Co(0001). We show that the adsorption geometry of the molecule with respect to the surface crystallographic orientation of the magnetic substrate as well as the strength of the interaction play a crucial role in the spin polarization of the hybrid orbitals. We find that a large spin polarization in vacuum above the buckyball can only be achieved if the molecule is adsorbed upon a bcc-(001) surface by its pentagonal ring. Therefore, bcc-Cr(001), bcc-Fe(001), and bcc-Co(001) are the optimal candidates. Spin-polarized scanning tunneling spectroscopy measurements on single C60 adsorbed on Cr(001) and Co/Pt(111) also confirm that the symmetry both of the substrate and of the molecular conformation has a strong influence on the induced spin polarization. Our finding may give valuable insights for further engineering of spin filtering devices through single molecular orbitals.
Synthesis and characterization of UV photocrosslinkable hydrogels with poly(N-vinyl-2-pyrrolidone): Determination of the network mesh size distribution

Hydrogels of poly(N-vinyl-2-pyrrolidone) were produced by UV irradiation of aqueous solutions of the polymer in presence of hydrogen peroxide, used as initiator. The mechanical and the nanostructural properties of the gels were characterized by a combination of experimental techniques including rheology, low field nuclear magnetic resonance spectroscopy (LF-NMR), and small angle X-ray scattering. Different irradiation doses as well as polymer and initiator concentrations were tested in the characterization. The study elucidates the relationship between different methods to estimate the mesh size of the gel polymeric network. Moreover, a novel correlation model was developed based on Chui and Scherer theories for the interpretation of LF-NMR dataset of polymer solutions and networks.
Synthesis, Characterizations of Superparamagnetic Fe₃O₄-Ag Hybrid Nanoparticles and Their Application for Highly Effective Bacteria Inactivation

In recent years, outbreaks of infectious diseases caused by pathogenic micro-organisms pose a serious threat to public health. In this work, Fe₃O₄-Ag hybrid nanoparticles were synthesized by simple chemistry method and these prepared nanoparticles were used to investigate their antibacterial properties and mechanism against methicillin-resistant Staphylococcus aureus (MRSA) pathogen. The formation of dimer-like nanostructure of Fe₃O₄-Ag hybrid NPs was confirmed by X-ray diffraction and High-resolution Transmission Electron Microscopy. Our biological analysis revealed that the Fe₃O₄-Ag hybrid NPs showed more noticeable bactericidal activity than that of plain Fe₃O₄ NPs and Ag-NPs. We suggest that the enhancement in bactericidal activity of Fe₃O₄-Ag hybrid NPs might be likely from main factors such as: (i) enhanced surface area property of hybrid nanoparticles; (ii) the high catalytic activity of Ag-NPs with good dispersion and aggregation stability due to the iron oxide magnetic carrier, and (iii) large direct physical contacts between the bacterial cell membrane and the hybrid nanoparticles. The superparamagnetic hybrid nanoparticles of iron oxide magnetic nanoparticles decorated with silver nanoparticles can be a potential candidate to effectively treat infectious MRSA pathogen with recyclable capability, targeted bactericidal delivery and minimum release into environment.
Synthesis of ligand-free CZTS nanoparticles via a facile hot injection route

Single-phase, ligand-free Cu2ZnSnS4 (CZTS) nanoparticles that can be dispersed in polar solvents are desirable for thin film solar cell fabrication, since water can be used as the solvent for the nanoparticle ink. In this work, ligand-free nanoparticles were synthesized using a simple hot injection method and the precursor concentration in the reaction medium was tuned to control the final product. The as-synthesized nanoparticles were characterized using various techniques, and were found to have a near-stoichiometric composition and a phase-pure kesterite crystal structure. No secondary phases were detected with Raman spectroscopy or scanning transmission electron microscopy energy dispersive x-ray spectroscopy. Furthermore, high resolution transmission electron microscopy showed large-sized nanoparticles with an average diameter of 23 nm ± 11 nm. This approach avoids all organic materials and toxic solvents that otherwise could hinder grain growth and limit the deposition techniques. In addition the synthesis route presented here results in nanoparticles of a large size compared to other ligand-free CZTS nanoparticles, due to the high boiling point of the solvents selected. Large particle size in CZTS nanoparticle solar cells may lead to a promising device performance. The results obtained demonstrate the suitability of the synthesized nanoparticles for application in low cost thin film solar cells.

General information
State: Published
Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Energy Conversion and Storage, Imaging and Structural Analysis, Department of Physics, Experimental Surface and Nanomaterials Physics, Center for Individual Nanoparticle Functionality, Nanyang Technological University
Authors: Mirbagheri, N. (Intern), Engberg, S. L. J. (Intern), Crovetto, A. (Intern), Simonsen, S. B. (Intern), Hansen, O. (Intern), Lam, Y. M. (Ekstern), Schou, J. (Intern)
Number of pages: 8
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Nanotechnology
Volume: 27
Synthesis of porous MnCo$_2$O$_4$ microspheres with yolk–shell structure induced by concentration gradient and the effect on their performance in electrochemical energy storage

In this study, novel spherical yolk–shell MnCo$_2$O$_4$ powders with concentration gradient have been synthesized. The porous microspheres with yolk–shell structure (2.00–3.00 μm in average diameter, ~200 nm in thickness of shell) are built up by irregular nanoparticles attached to each other. It is shown that the formation of yolk–shell structure may be induced by the core–shell concentration gradient. And the Co : Mn atomic ratios of core and shell are about 1.65 : 1 and 2.61 : 1, respectively. Interestingly, a similar uniform spherical MnCo2O4 without yolk–shell structure and concentration gradient prepared as a contrast, the superior electrochemical performance of the former by using in Li-ion batteries and supercapacitors has been proved including higher initial discharge capacity (1445.1 mA h g$^{-1}$ at 0.2 A g$^{-1}$) and initial specific capacitance (761.3 F g$^{-1}$ at 2 A g$^{-1}$), and more advanced capacity retention (~860.0 mA h g$^{-1}$ after 40 cycles at 0.2 A g$^{-1}$, and ~330.0 F g$^{-1}$ after 3000 cycles at 12 A g$^{-1}$).

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Tsinghua University
Authors: Huang, G. (Ekstern), Yang, Y. (Ekstern), Sun, H. (Intern), Xu, Z. (Ekstern)
Number of pages: 12
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Main Research Area: Technical/natural sciences

Publication information
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.736 SJR 0.863
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.06 SNIP 0.889 SJR 0.757
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.947 SNIP 0.834 CiteScore 3.42
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.113 SNIP 0.962 CiteScore 3.87
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.119 SNIP 0.904 CiteScore 3.74
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 0.872 SNIP 0.619 CiteScore 2.4
ISI indexed (2012): ISI indexed no
Web of Science (2012): Indexed yes
Targeted nanoparticles for colorectal cancer

Colorectal cancer (CRC) is highly prevalent worldwide, and despite notable progress in treatment still leads to significant morbidity and mortality. The use of nanoparticles as a drug delivery system has become one of the most promising strategies for cancer therapy. Targeted nanoparticles could take advantage of differentially expressed molecules on the surface of tumor cells, providing effective release of cytotoxic drugs. Several efforts have recently reported the use of diverse molecules as ligands on the surface of nanoparticles to interact with the tumor cells, enabling the effective delivery of antitumor agents. Here, we present recent advances in targeted nanoparticles against CRC and discuss the promising use of ligands and cellular targets in potential strategies for the treatment of CRCs.
Targeting HER2-positive cancer using multifunctional nanoparticles

Advanced delivery of chemotherapeutics to tumor tissue is an active field of research, as it offers several benefits over conventional cancer therapies. In the three introductory chapters of this thesis, the development of liposomes as drug carriers, including novel strategies to improve delivery efficiency, is thoroughly reviewed.

Chapter 4 encompasses a comprehensive manuscript, which describes the in vitro and in vivo evaluation of a novel liposomal delivery platform designed to target the HER2 receptor on cancer cells and be activated by enzyme activity in the tumor.

In Chapter 5, an alternative HER2-targeted liposome formulation was assessed in vitro. Rather than being enzyme-sensitive, these liposomes were responsive to reducing conditions. Such conditions are found in several cancers due to hypoxia as well as in endocytic compartments.

The progressive in vitro optimization of a complex multifunctional liposomal formulation is reviewed in Chapter 6. This formulation is similar to the one described in Chapter 4, but the lipid composition of the liposomes has been changed to make the formulation sensitive to low pH and prone to engage in advantageous interactions with other lipid membranes.

The final study, described in Chapter 7, comprises an in vivo evaluation of the potential benefits of combining enzyme-sensitive liposomal oxaliplatin with the HER2-targeted antibody trastuzumab.

As concluded in the final comments in Chapter 8, the extensive in vitro and in vivo data reported in this thesis demonstrate the potential of using HER2-targeting in combination with advanced drug release mechanisms and present exciting new perspectives for the development of novel delivery platforms.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces
Authors: Juul, C. A. (Intern), Andresen, T. L. (Intern), Hansen, A. E. (Intern)
Number of pages: 138
Publication date: 2016

Publication information
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Original language: English
Main Research Area: Technical/natural sciences

Relations
Projects:
Targeting HER2-positive cancer using multifunctional nanoparticles
Source: PublicationPreSubmission
Source-ID: 127612505
Publication: Research › Ph.D. thesis – Annual report year: 2016

Targeting the DCIR Receptor with a TLR7 Agonist Specifically Activates Monocytes and DCs

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Department of Systems Biology, Center for Biological Sequence Analysis, Disease Systems Immunology, Telormedix SA
Authors: Klauber, T. C. B. (Intern), Laursen, J. M. (Intern), Maj, R. (Ekstern), Pedersen, S. B. (Intern), Jensen, S. S. (Intern), Andresen, T. L. (Intern)
Publication date: 2016
Event: Abstract from The 43rd Annual Meeting & Exposition of the Controlled Release Society, Seattle, WA, United States.
Templated green synthesis of plasmonic silver nanoparticles in onion epidermal cells suitable for surface-enhanced Raman and hyper-Raman scattering

We report fast and simple green synthesis of plasmonic silver nanoparticles in the epidermal cells of onions after incubation with AgNO₃ solution. The biological environment supports the generation of silver nanostructures in two ways. The plant tissue delivers reducing chemicals for the initial formation of small silver clusters and their following conversion to plasmonic particles. Additionally, the natural morphological structures of the onion layers, in particular the extracellular matrix provides a biological template for the growth of plasmonic nanostructures. This is indicated by red glowing images of extracellular spaces in dark field microscopy of onion layers a few hours after AgNO₃ exposure due to the formation of silver nanoparticles. Silver nanostructures generated in the extracellular space of onion layers and within the epidermal cell walls can serve as enhancing plasmonic structures for one-and two-photon-excited spectroscopy such as surface enhanced Raman scattering (SERS) and surface enhanced hyper-Raman scattering (SEHRS). Our studies demonstrate a templated green preparation of enhancing plasmonic nanoparticles and suggest a new route to deliver silver nanoparticles as basic building blocks of plasmonic nanosensors to plants by the uptake of solutions of metal salts.
The distribution of work performed on a NIS junction: Paper

We propose an experimental setup to measure the work performed in a normal-metal/insulator/superconducting (NIS) junction, subjected to a voltage change and in contact with a thermal bath. We compute the performed work and argue that the associated heat release can be measured experimentally. Our results are based on an equivalence between the dynamics of the NIS junction and that of an assembly of two-level systems subjected to a circularly polarised field, for which we can determine the work-characteristic function exactly. The average work dissipated by the NIS junction, as well as its fluctuations, are determined. From the work characteristic function, we also compute the work probability-distribution and show that it does not have a Gaussian character. Our results allow for a direct experimental test of the Crooks–Tasaki fluctuation relation.
The hot pick-up technique for batch assembly of van der Waals heterostructures
The assembly of individual two-dimensional materials into van der Waals heterostructures enables the construction of layered three-dimensional materials with desirable electronic and optical properties. A core problem in the fabrication of these structures is the formation of clean interfaces between the individual two-dimensional materials which would affect device performance. We present here a technique for the rapid batch fabrication of van der Waals heterostructures, demonstrated by the controlled production of 22 mono-, bi- and trilayer graphene stacks encapsulated in hexagonal boron nitride with close to 100% yield. For the monolayer devices, we found semiclassical mean-free paths up to 0.9μm, with the narrowest samples showing clear indications of the transport being affected by boundary scattering. The presented method readily lends itself to fabrication of van der Waals heterostructures in both ambient and controlled atmospheres, while the ability to assemble pre-patterned layers paves the way for complex three-dimensional architectures.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Center for Nanostructured Graphene, Cornell University, Columbia University
The impact of transferrin receptor targeting on immunoliposomal cargo delivery across the blood-brain barrier.
The influence of removing sizing on strength and stiffness of conventional and high modulus E-glass fibres

Two types of E-glass fibres, a conventional and a high modulus where the last one in the following will be denoted as ECR-glass fibre, were investigated regarding density, diameter, stiffness and strength. The fibres were analysed as pristine and after sizing removal treatments. The sizing was removed by either burning at 565 °C or soxhlet extraction with acetone. It was found that the density and the stiffness increased after removing the sizing by the two removal treatments whereas the diameter did not change significantly. The strength of the fibres decreased after burning as the sizing, protecting against water and fibre-fibre damage, had been removed. The strength of the fibres after extraction was not significantly different from the strength of the pristine fibres despite removing the sizing. This indicates that the bonded part of sizing is still protecting the glass fibre surface.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Department of Wind Energy, Composites and Materials Mechanics
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Number of pages: 7
Publication date: 2016
Main Research Area: Technical/natural sciences

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BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.39 SJR 0.197 SNIP 0.535
Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 0.197 SNIP 0.361 CiteScore 0.22
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Scopus rating (2013): SJR 0.205 SNIP 0.287 CiteScore 0.16
ISI indexed (2013): ISI indexed no
Scopus rating (2012): SJR 0.183 SNIP 0.257 CiteScore 0.14
ISI indexed (2012): ISI indexed no
Scopus rating (2011): SJR 0.23 SNIP 0.355 CiteScore 0.1
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Scopus rating (2010): SJR 0.179 SNIP 0.155
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The Influence of Structure Heights and Opening Angles of Micro- and Nanocones on the Macroscopic Surface Wetting Properties

We discuss the influence of surface structure, namely the height and opening angles of nano-and microcones on the surface wettability. We show experimental evidence that the opening angle of the cones is the critical parameter on sample superhydrophobicity, namely static contact angles and roll-off angles. The textured surfaces are fabricated on silicon wafers by using a simple one-step method of reactive ion etching at different processing time and gas flow rates. By using hydrophobic coating or hydrophilic surface treatment, we are able to switch the surface wettability from superhydrophilic to superhydrophobic without altering surface structures. In addition, we show examples of polymer replicas (polypropylene and poly(methyl methacrylate) with different wettability, fabricated by injection moulding using templates of the silicon cone-structures.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Surface Engineering, Technical University of Denmark
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Main Research Area: Technical/natural sciences

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Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 4.63 SJR 1.692 SNIP 1.354
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.034 SNIP 1.597 CiteScore 5.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.163 SNIP 1.554 CiteScore 4.75
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.998 SNIP 1.57 CiteScore 4.06
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.531 SNIP 0.962 CiteScore 2.44
ISI indexed (2012): ISI indexed yes
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ISI indexed (2011): ISI indexed no
Original language: English
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Bibliographical note
Theory of optical-tweezers forces near a plane interface

Optical-tweezers experiments in molecular and cell biology often take place near the surface of the microscope slide that defines the bottom of the sample chamber. There, as elsewhere, force measurements require force-calibrated tweezers. In bulk, one can calculate the tweezers force from first principles, as recently demonstrated. Near the surface of the microscope slide, this absolute calibration method fails because it does not account for reverberations from the slide of the laser beam scattered by the trapped microsphere. Nor does it account for evanescent waves arising from total internal reflection of wide-angle components of the strongly focused beam. In the present work we account for both of these phenomena. We employ Weyl’s angular spectrum representation of spherical waves in terms of real and complex rays and derive a fast-converging recursive series of multiple reflections that describes the reverberations, including also evanescent waves. Numerical simulations for typical setup parameters evaluate these effects on the optical force and trap stiffness, with emphasis on axial trapping. Results are in good agreement with available experimental data. Thus, absolute calibration now applies to all situations encountered in practice.
Thermal analysis of CZTS nanoparticles and inks

General information
State: Published
Organisations: Department of Photonics Engineering, Department of Energy Conversion and Storage, Mixed Conductors, Department of Micro- and Nanotechnology, Silicon Microtechnology, Experimental Surface and Nanomaterials Physics, Optical Microsensors and Micromaterials, Nanyang Technological University
Authors: Engberg, S. L. J. (Intern), Agersted, K. (Ekstern), Crovetto, A. (Intern), Hansen, O. (Intern), Lam, Y. M. (Ekstern), Schou, J. (Intern)
Publication date: 2016
Event: Poster session presented at 2016 E-MRS Spring Meeting and Exhibit, Lille, France.
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Journal article – Annual report year: 2016

Thermal analysis of CZTS nanoparticles and inks

Thermally activated formation of martensite in Fe-C alloys and Fe-17%Cr-C stainless steels during heating from boiling nitrogen temperature

The thermally activated austenite-to-martensite transformation was investigated by magnetometry in three Fe-C alloys and in two 17%Cr stainless steels. After quenching to room temperature, samples were immersed in boiling nitrogen and martensite formation was followed during subsequent re-heating to room temperature. Different tests were performed applying heating rates from 0.5 K/min to 10 K/min. An additional test consisted in fast re-heating the samples by immersion in water. Thermally activated martensite formation was demonstrated for all investigated materials by a heating rate-dependent transformation curve. Moreover, magnetometry showed that the heating rate had an influence on the fraction of martensite formed during sub-zero Celsius treatment. The activation energy for thermally activated martensite formation was quantified in the range 11–21 kJ/mol by a Kissinger-like method.

General information
State: Published
Organisations: Department of Mechanical Engineering, Materials and Surface Engineering, Department of Micro- and Nanotechnology, Magnetic Systems
Authors: Villa, M. (Intern), Hansen, M. F. (Intern), Somers, M. A. J. (Intern)
The use of matrigel has no influence on tumor development or PET imaging in FaDu human head and neck cancer xenografts

Background: In preclinical research Matrigel® Basement Membrane Matrix (MG) is used frequently for the establishment of syngeneic and xenograft cancer models. Limited information on its influence on parameters including; tumor growth, vascularization, hypoxia and imaging characteristics is currently available. This study evaluates the potential effect of matrigel use in a human head and neck cancer xenograft model (FaDu; hypopharyngeal carcinoma) in NMRI nude mice. The FaDu cell line was chosen based on its frequent use in studies of cancer imaging and tumor microenvironment.

Methods: NMRI nude mice (n = 34) were divided into two groups and subcutaneously injected with FaDu cells in medium either including (+MG) or excluding matrigel (-MG). In sub study I seven mice from each group (+MG, n = 7; -MG, n = 7) were 18F-fluorodeoxyglucose (18F-FDG) PET/CT scanned on Day 5, 8, 12, 15, and 19. In sub study II ten mice from each group (+MG, n = 10; -MG, n = 10) were included and tumors collected for immunohistochemistry (IHC) analysis of tumor microenvironment including; proliferation ratio, micro vessel density, average vessel area, hypoxia, nuclear density, and necrosis. Tumors for IHC were collected according to size (200-400 mm³, 500-700 mm³, 800-1100 mm³).

Results: FDG uptake and tumor growth was statistically compatible for the tumors established with or without MG. The IHC analysis on all parameters only identified a significantly higher micro vessel density for tumor size 500-700 mm³ and 800-1100 mm³ and average vessel area for tumor size 500-700 mm³ in the -MG group. Comparable variations were observed for tumors of both the +MG and -MG groups. No difference in tumor take rate was observed between groups in study.

Conclusions: Matrigel did not affect tumor growth or tumor take for the FaDu xenograft model evaluated. Tumors in the -MG group displayed increased angiogenesis compared to the +MG tumors. No difference in 18F-FDG PET uptake for tumors of different groups was found. Based on these observations the influence of matrigel on tumor imaging and tumor microenvironment seems minor for this particular xenograft model.

General information
State: Published
Organisations: Department of Electrical Engineering, Department of Micro- and Nanotechnology, University of Copenhagen
Authors: Fliedner, F. P. (Ekstern), Hansen, A. E. (Intern), Jorgensen, J. T. (Ekstern), Kjær, A. (Ekstern)
Number of pages: 8
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BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.942 SJR 0.536
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.578 SNIP 0.752 CiteScore 1.56
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
The Use of Silk in Nanomedicine Applications

Biopolymers made up of silk proteins have been used in numerous drug delivery applications and represent an excellent source of natural biomaterials. In particular silk fibroin has proved valuable as a building block for nanomedicines and drug delivery implants, owing to its favorable biocompatibility, degradation, stabilization and controllability. In this chapter we will discuss the various sources of silk biomaterial and how this naturally occurring biopolymer has been utilized in the development of nanomedicines and implantable drug delivery systems, demonstrating how silk is a unique biological template which has opened up many possibilities for the generation of functional biomaterials and drug delivery systems in a green and cost-effective manner.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Harvard University
Authors: Chiasson, R. (Ekstern), Hasan, M. (Ekstern), Al Nazer, Q. (Ekstern), Farokhzad, O. C. (Ekstern), Kamaly, N. (Intern)
Pages: 245-278
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Host publication information
Title of host publication: Nanomedicine
Publisher: Springer
ISBN (Print): 978-1-4939-3632-8
Chapter: 11
Main Research Area: Technical/natural sciences
**THz photonics—wireless transmission of 160 Gbit/s bitrate**

We present a record bitrate wireless transmission in the THz band above 300 GHz by successfully demonstrating a 160 Gbit/s photonics wireless link operating in the 300–500 GHz band based on a single THz emitter.

**General information**

State: Published

Organisations: Department of Photonics Engineering, High-Speed Optical Communication, Centre of Excellence for Silicon Photonics for Optical Communications, Department of Micro- and Nanotechnology, Zhejiang University


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Main Research Area: Technical/natural sciences

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THz communications, THz photonics, RF photonics

Source: FindIt

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Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

**THz photonic wireless links with 16-QAM modulation in the 375-450 GHz band**

We propose and experimentally demonstrate THz photonic wireless communication systems with 16-QAM modulation in the 375-450 GHz band. The overall throughput reaches as high as 80 Gbit/s by exploiting four THz channels with 5 Gbaud 16-QAM baseband modulation per channel. We create a coherent optical frequency comb (OFC) for photonic generation of multiple THz carriers based on photo-mixing in a uni-travelling carrier photodiode (UTC-PD). The OFC configuration also allows us to generate reconfigurable THz carriers with low phase noise. The multiple-channel THz radiation is received by using a Schottky mixer based electrical receiver after 0.5 m free-space wireless propagation. 2-channel (40 Gbit/s) and 4-channel (80 Gbit/s) THz photonic wireless links with 16-QAM modulation are reported in this paper, and the bit error rate (BER) performance for all channels in both cases is below the hard decision forward error correction (HD-FEC) threshold of 3.8e-3 with 7% overhead. In addition, we also successfully demonstrate hybrid photonic wireless transmission of 40 Gbit/s 16-QAM signal at carrier frequencies of 400 GHz and 425 GHz over 30 km standard single mode fiber (SSMF) between the optical baseband signal transmitter and the THz wireless transmitter with negligible induced power penalty.

**General information**

State: Published

Organisations: Department of Photonics Engineering, High-Speed Optical Communication, Centre of Excellence for Silicon Photonics for Optical Communications, Department of Micro- and Nanotechnology, Tianjin University

Authors: Jia, S. (Ekstern), Yu, X. (Intern), Hu, H. (Intern), Yu, J. (Ekstern), Guan, P. (Intern), Da Ros, F. (Intern), Galili, M. (Intern), Morioka, T. (Intern), Oxenløwe, L. K. (Intern)

Pages: 23777-23783

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BFI (2018): BFI-level 2

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Atomic and Molecular Physics, and Optics, Bit error rate, Data communication systems, Digital television, Error correction, Modulation, Optical communication, Single mode fibers, Transmitters, Wireless telecommunication systems, Bit error rate (BER) performance, Photonic generations, Standard single mode fibers, Uni-travelling-carrier photodiodes, Wireless communication system, Wireless propagation, Wireless transmissions, Wireless transmitter, Terahertz waves
Time lens based optical fourier transformation for advanced processing of spectrally-efficient OFDM and N-WDM signals

We review recent progress in the use of time lens based optical Fourier transformation for advanced optical signal processing, with focus on all-optical generation, detection and format conversion of spectrally-efficient OFDM and N-WDM signals.

Timing jitter correction for THz-TDS measurements of graphene

We discuss how noncontact, quantitative large-area mapping of the conductance of thin films requires delicate corrections in order to deduce electrical properties such as graphene mobility from THz-TDS measurements.
Transfer and characterization of large-area CVD graphene for transparent electrode applications

The growth of chemical vapor deposited graphene on copper is approaching industrial maturity. A subsequent transfer of the graphene layer from its catalytic growth substrate is required for integration into optoelectronic devices and similar applications. It is well established that defects such as cracks, line defects, and wrinkles all contribute to lowering the quality and usability of graphene. This means that the development of transfer methods that does not introduce damage to the graphene layer and is non-destructive towards the catalytic growth substrate are of high importance.

This thesis addresses key issues for industrial integration of large area graphene for optoelectronic devices. This is done through optimization of existing characterization methods and development of new transfer techniques. A method for accurately measuring the decoupling of graphene from copper catalysts is introduced. The method is based on Raman spectroscopy, a standard characterization tool in the graphene community. By measuring when the graphene is fully decoupled from its growth substrate we are able to transfer graphene by mechanical peeling from 12 inch diameter copper thin films.

Additionally, results from an electrochemical transfer method and from a transfer method based on interfacial Cu oxidation in alkaline solution are presented. Both methods leave the copper catalyst intact for regrowths of graphene. The structural integrity of the transferred graphene is retained by these transfer methods and the electrical properties of graphene after transfer are superior compared to the standard etching transfer method.

Spatial mapping of the electrical properties of transferred graphene is performed using terahertz time-domain spectroscopy (THz-TDS). The non-contact nature of THz-TDS and the fact that it is an accurate and reliable probe of the graphene sheet conductivity makes it an interesting candidate for characterization of graphene production in industrial settings. Here we show that the electrical properties of graphene are measurable by THz-TDS on different substrates such as silicon wafers, glass, and polymer films, which only increases the suitability of THz-TDS for characterization of graphene in industrial settings.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon
Authors: Whelan, P. R. (Intern), Bøggild, P. (Intern), Booth, T. (Intern)
Number of pages: 158
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Publication information
Publisher: DTU Nanotech
Original language: English
Main Research Area: Technical/natural sciences

Relations
Projects:
Transfer and characterization of large-area CVD graphene for transparent electrode applications
Source: PublicationPreSubmission
Source-ID: 128932292
Publication: Research › Ph.D. thesis – Annual report year: 2017

Transition state theory demonstrated at the micron scale with out-of-equilibrium transport in a confined environment

Transition state theory (TST) provides a simple interpretation of many thermally activated processes. It applies successfully on timescales and length scales that differ several orders of magnitude: to chemical reactions, breaking of chemical bonds, unfolding of proteins and RNA structures and polymers crossing entropic barriers. Here we apply TST to out-of-equilibrium transport through confined environments: the thermally activated translocation of single DNA molecules over an entropic barrier helped by an external force field. Reaction pathways are effectively one dimensional and so long that they are observable in a microscope. Reaction rates are so slow that transitions are recorded on video. We find sharp transition states that are independent of the applied force, similar to chemical bond rupture, as well as transition states that change location on the reaction pathway with the strength of the applied force. The states of equilibrium and transition are separated by micrometres as compared with angstroms/nanometres for chemical bonds.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Stochastic Systems and Signals
Authors: Vestergaard, C. L. (Intern), Mikkelsen, M. B. L. (Intern), Reisner, W. (Intern), Kristensen, A. (Intern), Flyvbjerg, H. (Intern)
Number of pages: 9
This Ph.D. thesis presents fabrication and optimization of transparent plasmonic substrates that can be used for biological and chemical sensing by surface enhanced Raman spectroscopy (SERS) sensing and localized surface plasmon resonance refractive index (LSPR RI) sensing. These substrates are: glass nanopillars with gold caps for SERS sensing; polymer nanopillars with gold caps for SERS sensing; transferred gold nanocaps to polymer foil for SERS sensing; and glass hollow-core nanocylinders with gold nanorings for LSPR RI sensing.

These substrates were achieved using lithography-free fabrication methods, and resulted in large-area, high throughput and low cost production techniques. The fabrication techniques consisted of using aluminum patterned areas and reactive ion etching (RIE) to achieve nanopillars or nanocylinders in glass; using RIE to achieve nanopillars in silicon as a mould for polymer injection; and using RIE and imprinting to transfer gold nanocaps to a polymer foil.

The SERS substrates showed a 91%, a 94% and 8% Raman signal intensity compared to gold-capped silicon nanopillars for the glass nanopillars, the polymer injected nanopillars and the transferred metal nanocaps, respectively. As the substrates were transparent, measurements from the backside were possible, showing a 44%, 1.7% and 71% Raman signal intensity in comparison to the measurements from the front, for the glass nanopillars, the polymer injected nanopillars and the transferred metal nanocaps, respectively.
For LSPR, the glass hollow-core nanocylinders with suspended gold nanorings showed a sensitivity of 658 nm RIU with a gure-of-merit of 10. The LSPR wavelengths could be shifted by tuning the plasma etching parameters. Due to the low electrical conductivity of glass substrates, electrodes could be incorporated onto the glass nanopillars, resulting in a device that could be used for both electrochemistry and SERS measurements. The polymer injected nanopillars used an industrial high throughput and robust fabrication technique. The substrate was integrated into high throughput fluidic devices for in-situ SERS measurements. The fabrication methods presented in this Ph.D. thesis are scalable, high throughput and low cost, and result in high performance plasmonic surfaces for sensing.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Thilsted, A. H. (Intern), Boisen, A. (Intern), Rindzevicius, T. (Intern), Schmidt, M. S. (Intern)
Number of pages: 158
Publication date: 2016

Publication information
Publisher: DTU Nanotech
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions: Untitled.pdf

Relations
Projects:
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Source: PublicationPreSubmission
Source-ID: 128589069
Publication: Research › Ph.D. thesis – Annual report year: 2017

Triple co-culture cell model as an in vitro model for oral particulate vaccine systems
A triple co-culture cell model of Caco-2 cells, dendritic cells and macrophages (Figure 1) has previously been developed for studying intestinal permeability in a state of inflammation [1],[2]. The aim of this study was to investigate the applicability of this cell model for testing the immunostimulatory ability of particulate vaccine formulations designed for oral delivery. Levels of cytokine production in response to vaccine administration were measured following particulate vaccine administration, as an indication of dendritic cell and macrophage activation. Precursors of cubosomes containing the model antigen ovalbumin was spray dried to obtain a particulate vaccine model system for testing in the cell model. The precursors were shown to form cubosomes when dispersed in aqueous medium, and was therefore used as the vaccine formulation for testing on the co-cultures. After 11 days, the TEER values of the co-cultures were found to be 860-1340 Ω cm²; the formulations were incubated with the co-cultures at this time point. From confocal microscopy images, it was observed that the THP-1 cells (macrophages) migrated into the overlying Caco-2 cell monolayer when the co-cultures were incubated with particle formulations. This was not the case when incubating with ovalbumin solution or blank. The ELISA screening assay showed production of a wide range of cytokines following culture incubation with cubosomes (with and without ovalbumin) and LPS solutions, indicative of a stimulatory effect; this was not observed with ovalbumin and blank solution. An example of the results is shown in Figure 2 for IL-17A. An established co-culture of Caco-2, THP-1 and MUTZ-3 cells showed promise as an in vitro model for testing of oral vaccine formulations. Mobility of co-culture immune cells as well as cytokine production observed following treatment with spray dried cubosomes as a particulate vaccine formulation will be further investigated.

General information
State: Published
Organisations: Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Department of Micro- and Nanotechnology, Nanoprobes, Helmholtz Centre for Infection Research (HZI), Saarland University, University of Copenhagen, Monash University
Authors: Nielsen, L. H. (Intern), De Rossi, C. (Ekstern), Lehr, C. (Ekstern), Rades, T. (Ekstern), Boyd, B. (Ekstern), Boisen, A. (Intern), Gordon, S. (Ekstern)
Number of pages: 1
Publication date: 2016
Event: Poster session presented at BioBarriers 2016, Saarbrücken, Germany.
Main Research Area: Technical/natural sciences
Electronic versions: BB2016_cell_model.pdf

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Source: PublicationPreSubmission
Triple co-culture cell model as an in vitro model for oral particulate vaccine systems

General information
State: Published
Organisations: Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Department of Micro- and Nanotechnology, Nanoprobes, Helmholtz Centre for Infection Research (HIZ), University of Copenhagen, Monash University
Authors: Nielsen, L. H. (Intern), De Rossi, C. (Ekstern), Lehr, C. (Ekstern), Rades, T. (Ekstern), Boyd, B. (Ekstern), Boisen, A. (Intern), Gordon, S. (Ekstern)
Number of pages: 1
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Main Research Area: Technical/natural sciences
Electronic versions:
PBP_2016_Triple_co_culture_cell_model_as_an_in_vitro_model_for_oral_vaccines.pdf

Bibliographical note
Poster at conference, 10TH WORLD MEETING on Pharmaceutics, Biopharmaceutics and Pharmaceutical Technology
Source: PublicationPreSubmission
Source-ID: 125164776
Publication: Research - peer-review › Poster – Annual report year: 2016

Triple co-culture cell model as an in vitro model for oral particulate vaccine systems

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Helmholtz Institute for Pharmaceutical Research Saarland, Saarland University, University of Copenhagen, Monash University
Authors: Nielsen, L. H. (Intern), De Rossi, C. (Ekstern), Lehr, C. (Ekstern), Rades, T. (Ekstern), Boyd, B. (Ekstern), Boisen, A. (Intern), Gordon, S. (Ekstern)
Publication date: 2016
Event: Abstract from BioBarriers 2016, Saarbrücken, Germany.
Main Research Area: Technical/natural sciences
Electronic versions:
BB2016_cell_model.pdf

Bibliographical note
For poster presentation
Source: PublicationPreSubmission
Source-ID: 127315824
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Tunable on chip optofluidic laser
On chip tunable laser is demonstrated by realizing a microfluidic droplet array. The periodicity is controlled by the pressure applied to two separate inlets, allowing to tune the lasing frequency over a broad spectral range.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Hebrew University of Jerusalem
Authors: Bakal, A. (Ekstern), Vannahme, C. (Intern), Kristensen, A. (Intern), Levy, U. (Ekstern)
Number of pages: 2
Publication date: 2016

Host publication information
Title of host publication: Proceedings of 2016 Conference on Lasers and Electro-Optics
ISBN (Print): 978-1-5090-2434-6
Main Research Area: Technical/natural sciences
Conference: Conference on Lasers and Electro-Optics 2016, San Jose, California, United States, 05/06/2016 - 05/06/2016
Laser tuning, Laser modes, Microfluidics, Oils, Laser excitation, Laser applications
Tunneling spectra of graphene on copper unraveled

Scanning tunneling spectroscopy is often employed to study two-dimensional (2D) materials on conductive growth substrates, in order to gain information on the electronic structures of the 2D material-substrate systems, which can lead to insight into 2D material-substrate interactions, growth mechanisms, etc. The interpretation of the spectra can be complicated, however. Specifically for graphene grown on copper, there have been conflicting reports of tunneling spectra. A clear understanding of the mechanisms behind the variability is desired. In this work, we have revealed that the root cause of the variability in tunneling spectra is the variation in graphene-substrate coupling under various experimental conditions, providing a salutary perspective on the important role of 2D material-substrate interactions. The conclusions are drawn from measured data and theoretical calculations for monolayer, AB-stacked bilayer, and twisted bilayer graphene coexisting on the same substrates in areas with and without intercalated oxygen, demonstrating a high degree of consistency. The Van Hove singularities of the twisted graphene unambiguously indicate the Dirac energy between them, lending strong evidence to our assignment of the spectral features. In addition, we have discovered an O-Cu superstructure that has never been observed before.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Department of Physics, Center for Nanostructured Graphene, University at Buffalo, University of Tennessee
Authors: Zhang, X. (Ekstern), Stradi, D. (Intern), Liu, L. (Ekstern), Luo, H. (Ekstern), Brandbyge, M. (Intern), Gu, G. (Ekstern)
Pages: 17081-90
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Physical Chemistry Chemical Physics
Volume: 18
Issue number: 25
ISSN (Print): 1463-9076
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.089 SJR 1.686
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.06 SJR 1.685 SNIP 1.113
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.725 SNIP 1.205 CiteScore 4.45
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.771 SNIP 1.239 CiteScore 4.29
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.72 SNIP 1.207 CiteScore 4.05
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.921 SNIP 1.177 CiteScore 3.67
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.707 SNIP 1.19 CiteScore 3.6
ISI indexed (2011): ISI indexed yes
Two-phase model of hydrogen transport to optimize nanoparticle catalyst loading for hydrogen evolution reaction

With electrocatalysts it is important to be able to distinguish between the effects of mass transport and reaction kinetics on the performance of the catalyst. When the hydrogen evolution reaction (HER) is considered, an additional and often neglected detail of mass transport in liquid is the evolution and transport of gaseous H₂, since HER leads to the
continuous formation of $\text{H}_2$ bubbles near the electrode. We present a numerical model that includes the transport of both gaseous and dissolved $\text{H}_2$, as well as mass exchange between them, and combine it with a kinetic model of HER at platinum (Pt) nanoparticle electrodes.

We study the effect of the diffusion layer thickness and $\text{H}_2$ dissolution rate constant on the importance of gaseous transport, and the effect of equilibrium hydrogen coverage and Pt loading on the kinetic and mass transport overpotentials. Gaseous transport becomes significant when the gas volume fraction is sufficiently high to facilitate $\text{H}_2$ transfer to bubbles within a distance shorter than the diffusion layer thickness. At current densities below about 40 mA/cm$^2$ the model reduces to an analytical approximation that has characteristics similar to the diffusion of $\text{H}_2$. At higher current densities the increase in the gas volume fraction makes the $\text{H}_2$ surface concentration nonlinear with respect to the current density.

Compared to the typical diffusion layer model, our model is an extension that allows more detailed studies of reaction kinetics and mass transport in the electrolyte and the effects of gas bubbles on them.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Physics, Experimental Surface and Nanomaterials Physics, Aalto University
Authors: Kemppainen, E. (Ekstern), Halme, J. (Ekstern), Hansen, O. (Intern), Seger, B. (Intern), Lund, P. D. (Ekstern)
Pages: 7568-7581
Publication date: 2016
Main Research Area: Technical/natural sciences

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- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 2
- Scopus rating (2017): SJR 1.116 SNIP 1.267
- Web of Science (2017): Indexed yes
- BFI (2016): BFI-level 2
- Scopus rating (2016): CiteScore 3.74 SJR 1.145 SNIP 1.315
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): SJR 1.27 SNIP 1.314 CiteScore 3.46
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): SJR 1.207 SNIP 1.484 CiteScore 3.54
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 2
- Scopus rating (2013): SJR 1.265 SNIP 1.449 CiteScore 3.38
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 2
- Scopus rating (2012): SJR 1.499 SNIP 1.708 CiteScore 3.96
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 2
- Scopus rating (2011): SJR 1.443 SNIP 1.828 CiteScore 4.42
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 2
- Scopus rating (2010): SJR 1.579 SNIP 1.854
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 2
- Scopus rating (2009): SJR 1.32 SNIP 1.87
- Web of Science (2009): Indexed yes
Ultrafast coherent dynamics of a photonic crystal all-optical switch

We present pump-probe measurements of an all-optical photonic crystal switch based on a nanocavity, resolving fast coherent temporal dynamics. The measurements demonstrate the importance of coherent effects typically neglected when considering nanocavity dynamics. In particular, we report the observation of an idler pulse. The measurements are in good agreement with a theoretical model that allows us to ascribe the observation to oscillations of the free carrier population in the nanocavity. The effect opens perspectives for the realization of new all-optical photonic crystal switches with unprecedented switching contrast.

General information
State: Published
Organisations: Department of Photonics Engineering, Nanophotonics Theory and Signal Processing, Department of Micro- and Nanotechnology
Authors: Colman, P. (Intern), Hansen, P. L. (Intern), Yu, Y. (Intern), Mørk, J. (Intern)
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Physical Review Letters
Volume: 117
Issue number: 23
Article number: 233901
ISSN (Print): 0031-9007
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 2.464 SJR 3.622
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.33 SJR 4.196 SNIP 2.61
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.656 SNIP 2.538 CiteScore 5.76
Ultrafast dynamics in unaligned MWCNTs decorated with metal nanoparticles

The relaxation dynamics of unaligned multi-walled carbon nanotubes decorated with metallic nanoparticles have been studied by using transient optical measurements. The fast dynamics due to the short-lived free-charge carriers excited by the pump are not affected by the presence of nanoparticles. Conversely, a second long dynamics, absent in bare carbon nanotubes, appears only in the decorated samples. A combination of experiment and theory allows us to ascribe this long dynamics to relaxation channels involving electronic states localized at the tube-nanoparticle interface.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, Universita Cattolica del Sacro Cuore, Università degli Studi di Roma Tor Vergata, Friedrich-Schiller-Universität Jena
Authors: Manzoni, G. (Ekstern), Ponzoni, S. (Ekstern), Galimberti, G. (Ekstern), Scarselli, M. (Ekstern), Pulci, O. (Ekstern), Camilli, L. (Intern), Matthes, L. (Ekstern), Castrucci, P. (Ekstern), Pagliara, S. (Ekstern)
Number of pages: 5
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Nanotechnology
Volume: 27
Issue number: 23
Article number: 235704
ISSN (Print): 0957-4484
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 0.788 SJR 1.079
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.87 SJR 1.339 SNIP 0.945
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.257 SNIP 1.035 CiteScore 3.07
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.497 SNIP 1.269 CiteScore 3.09
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.602 SNIP 1.231 CiteScore 2.74
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.861 SNIP 1.307 CiteScore 3.34
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.899 SNIP 1.451 CiteScore 3.86
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.844 SNIP 1.252
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.809 SNIP 1.27
Web of Science (2009): Indexed yes
Ultra-high-speed all-channel serial-to-parallel conversion based on complete optical fourier transformation

We propose a serial-to-parallel conversion scheme based on complete OFT, allowing simultaneous conversion of all channels. We demonstrate all 32-channel simultaneous OTDM to WDM conversion of 320-Gbit/s DPSK and of 640-Gbit/s DQPSK signal, respectively.

General information
State: Published
Organisations: Department of Photonics Engineering, High-Speed Optical Communication, Centre of Excellence for Silicon Photonics for Optical Communications, Department of Micro- and Nanotechnology
Authors: Guan, P. (Intern), Røge, K. M. (Intern), Morioka, T. (Intern), Oxenløwe, L. K. (Intern)
Number of pages: 3
Pages: 3 pp.
Publication date: 2016

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Publisher: Optical Society of America (OSA)
Article number: W3D
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Series: 2016 Optical Fiber Communications Conference and Exhibition (ofc)
Main Research Area: Technical/natural sciences
Conference: 2016 Optical Fiber Communication Conference and Exhibition, Anaheim, California, United States, 20/03/2016 - 20/03/2016
Multiplexing and switching in optical communication, Modulation and coding methods, Laser beam modulation, pulsing and switching; mode locking and tuning, differential phase shift keying, Fourier transform optics, high-speed optical techniques, quadrature phase shift keying, wavelength division multiplexing, DQPSK, DPSK, WDM, OTDM, OFT, optical fourier transformation, ultra-high-speed all-channel serial-to-parallel conversion, bit rate 320 Gbit/s, bit rate 640 Gbit/s
Electronic versions:
OFC2016_paper_1.pdf
DOIs:
10.1364/OFC.2016.W3D.2
Ultrahigh-speed Si-integrated on-chip laser with tailored dynamic characteristics

For on-chip interconnects, an ideal light source should have an ultralow energy consumption per bandwidth (operating energy) as well as sufficient output power for error-free detection. Nanocavity lasers have been considered the most ideal for smaller operating energy. However, they have a challenge in obtaining a sufficient output power. Here, as an alternative, we propose an ultrahigh-speed microcavity laser structure, based on a vertical cavity with a high-contrast grating (HCG) mirror for transverse magnetic (TM) polarisation. By using the TM HCG, a very small mode volume and an un-pumped compact optical feedback structure can be realised, which together tailor the frequency response function for achieving a very high speed at low injection currents. Furthermore, light can be emitted laterally into a Si waveguide. From an 1.54-μm optically-pumped laser, a 3-dB frequency of 27 GHz was obtained at a pumping level corresponding to sub-mA. Using measured 3-dB frequencies and calculated equivalent currents, the modulation current efficiency factor (MCEF) is estimated to be 42.1 GHz/mA(1/2), which is superior among microcavity lasers. This shows a high potential for a very high speed at low injection currents or very small heat generation at high bitrates, which are highly desirable for both on-chip and off-chip applications.
Ultrasound-mediated delivery of novel bio-responsive nanoparticles

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Norwegian University of Science and Technology
Authors: Sereti, V. (Intern), Olsman, M. (Ekstern), Andresen, T. L. (Intern), Davies, C. D. L. (Ekstern)
Number of pages: 1
Publication date: 2016
Event: Abstract from The 8th National PhD Conference in Medical Imaging, Trondheim, Norfolk Island.
Main Research Area: Technical/natural sciences

Uncertainty budget for determinations of mean isomer shift from Mössbauer spectra
The magnetite/maghemite content within iron oxide nanoparticles can be determined using the mean isomer shift (δ). However, accurate characterisation of the composition is limited by the uncertainty associated with δ. We have identified four independent sources of uncertainty and developed a quantitative expression for the uncertainty budget. Sources of uncertainty are categorised as follows: that from the fitting of the Mössbauer spectrum (σ_fit), that of the calibration of the α-Fe reference spectrum (σ_cal), thermal corrections to the spectrum due to second order Doppler shift (SODS) (σ_SODS) and other experimental errors (σ_err). Each contribution is discussed in detail using 57Fe Mössbauer spectra obtained from an iron oxide nanoparticle system at temperatures between 16 K and 295 K on different spectrometers in two different laboratories.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Department of Physics, Neutrons and X-rays for Materials Physics, Physikalisch-Technische Bundesanstalt, University College London
Authors: Fock, J. (Intern), Bogart, L. K. (Ekstern), Posth, O. (Ekstern), Hansen, M. F. (Intern), Pankhurst, Q. A. (Ekstern), Frandsen, C. (Intern)
Number of pages: 11
Pages: 23
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Hyperfine Interactions
Volume: 237
Issue number: 1
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BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.484 SJR 0.368
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.65 SJR 0.487 SNIP 0.505
Understanding the self-assembly of TCNQ on Cu(111): a combined study based on scanning tunnelling microscopy experiments and density functional theory simulations

The structure of self-assembled monolayers of 7,7',8,8'-tetracyano-p-quinodimethane (TCNQ) adsorbed on Cu(111) has been studied using a combination of scanning tunnelling microscopy (STM) experiments and density functional theory (DFT) calculations. We show that the polymorphism of the self-assembled molecular layer can be controlled by tuning of the experimental conditions under which the deposition is carried out. When the Cu(111) substrate is held above room temperature ($T_{Cu(111)} = 350$ K) during deposition, a structure is formed in which the two molecules in the unit cell are oriented one perpendicular to the other. Conversely, when the substrate is held at room temperature during deposition and slightly annealed afterwards, a more complex structure with five molecules per unit cell is formed. DFT calculations complement the experimental results by revealing that the building blocks of the two superstructures are two mutually orthogonal adsorption configurations of the molecule. The relative stability between the two observed polymorphs is reproduced by models of the two superstructures based on these two adsorption configurations.
Uniform Fe₃O₄ microflowers hierarchical structures assembled with porous nanoplates as superior anode materials for lithium-ion batteries

Uniform Fe₃O₄ microflowers assembled with porous nanoplates were successfully synthesized by a solvothermal method and subsequent annealing process. The structural and compositional analysis of the Fe₃O₄ microflowers were studied by X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and X-ray photoelectron spectroscopy (XPS). The Brüauer-Emmett-Teller (BET) specific surface area was calculated by the nitrogen isotherm curve and pore size distribution of Fe₃O₄ microflowers was determined by the Barret-Joyner-Halenda (BJH) method. When evaluated as anode material for lithium-ion batteries, the as-prepared Fe₃O₄ microflowers electrodes delivered superior capacity, better cycling stability and rate capability than that of Fe₃O₄ microspheres electrodes. The improved electrochemical performance was attributed to the microscale flowerlike architecture and the porous sheet structural nature.
Using Microfluidic Chips with Nanochannels for Measuring the Mean Inner Potential of Liquid Water by Off-Axis Electron Holography

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows
Authors: Yesibolati, M. N. (Intern), Laganà, S. (Intern), Sun, H. (Intern), Canepa, S. (Intern), Canepa, S. (Intern), Mølhave, K. (Intern)
Number of pages: 2
Publication date: 2016
Conference: 3rd International Conference on In-Situ and Correlative Electron Microscopy, Saarbrücken, Germany, 11/10/2016 - 11/10/2016
Main Research Area: Technical/natural sciences

Publication information
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Volume: 22
Issue number: S5
ISSN (Print): 1431-9276
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.275 SJR 0.292
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.5 SJR 0.31 SNIP 0.279
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.311 SNIP 0.195 CiteScore 0.57
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.301 SNIP 0.46 CiteScore 1.41
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.286 SNIP 0.279 CiteScore 1.55
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.327 SNIP 0.408 CiteScore 0.52
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Volumetric Synthetic Aperture Imaging with a Piezoelectric 2-D Row-Column Probe.

The synthetic aperture (SA) technique can be used for achieving real-time volumetric ultrasound imaging using 2-D row-column addressed transducers. This paper investigates SA volumetric imaging performance of an in-house prototyped 3 MHz λ/2-pitch 62+62 element piezoelectric 2-D row-column addressed transducer array. Utilizing single element transmit events, a volume rate of 90 Hz down to 14 cm deep is achieved. Data are obtained using the experimental ultrasound scanner SARUS with a 70 MHz sampling frequency and beamformed using a delay-and-sum (DAS) approach. A signal-to-noise ratio of up to 32 dB is measured on the beamformed images of a tissue mimicking phantom with attenuation of 0.5 dB cm⁻¹ MHz⁻¹, from the surface of the probe to the penetration depth of 300λ. Measured lateral resolution as Full-Width-at-Half-Maximum (FWHM) is between 4λ and 10λ for 18 % to 65 % of the penetration depth from the surface of the probe. The averaged contrast is 13 dB for the same range. The imaging performance assessment results may represent a reference guide for possible applications of such an array in different medical fields.

General information
State: Published
Organisations: Department of Electrical Engineering, Biomedical Engineering, Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Center for Fast Ultrasound Imaging, Sound Technology, Inc., BK Ultrasound
Authors: Bouzari, H. (Intern), Engholm, M. (Intern), Christiansen, T. L. (Intern), Beers, C. (Ekstern), Lei, A. (Intern), Stuart, M. B. (Intern), Nikolov, S. I. (Ekstern), Thomsen, E. V. (Intern), Jensen, J. A. (Intern)
Number of pages: 9
Publication date: 2016

Host publication information
Title of host publication: Proceedings of SPIE
Volume: 9790
Publisher: SPIE - International Society for Optical Engineering
Editors: Duric, N., Heyde, B.
Article number: 97900Y
Main Research Area: Technical/natural sciences
Conference: SPIE Medical Imaging 2016, San Diego, California, United States, 27/02/2016 - 27/02/2016
3-D ultrasound imaging, 2-D row-column addressed transducer, Synthetic aperture (SA)
Electronic versions:
SPIE.pdf
Wafer-Scale Nanopillars Derived from Block Copolymer Lithography for Surface-Enhanced Raman Spectroscopy

We report a novel nanofabrication process via block copolymer lithography using solvent vapor annealing. The nanolithography process is facile and scalable, enabling fabrication of highly ordered periodic patterns over entire wafers as substrates for surface-enhanced Raman spectroscopy (SERS). Direct silicon etching with high aspect ratio templated by the block copolymer mask is realized without any intermediate layer or external precursors. Uniquely, an atomic layer deposition (ALD)-assisted method is introduced to allow reversing of the morphology relative to the initial pattern. As a result, highly ordered silicon nanopillar arrays are fabricated with controlled aspect ratios. After metallization, the resulting nanopillar arrays are suitable for SERS applications. These structures readily exhibit an average SERS enhancement factor of above $10^8$, SERS uniformities of 8.5% relative standard deviation across 4 cm, and 6.5% relative standard deviation over $5 \times 5 \text{ mm}^2$ surface area, as well as a very low SERS background. The as-prepared SERS substrate, with a good enhancement and large-area uniformity, is promising for practical SERS sensing applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Self-Organized Nanoporous Materials, Nanoprobes, Center for Nanostructured Graphene, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Li, T. (Intern), Wu, K. (Intern), Rindzevicius, T. (Intern), Wang, Z. (Intern), Schulte, L. (Intern), Schmidt, M. S. (Intern), Boisen, A. (Intern), Ndoni, S. (Intern)
Number of pages: 8
Pages: 15668-75
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: A C S Applied Materials and Interfaces
Volume: 8
Issue number: 24
ISSN (Print): 1944-8244
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 2.784 SNIP 1.543
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 7.6 SJR 2.561 SNIP 1.536
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.262 SNIP 1.555 CiteScore 7.38
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.125 SNIP 1.636 CiteScore 6.88
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.992 SNIP 1.548 CiteScore 6.05
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.199 SNIP 1.327 CiteScore 4.94
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.046 SNIP 1.404 CiteScore 4.41
ISI indexed (2011): ISI indexed no
Web of Science (2011): Indexed yes
**Wetting dynamics for structured surfaces**

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Technical University of Denmark
Authors: Sun, L. (Intern), Segaard, E. (Intern), Andersen, N. K. (Intern), Larsen, S. T. (Ekstern), Taboryski, R. J. (Intern)
Publication date: 2016
Event: Abstract from EMN Meeting on Droplets 2016, San Sebastian, Spain.
Main Research Area: Technical/natural sciences
Electronic versions: Rafael_Taboryski_Abstract.pdf
Source: PublicationPreSubmission
Source-ID: 127743595
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

**Wnt3a nanodisks promote ex vivo expansion of hematopoietic stem and progenitor cells**

**Background:** Wnt proteins modulate development, stem cell fate and cancer through interactions with cell surface receptors. Wnts are cysteine-rich, glycosylated, lipid modified, two domain proteins that are prone to aggregation. The culprit responsible for this behavior is a covalently bound palmitoleoyl moiety in the N-terminal domain.

**Results:** By combining murine Wnt3a with phospholipid and apolipoprotein A-I, ternary complexes termed nanodisks (ND) were generated. ND-associated Wnt3a is soluble in the absence of detergent micelles and gel filtration chromatography revealed that Wnt3a co-elutes with ND. In signaling assays, Wnt3a ND induced β-catenin stabilization in mouse fibroblasts as well as hematopoietic stem and progenitor cells (HSPC). Prolonged exposure of HSPC to Wnt3a ND stimulated proliferation and expansion of Lin− Sca-1+ c-Kit+ cells. Surprisingly, ND lacking Wnt3a contributed to Lin− Sca-1+ c-Kit+ cell expansion, an effect that was not mediated through β-catenin.

**Conclusions:** The data indicate Wnt3a ND constitute a water-soluble transport vehicle capable of promoting ex vivo expansion of HSPC.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, Children's Hospital Oakland Research Institute
Authors: Lalefar, N. R. (Ekstern), Witkowski, A. (Ekstern), Simonsen, J. B. (Intern), Ryan, R. O. (Ekstern)
Number of pages: 10
Publication date: 2016
Main Research Area: Technical/natural sciences

**Publication information**
Journal: Journal of Nanobiotechnology
Volume: 14
Issue number: 1
ISSN (Print): 1477-3155
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.398 SJR 1.38
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
A method for the chemical modification of polychlorinated biphenyls for improved affinity towards noble metal surfaces.

The present application discloses a method for the modification and analysis of a field sample suspected of containing contaminant(s) like polychlorinated biphenyls (PCBs). The invention also relates to a corresponding kit for the modification of samples suspected of containing such contaminant(s).

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes
Authors: Rindzevicius, T. (Intern), Boisen, A. (Intern), Schmidt, M. S. (Intern), Barten, J. A. (Ekstern), Vorobiev, M. (Ekstern)
Publication date: 17 Dec 2015

Publication information
IPC: G01N 33/00 A1
Patent number: WO2015189262
Date: 17/12/2015
Priority date: 10/06/2014
Priority number: EP20140171743
Original language: English
Electronic versions:
WO2015189262A1.pdf
Main Research Area: Technical/natural sciences
Source: espacenet
Source-ID: WO2015189262
Publication: Research › Patent – Annual report year: 2015
A surface refractive index scanning system and method.
The invention relates to a surface refractive index scanning system for characterization of a sample. The system comprises a grating device for holding or receiving the sample, the device comprising at least a first grating region having a first grating width along a transverse direction, and a second grating region having a second grating width in the transverse direction. The first grating region and the second grating region are adjacent in the transverse direction, wherein the first grating region has a grating period $\Lambda_1$ in a longitudinal direction, and the second grating region has a grating period $\Lambda_2$ in the longitudinal direction, where the longitudinal direction is orthogonal to the transverse direction. A grating period spacing $\Delta \Lambda = \Lambda_1 - \Lambda_2$ is finite. Further, the first and second grating periods are chosen to provide optical resonances for light respectively in a first wavelength band and a second wavelength band, light is being emitted, transmitted, or reflected in an out-of-plane direction, wherein the first wavelength band and the second wavelength band are at least partially non-overlapping in wavelength. The system further comprises a light source for illuminating at least a part of the grating device with light at an illumination wavelength band. Additionally, the system comprises an imaging system for imaging the emitted, transmitted or reflected light from the grating device. The imaging system comprises an optical element, such as a cylindrical lens or a bended mirror, configured for focusing light in a transverse direction and for being invariant in an orthogonal transverse direction, the optical element being oriented such that the longitudinal direction of the grating device is oriented to coincide with the invariant direction of the optical element, and an imaging spectrometer comprising an entrance slit having a longitudinal direction oriented to coincide with the invariant direction of the optical element. The imaging spectrometer further comprises a 2-dimensional image sensor. The invention further relates to a method.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Optofluidics, Fluidic Array Systems and Technology
Authors: Kristensen, A. (Intern), Vannahme, C. (Intern), Dufva, M. (Intern)
Publication date: 12 Nov 2015
Publication information
IPC: H01S 5/00 A I
Patent number: WO2015169324
Date: 12/11/2015
Priority date: 08/05/2014
Priority number: EP20140167484
Original language: English
Main Research Area: Technical/natural sciences
Source: espacenet
Source-ID: WO2015169324
Publication: Research › Patent – Annual report year: 2016

Method of and system for identification or estimation of a refractive index of a liquid
This invention relates to a method of and a system (100) for identification or estimation of a refractive index of a liquid (120) comprising a light receiving part (111) adapted to receive polarised or non-polarised light (125; 135), a light emitting part (112) adapted, during use, to transmit light (130), an optical structure (110) being adapted to receive, during use, polarised light (125) via or from the light receiving part (111), and being adapted to receive, during use, a liquid (120) having a predetermined refractive index to be identified or estimated, and a first polariser (115) adapted, during use, to receive transmitted light (132) from the optical structure (110) and the received liquid (120), wherein the light receiving part (111), the received liquid (120), the first polariser (115), and the light emitting part (112) defines an optical path and wherein the system (100) is adapted, during use, to pass the received light (135) through the optical path so that a narrow wavelength range of the transmitted light (130) is influenced by the predetermined refractive index of the received liquid (120) and that the influenced narrow wavelength range, when observed by a user and/or captured by an image capturing unit (501), enables identification or estimation of the predetermined refractive index of the liquid (120). In this way, a method and a system for identification or estimation of a refractive index of a liquid is readily provided.

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Optofluidics
Authors: Kristensen, A. (Intern), Hermannsson, P. G. (Intern), Vannahme, C. (Intern), Smith, C. (Intern)
Publication date: 15 Oct 2015
Publication information
All-optical orthogonal frequency division multiplexing (OFDM) transmitter
The invention relates to an all-optical orthogonal frequency division multiplexing (OFDM) transmitter for generating an OFDM output signal. The transmitter comprises a first time-domain optical Fourier transform (OFT) assembly, the first OFT assembly is of a K-D-K configuration and comprises in said order a first phase modulator, a dispersive element and a second phase modulator. The first and second phase modulators are configurable for exercising a parabolic phase modulation to substantially linearly phase chirp an optical signal so as to have a chirp rate K₁ and K₂, respectively. The dispersive element has a dispersion parameter D. The phase modulators are configurable to have nominally identical chirp rates, K₁ = K₂ = K, and the OFT assembly is further configurable such that D = 1/K₁. The invention further relates to methods of generating an OFDM signal.

General information
State: Published
Organisations: Department of Photonics Engineering, High-Speed Optical Communication, Centre of Excellence for Silicon Photonics for Optical Communications, Department of Micro- and Nanotechnology
Authors: Guan, P. (Intern), Mulvad, H. C. H. (Intern), Oxenløwe, L. K. (Intern)
Publication date: 9 Sep 2015

Publication information
Country: Denmark
IPC: H04J 14/00 A I
Patent number: EP2916472
Priority date: 06/03/2014
Priority number: EP20140158224
Original language: English
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Bibliographical note
WO2015131908 (A1)
Main Research Area: Technical/natural sciences
Source: espacenet
Source-ID: EP2916472
Publication: Research › Patent – Annual report year: 2015

Electrochemical method for transferring graphene
The present application discloses a method for separating a graphene-support layer laminate from a conducting substrate-graphene-support layer laminate, using a gentle, controllable electrochemical method. In this way, substrates which are fragile, expensive or difficult to manufacture can be used - and even re-used - without damage or destruction of the substrate or the graphene.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanointegration, Nanoprobes, Center for Nanostructured Graphene
Authors: Pizzocchero, F. (Intern), Booth, T. J. (Ekstern), Kostesha, N. (Intern), Amato, L. (Intern), Bøggild, P. (Intern)
Publication date: 15 Jan 2015

Publication information
IPC: C01B31/04; C25B1/00; C25F5/00
Patent number: WO2015004274
Date: 15/01/2015
Three dimensional (3D) biomaterial microarrays hold enormous promise for regenerative medicine because of their ability to accelerate the design and fabrication of biomimetic materials. Such tissue-like biomaterials can provide an appropriate microenvironment for stimulating and controlling stem cell differentiation into tissue-specific lineages. The use of 3D biomaterial microarrays can, if optimized correctly, result in a more than 1000-fold reduction in biomaterials and cells consumption when engineering optimal materials combinations, which makes these miniaturized systems very attractive for tissue engineering and drug screening applications.
3-D Imaging Using Row-Column-Addressed Arrays With Integrated Apodization: Part II: Transducer Fabrication and Experimental Results

This paper demonstrates the fabrication, characterization, and experimental imaging results of a 62×62 element λ/2-pitch row-column-addressed capacitive micromachined ultrasonic transducer (CMUT) array with integrated apodization. A new fabrication process was used to manufacture a 26.3 mm by 26.3 mm array using five lithography steps. The array includes an integrated apodization, presented in detail in Part I of this paper, which is designed to reduce the amplitude of the ghost echoes that are otherwise prominent for row-column-addressed arrays. Custom front-end electronics were produced with the capability of transmitting and receiving on all elements, and the option of disabling the integrated apodization. The center frequency and -6-dB fractional bandwidth of the array elements were 2.77 ± 0.26 MHz and 102 ± 10%, respectively. The surface transmit pressure at 2.5 MHz was 590 ± 73 kPa, and the sensitivity was 0.299 ± 0.090 V/Pa. The nearest neighbor crosstalk level was -23.9 ± 3.7 dB, while the transmit-to-receive-elements crosstalk level was -40.2 ± 3.5 dB. Imaging of a 0.3-mm-diameter steel wire using synthetic transmit focusing with 62 single-element emissions demonstrated axial and lateral FWHMs of 0.71 mm and 1.79 mm (f-number: 1.4), respectively, compared with simulated axial and lateral FWHMs of 0.69 mm and 1.76 mm. The dominant ghost echo was reduced by 15.8 dB in measurements using the integrated apodization compared with the disabled configuration. The effect was reproduced in simulations, showing a ghost echo reduction of 18.9 dB.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering, BK Medical ApS
Authors: Christiansen, T. L. (Intern), Rasmussen, M. F. (Intern), Bagge, J. P. (Ekstern), Moesner, L. N. (Ekstern), Jensen, J. A. (Intern), Thomsen, E. V. (Intern)
Number of pages: 13
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Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control
Volume: 62
ISSN (Print): 0885-3010
Ratings:
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SJR 1.183 SNIP 1.447
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.73 SJR 0.986 SNIP 1.402
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.814 SNIP 1.494 CiteScore 2.43
This paper investigates the effect of transducer-integrated apodization in row–column-addressed arrays and presents a beamforming approach specific for such arrays. Row–column addressing 2-D arrays greatly reduces the number of active channels needed to acquire a 3-D volume. A disadvantage of row–column-addressed arrays is an apparent ghost effect in the point spread function caused by edge waves. This paper investigates the origin of the edge waves and the effect of introducing an integrated apodization to reduce the ghost echoes. The performance of a λ/2-pitch 5-MHz 128 + 128 row–column-addressed array with different apodizations is simulated. A Hann apodization is shown to decrease imaging
performance away from the center axis of the array because of a decrease in main lobe amplitude. Instead, a static roll-off apodization region located at the ends of the line elements is proposed. In simulations, the peak ghost echo intensity of a scatterer at \((x, y, z) = (8, 3, 30)\) mm was decreased by 43 dB by integrating roll-off apodization into the array. The main lobe was unaffected by the apodization. Simulations of a 3-mm-diameter anechoic blood vessel at 30 mm depth showed that applying the transducer-integrated apodization increased the apparent diameter of the vessel from 2.0 mm to 2.4 mm, corresponding to an increase from 67% to 80% of the true vessel diameter. The line element beamforming approach is shown to be essential for achieving correct time-of-flight calculations, and hence avoid geometrical distortions. In Part II of this work, experimental results from a capacitive micromachined ultrasonic transducer with integrated roll-off apodization are given to validate the effect of integrating apodization into the line elements.

**General information**

**State**: Published  
**Organisations**: Department of Electrical Engineering, Center for Fast Ultrasound Imaging, Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Biomedical Engineering  
**Authors**: Rasmussen, M. F. (Intern), Christiansen, T. L. (Intern), Thomsen, E. V. (Intern), Jensen, J. A. (Intern)  
**Number of pages**: 12  
**Pages**: 947-958  
**Publication date**: 2015  
**Main Research Area**: Technical/natural sciences

**Publication information**

**Journal**: IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control  
**Volume**: 62  
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**ISSN (Print)**: 0885-3010  
**Ratings**:

- **BFI (2018)**: BFI-level 2
- **Web of Science (2018)**: Indexed yes
- **BFI (2017)**: BFI-level 2
- **Scopus rating (2017)**: SJR 1.183 SNIP 1.447
- **Web of Science (2017)**: Indexed yes
- **BFI (2016)**: BFI-level 2
- **Scopus rating (2016)**: CiteScore 2.73 SJR 0.986 SNIP 1.402
- **Web of Science (2016)**: Indexed yes
- **BFI (2015)**: BFI-level 2
- **Scopus rating (2015)**: SJR 0.814 SNIP 1.494 CiteScore 2.43
- **Web of Science (2015)**: Indexed yes
- **BFI (2014)**: BFI-level 2
- **Scopus rating (2014)**: SJR 1.088 SNIP 1.627 CiteScore 2.18
- **Web of Science (2014)**: Indexed yes
- **BFI (2013)**: BFI-level 2
- **Scopus rating (2013)**: SJR 0.872 SNIP 1.496 CiteScore 2.18
- **ISI indexed (2013)**: ISI indexed yes
- **Web of Science (2013)**: Indexed yes
- **BFI (2012)**: BFI-level 2
- **Scopus rating (2012)**: SJR 0.802 SNIP 1.479 CiteScore 1.87
- **ISI indexed (2012)**: ISI indexed yes
- **Web of Science (2012)**: Indexed yes
- **BFI (2011)**: BFI-level 2
- **Scopus rating (2011)**: SJR 0.733 SNIP 1.325 CiteScore 1.95
- **ISI indexed (2011)**: ISI indexed yes
- **Web of Science (2011)**: Indexed yes
- **BFI (2010)**: BFI-level 2
- **Scopus rating (2010)**: SJR 0.928 SNIP 1.562
- **Web of Science (2010)**: Indexed yes
- **BFI (2009)**: BFI-level 2
- **Scopus rating (2009)**: SJR 1.296 SNIP 1.775
- **Web of Science (2009)**: Indexed yes
3-D Vector Velocity Estimation with Row-Column Addressed Arrays

The concept of 2-D row-column (RC) addressed arrays for 3-D imaging have shown to be an interesting alternative to 2-D matrix array, due to the reduced channel count. However, the properties for RC arrays to estimate blood velocities have never been reported, which is of great importance for a clinical implementation of this type of array. The aim of this study is, thus, to develop a technique for estimating 3-D vector flow with a RC array using the transverse oscillation (TO) method. The properties are explored both in a simulation study and with a prototype probe for experimental use. In both setups, a 124 channel 2-D RC array with integrated apodization, pitch = 270 µm and a center frequency of 3.0 MHz was used. The performance of the estimator was tested on a simulated vessel (Ø = 12 mm) with a parabolic flow profile and a peak velocity of 1 m/s. Measurements were made in a flowrig (Ø = 12 mm) containing a laminar parabolic flow and a peak velocity of 0.54 m/s. Data was sampled and stored on the experimental ultrasound scanner SARUS. Simulations yields relative mean biases at (-1.1%, -1.5%, -1.0%) with mean standard deviations of σ were (8.5%, 9.0%, 1.4%) % for (vx, vy, vz) from a 3-D velocity vector in a 15° rotated vessel with a 75° beam-to-flow angle. In the experimental setup with a 90° beam-to-flow angle, the relative mean biases were (-2.6%, -1.3%, 1.4%) with a relative standard deviation of (5.0%, 5.2%, 1.0%) for the respective transverse, lateral and axial velocity component.
Acoustical cross-talk in row–column addressed 2-D transducer arrays for ultrasound imaging

The acoustical cross-talk in row–column addressed 2-D transducer arrays for volumetric ultrasound imaging is investigated. Experimental results from a 2.7 MHz, λ/2-pitch capacitive micromachined ultrasonic transducer (CMUT) array with 62 rows and 62 columns are presented and analyzed in the frequency-wavenumber domain. The sources of cross-talk are identified and predicted theoretically. The nearest neighbor cross-talk is 23.9±3.7 dB when the array is used as a 1-D array with the rows functioning as both transmitters and receivers. In the row–column configuration, with the columns transmitting and the rows receiving, the cross-talk is reduced to 40.2±3.5 dB.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering
Authors: Christiansen, T. L. (Intern), Jensen, J. A. (Intern), Thomsen, E. V. (Intern)
Number of pages: 5
Pages: 174–178
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: Ultrasonics
Volume: 63
ISSN (Print): 0041-624X
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.714 SJR 0.973
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.51 SJR 0.834 SNIP 1.728
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.708 SNIP 1.655 CiteScore 2.23
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.848 SNIP 2.156 CiteScore 2.41
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.67 SNIP 1.727 CiteScore 2.12
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.675 SNIP 1.886 CiteScore 2.09
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.707 SNIP 1.72 CiteScore 2.2
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.745 SNIP 1.493
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.587 SNIP 1.31
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Acoustic streaming in microchannels: The trinity of analytics, numerics and experiments

This thesis presents studies of boundary-driven acoustic streaming in microfluidic channels, which is a steady flow of the fluid initiated by the interactions of an oscillating acoustic standing wave and the rigid walls of the microchannel. The studies present analysis of the acoustic resonance, the acoustic streaming flow, and the forces on suspended microparticles. The work is motivated by the application of particle focusing by acoustic radiation forces in medical, environmental and food sciences. Here acoustic streaming is most often unwanted, because it limits the focusability of particles smaller than a given critical size. One of the main goals of this thesis work has been to overcome this limitation. The main text of this thesis serves to give an introduction to the theory and numerical models applied in the five journal papers supplied in the Appendixes, which constitute this thesis work.

Based on first- and second-order perturbation theory, assuming small acoustic amplitudes, we derived the time-dependent governing equations under adiabatic conditions. The adiabatic first- and second-order equations are solved analytically for the acoustic field between two orthogonally oscillating plates. Furthermore, under general thermodynamic conditions, we derive the time-dependent first- and second-order equations for the conservation of mass, momentum, and energy. The coupling from fluid equations to particle motion is achieved through the expressions for the streaming-induced drag force and the acoustic radiation force acting on particles suspended in the fluid. Lastly, the numerical method is discussed, with emphasis on how proper numerical convergence is ensured.

Three numerical studies are presented, in which the acoustic resonance and the acoustic streaming flow are investigated, both in the transient regime and in the purely periodic state. The solutions for the periodic acoustic resonance and the steady streaming flow are used to simulate the motion of suspended particle in a Lagrangian description, which mimics experimental particle tracking velocimetry.

In the forth study, the numerical model is used to engineer a single roll streaming flow, which does not counteract the focusing by the acoustic radiation force, contrary to the usual quadrupolar streaming flow. The single roll streaming flow is observed experimentally in a nearly-square channel, and acoustophoretic focusing of E. coli bacteria and 0.6 µm particles is achieved. These particles are considerably smaller than the critical particle size of approximately 2 µm for the usual half-wavelength resonance in a rectangular channel.

The fifth study presents a quantitative comparison of analytical, numerical, and experimental results for the streaming-induced drag force dominated motion of particles suspended in a water-filled microchannel supporting a transverse half-wavelength resonance. The experimental and theoretical results agree within a mean relative difference of approximately 20%, a low deviation given state-of-the-art in the field. Furthermore, the analytical solution for the acoustic streaming in rectangular channels with arbitrary large height-to-width ratios is derived. This accommodates the analytical theory of acoustic streaming to applications within acoustofluidics.
A critical assessment of visual identification of marine microplastic using Raman spectroscopy for analysis improvement

Identification and characterisation of microplastic (MP) is a necessary step to evaluate their concentrations, chemical composition and interactions with biota. MP ≥10 μm diameter filtered from below the sea surface in the European and subtropical North Atlantic were simultaneously identified by visual microscopy and Raman micro-spectroscopy. Visually identified particles below 100 μm had a significantly lower percentage confirmed by Raman than larger ones indicating that visual identification alone is inappropriate for studies on small microplastics. Sixty-eight percent of visually counted MP (n = 1279) were spectroscopically confirmed being plastic. The percentage varied with type, colour and size of the MP. Fibres had a higher success rate (75%) than particles (64%). We tested Raman micro-spectroscopy applicability for MP identification with respect to varying chemical composition (additives), degradation state and organic matter coating. Partially UV-degraded postconsumer plastics provided identifiable Raman spectra for polymers most common among marine MP, i.e. polyethylene and polypropylene.
Activated carbon enhancement with covalent organic polymers: An innovative material for application in water purification and carbon dioxide capture

Covalent organic polymers (COPs) have emerged as one of the leading advanced materials for environmental applications, such as the capture and recovery of carbon dioxide and the removal of contaminants from polluted water.1–4 COPs exhibit many remarkable properties that other leading advanced materials do not all-encompassing possess. Moreover, COPs have proven to be extremely stable in a wide variety of conditions, i.e. extremely high temperatures and boiling water for weeks at a time, which make them ideal for environmental applications;1 ranging from CO2 capture and recovery to organic solvent uptake in concentrated streams to metal and organic pollutant adsorption in contaminated waters.2 However, given the nanoscale structure of these COPs, real-world application has yet remained elusive for these materials. By creating a material large and robust enough to be used in a full-scale operation, and by retaining the unique properties that only nanomaterials can offer; this novel class of carbon-based materials promises to be a practical and efficient solution to many environmental applications. Herein, we report the functionalization of COPs onto the surface of activated carbon granules; through a series of surface modification techniques, followed by the synthesis of a COP “shell” around the carbon granule. Activated carbon, established as one of the cheapest, robust, and most effective environmental remediation materials of all time, provides the ideal base material for the grafting of COPs onto a material large enough to be able to be used in a packed-bed column. These columns can then be applied in biogas purification to remove CO2 and up-concentrate methane, in the exhaust flue gas stream from a power plant. Furthermore, by impregnating nanoscale zero valent iron (nZVI) inside the COP matrix, these columns can subsequently degrade organic contaminants, e.g. halogenated solvents, azo dyes, antibiotics, etc., during the water treatment process as a flow-through water treatment column that can synergetically adsorb and degrade various pollutants in various water sources. A first of its kind, activated carbon with a COP-functionalized shell provides a robust and regenerate-able material with the durability and versatility for a wide range of environmental applications.
Acylation of salmon calcitonin modulates in vitro intestinal peptide flux through membrane permeability enhancement

Acylation of peptide drugs with fatty acid chains has proven beneficial for prolonging systemic circulation, as well as increasing enzymatic stability and interactions with lipid cell membranes. Thus, acylation offers several potential benefits for oral delivery of therapeutic peptides, and we hypothesize that tailoring the acylation may be used to optimize intestinal translocation. This work aims to characterize acylated analogues of the therapeutic peptide salmon calcitonin (sCT), which lowers blood calcium, by systematically increasing acyl chain length at two positions, in order to elucidate its influence on intestinal cell translocation and membrane interaction. We find that acylation drastically increases in vitro intestinal peptide flux and confers a transient permeability enhancing effect on the cell layer. The analogues permeabilize model lipid membranes, indicating that the effect is due to a solubilization of the cell membrane, similar to transcellular oral permeation enhancers. The effect is dependent on pH, with larger effect at lower pH, and is impacted by acylation chain length and position. Compared to the unacylated peptide backbone, N-terminal acylation with a short chain provides 6- or 9-fold increase in peptide translocation at pH 7.4 and 5.5, respectively. Prolonging the chain length appears to hamper translocation, possibly due to self-association or aggregation, although the long chain acylated analogues remain superior to the unacylated peptide. For K(18)-acylation a short chain provides a moderate improvement, whereas medium and long chain analogues are highly efficient, with a 12-fold increase in permeability compared to the unacylated peptide backbone, on par with currently employed oral permeation enhancers. For K(18)-acylation the medium chain acylation appears to be optimal, as elongating the chain causes greater binding to the cell membrane but similar permeability, and we speculate that increasing the chain length further may decrease the permeability. In conclusion, acylated sCT acts as its own in vitro intestinal permeation enhancer, with reversible effects on Caco-2 cells, indicating that acylation of sCT may represent a promising tool to increase intestinal permeability without adding oral permeation enhancers.

General information
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Scopus rating (2015): SJR 1.437 SNIP 1.471 CiteScore 4.37
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Scopus rating (2014): SJR 1.481 SNIP 1.583 CiteScore 4.44
Adhesive tape exfoliation: Why it works for graphene
Single-crystal graphite can be cleaved by the use of an adhesive tape. This was also the initial route for obtaining graphene, a one-layer thick graphite slab. In this letter a few simple and fun considerations are presented in an attempt to shed some light on why this procedure is successful. In particular on the nature of the surprisingly small number of repetitive steps that are needed in order to obtain a single-layer slab. Two frameworks for exfoliation are investigated: parallel exfoliation involving repetitive simultaneous cleaving, the other, serial exfoliation, which involves the repetitive cleaving of a single chunk of graphite. For both cases, parallel and serial exfoliation, it is investigated how many generations of cleavages are needed. An approximate model with the probability distribution expressed as a simple closed form is presented and compared with the simulations.
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.18 SJR 0.549 SNIP 0.603
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.555 SNIP 0.579 CiteScore 1.04
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BFI (2013): BFI-level 2
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Web of Science (2013): Indexed yes
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Scopus rating (2012): SJR 0.816 SNIP 0.592 CiteScore 1.28
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.389 SNIP 0.758 CiteScore 1.86
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Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.787 SNIP 0.762
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BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.028 SNIP 0.972
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.771 SNIP 1.021
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.968 SNIP 1.062
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.927 SNIP 1.055
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.953 SNIP 1.075
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.905 SNIP 1.141
Scopus rating (2003): SJR 1.972 SNIP 1.139
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 2.14 SNIP 1.361
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 2.153 SNIP 1.193
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 2.149 SNIP 1.121
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Adsorption and Vibrational Study of Folic Acid on Gold Nanopillar Structures Using Surface-enhanced Raman Scattering Spectroscopy

This paper presents a study of adsorption and vibrational features of folic acid, using surface-enhanced Raman scattering (SERS). A gold-capped silicon nanopillar (Au NP) with a height of 600 nm and a width of 120 nm was utilized to study the vibrational features of FA molecules adsorbed on the nanopillars within the high electromagnetic field areas. The adsorption behaviour of folic acid and the band assignment of the main vibrations together with the optimized geometry of folic acid and folic acid in the presence of a cluster of 10 gold atoms were assessed using the density functional theory (B3LYP(6-31G(d))) and the scalar relativistic effective core potential with a double-zeta basis set (LANL2DZ). The vibrations obtained from the solid-state folic acid and the folic acid on a gold cluster were in accordance with those observed experimentally. The analysis of the main vibrations indicated that the interaction of folic acid with the Au NP occurred primarily through the nitrogen atoms, from their pteridine ring. Finally, the obtained adsorption isotherm for folic acid was deduced from the analysis of the SERS spectra and it followed a negative cooperative binding model.
Adsorption of Cationic Peptides to Solid Surfaces of Glass and Plastic

Cationic membrane-active peptides have been studied for years in the hope of developing them into novel types of therapeutics. In this article, we investigate an effect that might have significant experimental implications for investigators who wish to study these peptides, namely, that the peptides adsorb to solid surfaces of glass and plastic. Specifically, we use analytical HPLC to systematically quantify the adsorption of the three cationic membraneactive peptides mastoparan X, melittin, and magainin 2 to the walls of commonly used glass and plastic sample containers. Our results show that, at typical experimental peptide concentrations, 90% or more of the peptides might be lost from solution due to rapid adsorption to the walls of the sample containers. Thus, our results emphasize that investigators should always keep these adsorption effects in mind when designing and interpreting experiments on cationic membrane-active peptides. We conclude the article by discussing different strategies for reducing the experimental impact of these adsorption effects.

General information
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Web of Science (2016): Indexed yes
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BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.982 SNIP 1.156 CiteScore 4.15
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
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ISI indexed (2011): ISI indexed no
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BFI (2010): BFI-level 1
Scopus rating (2010): SJR 2.705 SNIP 1.178
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 2.614 SNIP 1.046
configuration A and C as being the most effective method to lower the relative standard deviation on the measured study points out the van der Pauw position correction strategy based on combined measurement in four-point static and dynamic, in-line and off-line electrode position errors on four-point resistance measurements on MTJs. This using the same strategy. Based on Monte Carlo simulations we have studied the influence of electrical noise as well as measurements is limited by electrode position errors, the importance of which increases for decreasing electrode pitch. This is a challenge to the measurement method as such and may become even more so in the future, when the cell size of MRAM is scaled down to increase memory density. The fundamental goal of this project has been to provide cheaper, faster and more precise metrology for MTJs.

This goal has been achieved in part by the demonstration of a static field CIPT method, which allows us to reduce the measurement time by a factor of 5, by measuring only RA thus excluding TMR. This enhancement is obtained purely by acquiring only half of the data needed for the conventional switching field CIPT measurement and particularly by avoiding magnetic field switching. We observe that the new method measures essentially the same RA values as compared to the conventional strategy. By offering the choice of characterizing either RA_{low} or RA_{high}, the static field CIPT method has an added advantage over the conventional switching field CIPT method, which relies on the characterization of both RA values. This allows for an improved matching of the range of available electrode pitches and sample transfer lengths, which may effectively increases the dynamic range of any given micro 12-point probe (M12PP).

Without the requirement for switching magnetic fields during measurements the static field CIPT method has inspired the concept of detached magnet setups for future CIPTech tools. While lowering the complexity of the measurement system a detached magnet setup, e.g. a proposed letterbox magnet, could provide superior dynamic range and field homogeneity compared to current state of the art solutions. We have carried out an extensive characterization of electrode position errors and experimentally shown that the dominant sources of error in single configuration micro four-point probe resistance measurements are in-line probe geometry errors and in-line static position errors. These errors were shown to be eliminated very effectively using dual-configuration measurements and position error correction algorithms. The standard deviation of the static in-line position error for measurements with Au coated electrodes on Ru thin film samples was found to be in the range from 3.9 nm to 7.5 nm. The standard deviation of the dynamic in-line position error was shown to be small ~3 Å and only detectable in measurements with high measurement current. At lower measurement currents the electrical measurement noise was the dominant error source. No significant ageing effect on position errors (except for a very slight reduction in position error with measurement age) was observed for a probe in the course of 5000 measurements. We have demonstrated how new probe designs may be evaluated and benchmarked against each other using the same strategy. Based on Monte Carlo simulations we have studied the influence of electrical noise as well as static and dynamic, in-line and off-line electrode position errors on four-point resistance measurements on MTJs. This study points out the van der Pauw position correction strategy based on combined measurement in four-point configuration A and C as being the most effective method to lower the relative standard deviation on the measured
resistance. In line with this we find that the same method also provides the broadest dynamic range for the M12PP used in this project. As a means to further enhance the measurement precision we have proposed the addition of more subprobes of nominally identical electrode spacing and shown, that for one added sub-probe, the option for which two sub-probes shares two pins, yields the most significant reduction of electrode positional errors. Finally, a radical probe design entirely occupied by equidistant electrodes was proposed.

**General information**
State: Published
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**A hand-held row-column addressed CMUT probe with integrated electronics for volumetric imaging**
A 3 MHz, λ / 2-pitch 62+62 channel row-column addressed 2-D CMUT array designed to be mounted in a probe handle and connected to a commercial BK Medical scanner for real-time volumetric imaging is presented. It is mounted and wire-bonded on a flexible PCB, which is connected to two rigid PCBs with pre-amplifiers for driving the cable to the scanner. The array and PCBs are encapsulated in a 3-D printed handle, and a grounded shielding layer and silicone coating is applied to the front-side of the array for physical and electrical isolation. The handle is assembled together with a 192-channel coaxial cable that connects it to the ultrasound scanner, which supplies the probe with a 190 V DC bias voltage and up to ±75V AC excitation voltage. The probe was successfully connected to a BK3000 scanner and used as two decoupled 1-D phased arrays. Volumetric imaging was demonstrated using the experimental SARUS scanner with 132 volumes/sec.

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Organisations: Department of Micro- and Nanotechnology, MEMS-AppliedSensors, Department of Electrical Engineering, Biomedical Engineering, Center for Fast Ultrasound Imaging, BK Ultrasound
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**A hydrogel based nanosensor with an unprecedented broad sensitivity range for pH measurements in cellular compartments**
Optical pH nanosensors have been applied for monitoring intracellular pH in real-time for about two decades. However, the pH sensitivity range of most nanosensors is too narrow, and measurements that are on the borderline of this range may not be correct. Furthermore, ratiometric measurements of acidic intracellular pH (pH < 4) in living cells are still challenging due to the lack of suitable nanosensors. In this paper we successfully developed a multiple sensor, a fluorophore based nanosensor, with an unprecedented broad measurement range from pH 1.4 to 7.0. In this nanosensor,
three pH-sensitive fluorophores (difluoro-Oregon Green, Oregon Green 488, and fluorescein) and one pH-insensitive fluorophore (Alexa 568) were covalently incorporated into a nanoparticle hydrogel matrix. With this broad range quadruple-labelled nanosensor all physiological relevant pH levels in living cells can be measured without being too close to the limits of its pH-range. The nanosensor exhibits no susceptibility to interference by other intracellular ions at physiological concentrations. Due to its positive surface charge it is spontaneously internalized by HeLa cells and localizes to the lysosomes where the mean pH was measured at 4.6. This quadruple-labelled nanosensor performs accurate measurements of fluctuations of lysosomal pH in both directions, which was shown by treatment with the V-ATPase inhibitor bafilomycin A1 or its substrate ATP in HeLa cells. These measurements indicate that this novel quadruple-labelled nanosensor is a promising new tool for measuring the pH of acidic compartments in living cells.

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Web of Science (2005): Indexed yes
A lab-on-a-chip system with integrated sample preparation and loop-mediated isothermal amplification for rapid and quantitative detection of Salmonella spp. in food samples

Foodborne disease is a major public health threat worldwide. Salmonellosis, an infectious disease caused by Salmonella spp., is one of the most common foodborne diseases. Isolation and identification of Salmonella by conventional bacterial culture or molecular-based methods are time consuming and usually take a few hours to days to complete. In response to the demand for rapid on line or at site detection of pathogens, in this study, we describe for the first time an eight-chamber lab-on-a-chip (LOC) system with integrated magnetic beads-based sample preparation and loop-mediated isothermal amplification (LAMP) for rapid and quantitative detection of Salmonella spp. in food samples. The whole diagnostic procedures including DNA isolation, isothermal amplification, and real-time detection were accomplished in a single chamber. Up to eight samples could be handled simultaneously and the system was capable to detect Salmonella at concentration of 50 cells per test within 40 min. The simple design, together with high level of integration, isothermal amplification, and quantitative analysis of multiple samples in short time will greatly enhance the practical applicability of the LOC system for rapid on-site screening of Salmonella for applications in food safety control, environmental surveillance, and clinical diagnostics.

General information
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Organisations: Department of Micro- and Nanotechnology, BioLabChip, Division of Food Microbiology, National Food Institute
Authors: Sun, Y. (Intern), Than Linh, Q. (Intern), Hung, T. Q. (Intern), Chin, W. H. (Intern), Wolff, A. (Intern), Bang, D. D. (Intern)
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A Lab-on-a-Disc Platform for Trapping of Cell Population, Monitoring of Cell growth and Evaluation of Redox Metabolism

General information
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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Bioanalytics, Technical University of Denmark
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Main Research Area: Technical/natural sciences
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A Lab-on-a-disc platform for trapping of cells, monitoring of cell behaviour and evaluation of redox metabolism
In this work, we demonstrate an integrated electrochemical system on a centrifugal microfluidic platform for cell studies by combining electrochemical impedance spectroscopy and amperometry, and comparison of different cleaning protocols for gold electrodes on plastic substrate.
All Polymer Lab-on-a-chip System for Virus Detection in Water

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Organisations: Department of Micro- and Nanotechnology, Polymer Microsystems for Medical Diagnostics, Nano Bio Integrated Systems
Authors: Kirkegaard, J. (Intern), Olsen, M. H. (Intern), Dimaki, M. (Intern), Rozlosnik, N. (Intern)
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All-polymer photonic crystal slab sensor

An all-polymer photonic crystal slab sensor is presented, and shown to exhibit narrow resonant reflection with a FWHM of less than 1 nm and a sensitivity of 31 nm/RIU when sensing media with refractive indices around that of water. This results in a detection limit of $4.5 \times 10^{-6}$ RIU when measured in conjunction with a spectrometer of 12 pm/pixel resolution. The device is a two-layer structure, composed of a low refractive index polymer with a periodically modulated surface height, covered with a smooth upper-surface high refractive index inorganic-organic hybrid polymer modified with ZrO$_2$-based nanoparticles. Furthermore, it is fabricated using inexpensive vacuum-less techniques involving only UV nanoreplication and polymer spin-casting, and is thus well suited for single-use biological and refractive index sensing applications.

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Organisations: Department of Micro- and Nanotechnology, Optofluidics, Micro Resist Technology GmbH
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Web of Science (2017): Indexed yes
A microfluidic platform for the rapid determination of distribution coefficients by gravity assisted droplet-based liquid-liquid extraction

The determination of pharmacokinetic properties of drugs, such as the distribution coefficient, D, is a crucial measurement in pharmaceutical research. Surprisingly, the conventional (gold standard) technique used for D measurements, the shake-flask method, is antiquated and unsuitable for the testing of valuable and scarce drug candidates. Herein we present a simple micro fluidic platform for the determination of distribution coefficients using droplet-based liquid-liquid extraction. For simplicity, this platform makes use of gravity to enable phase separation for analysis and is 48 times faster and uses 99 % less reagents than performing an equivalent measurement using the shake-flask method. Furthermore, the D measurements achieved in our platform are in good agreement with literature values measured using traditional shake-flask techniques. Since D is affected by volume ratios, we use the apparent acid dissociation constant, pK', as a proxy for inter-system comparison. Our platform determines a pK' value of 7.24 ± 0.15, compared to 7.25 ± 0.58 for the shake-flask method in our hands and 7.21 for the shake-flask method in literature. Devices are fabricated using injection moulding, the batch-wise fabrication time is less than 2 minutes per device (at a cost of 1 USD per device) and the inter-device reproducibility is high.
Analysis of magnetic relaxation with pre-existing nucleation sites based on the Fatuzzo-Labrune model

Time-resolved magnetic domain patterns of (Co/Pt) and (CoFeB/Pd) multilayers with perpendicular magnetic anisotropy are observed by means of magneto-optical microscopy, from which magnetic relaxation curves are determined via a quantitative image analysis. Interestingly, it has been observed that the relaxation processes starting with pre-existing nucleation sites, as well as starting from a fully saturated state, are well explained based on the Fatuzzo-Labrune model, although the pre-existing nucleation sites significantly modify the magnetization reversal behaviors.
An easy-to-use microfluidic interconnection system to create quick and reversibly interfaced simple microfluidic devices

The presented microfluidic interconnection system provides an alternative for the individual interfacing of simple microfluidic devices fabricated in polymers such as polymethylmethacrylate, polycarbonate and cyclic olefin polymer. A modification of the device inlet enables the direct attachment of tubing (such as polytetrafluoroethylene tubing) secured and sealed by using a small plug, without the need for additional assembly, glue or o-rings. This provides a very clean connection that does not require additional, potentially incompatible, materials. The tightly sealed connection can withstand pressures above 250 psi and therefore supports applications with high flow rates or highly viscous fluids. The ease of incorporation, configuration, fabrication and use make this interconnection system ideal for the rapid prototyping of simple microfluidic devices or other integrated systems that require microfluidic interfaces. It provides a valuable addition to the toolbox of individual and small arrays of connectors suitable for micromachined or template-based injection molded devices since it does not require protruding, threaded or glued modifications on the inlet and avoids bulky and expensive fittings.
A new metastable form of glycolide obtained via large scale high pressure experiments

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Colloids and Biological Interfaces, University of Strathclyde
Authors: Hutchison, I. B. (Ekstern), Urquhart, A. (Intern), Oswald, I. D. (Ekstern)
Pages: e45-e46
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Controlled Release
Volume: 213
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Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
We report angle resolved characterization of nanostructured and conventionally textured silicon solar cells. The nanostructured solar cells are realized through a single step, mask-less, scalable reactive ion etching (RIE) texturing of the surface. Photovoltaic properties including short circuit current, open circuit voltage, fill factor (FF) and power conversion efficiency are each measured as function of the relative incident angle between the solar cell and the light source. The relative incident angle is varied from 0° to 90° in steps of 10° in orthogonal axes, such that each solar cell is characterized at 100 different angle combinations. The angle resolved photovoltaic properties are summarized in terms of the average, angle-dependent electrical power output normalized to the power output at normal incidence and differently textured cells on different silicon substrates are compared in terms of angle resolved performance. The results show a 3% point
improvement in average electrical power output normalized with respect to normal incidence power output of RIE textured, multicrystalline Si cells compared to conventional multicrystalline Si cells and above 1% point improvement of RIE textured monocrystalline Si cells compared to conventional monocrystalline Si cells.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Nanoprobes, Department of Physics, Experimental Surface and Nanomaterials Physics, Technical University of Denmark, Institute for Energy Technology
Authors: Davidsen, R. S. (Intern), Ormstrup, J. (Ekstern), Ommen, M. L. (Ekstern), Larsen, P. E. (Intern), Schmidt, M. S. (Intern), Boisen, A. (Intern), Nordseth, Ø. (Ekstern), Hansen, O. (Intern)
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BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.532 SJR 1.459
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.97 SJR 1.599 SNIP 1.71
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.8 SNIP 1.851 CiteScore 5.16
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.19 SNIP 2.348 CiteScore 5.87
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 2.179 SNIP 2.529 CiteScore 5.58
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 2.441 SNIP 2.654 CiteScore 5.25
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.182 SNIP 2.577 CiteScore 5.16
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 2.494 SNIP 2.105
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.942 SNIP 1.957
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.626 SNIP 1.449
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.363 SNIP 1.49
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.438 SNIP 1.788
An in vitro Method for Predicting Inhalation Toxicity of Impregnation Spray Products

Impregnation spray products are used for making surfaces water and dirt repellent. The products are composed of one or more active film-forming components dissolved or suspended in an appropriate solvent mixture. Exposure to impregnation spray products may cause respiratory distress and new cases are reported frequently. The toxicity appears to be driven by a disruption of the pulmonary surfactant film, which coats the inside of the lungs. Due to the complex chemistry of impregnation spray products, it is impossible to predict if inhalation of an aerosolized product is toxic in vivo. The aim of this study was to evaluate whether disruption of the pulmonary surfactant film can be used as a predictor of the toxic effects in vivo. Nine impregnation products with various chemical compositions were selected for testing and the main constituents of each product, e.g., solvents, co-solvents and film-forming compounds, were identified by mass spectrometry. We used a capillary surfactometry method to assess disruption of pulmonary surfactant function in vitro and a mouse model to evaluate acute respiratory toxicity during inhalation. Concentration-response relationships were successfully determined both in vitro and in vivo. The true positive rate of the in vitro method was 100%, i.e. the test could correctly identify all products with toxic effects in vivo, the true negative rate was 40%. Investigation of inhibition of the pulmonary surfactant system, e.g. by capillary surfactometry, was found useful for evaluation of the inhalation toxicity of impregnation spray products and thus may reduce the need for animal testing.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, National Research Center for Working Environment
Authors: Sørli, J. B. (Ekstern), Hansen, J. S. (Ekstern), Nørgaard, A. W. (Ekstern), Levin, M. (Intern), Larsen, S. T. (Ekstern)
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Journal: A L T E X. Alternatives to Animal Experimentation
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
BFI (2015): BFI-level 1
Web of Science (2015): Indexed yes
An impedance method for spatial sensing of 3D cell constructs – towards applications in tissue engineering

We present the characterisation and validation of multiplexed 4-terminal (4T) impedance measurements as a method for sensing the spatial location of cell aggregates within large three-dimensional (3D) gelatin scaffolds. The measurements were performed using an array of four rectangular chambers, each having eight platinum needle electrodes for parallel analysis. The electrode positions for current injection and voltage measurements were optimised by means of finite element simulations to maximise the sensitivity field distribution and spatial resolution. Eight different 4T combinations were experimentally tested in terms of the spatial sensitivity. The simulated sensitivity fields were validated using objects (phantoms) with different conductivity and size placed in different positions inside the chamber. This provided the detection limit (volume sensitivity) of 16.5%, i.e., the smallest detectable volume with respect to the size of the measurement chamber. Furthermore, the possibility for quick single frequency analysis was demonstrated by finding a common frequency of 250 kHz for all the presented electrode combinations. As final proof of concept, a high density of human hepatoblastoma (HepG2) cells were encapsulated in gelatin to form artificial 3D cell constructs and detected when placed in different positions inside large gelatin scaffolds. Taken together, these results open new perspectives for impedance-based sensing technologies for non-invasive monitoring in tissue engineering applications providing spatial information of constructs within biologically relevant 3D environments.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Bioanalytics, Nanoprobes, BioLabChip, Fluidic Array Systems and Technology, Oslo University Hospital
Authors: Canali, C. (Intern), Mazzoni, C. (Intern), Larsen, L. B. (Intern), Heiskanen, A. (Intern), Martinsen, Ø. (Ekstern), Wolff, A. (Intern), Dufva, M. (Intern), Emnéus, J. (Intern)
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BFI (2018): BFI-level 1
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BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Anomalous kinetics of lath martensite formation in stainless steel
The kinetics of lath martensite formation in Fe-17.3 wt-%Cr-7.1 wt-%Ni-1.1 wt-%Al-0.08 wt-%C stainless steel was investigated with magnetometry and microscopy. Lath martensite forms during cooling, heating and isothermally. For the first time, it is shown by magnetometry during extremely slow isochronal cooling that transformation rate maxima occur, which are interrupted by virtually transformation free temperature regions. Microscopy confirms martensite formation after athermal nucleation of clusters followed by their time dependent growth. The observations are interpreted in terms of time dependent autocatalytic lath martensite formation followed by mechanical stabilisation of austenite during the transformation process.

General information
State: Published
Organisations: Department of Mechanical Engineering, Materials and Surface Engineering, Department of Micro- and Nanotechnology, Magnetic Systems
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Pages: 1355-1361
Publication date: 2015
Main Research Area: Technical/natural sciences
A novel approach for studying programmed cell death in living plant tissues

Programmed cell death (PCD) is a highly regulated process in which cells are killed as part of developmental programmes or as defence mechanisms against pathogens, but the process is less well understood in plant cells compared to animal cells. Reactive oxygen species (ROS) are involved in PCD in plants, but the relationship between and mechanisms behind ROS and PCD has not yet been fully elucidated due to the involvement of complex signalling networks. Elucidation of these mechanisms and signalling pathways will allow manipulation of cell death in plants, which could help to improve yield and quality of crops and thus contribute to solving the increasing food demands of the planet. Examples of this could be the development of cultivars with enhanced and/or faster response to pathogen attacks, or cultivars with increased grain filling and hence increased starch content through delayed cell death of the endosperm. The barley aleurone layer is a generally accepted model system for studying phytohormone signalling, enzyme secretion, and PCD during seed germination. However, two main issues affect PCD-related research in the barley aleurone layer: Firstly, the current knowledge about ROS signaling and the cellular redox environment in aleurone layers undergoing PCD is mainly based on analyses of cell extracts, which do not evaluate the overall cellular redox environment in intact plant cells. Secondly, analyses based on cell extracts are end-point measurements, which are limited by the fact that each analysis is performed on a different pool of samples, as each tissue sample or population of cells can only be analysed at a single time point. This is of great importance for studies of time-dependent processes such as PCD, as time course experiments can be affected by biological and experimental diversity between independent samples, which could distort the interpretation of the results. Time course experiments on the same tissue or population of cells can be enabled by the use of assays that do not destroy cellular integrity, which could also facilitate the combination of multiple assays. However, time course studies with analysis of multiple parameters using different detection techniques remain challenging, as the different assays under consideration may be incompatible, and some assays may affect the plant tissue and therefore influence the outcome of simultaneous or subsequent analyses.

A previously described optical method was used to monitor PCD, while a previously described method for electrochemical detection of intracellular redox activity was tested and optimised for use with the aleurone layers. The electrochemical method had not previously been used in plant biology, and provided new insight by determining both the intra- and extracellular reducing capacity in living cells rather than using cell extracts. The reducing capacity of aleurone cells was shown to increase over time in parallel with the increase in cell death. Use of the flavoenzyme inhibitor diphenyleniodonium chloride (DPI) provided evidence that the gibberellic acid-induced increase in reducing capacity is dependent on the plasma membrane-bound NADPH oxidase. A preliminary proteomics investigation also showed indirect effects of DPI on the abundance of glyceraldehyde-3-phosphate dehydrogenase 2 but not on the very similar paralogues glyceraldehyde-3-phosphate dehydrogenase 1. Further investigations are needed to clarify these effects and to determine which other enzymes are affected by DPI. A 24-well plate incubation system for immobilised plant tissues was developed to allow time course studies on the same tissues and to enable parallel use of multiple non-destructive assays. Immobilisation of the tissues in the lid of a 24-well plate facilitated easy combination of multiple assays by movement of the plate lid, lessened the workload by decreasing the amount of aleurone layers to be dissected 25-fold, and enabled a higher throughput. The system was used for parallel time course studies of cell viability, intracellular reducing capacity and transient expression profiles in immobilised tissue under multiple incubation conditions. Immobilisation resulted in decreased rates of cell death due to the lower exposure of immobilised tissues to the incubation buffer, but tendencies for both cell viability and reducing capacity remained the same for both non-immobilised and immobilised tissues. The parallel studies of cell viability and reducing capacity also revealed that PCD is induced by different mechanisms for tunicamycin, an inducer of protein unfolding in the endoplasmic reticulum, and the NO scavenger 2-(4-carboxyphenyl)-4,4,5,5-tetramethylimidazole-1-oxyl-3-oxide.

Using optical and electrochemical detection techniques, this project has obtained new knowledge of increases in intra- and extracellular reducing capacity taking place in parallel with PCD, and proposed this increased reducing capacity as a mechanism for holding the ‘oxidative window’ for germination open. The involvement of the NADPH oxidase or other flavoenzymes in determining the level of gibberellic acid-induced reducing capacity was also shown using the inhibitor DPI. The new incubation system for immobilised aleurone layers enabled simple, user-friendly handling of plant tissue incubations and facilitated transient expression studies in plant tissues by particle bombardment as well as time course studies on the same population of cells combining multiple non-destructive assays. The immobilised approach allowed single transformed cells to be followed over time and provided an insight into the cell-to-cell variability of the actual transformation event, yielding a more detailed picture of transient expression profiles compared to traditional approaches. Future applications of this type of setup could be used for other types of plant tissues such as leaves or germinating embryos for studying the effects of e.g. biotic and abiotic stresses or for screening of compounds for biological effects. Due to the ease of use and many possibilities of assay combinations, the setup has great potential in the area of plant...
A polymer chip-integrable piezoelectric micropump with low backpressure dependence

We describe a piezoelectric micropump constructed in polymers with conventional machining methods. The micropump is self-contained and can be built as an independent device or as an on-chip module within laminated microfluidic chips. We demonstrate on-chip integrability by the fabrication and testing of an active micromixer with two pumps. Average flow rates from sub-mL min(-1) to 300 μL min(-1) can be obtained with low influence from the backpressure up to approximately 10 kPa. The micropump design allows potential use in low-cost disposable polymeric Lab on a Chip devices.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology, Instituto Nacional de Tecnologia Industrial, Universidad de Buenos Aires, Universidad Nacional de Tucuman
Authors: Conde, A. J. (Ekstern), Bianchetti, A. (Ekstern), Veiras, F. E. (Ekstern), Federico, A. (Ekstern), Cabaleiro, J. M. (Ekstern), Dufva, M. (Intern), Madrid, R. E. (Ekstern), Fraigi, L. (Ekstern)
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Main Research Area: Technical/natural sciences

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BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.736 SJR 0.863
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.06 SJR 0.889 SNIP 0.757
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.947 SNIP 0.834 CiteScore 3.42
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.113 SNIP 0.962 CiteScore 3.87
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.119 SNIP 0.904 CiteScore 3.74
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Aquaporin-Based Biomimetic Polymeric Membranes: Approaches and Challenges

In recent years, aquaporin biomimetic membranes (ABMs) for water separation have gained considerable interest. Although the first ABMs are commercially available, there are still many challenges associated with further ABM development. Here, we discuss the interplay of the main components of ABMs: aquaporin proteins (AQPs), block copolymers for AQP reconstitution, and polymer-based supporting structures. First, we briefly cover challenges and review recent developments in understanding the interplay between AQP and block copolymers. Second, we review some experimental characterization methods for investigating AQP incorporation including freeze-fracture transmission electron microscopy, fluorescence correlation spectroscopy, stopped-flow light scattering, and small-angle X-ray scattering. Third, we focus on recent efforts in embedding reconstituted AQPs in membrane designs that are based on conventional thin film interfacial polymerization techniques. Finally, we describe some new developments in interfacial polymerization using polyhedral oligomeric silsesquioxane cages for increasing the physical and chemical durability of thin film composite membranes.

General information
State: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, University of Copenhagen, Aquaporin A/S
Authors: Habel, J. E. O. (Intern), Hansen, M. (Ekstern), Kynde, S. (Ekstern), Larsen, N. (Ekstern), Midtgaard, S. R. (Ekstern), Jensen, G. V. (Ekstern), Bomholt, J. (Ekstern), Ogbonna, A. (Ekstern), Almdal, K. (Intern), Schulz, A. (Ekstern), Hélix-Nielsen, C. (Intern)
Number of pages: 45
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A reusable device for electrochemical applications of hydrogel supported black lipid membranes

Black lipid membranes (BLMs) are significant in studies of membrane transport, incorporated proteins/ion transporters, and hence in construction of biosensor devices. Although BLMs provide an accepted mimic of cellular membranes, they are inherently fragile. Techniques are developed to stabilize them, such as hydrogel supports. In this paper, we present a reusable device for studies on hydrogel supported (hs) BLMs. These are formed across an ethylene tetrafluoroethylene (ETFE) aperture array supported by the hydrogel, which is during in situ polymerization covalently "sandwiched" between the ETFE substrate and a gold electrode microchip, thus allowing direct electrochemical studies with the integrated working electrodes. Using electrochemical impedance spectroscopy (EIS), X-ray photoelectron spectroscopy and contact angle measurements, we demonstrate the optimized chemical modifications of the gold electrode microchips and plasma modification of the ETFE aperture arrays facilitating covalent "sandwiching" of the hydrogel. Both fluorescence microscopy and EIS were used to demonstrate the induced spontaneous thinning of a deposited lipid solution, leading to formation of stabilized hsBLMs on average in 10 min. The determined specific membrane capacitance and resistance were shown to vary in the range 0.31-0.49 μF/cm² and 45-65 kΩ cm², respectively, corresponding to partially solvent containing BLMs with an average life time of 60-80 min. The characterized hsBLM formation and devised equivalent circuit models lead to a schematic model to illustrate lipid molecule distribution in hydrogel-supported apertures. The functionality of stabilized hsBLMs and detection sensitivity of the platform were verified by monitoring the effect of the ion transporter valinomycin.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Bioanalytics, Department of Physics, Aquaporin A/S
Authors: Mech-Dorosz, A. (Intern), Heiskanen, A. (Intern), Bäckström, S. (Ekstern), Perry, M. (Ekstern), Larsen, L. B. (Intern), Helix Nielsen, C. (Intern), Emnéus, J. (Intern)
Publication date: 2015
Main Research Area: Technical/natural sciences

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BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.639 SJR 0.538
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.29 SJR 0.606 SNIP 0.743
A Smart Mobile Lab-on-Chip-Based Medical Diagnostics System Architecture Designed For Evolvability

Unprecedented knowledge levels in life sciences along with technological advances in micro- and nanotechnologies and microfluidics have recently conditioned the advent of Lab-on-Chip (LoC) devices for In-Vitro Medical Testing (IVMT). Combined with smart-mobile technologies, LoCs are pervasively giving rise to opportunities to better diagnose disease, predict and monitor personalised treatment efficacy, or provide healthcare decision-making support at the Point-of-Care (PoC). Although made increasingly available to the consumer market, the adoption of LoC-based PoC In-Vitro Medical Testing (IVMT) systems is still in its infancy. This attrition partly pertains to the intricacy of designing and developing complex systems, destined to be used sporadically, in a fast-pace evolving technological paradigm. System evolvability is therefore key in the design process and constitutes the main motivation for this work.

We introduce a smart-mobile and LoC-based system architecture designed for evolvability. By propagating LoC programmability, instrumentation, and control tools to the highlevel abstraction smart-mobile software layer, our architecture...
facilitates the realisation of new use-cases and the accommodation for incremental LoC-technology developments. We demonstrate these features with an implementation allowing the interfacing of LoCs embedding current- or impedance-based biosensors such as Silicon Nanowire Field Effect Transistors (SiNW-FETs) or electrochemical transducers. Structural modifications of these LoCs or changes in their specific operation may be addressed by the sole reengineering of the mobile software layer, minimising system upgrade development and validation costs and efforts.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems, Center for Bachelor of Engineering Studies, Afdelingen for EI-teknologi, Department of Applied Mathematics and Computer Science, Embedded Systems Engineering
Authors: Patou, F. (Intern), Dimaki, M. (Intern), Svendsen, W. E. (Intern), Kjærgaard, C. (Intern), Madsen, J. (Intern)
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Assembly of Gold Nanoparticle Mono-and Multi-Layer Structures and Evaluation of Their Physicochemical Characteristics
General information
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Organisations: Department of Micro- and Nanotechnology, Bioanalytics, Malmö University, Lund University, Vilnius University
Authors: Krikstolaityte, V. (Intern), Hamit-Eminovski, J. (Ekstern), Abariute, L. (Ekstern), Niaura, G. (Ekstern), Arnebrant, T. (Ekstern), Emnéus, J. (Intern), Ruzgas, T. (Ekstern)
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A uniform measurement expression for cross method comparison of nanoparticle aggregate size distributions
Available measurement methods for nanomaterials are based on very different measurement principles and hence produce different values when used on aggregated nanoparticle dispersions. This paper provides a solution for relating measurements of nanomaterials comprised of nanoparticle aggregates determined by different techniques using a uniform expression of a mass equivalent diameter (MED). The obtained solution is used to transform into MED the size distributions of the same sample of synthetic amorphous silica (nanomaterial comprising aggregated nanoparticles) measured by six different technical techniques: scanning electron microscopy in both high vacuum (SEM) and liquid cell setup (Wet-SEM); gasphase electrophoretic mobility molecular analyzer (GEMMA); centrifugal liquid sedimentation (CLS); nanoparticle tracking analysis (NTA); and asymmetric flow field flow fractionation with inductively coupled plasma mass spectrometry detection (AF4-ICP-MS). Transformed size distributions are then compared between the methods and conclusions drawn on methods' measurement accuracy, limits of detection and quantification related to the synthetic amorphous silica's size. Two out of the six tested methods (GEMMA and AF4-ICP-MS) cross validate the MED distributions between each other, providing a true measurement. The measurement accuracy of other four techniques is shown to be compromised either by the high limit of detection and quantification (CLS, NTA, Wet-SEM) or the sample preparation that is biased by increased retention of smaller nanomaterials (SEM). This study thereby presents a successful and conclusive cross-method comparison of size distribution measurements of aggregated nanomaterials. The authors recommend the uniform MED size expression for application in nanomaterial risk assessment studies and
clarifications in current regulations and definitions concerning nanomaterials.

**General information**

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Organisations: Department of Micro- and Nanotechnology, Molecular Windows, The Food and Environment Research Agency, University of Vienna, Vienna University of Technology, University of York, University of Salzburg, Institute for Reference Materials and Measurements


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Web of Science (2018): Indexed yes

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Web of Science (2016): Indexed yes

Scopus rating (2016): CiteScore 3.92

Web of Science (2015): Indexed yes

BFI (2014): BFI-level 1
Web of Science (2014): Indexed yes

Scopus rating (2014): CiteScore 4.1

Web of Science (2013): Indexed yes

BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 4.11
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes

BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.88
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes

BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 4.16
ISI indexed (2011): ISI indexed yes
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BFI (2010): BFI-level 1
Web of Science (2010): Indexed yes

BFI (2009): BFI-level 1
Web of Science (2009): Indexed yes

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Web of Science (2002): Indexed yes
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Automated synthesis and PET evaluation of both enantiomers of [18F]FMISO

Introduction: [18F]FMISO, the widely used positron emission tomography (PET) hypoxia tracer, is a chiral compound clinically used as a racemic mixture. The purpose of this study was to synthesize the individual (R)- and the (S)-enantiomers of [18F]FMISO and compare their PET imaging characteristics.

Methods: The radiosynthesis of enantiopure (R)- and (S)[18F]FMISO was based on Co(salen) (N,N’-bis(3,5-di-tert-butylsalicylidene)-1,2-cyclohexanediaminocobalt)-mediated opening of enantiopure epoxides with [18F]HF. The uptake and clearance of the individual [18F]FMISO enantiomers were investigated using micro-PET/CT imaging performed on mice bearing FaDu tumors. Image-derived biodistribution was obtained from micro-PET/CT scans performed at 1 and 3 hours post injection (p.i.). In addition, the uptake patterns of each enantiomer were observed using two-hour dynamic micro-PET/CT scans and the time-activity curves from different organs were compared. Results: The individual (R)- and (S)-[18F]FMISO enantiomers were synthesized in one step with high enantiomeric excess (ee) > 99% and radiochemical purity > 97% using custom-made automation module. The dynamic micro-PET/CT scanning revealed a faster initial uptake of the (R)-[18F]FMISO enantiomer in tumor and muscle tissues, however the difference became progressively smaller with time. The tumor-to-muscle (T/M) and tumor-to-liver (T/L) ratios remained nearly identical for the (R)- and (S)-forms at all time points. The micro-PET/CT imaging at 1 and 3 hours p.i. did not show any significant enantioselective tissue uptake. Conclusions: Although the (R)-enantiomer of [18F]FMISO demonstrated a somewhat faster initial tumor and muscle uptake no significant enantioselective tissue uptake was observed at later time points. The T/M- and T/L- ratios for the (R)- and (S)-forms were the same within the experimental error at all times. Therefore, the use of enantiopure [18F]FMISO is unlikely to present any practical clinical benefit for PET imaging.

General information
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BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.946 SNIP 0.959 CiteScore 2.53
Web of Science (2014): Indexed yes
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We automate the manipulation of genomic-length DNA in a nanofluidic device based on real-time analysis of fluorescence images. In our protocol, individual molecules are picked from a microchannel and stretched with pN forces using pressure driven flows. The millimeter-long DNA fragments free flowing in micro- and nanofluidics emit low fluorescence and change shape, thus challenging the image analysis for machine vision. We demonstrate a set of image processing steps that increase the intrinsically low signal-to-noise ratio associated with single-molecule fluorescence microscopy. Furthermore, we demonstrate how to estimate the length of molecules by continuous real-time image stitching and how to increase the effective resolution of a pressure controller by pulse width modulation. The sequence of image-processing steps addresses the challenges of genomic-length DNA visualization; however, they should also be general to other applications of fluorescence-based microfluidics.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, University of Copenhagen
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A viable quantitative approach (v-qPCR) for detecting Arcobacter species

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Organisations: National Food Institute, Research Group for Diagnostic Engineering, Department of Micro- and Nanotechnology, BioLabChip, Universitat Rovira i Virgili, IRTA, Food Safety Programme
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Back-illuminated Si photocathode: a combined experimental and theoretical study for photocatalytic hydrogen evolution

General information
State: Published
Organisations: Department of Physics, Experimental Surface and Nanomaterials Physics, Department of Micro- and Nanotechnology, Silicon Microtechnology, University of Oslo
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Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 26.39 SJR 12.283 SNIP 4.325
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 7.769 SNIP 4.001 CiteScore 19.28
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Scopus rating (2013): SJR 6.019 SNIP 2.996 CiteScore 14.81
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Baking-powder driven centripetal pumping controlled by event-triggering of functional liquids

This paper reports radially inbound pumping by the event-triggered addition of water to on-board stored baking powder in combination with valving by an immiscible, high-specific weight liquid on a centrifugal microfluidic platform. This technology allows making efficient use of precious real estate near the center of rotation by enabling the placement of early sample preparation steps as well as reagent reservoirs at the spacious, high-field region on the perimeter of the disc-shaped rotor. This way the number of process steps and assays that can be integrated on these of this "Lab-on-a-Disc" (LoaD) cartridge can be significantly enhanced while maintaining minimum requirements on the intrinsically simple, spindle-motor based instrumentation.

Basic Microfluidics Theory

Flow in microsystems behaves very different than flow on the macroscale, i.e., the flow we are used to in our everyday life. The most obvious difference is that the chaotic turbulent flow we most often observe, e.g., rivers flowing or tap water running does not appear on the microscale. Here, the flow is more smooth and most often what we call laminar flow. Other parameters considered important on the macroscale such as inertia are insignificant on the microscale, whereas viscosity becomes extremely important. Diffusion, which on large scale is a hopeless parameter to use for transport, becomes
significant on microscale. The surface of your system has to be considered more carefully as the surface to volume ratio (S/V) increases dramatically as you downscale your system. Take for example a cubic macrosystem with sides of 1 m, here S/V = 6 m⁻¹, whereas for a system with sides of 1 μm the V/S = 600,000 m⁻¹, which is a huge difference and has a large impact on flow behavior. In this chapter the basic microfluidic theory will be presented, enabling the reader to gain a comprehensive understanding of how liquids behave at the microscale, enough to be able to engage in design of micro systems and to support the theory used in other chapters in the book, but without going into the deep underlying theoretical approach.

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Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems
Authors: Svendsen, W. E. (Intern)
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Main Research Area: Technical/natural sciences

**Bioimpedance monitoring of 3D cell culturing—Complementary electrode configurations for enhanced spatial sensitivity**

A bioimpedance platform is presented as a promising tool for non-invasive real-time monitoring of the entire process of three-dimensional (3D) cell culturing in a hydrogel scaffold. In this study, the dynamics involved in the whole process of 3D cell culturing, starting from polymerisation of a bare 3D gelatin scaffold, to human mesenchymal stem cell (MSC) encapsulation and proliferation, was monitored over time. The platform consists of a large rectangular culture chamber with four embedded vertical gold plate electrodes that were exploited in two- and three terminal (2T and 3T) measurement configurations. By switching between the different combinations of electrode couples, it was possible to generate a multiplexing-like approach, which allowed for collecting spatially distributed information within the 3D space. Computational finite element (FE) analysis and electrochemical impedance spectroscopic (EIS) characterisation were used to determine the configurations’ sensitivity field localisation. The 2T setup gives insight into the interfacial phenomena at both electrode surfaces and covers the central part of the 3D cell culture volume, while the four 3T modes provide focus on the dynamics at the corners of the 3D culture chamber. By combining a number of electrode configurations, complementary spatially distributed information on a large 3D cell culture can be obtained with maximised sensitivity in the entire 3D space. The experimental results show that cell proliferation can be monitored within the tested biomimetic environment, paving the way to further developments in bioimpedance tracking of 3D cell cultures and tissue engineering.

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Scopus rating (2017): SNIP 1.65 SJR 2.373
Web of Science (2017): Indexed yes
Bio-inspired aesthetic solar cells

General information
State: Published
Organisations: Department of Mechanical Engineering, Engineering Design and Product Development, Department of Micro- and Nanotechnology, Optofluidics
Biomimetic polymeric membranes for water treatment
This project is about the interplay of the three major components of aquaporin based biomimetic polymeric membranes (ABPMs): Aquaporins (AQPs), amphiphilic block copolymers, serving as a vesicular matrix for the hydrophobic AQP exterior (proteopolymersomes) and a polymeric membrane as embedment for the proteopolymersomes and mechanical support. To reach maximal functionality of ABPMs, the interplay of each component needs to be optimized. The optimization of AQPs and amphiphilic block copolymers was investigated by mixing bacterial Aquaporin Z (AqpZ) with polybutadiene polyethylene oxide (PB-PEO) diblock copolymers, where molecular weight (Mn) and hydrophilic volume ratio (f) were systematically varied to study the effect of incorporation efficiency on these molecular parameters. The incorporation was characterized using freeze fracture transmission electron microscopy (FF-TEM), fluorescence correlation spectroscopy (FCS), small-angle x-ray and neutron scattering (SAXS/SANS), stopped-flow light scattering (SFLS) and Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE). Proteopolymersomes as separate systems were further characterized on their molecular parameters, on formation and analysis methods. The interplay of proteopolymersomes and polymeric mesh support (in this case polyethersulfone, PES) was examined via integration of (proteo)polymersomes in an active layer (AL) formed by interfacial polymerisation between a linker molecule in aqueous phase and another in organic phase on top of the PES. The resulting thin-film composite (TFC) membrane was analyzed via cross-flow forward osmosis (FO), scanning electron microscopy (SEM), fourier-transformed infrared spectroscopy (FTIR), as well as in the non-supported form over FTIR and a specialized microfluidic visualization approach. Where no clear differences between proteopolymersomes and polymersomes could be obtained within FF-TEM, SAXS showed that the incorporation of AQPs in a polymersome bilayer changed its property to a more smooth and well-defined shape, as well as to a shift to more vesicular structures, as compared to coexisting micellar structures in the case of polymersomes. FCS revealed a protein-to-vesicle-ratio of 2.78, when AQP10 was incorporated in polymersome of a low Mn PB-PEO polymer. With regard to the molecular parameters of the polymersomes, FF-TEM and DLS revealed that the size and polydispersity of polymersomes is expressed in three main regions of Mn and f: Low Mn/high f (mixed sizes/polydisperse), low f (small size/monodisperse) and high Mn/high f (large size/monodisperse). This could be related to a less determined free energy function for polymersome formation with several minima for the first region. With regard to polymersome formation, polymersomes formed with detergent-mediated film dehydration (FR) were found to be less brittle than the ones formed by solvent evaporation (SE). This was revealed by SFLS, where a higher signal was obtained for FR prepared polymersomes and by DLS. The brittleness of SE prepared polymersomes was significantly increased from polymers of 3.75 kg/mol Mn and lower as compared to to 3.8 kg/mol and higher, where it was slightly increased above polymer concentrations of 5 mg/ml. FR prepared polymersomes were furthermore modified using biobead removal and dialysis at varying temperature and time. No dience in polymersome size and configuration was obtained between any of the variations. With regard to polymersome analysis, 17 different analysis techniques were used to obtain polymersome size, lamellarity, bilayer thickness or surface charge. Novel methods like atomic force microscopy and nanoparticle tracking analysis turned out to give reliable information on polymersome size like known techniques such as Cryo-TEM. Cryo-TEM gave as well reliable information about lamellarity, SAXS/SANS about bilayer thickness. SEM, FTIR and microfluidic experiments on the interaction between all three components of ABPMs revealed that proteopolymersomes could be integrated successfully in the AL for the one AL linker couple (polyhydral oligomeric silsesquioxane, POSS and trimesoyl chloride, TMC) where for the other couple (polyethyleneimine, PEI and cyanuric chloride, CC), the AL was almost not formed in presence of the proteopolymersomes. The modest membrane performance of all membranes revealed however defects in the AL, which could be due to the micrometer sized pores of PES. ABPMs could provide a smart solution to one of the worlds greatest challenges in the next decades: the scarcity of clean water and sanitation access.
Bioreactor process monitoring using an automated microfluidic platform for cell-based assays

We report on a novel microfluidic system designed to monitor in real-time the concentration of live and dead cells in industrial cell production. Custom-made stepper motor actuated peristaltic pumps and valves, fluidic interconnections, sample-to-waste liquid management and image cytometry-based detection contribute to the high programmability and automation of this platform. Furthermore, this is to the best of our knowledge, the first use of Dean vortices to implement a wide range of dilution factors to highly concentrated cell samples. The combination of a curved channel geometry and high flow rates enables the rapid passive mixing and homogenization of the diluted cell plug.

Black metal thin films by deposition on dielectric antireflective moth-eye nanostructures

Although metals are commonly shiny and highly reflective, we here show that thin metal films appear black when deposited on a dielectric with antireflective moth-eye nanostructures. The nanostructures were tapered and close-packed, with heights in the range 300-600 nm, and a lateral, spatial frequency in the range 5-7 μm⁻¹. A reflectance in the visible spectrum as low as 6%, and an absorbance of 90% was observed for an Al film of 100 nm thickness. Corresponding experiments on a planar film yielded 80% reflectance and 20% absorbance. The observed absorbance enhancement is attributed to a gradient effect causing the metal film to be antireflective, analogous to the mechanism in dielectrics and semiconductors. We find that the investigated nanostructures have too large spatial frequency to facilitate efficient coupling to the otherwise non-radiating surface plasmons. Applications for decoration and displays are discussed.
Bubbles in graphene: a computational study

Strain-induced deformations in graphene are predicted to give rise to large pseudomagnetic fields. We examine theoretically the case of gas-inflated bubbles to determine whether signatures of such fields are present in the local density of states. Sharp-edged bubbles are found to induce Friedel-type oscillations which can envelope pseudo-Landau level features in certain regions of the bubble. However, bubbles which minimise interference effects are also unsuitable for pseudo-Landau level formation due to more spatially varying field profiles.

General information
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Organisations: Department of Micro- and Nanotechnology, Center for Nanostructured Graphene, Theoretical Nanotechnology, Theoretical Nanoelectronics
Authors: Settnes, M. (Intern), Power, S. (Intern), Lin, J. (Intern), Petersen, D. H. (Intern), Jauho, A. (Intern)
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Calculations of Non-equilibrium Effects in Nano-conductors

This thesis is concerned with the interplay between electrical current and vibrational and plasmonic excitations. The development of nano-scale devices for electronics relies on the ability to identify individual atoms and molecules as well as their geometry and electronic structure. In this thesis we show how measuring the noise can give information about the quantum nature of the device and relate the high frequency noise to light-emission. A first principle method is presented for calculating the light-emission and is utilized to calculate the light-emission from two STM experiments: An adatom on a Ag(111)surface and a C$_{60}$ molecule on a Cu(111) surface. The calculated photon yield is found to agree with experiments for photons with energies below the applied bias (h$\omega < eV$). Inelastic electron tunneling spectroscopy (IETS) serves as a powerful tool for non-destructive characterization. A new fast method for calculating the energy dependent IETS signal is presented, and applied to a one-level model revealing how a symmetric system can give rise to peak-dip features in the IETS. The new method is used to explain the IETS signal obtained for a 1,4-benzene-dithiol(BDT) molecule in a symmetric gold junction as a function of gate voltage. Gating molecules in 3D metal junctions is difficult due to screening effects.
other hand, graphene devices are routinely gated. Thus, we study the IETS signal from gated graphene nano ribbons (GNR). We study pristine GNRs with both zigzag and armchair chirality, and related the IETS signal to the phononic band structure. For the spin-polarized zigzag GNRs the role of the spin-polarization is investigated, revealing IETS as an indirect measurement of spin-polarization. Further, the role of impurities is explored, revealing the possibility of detecting defects in the hydrogen passivisation by IETS. Lastly a preliminary study of the heating due to the electrical current is described, investigating the effect of the deterministic current-induced forces, treated within the framework of the semi-classical generalized Langevin equation (SGLE). For a pristine zigzag ribbon the deterministic current-induced forces is seen to give rise to runaway modes. For an armchair ribbon with partly dehydrogenated edges the deterministic current-induced forces is seen to break the symmetry and increase the excess heating.

**Carbon black nanoparticles induce biphasic gene expression changes associated with inflammatory responses in the lungs of C57BL/6 mice following a single intratracheal instillation**

Inhalation of carbon black nanoparticles (CBNPs) causes pulmonary inflammation; however, time course data to evaluate the detailed evolution of lung inflammatory responses are lacking. Here we establish a time-series of lung inflammatory response to CBNPs. Female C57BL/6 mice were intratracheally instilled with 162μg CBNPs alongside vehicle controls. Lung tissues were examined 3h, and 1, 2, 3, 4, 5, 14, and 42days (d) post-exposure. Global gene expression and pulmonary inflammation were assessed. DNA damage was evaluated in bronchoalveolar lavage (BAL) cells and lung tissue using the comet assay. Increased neutrophil influx was observed at all time-points. DNA strand breaks were increased in BAL cells 3h post-exposure, and in lung tissues 2-5d post-exposure. Approximately 2600 genes were differentially expressed (±1.5 fold; p≤0.05) across all time-points in the lungs of exposed mice. Altered transcript levels were associated with immune-inflammatory response and acute phase response pathways, consistent with the BAL profiles and expression changes found in common respiratory infectious diseases. Genes involved in DNA repair, apoptosis, cell cycle regulation, and muscle contraction were also differentially expressed. Gene expression changes associated with inflammatory response followed a biphasic pattern, with initial changes at 3h post-exposure declining to base-levels by 3d, increasing again at 14d, and then persisting to 42d post-exposure. Thus, this single CBNP exposure that was equivalent to nine 8-h working days at the current Danish occupational exposure limit induced biphasic inflammatory response in gene expression that lasted until 42d post-exposure, raising concern over the chronic effects of CBNP exposure.
Carbon nanopillars for stem cell differentiation and dopamine detection

General information
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Carbon Nanotube-Based Separation Columns for Microchip Electrochromatography

Fabrication of the stationary phase for microchip chromatography is most often done by packing of the individual separation channel after fabrication of the microfluidic chip, which is a very time-consuming and costly process (Kutter, J. Chromatogr A 1221:72–82, 2012). Here, we describe in detail the fabrication and operation protocols for devices with microfabricated carbon nanotube stationary phases for reverse-phase chromatography. In this protocol, the lithographically defined stationary phase is fabricated in the channel before bonding of a lid, thereby circumventing the difficult packaging procedures used in more conventional protocols.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology, ChemLabChip
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Source: PublicationPreSubmission
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Cavity-less sub-picosecond pulse generation for the demultiplexing of a 640 Gbaud OTDM signal

A 703 fs cavity-less pulse source based on pulse carving and pulse compression is demonstrated and utilized for demultiplexing a 640 Gbaud OTDM signal. Timing jitter is found to be the main limiting factor.

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Publisher: IEEE
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Centrifugal Microfluidic Platform Using Supported Liquid Membrane Extraction for Combined Sample Clean-Up and Enrichment of Trace Analytes

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Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Bioanalytics, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Andreasen, S. Z. (Intern), Burger, R. (Intern), Emnéus, J. (Intern), Boisen, A. (Intern)
Number of pages: 1
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Main Research Area: Technical/natural sciences
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Chalcogenide compounds made by pulsed laser deposition at 355 and 248 nm
Thin films made by pulsed laser deposition may differ depending on the laser wavelength. We compared ZnS, Cu2SnS3 and a target enriched with SnS relative to Cu2SnS3 using 355 nm and 248 nm lasers

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Organisations: Department of Photonics Engineering, Optical Microsensors and Micromaterials, Department of Micro- and Nanotechnology, Silicon Microtechnology, DTU Danchip, Department of Energy Conversion and Storage, Electrofunctional materials, Technical University of Denmark
Authors: Ettlinger, R. B. (Intern), Cazzaniga, A. C. (Intern), Crovetto, A. (Intern), Ravnikilde, L. (Ekstern), Youngman, T. H. (Intern), Pryds, N. (Intern), Schou, J. (Intern)
Number of pages: 1
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Main Research Area: Technical/natural sciences
Changes in cholesterol homeostasis and acute phase response link pulmonary exposure to multi-walled carbon nanotubes to risk of cardiovascular disease

Adverse lung effects following pulmonary exposure to multi-walled carbon nanotubes (MWCNTs) are well documented in rodents. However, systemic effects are less understood. Epidemiological studies have shown increased cardiovascular disease risk after pulmonary exposure to airborne particles, which has led to concerns that inhalation exposure to MWCNTs might pose similar risks. We analyzed parameters related to cardiovascular disease, including plasma acute phase response (APR) proteins and plasma lipids, in female C57BL/6 mice exposed to a single intratracheal instillation of 0, 18, 54 or 162 μg/mouse of small, entangled (CNTsmall, 0.8 +/- 0.1 pm long) or large, thick MWCNTs (CNTLarge, 4 +/- 0.4 μm long). Liver tissues and plasma were harvested 1.3 and 28 days post-exposure. In addition, global hepatic gene expression, hepatic cholesterol content and liver histology were used to assess hepatic effects. The two MWCNTs induced similar systemic responses despite their different physicochemical properties. APR proteins SAA3 and haptoglobin, plasma total cholesterol and low-density/very low-density lipoprotein were significantly increased following exposure to either MWCNTs. Plasma SAA3 levels correlated strongly with pulmonary Saa3 levels. Analysis of global gene expression revealed perturbation of the same biological processes and pathways in liver, including the HMG-CoA reductase pathway. Both MWCNTs induced similar histological hepatic changes, with a tendency towards greater response following CNTlarge exposure. Overall, we show that pulmonary exposure to two different MWCNTs induces similar systemic and hepatic responses, including changes in plasma APR, lipid composition, hepatic gene expression and liver morphology. The results link pulmonary exposure to MWCNTs with risk of cardiovascular disease. (C) 2015 The Authors. Published by Elsevier Inc.
Characterising interactions between alginates of different sizes and beta-lactoglobulin

General Information
State: Published
Organisations: Department of Systems Biology, Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Enzyme and Protein Chemistry, University of Copenhagen, Roskilde University, Technical University of Denmark
Authors: Stender, E. G. P. (Intern), Khan, S. (Intern), Mäkinen, O. E. (Ekstern), Almdal, K. (Intern), Westh, P. (Ekstern), Ibsen, R. (Ekstern), Abou Hachem, M. (Intern), Svensson, B. (Intern)
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Characterization of copper oxidation at graphene/copper interfaces by transmission electron microscopy

General information
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Organisations: Department of Micro- and Nanotechnology, Nanointegration, Center for Electron Nanoscopy
Authors: Whelan, P. R. (Intern), Kostesha, N. (Intern), Larsen, M. B. S. (Intern), Balogh, Z. I. (Intern), Bøggild, P. (Intern), Booth, T. (Intern)
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Source-ID: 103005608
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2015

Characterization of Genotoxic Response to 15 Multiwalled Carbon Nanotubes with Variable Physicochemical Properties Including Surface Functionalizations in the FE1-Muta(TM) Mouse Lung Epithelial Cell Line
Carbon nanotubes vary greatly in physicochemical properties. We compared cytotoxic and genotoxic response to 15 multiwalled carbon nanotubes (MWCNT) with varying physicochemical properties to identify drivers of toxic responses. The studied MWCNT included OECD Working Party on Manufactured Nanomaterials (WPMN) (NM-401, NM-402, and NM-403), materials (NRCWE-026 and MWCNT-XNRI-7), and three sets of surface-modified MWCNT grouped by physical characteristics (thin, thick, and short I-III, respectively). Each Groups I-III included pristine, hydroxylated and carboxylated MWCNT. Group III also included an amino-functionalized MWCNT. The level of surface functionalization of the MWCNT was low. The level and type of elemental impurities of the MWCNT varied by

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Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment
Authors: Jackson, P. (Ekstern), Kling, K. (Ekstern), Jensen, K. A. (Ekstern), Clausen, P. A. (Ekstern), Madsen, A. M. (Ekstern), Wallin, H. (Ekstern), Vogel, U. B. (Intern)
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
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Web of Science (2016): Indexed yes
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Characterization of magnetic tunnel junction test pads

We show experimentally as well as theoretically that patterned magnetic tunnel junctions can be characterized using the current-in-plane tunneling (CIPT) method, and the key parameters, the resistance-area product (RA) and the tunnel magnetoresistance (TMR), can be determined. The CIPT method relies on four-point probe measurements performed with a range of different probe pitches and was originally developed for infinite samples. Using the method of images, we derive a modified CIPT model, which compensates for the insulating boundaries of a finite rectangular sample geometry. We measure on square tunnel junction pads with varying sizes and analyze the measured data using both the original and the modified CIPT model. Thus, we determine in which sample size range the modified CIPT model is needed to ensure validity of the extracted sample parameters, RA and TMR. In addition, measurements as a function of position on a square tunnel junction pad are used to investigate the sensitivity of the measurement results to probe misalignment.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Department of Physics, Experimental Surface and Nanomaterials Physics, Nanocarbon, Capres A/S
Authors: Østerberg, F. W. (Intern), Kjær, D. (Intern), Nielsen, P. F. (Intern), Hansen, O. (Intern), Petersen, D. H. (Intern)
Number of pages: 7
Pages: 143901
Publication date: 2015
Main Research Area: Technical/natural sciences
Characterization of positional errors and their influence on micro four-point probe measurements on a 100 nm Ru film

Thin-film sheet resistance measurements at high spatial resolution and on small pads are important and can be realized with micrometer-scale four-point probes. As a result of the small scale the measurements are affected by electrode position errors. We have characterized the electrode position errors in measurements on Ru thin film using an Au-coated 12-point probe. We show that the standard deviation of the static electrode position error is on the order of 5 nm, which significantly affects the results of single configuration measurements. Position-error-corrected dual-configuration measurements, however, are shown to eliminate the effect of position errors to a level limited either by electrical measurement noise or dynamic position errors. We show that the probe contact points remain almost static on the surface during the measurements (measured on an atomic scale) with a standard deviation of the dynamic position errors of 3 Å. We demonstrate how to experimentally distinguish between different sources of measurement errors, e.g. electrical measurement noise, probe geometry error as well as static and dynamic electrode position errors.
We present a detailed investigation of a double-time-lens subsystem for spectral compression of OFDM symbols. We derive optimized parameter settings by simulations and experimental characterization. The required chirp for OFDM spectral compression is very large.

Characterization of spectral compression of OFDM symbols using optical time lenses

We present a detailed investigation of a double-time-lens subsystem for spectral compression of OFDM symbols. We derive optimized parameter settings by simulations and experimental characterization. The required chirp for OFDM spectral compression is very large.
Characterization of the zero-dispersion wavelength variation in a strained highly nonlinear fiber

We present an experimental characterization of longitudinal zero-dispersion wavelength variations in a novel, strained, highly nonlinear fiber, by simple four-wave mixing spectrum analysis, and provide new insights to the analysis supported by detailed numerical simulations.

Chemically Modified Hierarchical Metal Oxide Nanostructures for Excellent Lithium Storage

We present an experimental characterization of longitudinal zero-dispersion wavelength variations in a novel, strained, highly nonlinear fiber, by simple four-wave mixing spectrum analysis, and provide new insights to the analysis supported by detailed numerical simulations.
Chemical Vapour Deposition of Large Area Graphene

Chemical Vapour Deposition (CVD) is a viable technique for fabrication of large areas of graphene. CVD fabrication is the most prominent and common way of fabricating graphene in industry. In this thesis I have attempted to optimize a growth recipe and catalyst layer for CVD fabrication of uniform, single layer, and high carrier mobility large area graphene. The main goals of this work are; (1) explore the graphene growth mechanics in a low pressure cold-wall CVD system on a copper substrate, and (2) optimize the process of growing high quality graphene in terms of carrier mobility, and crystal structure. Optimization of a process for graphene growth on commercially available copper foil is limited by the number of aluminium oxide particles on the surface of the catalyst. By replacing the copper foil with a thin deposited copper film on a SiO₂/Si or c-plane sapphire wafer the particles can be eliminated. Further opportunities arise when exchanging the copper foil for copper thin film on a wafer e.g. better integration with current cleanroom processing of devices and better control over the copper crystallinity. Typical strategies for controlling the temperature during CVD fabrication of graphene are proportional, integral, and derivative (PID) controllers. The PID controller in a CVD system works off feedback temperatures from a thermocouple. The thermocouples used in this work suffer from degradation at the temperatures and the hydrogen gasses needed for high quality graphene growth. The degradation of thermocouples leads to large variations in the grown graphene. This was solved by controlling the temperature through applying a set power to the heat source, resulting in a more stable temperature from process to process. Micro Raman spectroscopy is used to characterize the structural quality of the grown graphene on the copper surface as well as after a transfer process to a SiO₂ substrate. Raman mapping is especially suited for uniformity characterization on a scale of a few to hundreds of microns. In this work I have also used spatially resolved micro Raman spectroscopy to map the full width at half maximum (FWHM) of the graphene G-band and the 2D and G peak positions, for as-grown graphene on copper catalyst layers, for transferred graphene on copper, and for micro-mechanically exfoliated graphene. This was done to characterize the effects of a transfer process on the graphene properties. The FWHM(G) indicates the doping level of graphene, and the ratio of the shifts in the 2D and G bands as an indicator of strain. The transfer process introduces an isotropic, spatially uniform, compressive strain in graphene, and increases the carrier concentration. Copper foil was found to exhibit a polycrystalline surface with a predominantly Cu(001) orientation, through electron backscatter diffraction mapping. Copper thin film deposited on a SiO₂/Si wafer display a polycrystalline nature with the Cu(111) orientation dominating, when the crystals increase in size. Copper thin film sputtered on a c-plane sapphire wafer shows almost single crystal formation of Cu(111) across a 4 inch wafer. The polycrystalline nature of a thin copper film on a SiO₂/Si wafer was investigated through annealing. A variation in the annealing temperature was found to have a significant effect on the crystal size, while the annealing time was found to have little effect on the crystal sizes. Electronic hall-bar devices were fabricated from CVD graphene grown on copper foil, copper on SiO₂/Si wafers, and copper on sapphire wafers. Preliminary results show the highest carrier mobility was achieved from graphene grown on copper on sapphire, while graphene grown on copper foil showed the lowest carrier mobility.

General Information

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanointegration, Center for Nanostructured Graphene, Nanocarbon, DTU Danchip
Authors: Larsen, M. B. B. S. (Intern), Bøggild, P. (Intern), Booth, T. (Intern), Jørgensen, A. M. (Intern)
Number of pages: 202
Publication date: 2015

PhD thesis Martin Benjamin Larsen.pdf
Source: Publication PreSubmission
Source-ID: 110749612
Publication: Research Ph.D. thesis – Annual report year: 2015

Classical and quantum effects in noble metal and graphene plasmonics

Plasmonics — the interaction of light with free electrons in metals — is commonly understood within classical electrodynamics using local-response constitutive laws (such as Ohm's law). However, the tight localization of plasmons to small volumes is revealing intriguing new physics such as nonclassical electrodynamics with a nonlocal response of the plasmons. Nonlocal effects are being explored both theoretically and experimentally in different charge-conducting material systems with examples ranging from sub-10 nanometer noble metal particles to one-atom thin disks of doped graphene.

General Information

State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Photonics Engineering, Structured Electromagnetic Materials
Authors: Mortensen, N. A. (Intern)
Pages: 9-11
Publication date: 2015

**Classification of analysis methods for characterization of magnetic nanoparticle properties**

The aim of this paper is to provide a roadmap for the standardization of magnetic nanoparticle (MNP) characterization. We have assessed common MNP analysis techniques under various criteria in order to define the methods that can be used as either standard techniques for magnetic particle characterization or those that can be used to obtain a comprehensive picture of a MNP system. This classification is the first step on the way to develop standards for nanoparticle characterization.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Physikalisch-Technische Bundesanstalt, University College London, Uppsala University, Micromod Partikeltechnologie GmbH, Universidad de Cantabria, Bundesanstalt für Materialforschung und Prüfung, Technische Universität Braunschweig, nanoPET Pharma GmbH, RISE ICT, National Physical Laboratory
Authors: Posth, O. (Ekstern), Hansen, M. F. (Intern), Steinhoff, U. (Ekstern), Bogart, L. (Ekstern), Southern, P. (Ekstern), Svedlindh, P. (Ekstern), Grüttnner, C. (Ekstern), Barquin, L. F. (Ekstern), Szczerba, W. (Ekstern), Ludwig, F. (Ekstern), Gerhke, N. (Ekstern), Kazakova, O. (Ekstern), Johansson, C. (Ekstern)
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Aerospace, Bioengineering, Communication, Networking and Broadcast Technologies, Components, Circuits, Devices and Systems, Computing and Processing, Engineered Materials, Dielectrics and Plasmas, Fields, Waves and Electromagnetics, Photonics and Electrooptics, Atom optics, Electrodynamics, Graphene, Metals, Nanostructures, Photonics, Plasmons
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Source-ID: 276303980
Publication: Research - peer-review › Article in proceedings – Annual report year: 2015
Collagen Type I Improves the Differentiation of Human Embryonic Stem Cells towards Definitive Endoderm

Human embryonic stem cells have the ability to generate all cell types in the body and can potentially provide an unlimited source of cells for cell replacement therapy to treat degenerative diseases such as diabetes. Current differentiation protocols of human embryonic stem cells towards insulin producing beta cells focus on soluble molecules whereas the impact of cell-matrix interactions has been mainly unattended. In this study almost 500 different extracellular matrix protein combinations were screened to systemically identify extracellular matrix proteins that influence differentiation of human embryonic stem cells to the definitive endoderm lineage. The percentage of definitive endoderm cells after differentiation on collagen I and fibronectin was >85% and 65%, respectively. The cells on collagen I substrates displayed different morphology and gene expression during differentiation as assessed by time lapse studies compared to cells on the other tested substrates. Global gene expression analysis showed that cells differentiated on collagen I were largely similar to cells on fibronectin after completed differentiation. Collectively, the data suggest that collagen I induces a more rapid and consistent differentiation of stem cells to definitive endoderm. The results shed light on the importance of extracellular matrix proteins for differentiation and also points to a cost effective and easy method to improve differentiation.
Color metasurfaces in industrial perspective

This doctoral thesis describes the utilization of color metasurfaces in an industrial perspective, where nano-scale textures and contingent post processing replace inks, dyes and pigments in plastic production. The concept of colors by structure arguably reduces the number of raw materials and eliminates mechanical color sorting in the recycling stage. First, the development of experimental processes, techniques and equipment is described. A single-spot electron beam lithography scheme for master pattern definition is developed, and optical characterization equipment for both laboratory and production environments is developed.

Second, the fundamental optical surface properties of dielectric materials are investigated within the framework of mass production applicability. Different colors can be realized using a single-step etching process by altering the nano-texture in high-index materials, exemplified in silicon. However, only corresponding faint colors appear in polymeric materials. The concept of all-polymer pigment-free coloration seems somewhat restricted in relation to widespread industrial employment. Finally, a novel plasmon color technology for structural coloration in plastics is developed based on metal-coated polymer nano-textures and a protective coating system. The technology utilizes a hybrid disk-hole plasmonic mode for resonances in the visible spectrum, based on aluminum as a cheap and abundant plasmonic material. Angle-insensitive scratch-resistant colors are demonstrated, and it is shown that the dependence on polarization can be controlled. In collaboration with industry, polymer-based colored metasurfaces of square-centimeter size are demonstrated by embossing, injection molding, roll-to-roll printing, and film insert molding with full compatibility. Furthermore, post production color modification by laser ablation is briefly described. The environmental benefits are analyzed by life cycle analysis, where the high recyclability leads to reduced environmental impact compared to conventional plastic production. In summary, a promising future is anticipated for plasmonic colors as a decoration element for everyday use.
Comparison of delay-interferometer and time-lens-based all-optical OFDM demultiplexers

In this paper we present the first detailed numerical comparison of two promising all-optical schemes to demultiplex orthogonal frequency-division multiplexing (OFDM) signals. The investigated schemes are the optical discrete Fourier transformation (O-DFT) and the optical spectral magnification (SM) based on time lenses. In the former scheme, cascaded delay-interferometers (DIs) are used to perform the O-DFT, with subsequent active optical gating to remove the intercarrier interference (ICI). Here a reduced-complexity partial O-DFT, realized by replacing a number of DIs with optical bandpass filters, is investigated. In the latter scheme the OFDM spectrum is magnified, allowing for simple optical bandpass filtering of the individual subcarriers with reduced ICI. Ideally only a single unit consisting of two time lenses is needed, reducing the complexity and potentially the energy consumption compared to the type of O-DFT scheme relying on many active gates. The bit-error-rate is estimated down to \( \sim 10^{-6} \) by Monte Carlo bit-error counting for a 32-subcarrier OFDM input signal, showing that a performance close to the ideal O-DFT is achievable for both the reduced-complexity O-DFT and the SM scheme.

General information
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Organisations: National Space Institute, Department of Photonics Engineering, High-Speed Optical Communication, Department of Micro- and Nanotechnology
Authors: Lillieholm, M. (Intern), Mulvad, H. C. H. (Intern), Galili, M. (Intern), Oxenløwe, L. K. (Intern)
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Photons and Electrooptics, All-optical OFDM, Bit error rate, Chirp, Chlorine, Complexity theory, Lenses, OFDM, optical discrete Fourier transformation, Optical filters, optical Fourier transformation, time lens
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Comparison of optical methods for surface roughness characterization

We report a study of the correlation between three optical methods for characterizing surface roughness: a laboratory scatterometer measuring the bi-directional reflection distribution function (BRDF instrument), a simple commercial scatterometer (rBRDF instrument), and a confocal optical profiler. For each instrument, the effective range of spatial surface wavelengths is determined, and the common bandwidth used when comparing the evaluated roughness parameters. The compared roughness parameters are: the root-mean-square (RMS) profile deviation (Rq), the RMS profile slope (Rdq), and the variance of the scattering angle distribution (Aq). The twenty-two investigated samples were manufactured with several methods in order to obtain a suitable diversity of roughness patterns. Our study shows a one-to-one correlation of both the Rq and the Rdq roughness values when obtained with the BRDF and the confocal instruments, if the common bandwidth is applied. Likewise, a correlation is observed when determining the Aq value with the BRDF and the rBRDF instruments. Furthermore, we show that it is possible to determine the Rq value from the Aq value, by applying a simple transfer function derived from the instrument comparisons. The presented method is validated for surfaces with predominantly 1D roughness, i.e. consisting of parallel grooves of various periods, and a reflectance similar to stainless steel. The Rq values are predicted with an accuracy of 38% at the 95% confidence interval.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Department of Mechanical Engineering, Manufacturing Engineering, Danish Fundamental Metrology
Authors: Feidenhans'l, N. A. (Intern), Hansen, P. E. (Ekstern), Pilny, L. (Intern), Madsen, M. H. (Ekstern), Bissacco, G. (Intern), Pettersen, J. C. (Ekstern), Taboryski, R. J. (Intern)
Number of pages: 10
Publication date: 2015
Main Research Area: Technical/natural sciences
Comparison of the performance of cop-coated and pt-coated radial junction $n^+ p$-silicon microwire-array photocathodes for the sunlight-driven reduction of water to $H_2(g)$

The electrocatalytic performance for hydrogen evolution has been evaluated for radial-junction $n^+ p$-Si microwire (MW) arrays with Pt or cobalt phosphide, CoP, nanoparticulate catalysts in contact with 0.50 M $H_2SO_4(aq)$. The CoP-coated (2.0 mg cm$^{-2}$) $n^+ p$-Si MW photocathodes were stable for over 12 h of continuous operation and produced an open-circuit photovoltage ($V_{OC}$) of 0.48 V, a light-limited photocurrent density ($J_{ph}$) of 17 mA cm$^{-2}$, a fill factor (ff) of 0.24, and an ideal regenerative cell efficiency ($η_{IRC}$) of 1.9% under simulated 1 Sun illumination. Pt-coated (0.5 mg cm$^{-2}$) $n^+ p$-Si MW-array photocathodes produced $V_{OC} = 0.44$ V, $J_{ph} = 14$ mA cm$^{-2}$, ff = 0.46, and $η = 2.9$% under identical conditions. Thus, the MW geometry allows the fabrication of photocathodes entirely comprised of earth-abundant materials that exhibit performance comparable to that of devices that contain Pt.
Concentrating Genomic Length DNA in a Microfabricated Array

We demonstrate that a microfabricated bump array can concentrate genomic-length DNA molecules efficiently at continuous, high flow velocities, up to 40 μm/s, if the single-molecule DNA globule has a sufficiently large shear modulus. Increase in the shear modulus is accomplished by compacting the DNA molecules to minimal coil size using polyethylene glycol (PEG) derived depletion forces. We map out the sweet spot, where concentration occurs, as a function of PEG concentration and flow speed using a combination of theoretical analysis and experiment. Purification of DNA from enzymatic reactions for next-generation DNA-sequencing libraries will be an important application of this development.
Conductometric analysis in bio-applications: A universal impedance spectroscopy-based approach using modified electrodes

We present a universal protocol for quick and reproducible conductivity determinations in bio-applications using electrochemical impedance spectroscopy (EIS), electrode modification and automate spectral analysis. Two-terminal EIS measurements may be acquired using any standard impedance analyser adjusting the applied sinusoidal potential and frequency range for spectral analysis. An implemented Matlab algorithm displays the acquired spectra, automatically identifies the frequency at which the phase angle (ϕ) is closest to 0° and determines the impedance magnitude, i.e. the solution resistance (RS). The corresponding conductivity value is immediately calculated as the ratio of the conductivity cell constant(K), determined based on calibration, and RS. This protocol eliminates the need for evaluating a specific equivalent circuit followed by non-linear regression based curve fitting that is generally required in EIS-based conductivity determinations. The protocol is applicable to conductivity determinations using different conductivity cell configurations in any electrolyte solution regardless of its composition, i.e. in solutions with or without electroactive species that give rise to faradaic interface impedance. Conducted measurements showed high reproducibility in good agreement with a commercial conductometer in a wide range of ionic strengths up to five times that of physiological PBS. Since measurements in cell culture medium with bare gold electrodes indicated the need for recalibration to counteract the effect of biomolecule physisorption, the validity of the protocol was further extended using a protein-repellent coating of poly(ethylene glycol) methyl ether thiol self-assembled monolayer. This effectively eliminated electrode fouling, facilitating high reproducibility in repeated conductivity determinations in the presence of proteins. © 2015 Elsevier B.V. All rights reserved

General information
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Organisations: Department of Micro- and Nanotechnology, Bioanalytics, University of Oslo
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Scopus rating (2016): CiteScore 5.07 SJR 1.343 SNIP 1.464
Web of Science (2016): Indexed yes
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Scopus rating (2015): SJR 1.225 SNIP 1.484 CiteScore 4.84
Web of Science (2015): Indexed yes
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Scopus rating (2014): SJR 1.229 SNIP 1.658 CiteScore 4.37
Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 1.261 SNIP 1.638 CiteScore 4.25
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
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Scopus rating (2012): SJR 1.412 SNIP 1.674 CiteScore 3.92
ISI indexed (2012): ISI indexed yes
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Electrochemical impedance spectroscopy, Universal protocol for impedance-based conductivity determination, Customised Matlab-based algorithm for automated spectral analysis, Protein-repellent electrode modification, Conductivity measurements in cell culture medium

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**Configurational Statistics of Magnetic Bead Detection with Magnetoresistive Sensors**
Magnetic biosensors detect magnetic beads that, mediated by a target, have bound to a functionalized area. This area is often larger than the area of the sensor. Both the sign and magnitude of the average magnetic field experienced by the sensor from a magnetic bead depends on the location of the bead relative to the sensor. Consequently, the signal from multiple beads also depends on their locations. Thus, a given coverage of the functionalized area with magnetic beads does not result in a given detector response, except on the average, over many realizations of the same coverage. We present a systematic theoretical analysis of how this location-dependence affects the sensor response. The analysis is done for beads magnetized by a homogeneous in-plane magnetic field. We determine the expected value and standard deviation of the sensor response for a given coverage, as well as the accuracy and precision with which the coverage can be determined from a single sensor measurement. We show that statistical fluctuations between samples may reduce the sensitivity and dynamic range of a sensor significantly when the functionalized area is larger than the sensor area. Hence, the statistics of sampling is essential to sensor design. For illustration, we analyze three important published cases for which statistical fluctuations are dominant, significant, and insignificant, respectively.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Magnetic Systems, Department of Physics, Stochastic Systems and Signals
Confinement dependent chemotaxis in two-photon polymerized linear migration constructs with highly definable concentration gradients

Dendritic cell chemotaxis is known to follow chemoattractant concentration gradients through tissue of heterogeneous pore sizes, but the dependence of migration velocity on pore size and gradient steepness is not fully understood. We enabled chemotaxis studies for at least 42 hours at confinements relevant to tissue models by two-photon polymerization of linear channel constructs with cross-sections from 10 × 10 μm² to 20 × 20 μm² inside commercially available chemotaxis analysis chips. Faster directed migration was observed with decreasing channel dimensions despite substantial cell deformation in the narrower channels. Finite element modeling of a cell either partly or fully obstructing chemokine diffusion in the narrow channels revealed strong local accentuation of the chemokine concentration gradients. The modeled concentration differences across a cell correlated well with the observed velocity dependence on channel cross-section. However, added effects due to spatial confinement could not be excluded. The design freedom offered by two-photon polymerization was exploited to minimize the accentuated concentration gradients in cell-blocked channels by introducing "venting slits" to the surrounding medium at a length scale too small (≤500 nm) for the cells to explore, thereby decoupling effects of concentration gradients and spatial confinement. Studies in slitted 10 × 10 μm² channels showed significantly reduced migration speeds indistinguishable from speeds observed in unslitted 20 × 20 μm² channel. This result agrees with model predictions of very small concentration gradient variations in slitted channels, thus indicating a strong influence of the concentration gradient steepness, not the channel size, on the directed migration velocity.
This work describes an improvement in the layout of coplanar electrodes for electrical impedance spectroscopy. We have developed, fabricated, and tested an improved electrode layout, which improves the sensitivity of an impedance flow cytometry chip. The improved chip was experimentally tested and compared to a chip with a conventional electrode layout. The improved chip was able to discriminate 0.5 μm beads from 1 μm as opposed to the conventional chip. Furthermore, finite element modeling was used to simulate the improvements in electrical field density and uniformity between the electrodes of the new electrode layout. Good agreement was observed between the model and the obtained experimental results.

**Coplanar Electrode Layout Optimized for Increased Sensitivity for Electrical Impedance Spectroscopy**

This work describes an improvement in the layout of coplanar electrodes for electrical impedance spectroscopy. We have developed, fabricated, and tested an improved electrode layout, which improves the sensitivity of an impedance flow cytometry chip. The improved chip was experimentally tested and compared to a chip with a conventional electrode layout. The improved chip was able to discriminate 0.5 μm beads from 1 μm as opposed to the conventional chip. Furthermore, finite element modeling was used to simulate the improvements in electrical field density and uniformity between the electrodes of the new electrode layout. Good agreement was observed between the model and the obtained experimental results.

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems, SBT Aqua ApS
Authors: Clausen, C. H. (Intern), Skands, G. E. (Intern), Bertelsen, C. V. (Intern), Svendsen, W. E. (Intern)
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Main Research Area: Technical/natural sciences

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Scopus rating (2017): SNIP 0.987 SJR 0.493
Covalent organic polymer functionalized activated carbon: A novel material for water contaminant removal and CO\textsubscript{2} capture

Covalent organic polymers (COPs) have emerged as one of the leading advanced materials for environmental applications, such as the capture and recovery of carbon dioxide and the removal of contaminants from polluted water. COPs exhibit many remarkable properties that other leading advanced materials do not all-encompass possess. Moreover, COPs have proven to be extremely stable in a wide variety of conditions, i.e. extremely high temperatures and boiling water for weeks at a time, which make them ideal for environmental applications; ranging from CO\textsubscript{2} capture and recovery to organic solvent uptake in concentrated streams to metal and organic pollutant adsorption in contaminated waters. However, given the nanoscale structure of these COPs, real-world application has yet remained elusive for these materials. Herein, we report the functionalization of COPs onto the surface of activated carbon granules; through a series of surface modification techniques, followed by the synthesis of a COP “shell” around the carbon granule. Activated carbon, established as one of the cheapest and most effective environmental remediation materials of all time, provides the perfect base material for the attachment of COPs onto a material large enough to be able to be used in a packed-bed column. These columns can then be applied to the exhaust flue gas stream from a power plant or as a flow-through water treatment column. Furthermore, by impregnating nanoscale zero valent iron (nZVI) inside the COP matrix, these columns can subsequently degrade organic contaminants, e.g. halogenated solvents, azo dyes, antibiotics, etc., during the water treatment process. A first of its kind, activated carbon with a COP-functionalized shell provides a robust and regenerable material with the durability and versatility for a wide range of environmental applications.
Creating New VLS Silicon Nanowire Contact Geometries by Controlling Catalyst Migration

The formation of self-assembled contacts between vapor-liquid-solid grown silicon nanowires and flat silicon surfaces was imaged in situ using electron microscopy. By measuring the structural evolution of the contact formation process, we demonstrate how different contact geometries are created by adjusting the balance between silicon deposition and Au migration. We show that electromigration provides an efficient way of controlling the contact. The results point to novel device geometries achieved by direct nanowire growth on devices.
CRIM-TRACK: Sensor System for Detection of Criminal Chemical Substances

Detection of illegal compounds requires a reliable, selective and sensitive detection device. The successful device features automated target acquisition, identification and signal processing. It is portable, fast, user friendly, sensitive, specific, and cost efficient. LEAs are in need of such technology. CRIM-TRACK is developing a sensing device based on these requirements. We engage highly skilled specialists from research institutions, industry, SMEs and LEAs and rely on a team of end users to benefit maximally from our prototypes. Currently we can detect minute quantities of drugs, explosives and precursors thereof in laboratory settings. Using colorimetric technology we have developed prototypes that employ disposable sensing chips. Ease of operation and intuitive sensor response are highly prioritized features that we implement as we gather data to feed into machine learning. With machine learning our ability to detect threat compounds amidst harmless substances improves. Different end users prefer their equipment optimized for their specific field. In an explosives-detecting scenario, the end user may prefer false positives over false negatives, while the opposite may be true in a drug-detecting scenario. Such decisions will be programmed to match user preference. Sensor output can be as detailed as the sensor allows. The user can be informed of the statistics behind the detection, identities of all detected substances, and quantities thereof. The response can also be simplified to "yes" vs. "no". The technology under development in CRIM-TRACK will provide custom officers, police and other authorities with an effective tool to control trafficking of illegal drugs and drug precursors.
Crystalline TiO₂: A Generic and Effective Electron-Conducting Protection Layer for Photoanodes and Cathodes

Stabilizing efficient photoborbers for solar water splitting has recently shown significant progress with the development of various protection layers. Suitable protection layers for tandem devices should be conductive, transparent, and stable in strongly acidic or alkaline solutions. This paper shows that under certain conditions n-type semiconductors, such as TiO₂, can be used as protection layers for Si-based photoanodes. It also provides evidence that even in a photoanode assembly TiO₂ is conducting only electrons (not holes as in p-type protection layers), and therefore TiO₂ can be described as a simple ohmic contact. This renders n-type semiconductors, such as TiO₂, to be versatile and simple protection layers, which can be used for photoanodes and as previously shown for photocathodes. The ohmic behavior of n-type TiO₂ in a Si/TiO₂-photoanode assembly is demonstrated under dark and illuminated conditions by performing the oxygen evolution reaction (OER) and using the Fe(II)/Fe(III) redox couple. These measurements reveal that the performance of the Si/TiO₂-photoanode assembly is strongly dependent on the TiO₂/electrolyte interaction. Finally, the conditions and requirements that make TiO₂ generally applicable for photoanode assemblies, and thus for protecting tandem devices, are outlined and quantitatively shown by band diagram calculations. The results presented here provide the understanding required for the design of highly efficient and stable photoelectrochemical water splitting devices.
C$_{60}$ as an Atom Trap to Capture Co Adatoms

C$_{60}$ molecules were used to trap Co adatoms and clusters on a Au(111) surface using atomic/molecular manipulation with a scanning tunneling microscope. Two manipulation pathways (successive integration of single Co atoms in one molecule or direct integration of a Co cluster) were found to efficiently allow the formation of complexes mixing a C$_{60}$ molecule with Co atoms. Scanning tunneling spectroscopy reveals the robustness of the pi states of C$_{60}$ that are preserved after Co trapping. Scanning tunneling microscopy images and density functional theory calculations reveal that dissociated Co clusters of up to nine atoms can be formed at the molecule-substrate interface. These results open new perspectives in the interactions between metal adatoms and molecules, for applications in metal-organic devices.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, University Paris Diderot - Paris 7, Service de Physique de l’Etat Condensé
Authors: Yang, P. (Ekstern), Li, D. (Ekstern), Repain, V. (Ekstern), Chacon, C. (Ekstern), Girard, Y. (Ekstern), Rousset, S. (Ekstern), Smogunov, A. (Ekstern), Dappe, Y. J. (Ekstern), Barreteau, C. (Intern), Lagoute, J. (Ekstern)
Number of pages: 7
Pages: 6873-6879
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: The Journal of Physical Chemistry Part C
Volume: 119
Issue number: 12
ISSN (Print): 1932-7447
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 2.135 SNIP 1.147
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.48 SJR 1.964 SNIP 1.195
Current-Induced Forces and Hot Spots in Biased Nanojunctions

We investigate theoretically the interplay of current-induced forces (CIFs), Joule heating, and heat transport inside a current-carrying nanoconductor. We find that the CIFs, due to the electron-phonon coherence, can control the spatial heat dissipation in the conductor. This yields a significant asymmetric concentration of excess heating (hot spot) even for a symmetric conductor. When coupled to the electrode phonons, CIFs drive different phonon heat flux into the two electrodes. First-principles calculations on realistic biased nanojunctions illustrate the importance of the effect.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Theoretical Nanoelectronics, Center for Nanostructured Graphene, National University of Singapore, University of Copenhagen
Authors: Lu, J. T. (Intern), Christensen, R. B. (Intern), Wang, J. (Ekstern), Hedegård, P. (Ekstern), Brandbyge, M. (Intern)
Number of pages: 5
Defect/oxygen assisted direct write technique for nanopatterning graphene

High resolution nanopatterning of graphene enables manipulation of electronic, optical and sensing properties of graphene. In this work we present a straightforward technique that does not require any lithographic mask to etch nanopatterns into graphene. The technique relies on the damaged graphene to be etched selectively in an oxygen rich environment with respect to non-damaged graphene. Sub-40 nm features were etched into graphene by selectively exposing it to a 100 keV electron beam and then etching the damaged areas away in a conventional oven. Raman spectroscopy was used to evaluate the extent of damage induced by the electron beam as well as the effects of the selective oxidative etching on the remaining graphene.

Bibliographical note
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Publication: Research - peer-review › Journal article – Annual report year: 2015

Defect/oxygen assisted direct write technique for nanopatterning graphene

High resolution nanopatterning of graphene enables manipulation of electronic, optical and sensing properties of graphene. In this work we present a straightforward technique that does not require any lithographic mask to etch nanopatterns into graphene. The technique relies on the damaged graphene to be etched selectively in an oxygen rich environment with respect to non-damaged graphene. Sub-40 nm features were etched into graphene by selectively exposing it to a 100 keV electron beam and then etching the damaged areas away in a conventional oven. Raman spectroscopy was used to evaluate the extent of damage induced by the electron beam as well as the effects of the selective oxidative etching on the remaining graphene.
Degradation studies of spray coated polymer films using cantilever sensors

General information
State: Published
Organisations: Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Amphiphilic Polymers in Biological Sensing, Nanoprobes, Biomaterial Microsystems, Department of Applied Mathematics and Computer Science, Cognitive Systems
Authors: Almdal, K. (Intern), Bose, S. (Intern), Keller, S. S. (Intern), Alstrøm, T. S. (Intern), Boisen, A. (Intern)
Number of pages: 1
Publication date: 2015
Event: Poster session presented at Fourth International Symposium Frontiers in Polymer Science, Riva del Garda, Italy.
Main Research Area: Technical/natural sciences
Electronic versions:
Frontiers_2015_poster_A3.pdf
Source: PublicationPreSubmission
Source-ID: 110839877
Publication: Research - peer-review › Poster – Annual report year: 2015

Dense high-aspect ratio 3D carbon pillars on interdigitated microelectrode arrays

In this work we present high-aspect ratio carbon pillars (1.4 μm in diameter and ~11 μm in height) on top of interdigitated electrode arrays to be used for electrochemical applications. For this purpose, different types of 2D and 3D pyrolysed carbon structures were fabricated and characterised including surface- and microstructure, electrical and electrochemical properties. A pre-treatment of oxidised Si wafers is introduced to eliminate electrode delamination and ensure structure stability in water during long time-experiments. Additionally, a heat treatment method is reported for regeneration of pyrolysed carbon films with increased film resistance due to oxidation during storage.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Bioanalytics, Lund University, Capres A/S, Technical University of Denmark
Authors: Amato, L. (Intern), Heiskanen, A. (Intern), Hansen, R. (Ekstern), Gammelgaard, L. (Ekstern), Rindzevicius, T. (Intern), Tenje, M. (Ekstern), Emnéus, J. (Intern), Keller, S. S. (Intern)
Number of pages: 12
Pages: 792-803
Design and Simulation of Lab-on-a-Chip Devices

Microfluidic channels are an essential part of any lab-on-a-chip system. They usually perform various functions, such as transporting liquids from A to B or mixing or separating liquids. As production costs for such systems are not insignificant, it is essential that the systems are designed properly before the fabrication, in order to avoid unnecessary fabrication repetitions. The use of simulations can give a good idea of how microfluidic systems work, to the point where a significant part of the design optimisation can be done theoretically. This chapter will provide some basic information on how to embark on these types of simulations, explaining the basics of microfluidic modelling and providing examples.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nano Bio Integrated Systems, Theoretical Microsystems
Optimization
Authors: Dimaki, M. (Intern), Okkels, F. (Intern)
Pages: 27-51
Publication date: 2015

Design and use of guided mode resonance filters for refractive index sensing

This Ph.D. thesis is concerned with the design and use of guided mode resonance filters (GMRF) for applications in refractive index sensing. GMRFs are optical nanostructures capable of efficiently and resonantly reflecting a narrow wavelength interval of incident broad band light. They combine a diffractive element with a waveguiding element, and it is the coupling between diffracted light and quasi guided modes that gives rise to the resonant response. The linewidth of the resonance can be tuned by the material and geometrical configuration of the device. The resonance wavelength is highly sensitive to changes in refractive index that occur within the region overlapped by the quasi guided mode, and GMRFs are thus well suited for optical sensing and tunable filter applications. They produce a polarization dependent response and can be optically characterized in both reflection and transmission.

The structures investigated in this thesis were fabricated in a process based on nanoreplication, in which the surface of a polymer was patterned with a structured master, cured with ultra-violet light and coated with a high refractive index material. The masters were defined using electron beam lithography, a lift-off process, and reactive ion etching. After an introduction to the history and principles of GMRFs, the thesis describes the state-of-the-art of relevant research in the field, covers the necessary theoretical background required to understand their operation, and discusses the fabrication and characterization methods used. The thesis furthermore includes three journal articles. The first concerns an iterative computational model for the analytical prediction of the wavelengths at which resonances will occur, which is beneficial for e.g. device sensitivity optimization. The second paper discusses an all-polymer GMRF, which exhibits narrow resonance linewidths and a low detection limit, made by rapid and inexpensive fabrication methods. The third paper presents a novel method for measuring the refractive index dispersion of liquids using an array of GMRFs of different periods.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
Authors: Hermannsson, P. G. (Intern), Kristensen, A. (Intern), Vannahme, C. (Intern), Smith, C. (Intern)
Number of pages: 140
Publication date: 2015
Detection of bacterial metabolites through dynamic acquisition from surface enhanced raman spectroscopy substrates integrated in a centrifugal microfluidic platform

In this work we present a novel technology that combines the advantages of centrifugal microfluidics with dynamic in-situ Surface Enhanced Raman Spectroscopy (SERS) sensing. Our technology is based on an automated readout system that allows on-line SERS acquisition on a rotating centrifugal microfluidic platform with embedded gold nanopillar substrates. While spinning, the disc platform enables dynamic SERS acquisition of multiple chips, significantly reducing time-to-result and improving the reproducibility of the acquired spectra, reducing the fluctuation by a factor of 2.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Authors: Durucan, O. (Intern), Morelli, L. (Intern), Schmidt, M. S. (Intern), Burger, R. (Intern), Rindzевич, T. (Intern), Boisen, A. (Intern)
Number of pages: 3
Pages: 1831-1833
Publication date: 2015

Host publication information
Title of host publication: 19th International Conference on Miniaturized Systems for Chemistry and Life Sciences, MicroTAS 2015
Publisher: Chemical and Biological Microsystems Society
ISBN (Electronic): 9780979806483
Main Research Area: Technical/natural sciences
Surface Enhanced Raman Spectroscopy (SERS), Dynamic SERS, Centrifugal microfluidics
Source: FindIt
Source-ID: 2342840484
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

Detection of extracellular vesicles on a magnetoresistive sensor platform

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Microsystems for Medical Diagnostics, International Iberian Nanotechnology Laboratory, Instituto de Engenharia de Sistemas e Computadores do Porto
Authors: Cherré, S. (Intern), Fernandes, E. (Ekstern), Oliveira, M. (Ekstern), Dias, T. (Ekstern), Cardoso, S. (Ekstern), Rozlozník, N. (Intern), Freitas, P. (Ekstern)
Number of pages: 2
Publication date: 2015
Event: Abstract from First Iberian Symposium on Extracellular vesicles, Porto, Portugal.
Main Research Area: Technical/natural sciences
Electronic versions:
Cherre_abstract_2.pdf
Source: PublicationPreSubmission
Source-ID: 123726884
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016

Detection of small organics in water: the MUSE project

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Surface Engineering
Authors: Frøhling, K. B. (Intern)
Number of pages: 16
Publication date: 2015

Publication information
Detection of small organics in water: The MUSE project
Publication: Research › Sound/Visual production (digital) – Annual report year: 2015

Developing methods for In-situ TEM and potential studies in energy storage, electrochemistry, material science, and bioscience etc.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows
Authors: Yesibolati, M. N. (Intern), Canepa, S. (Intern), Møller-Nilsen, R. (Intern), Laganà, S. (Intern), Sun, H. (Intern), Mølhave, K. (Intern)
Number of pages: 1
Publication date: 2015

Host publication information
Title of host publication: Book of Abstracts. DTU's Sustain Conference 2015
Place of publication: Lyngby
Publisher: Technical University of Denmark (DTU)
Article number: M-16
Main Research Area: Technical/natural sciences
Conference: DTU Sustain Conference 2015, Lyngby, Denmark, 17/12/2015 - 17/12/2015
Electronic versions:
M16_DTU_Sustain_2015.pdf

Bibliographical note
Poster presentation
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2015

Development of a Plastic Membrane Containing Micro-hole(s) for a Potential Bio-Sensing Application

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Bioanalytics, Malmö University
Authors: Krikstolaityte, V. (Intern), Ruzgas, T. (Ekstern), Heiskanen, A. (Intern), Canali, C. (Intern), Emnéus, J. (Intern)
Number of pages: 1
Publication date: 2015

Host publication information
Title of host publication: Book of Abstracts. DTU's Sustain Conference 2015
Place of publication: Lyngby
Publisher: Technical University of Denmark (DTU)
Article number: Q-6
Main Research Area: Technical/natural sciences
Conference: DTU Sustain Conference 2015, Lyngby, Denmark, 17/12/2015 - 17/12/2015
Electronic versions:
Q6_DTU_Sustain_2015.pdf

Bibliographical note
Poster presentation
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2015

Development of a SERS aptasensor for detection of medical residues
Low levels of medical residues in environmental, industrial and domestic water systems is a growing concern. The biosensor industry is trying to accomodate the need of sensitive and specific sensor systems capable of ultra-low level detection of medical residues. In this PhD project a surface enhanced Raman spectroscopy (SERS) sensor for the female sexhormone 17β-estradiol was attempted. It is commonly used in contraceptive pills from where it find its way through waste water treatment plants and into the environment. The SERS substrate was fabricated in a cleanroom facility using techniques well known from the electronics industry. The substrate consisted of silver or gold covered silicon nanopillars. The nanopillars were chemically functionalised with a DNA aptamer specific towards 17β-estradiol using thiol chemistry.
At first, an entire functionalisation protocol was carried out to detect Estradiol Glow, which is fluorescently labelled 17β-estradiol. It was shown that Estradiol Glow exhibit very strong Raman activity and was such ideal for initial test. Since a large amount of data was gathered for this experiment it was necessary to develop an algorithm capable of analysing large data sets. Non-negative Matrix Factorization (NMF) was utilised to effectively improve the detection limit of the system by one order of magnitude.

Due to issues relating to the functionalisation protocol it was secondly investigated whether the aptamer was properly immobilised on the nanopillar surface. By hybridisation to a labelled complementary strand it was proven that aptamer was indeed immobilised. It was also found that stronger binding to the gold covered nanopillars could be obtained by a short treatment in reactive O₂ plasma. Likewise it was found that the addition of a detergent to the washing buffer had a great influence on the unspecific binding to the nanopillars.

A thorough study of the parameters influencing the degree of functionalisation was then conducted. By utilizing a developed peak-fitting model it was possible to directly inspect the interplay between DNA aptamer and 6-mercapto-1-hexanol (MCH) used for blocking unspecific binding to gold. By inspecting the spectra of the molecules and their combination it was possible to observe attachment of DNA aptamer and MCH. Displacement/removal of DNA aptamer was also observed for high concentrations of MCH.

The final study was an attempt to detect pure 17β-estradiol using the developed functionalisation parameters. Unfortunately the inherent weak Raman signal of 17β-estradiol proved to faint for direct detection. Therefore Estradiol Glow was employed, however without success. Despite several attempts with varying degree of stringency successful detection was never accomplished.

In conclusion, this PhD project successfully characterised the chemical functionalisation parameters needed for generic SERS aptasensor development using only the Raman signals of the molecules. The SERS substrate was successfully fabricated repeatedly and showed great enhancement of Raman signals. Two analysis methods (NMF and peak-fitting) was developed in collaboration with DTU Compute in order to accommodate for the large amount of data gathered throughout the project. This work displays the complexity in SERS aptasensor development, which is needed for sensitive and selective capture of medical residues.
**Development of injection moulded, ultrasonically welded immiscible phase filtration devices**

Having advanced tremendously over the past two decades, microfluidics is today a well-established scientific field. The governing physics are under control and the teething troubles of preliminary device fabrication have been overcome. The applications of microfluidics are wide ranging from components in inkjet printing, to disposable chips for point-of-care diagnostics, to advanced chemical analysis systems. Nevertheless, the original prophesied commercial success as a whole has been limited.

The modest existence of microfluidic devices as products is due in part to a manufacturing schism that has befallen the field. In academia, microfluidic devices have historically been fabricated using materials and technologies that while efficient at rapid prototyping, are near incompatible with industrial mass production. The research conducted has generated immense knowledge of such techniques and materials, however, technology transfer to the industry is challenging.

This PhD project has focused on applying industry-compliable technologies for rapid prototyping of microfluidic devices. In specific, a thermoplastic disposable microfluidic chip system for sample preparation has been realised. The device applies magnetic bead-based solid-phase extraction for nucleic acid extraction from biological samples, using the immiscible phase filtration (IPF) approach. Device development has employed injection moulding for part fabrication and ultrasonic welding for bonding. Rapid prototyping was accomplished by micromilling and laser micromachining of mould inserts, allowing for design-to-production of chips within a day. The rapid overall fabrication cycle of a few minutes per chip allowed for conducting research in a single-use disposable fashion.

Chip development has centred on manufacturing of an IPF chip, by generating a microfluidic channel system capable of fluid handling using capillary forces. A key aspect of IPF is to replace the required washing steps of the magnetic beads with passage through capillary microvalves. Furthermore, much development has gone into creating energy directors for ultrasonic welding, suitable for microfluidic systems. A methodology has been established where energy directors can be quickly added to existing mould inserts, using laser micromachining. The produced device was performance tested by isolating methicillin-resistant Staphylococcus aureus from bovine whole blood, followed by off-chip quantification using real-time quantitative polymerase chain reaction.

**Development of microfluidic cell culture devices towards an in vitro human intestinal barrier model**

Existing in vitro models of the human intestine such as the established epithelial cell line, Caco-2, cultured on porous membranes have been extensively used for assessing and predicting permeability and absorption of oral drugs in the pharmaceutical industries. However, such in vitro human intestinal models fail to support any form of luminal flow conditions on the cells in order to more closely mimic in vivo conditions. Although these existing systems are easy to use, they require a large amount of cells, culture media, samples and reagents. Microfluidics is a technology that has the potential to revolutionise the way of in vitro cell culture. In particular, microfluidics provides avenues for researchers to tailor the cellular microenvironment to better mimic the cell-cell and cell-extracellular matrix interactions, while at the same time reducing the scale of the experimental studies. Moreover, microfluidics also offers the possibility of dynamic cell culture in microperfusion systems to deliver continuous nutrient supplies for long term cell culture. When combined with electronic or optical components such as sensors, actuators, and control logic, microfluidics has the potential to enable real-time detection of cell responses, adjustment of cellular stimulation etc. leading to establishment of conditional experiments. In this project, microfluidic systems engineering was leveraged to develop an eight chamber multi-layer microchip for intestinal barrier studies. Sandwiched between the layers was a modified Teflon porous membrane for cell culture. The novelty lies in modifying the surface of the porous Teflon support membrane using thiol-ene ‘click’ chemistry, thus allowing the modified Teflon membrane to be bonded between the chip layers to form an enclosed microchamber.

Successful application of the multi-layer microchip was demonstrated by integrating the microchip to an existing cell culture fluidic system to culture the human intestinal epithelial cells, Caco-2, for long term studies. Under the continuous low flow conditions, the cells differentiated into columnar cells displaying folds that closely resembled the intestinal villi and formation of a tight barrier. Furthermore, the microelectrodes embedded in the microchip also allow real-time monitoring of the barrier integrity by means of measuring the trans-epithelial electrical resistance. Demonstrations of transport studies using different compounds on the in vitro human intestinal model in the microfluidic device showed comparable results with static cultures. In addition, a normal commensal intestinal bacteria, Escherichia coli (E. coli) was successfully co-cultured on the luminal surface of the cultured epithelium without compromising the epithelial cell viability and barrier function. Such a platform paves the way towards an alternative in vitro intestinal model for high throughput screening of drugs, chemicals, pathogens, intestinal diseases as well as toxicological studies.

**General information**

**State:** Published

**Organisations:** Department of Micro- and Nanotechnology, Magnetic Systems, BioLabChip

**Authors:** Kistrup, K. (Intern), Hansen, M. F. (Intern), Wolff, A. (Intern)

**Publication date:** 2015

**Publication information**

**Publisher:** DTU Nanotech

**Original language:** English

**Main Research Area:** Technical/natural sciences

**Publication:** Research > Ph.D. thesis – Annual report year: 2015
Development of nanoparticle based delivery systems for sublingual immunotherapy

The prevalence of IgE mediated allergic diseases is increasing dramatically in industrialized countries. Sublingual immunotherapy (SLIT) has been demonstrated to be a safe and efficacious treatment for IgE mediated allergic diseases, but requires protracted treatment duration. Even though SLIT is considered to have a better safety profile than subcutaneous immunotherapy, SLIT can still cause adverse events requiring clinical supervision for the first administration. Optimization of SLIT, by reducing the administration dose and treatment duration, would improve safety profile. For this purpose, development of nanoparticle delivery systems that can carry antigen across oral mucosa and improve targeting of antigen to the oral immune system would be favourable. This thesis presents seven delivery systems, including liposomes (neutral and cationic) and acylated peptide, which were tested in an ovalbumin (OVA)-induced allergic airway inflammation model for their ability to improve immune tolerance induction of ovalbumin (protein and peptide) when delivered sublingually. In the liposome study, mice were treated sublingually during two weeks with free or liposome encapsulated OVA (OVA-liposomes) followed by intraperitoneal injections and intranasal challenge. Mice treated sublingually with OVA-liposomes showed a significant reduction of airway eosinophilia, OVA-specific IgE antibodies and splenocyte proliferation in comparison to free OVA. In addition, reduced levels of IFN-γ and IL-5 were observed in spleen cell supernatants from OVA-liposome treated mice compared to the sham-treated group. A non-significant reduction of IL-4 and IL-10 in comparison to the sham-treated group was seen. In the study with acylated peptide, mice were SLIT treated with free or acylated OVApeptide during two weeks followed by intraperitoneal injection. Mice treated with acylated OVA showed a non-significant tendency of downregulating the proliferation of spleen cells compared to free OVA. The same down-regulating tendency was seen for IFN-γ, IL-4, IL-5 and IL-10.

Development of silicon based bottom cell for tandem photoelectrochemical water splitting device structures

General information
State: Published
Organisations: Department of Physics, Experimental Surface and Nanomaterials Physics, Silicon Microtechnology
Authors: Bae, D. (Intern), Chorkendorff, I. (Intern), Hansen, O. (Intern), Vesborg, P. C. K. (Intern)
Number of pages: 172
Publication date: 2015

Publication information
Publisher: Department of Physics, Technical University of Denmark
Original language: English
Discovery of Peptidic Anti-cobratoxins by Next Generation Phage Display

Antivenoms are still being produced by animal immunization protocols and are therefore associated with high immunogenicity for human recipients. Here we report the first step towards discovery of synthetic antitoxins that could be used for development of a fully synthetic antivenom against neurotoxin from cobras (Naja genus).

General information
State: Published
Organisations: Department of Systems Biology, Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology, Center for Biological Sequence Analysis, Network Engineering of Eukaryotic Cell Factories, University of Copenhagen, Universidad de Costa Rica
Authors: Laustsen, A. H. (Intern), Lynagh, T. (Forskerdatabase), Kringelum, J. V. (Intern), Christiansen, A. (Intern), Johannesen, J. (Ekstern), Engmark, M. (Intern), Pless, S. A. (Forskerdatabase), Olsen, L. (Ekstern), Fernández, J. (Ekstern), Gutiérrez, J. M. (Ekstern), Lomonte, B. (Ekstern), Lohse, B. (Ekstern)
Number of pages: 1
Publication date: 2015
Event: Poster session presented at PhD Day 2015, Faculty of Health Sciences, University of Copenhagen, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
Electronic versions:
PhD_Day_2015.pdf
Publication: Research - peer-review › Poster – Annual report year: 2016

DNA Damage Following Pulmonary Exposure by Instillation to Low Doses of Carbon Black (Printex 90) Nanoparticles in Mice

We previously observed genotoxic effects of carbon black nanoparticles at low doses relative to the Danish Occupational Exposure Limit (3.5 mg/m³). Furthermore, DNA damage occurred in broncho-alveolar lavage (BAL) cells in the absence of inflammation, indicating that inflammation is not required for the genotoxic effects of carbon black. In this study, we investigated inflammatory and acute phase response in addition to genotoxic effects occurring following exposure to nanoparticulate carbon black (NPCB) at even lower doses. C57BL/6J.BomTac mice were examined 1, 3, and 28 days after a single instillation of 0.67, 2, 6, and 162 μg of Printex 90 NPCB and vehicle. Cellular composition and protein concentration was evaluated in BAL fluid as markers of inflammatory response and cell damage. DNA strand breaks in BAL cells, lung, and liver tissue were assessed using the alkaline comet assay. The pulmonary acute phase response was analyzed by Saa3 mRNA real-time quantitative PCR. Instillation of the low doses of NPCB induced a slight neutrophil influx one day after exposure. Pulmonary exposure to small doses of NPCB caused an increase in DNA strand breaks in BAL cells and lung tissue measured using the comet assay. We interpret the increased DNA strand breaks occurring following these low exposure doses of NPCB as DNA damage caused by primary genotoxicity in the absence of substantial inflammation, cell damage, and acute phase response. Environ. Mol. Mutagen. 56:41-49, 2015. (c) 2014 The Authors. Environmental and Molecular Mutagenesis published by Wiley Periodicals, Inc. on behalf of Environmental Mutagen Society

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment
Number of pages: 9
Pages: 41-49
Publication date: 2015
Main Research Area: Technical/natural sciences
Publication information
Journal: Environmental and Molecular Mutagenesis
Volume: 56
Issue number: 1
ISSN (Print): 0893-6692
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
DNA strand breaks, acute phase response and inflammation following pulmonary exposure by instillation of the diesel exhaust particle NIST1650b in mice

We investigated the inflammatory response, acute phase response and genotoxic effect of diesel exhaust particles (DEPs, NIST1650b) following a single intratracheal instillation. C57BL/6J BomTac mice received 18, 54 or 162 µg/mouse and were killed 1, 3 and 28 days post-exposure. Vehicle controls and the benchmark particle carbon black (CB, Printex 90; 162 µg/mouse) were tested alongside for comparison. The cellular composition and protein concentration were determined in bronchoalveolar lavage (BAL) fluid as markers for an inflammatory response. Pulmonary and systemic genotoxicity was analysed by the alkaline comet assay as DNA strand breaks in BAL cells, lung and liver tissue. The pulmonary acute phase response was analysed by Saa3 mRNA levels by real-time quantitative polymerase chain
reaction. Instillation of DEP induced a strong neutrophil influx 1 and 3 days, but not 28 days post-exposure. Saa3 mRNA levels were increased at all time point for the highest dose and 28 days post-exposure for the middle dose. DEP increased levels of DNA strand breaks in lung tissue for all doses 1 day post-exposure and after 28 days for mid- and high-dose groups. Pulmonary exposure to DEP induced transient inflammation but long-lasting pulmonary acute phase response as well as genotoxicity in lung tissue 28 days post-exposure. The observed long-term pulmonary genotoxicity by DEP was less than the previously observed genotoxicity for CB using identical experimental set-up.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, National Research Center for Working Environment, University of Copenhagen
Number of pages: 9
Pages: 499-507
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: Mutagenesis
Volume: 30
Issue number: 4
ISSN (Print): 0267-8357
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 0.736 SJR 0.916
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.42 SJR 1.093 SNIP 0.884
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.965 SNIP 0.848 CiteScore 2.44
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.304 SNIP 1.405 CiteScore 3.41
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.195 SNIP 1.564 CiteScore 3.6
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.353 SNIP 1.337 CiteScore 3.51
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.092 SNIP 1.458 CiteScore 3.48
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.246 SNIP 1.431
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.169 SNIP 1.343
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.133 SNIP 1.15
Scopus rating (2007): SJR 0.866 SNIP 1.091
Scopus rating (2006): SJR 0.947 SNIP 1.122
Scopus rating (2005): SJR 0.684 SNIP 0.908
Scopus rating (2004): SJR 0.672 SNIP 0.825
Projects:

**Micropatch for allergy testing in the skin**

Department of Micro- and Nanotechnology  
Period: 01/04/2018 → 31/03/2021  
Number of participants: 4  
PhD Student:  
Esmail Tehrani, Sheida (Intern)  
Supervisor:  
Emnéus, Jenny (Intern)  
Jensen, Bettina Margrethe (Ekstern)  
Main Supervisor:  
Keller, Stephan Sylvest (Intern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: Samfinansieret - Andet  
Project: PhD

**A human-gut-on-a-chip for drug delivery testing and disease modelling: breaking through the gut barrier**

Department of Micro- and Nanotechnology  
Period: 01/03/2018 → 28/02/2021  
Number of participants: 3  
PhD Student:  
Taebnia, Nayere (Intern)  
Supervisor:  
Dolatshahi-Pirouz, Alireza (Intern)  
Main Supervisor:  
Andresen, Thomas Lars (Intern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: Fonde  
Project: PhD

**Single-particle and super-resolution microscopy data analysis**

Department of Micro- and Nanotechnology  
Period: 01/03/2018 → 28/02/2021  
Number of participants: 4  
PhD Student:  
Schmidt, Martin (Intern)  
Supervisor:  
Pedersen, Jonas Nyvold (Intern)
Synthesis of TLR Agonists and Peptide Antigens for Lancer Therapy

Department of Micro- and Nanotechnology
Period: 01/03/2018 → 28/02/2021
Number of participants: 3
PhD Student:
Colliander, Anna (Intern)
Supervisor:
Hansen, Anders Elias (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

Development of LOCs with integrated for real time on-site monitoring of environmental impact of pathogens and toxic compounds

Department of Micro- and Nanotechnology
Period: 15/02/2018 → 14/02/2021
Number of participants: 4
PhD Student:
D’Costa, Claudy (Intern)
Supervisor:
Heiskanen, Arto (Intern)
Wolff, Anders (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Screening of Food Pathogens using Impedance Flow Cytometry

Department of Micro- and Nanotechnology
Period: 15/02/2018 → 14/02/2021
Number of participants: 4
PhD Student:
Bertelsen, Christian Vinther (Intern)
Supervisor:
Clausen, Casper Hyttel (Intern)
Skands, Gustav Erik (Intern)
Main Supervisor:
Svendsen, Winnie Edith (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Industrial PhD
Project: PhD
Microcontainers for oral drug delivery
Department of Micro- and Nanotechnology
Period: 01/02/2018 → 31/01/2021
Number of participants: 3
PhD Student:
Hansen, Stine Egebro (Intern)
Supervisor:
Nielsen, Line Hagner (Intern)
Main Supervisor:
Boisen, Anja (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Assembly and Characterization of Red Blood Cell Substitutes
Department of Micro- and Nanotechnology
Period: 01/01/2018 → 31/12/2020
Number of participants: 3
PhD Student:
Jansman, Michelle (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Main Supervisor:
Hosta-Rigau, Leticia (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Mucosal adaptive immunity - regulatory properties of mucosal B cells
Department of Micro- and Nanotechnology
Period: 01/12/2017 → 30/11/2020
Number of participants: 3
PhD Student:
Sayal, Imran Akdemir (Intern)
Supervisor:
Bekiaris, Vasileios (Intern)
Main Supervisor:
Lindbom, Bengt Johansson (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansierede - Virksomhed
Project: PhD

Synthesis of TLR agonists for immunotherapy
Department of Micro- and Nanotechnology
Period: 01/12/2017 → 30/11/2020
Number of participants: 2
PhD Student:
Jørgensen, Kira Rapke (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
3D oxygenation of thymic organoids

Department of Micro- and Nanotechnology
Period: 01/11/2017 → 31/10/2020
Number of participants: 2
Phd Student:
Wesseler, Milan Finn Laszlo (Intern)
Main Supervisor:
Larsen, Niels Bent (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Development of Highly sensitive raman spectroscopy system for monitoring of multicomponent drug mixtures in the PPM Concentration range

Department of Micro- and Nanotechnology
Period: 01/11/2017 → 31/10/2020
Number of participants: 4
Phd Student:
Slipets, Roman (Intern)
Supervisor:
Ilchenko, Oleksii (Intern)
Rindzevicius, Tomas (Intern)
Main Supervisor:
Boisen, Anja (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Development of Targeted Polymeric Nanomedicines for Intelligent Combination Nanotherapies

Department of Micro- and Nanotechnology
Period: 01/11/2017 → 31/10/2020
Number of participants: 2
Phd Student:
Sadeghi, Saeed (Intern)
Main Supervisor:
Kamaly, Nazila (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

Nanofluidics devices for bioimaging

Department of Micro- and Nanotechnology
Period: 01/11/2017 → 31/10/2020
Number of participants: 3
Phd Student:
Rasmussen, Martin Kjærulf (Intern)
Supervisor:
Pedersen, Jonas Nyvold (Intern)
Main Supervisor:
Marie, Rodolphe (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

**Statistical Modelling of TCR Repertoires for Immunotherapy and Drug Delivery Systems**
Department of Micro- and Nanotechnology
Period: 15/10/2017 → 14/10/2020
Number of participants: 3
Phd Student:
Vujovic, Milena (Intern)
Supervisor:
Kaplinsky, Joseph John (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

**3D printing of perfusable hybrid 3D scaffolds- and biomaterials**
Department of Micro- and Nanotechnology
Period: 01/10/2017 → 30/09/2020
Number of participants: 3
Phd Student:
Gürbüz, Hakan (Intern)
Supervisor:
Heiskanen, Arto (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)

** Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

**Biomineralization and Biomimetics**
Department of Micro- and Nanotechnology
Period: 01/10/2017 → 01/04/2021
Number of participants: 3
Phd Student:
Mandsberg, Nikolaj Kofoed (Intern)
Supervisor:
Aizenberg, Joanna (Ekstern)
Main Supervisor:
Berg, Rolf Henrik (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD
Development of advanced drug delivery systems for therapeutic radionuclides in cancer treatment

Department of Micro- and Nanotechnology
Period: 01/10/2017 → 30/09/2020
Number of participants: 4
Phd Student:
Magnus, Charlotte Busk (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Herth, Matthias (Ekstern)
Main Supervisor:
Jensen, Andreas Tue Ingemann (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Optical Sensor Disc

Department of Micro- and Nanotechnology
Period: 01/10/2017 → 30/09/2020
Number of participants: 4
Phd Student:
Serioli, Laura (Intern)
Supervisor:
Rindzevicius, Tomas (Intern)
Zor, Kinga (Intern)
Main Supervisor:
Boisen, Anja (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Reconstituted high-density lipoproteins for immuno- and chemotherapeutic drug delivery

Department of Micro- and Nanotechnology
Period: 01/10/2017 → 30/09/2020
Number of participants: 3
Phd Student:
Pedersbæk, Dennis (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Main Supervisor:
Simonsen, Jens Bæk (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Towards accurate prediction of T cell targets: Learning the rules of T cell receptor interaction

Department of Micro- and Nanotechnology
Period: 01/10/2017 → 30/09/2020
Number of participants: 3
Phd Student:
Holm, Jeppe Sejerø (Intern)
Supervisor:
Nielsen, Morten (Intern)
Main Supervisor:
Hadrup, Sine Reker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Characterization of intestinal stromal cells
Department of Micro- and Nanotechnology
Period: 01/09/2017 → 31/08/2020
Number of participants: 3
Phd Student:
Pærregaard, Simone Isling (Intern)
Supervisor:
Agace, William Winston (Intern)
Main Supervisor:
Hadrup, Sine Reker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

CodeSphere - Molecular encoding of Nanoparticles for targeted cargo delivery
Department of Micro- and Nanotechnology
Period: 01/09/2017 → 31/08/2020
Number of participants: 4
Phd Student:
Moss, Keith Henry (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Jakobsen, Søren Nyboe (Intern)
Main Supervisor:
Hadrup, Sine Reker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Growth of Hexagonal-boron Nitride (h-BN) for Large-scale Graphene Devices
Department of Micro- and Nanotechnology
Period: 01/09/2017 → 31/08/2020
Number of participants: 3
Phd Student:
Chen, Xin (Intern)
Supervisor:
Booth, Tim (Intern)
Main Supervisor:
Bøggild, Peter (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD
Immune activation status as predictive marker for cancer progression

Department of Micro- and Nanotechnology
Period: 01/08/2017 → 31/07/2020
Number of participants: 4
Phd Student:
Snejbjerg, Dorthe Blirup (Intern)
Supervisor:
Kirschner, Benny (Ekstern)
Kjær, Susanne Krüger (Ekstern)
Main Supervisor:
Hadrup, Sine Reker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansierede - Virksomhed
Project: PhD

3D micro/nanotopography and material cues for stem cell differentiation

Department of Micro- and Nanotechnology
Period: 01/07/2017 → 30/06/2020
Number of participants: 4
Phd Student:
Asif, Afia (Intern)
Supervisor:
Keller, Stephan Sylvest (Intern)
Serrano, Alberto M. (Ekstern)
Main Supervisor:
Emnéus, Jenny (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)
Project: PhD

Bioinspired Targeted Polymeric Nanomedicines for Atherosclerosis Therapy

Department of Micro- and Nanotechnology
Period: 01/07/2017 → 30/06/2020
Number of participants: 3
Phd Student:
Bazban-Shotorbani, Salime (Intern)
Supervisor:
Dufva, Martin (Intern)
Main Supervisor:
Kamaly, Nazila (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

Multiplex digital analysis of serum samples for Alzheimers disease diagnostics

Department of Micro- and Nanotechnology
Period: 01/07/2017 → 30/06/2020
Number of participants: 3
Phd Student:
Toppi, Arianna (Intern)
Supervisor:
Taboryski, Rafael J. (Intern)
Main Supervisor:
Dufva, Martin (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)
Project: PhD

3D perfusion LOCs with integrated bioreactorisand sensors for modelling neuronal disorders
Department of Micro- and Nanotechnology
Period: 15/06/2017 → 14/06/2020
Number of participants: 3
Phd Student:
Khan, Muhammad Salman (Intern)
Supervisor:
Heiskanen, Arto (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)
Project: PhD

Development of Targeted Drug Delivery Systems for The Brain
Department of Micro- and Nanotechnology
Period: 01/06/2017 → 31/05/2020
Number of participants: 3
Phd Student:
Kostrikov, Serhii (Intern)
Supervisor:
Hempel, Casper (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

Perfusable 3D scaffold based drug and compound delivery systems for developmental patterning and regenerative medicine
Department of Micro- and Nanotechnology
Period: 01/06/2017 → 31/05/2020
Number of participants: 4
Phd Student:
Ghani, Mozhdeh (Intern)
Supervisor:
Alm, Martin (Ekstern)
Heiskanen, Arto (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt EU-finansieret
Project: PhD
Technology for CZTS-Silicon Tandem Solar Cells

Department of Micro- and Nanotechnology
Period: 01/06/2017 → 31/05/2020
Number of participants: 4
PhD Student: Hajjifarassar, Alireza (Intern)
Supervisor: Crovetto, Andrea (Intern)
Pedersen, Thomas (Intern)
Main Supervisor: Hansen, Ole (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Nanocrafts - nano jewelry proof of concept
At DTU Nanotech several nanotechnologies were intensively used for texturing, patterning, and protection of surfaces. Nanotechnology can provide a new space for creative design in jewelry with unique features and effects (for instance optical effects implied by nanostructures), bring the deep meaning of emotions and relations to a new level – the nanolevel.
With significant value to the jewelry industry nanotechnology can result in unique technical qualities such as improved durability of items and fraud protection and data encryption technology, and a new way of sensing the item. Micro and nanopatterning allow individual design fabrication on a single wafer. With nanoceramic layers, we can protect golden or other jewelry items from mechanical damage or natural degradation. In this project, we apply
• Surface nanostructuring for physical effects enhancement
• Optical coloring with thin film deposition
• Visual patterning with laser engraving and UV photolithography
• Nanoplasmonic coloring
• Laser engraving on surfaces for data encryption and individual design patterns at the scale of few micrometers

Department of Energy Conversion and Storage

Silicon Microtechnology
Period: 01/05/2017 → 30/09/2017
Number of participants: 1
Acronym: Nanocrafts
Project participant: Plakhotnyuk, Maksym (Intern)

Polymer and carbon based optoelectrical waveguides
Department of Micro- and Nanotechnology
Period: 01/05/2017 → 30/04/2020
Number of participants: 3
PhD Student: Vasudevan, Shashank (Intern)
Supervisor: Keller, Stephan Sylvest (Intern)
Main Supervisor: Emnéus, Jenny (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)
Project: PhD
Sensors on disc
Department of Micro- and Nanotechnology
Period: 01/05/2017 → 30/04/2020
Number of participants: 4
Phd Student:
Thoppe Rajendran, Sriram (Intern)
Supervisor:
Rindzevicius, Tomas (Intern)
Zor, Kinga (Intern)
Main Supervisor:
Boisen, Anja (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

Development of novel drug delivery systems for cancer immunotherapy
Department of Micro- and Nanotechnology
Period: 15/03/2017 → 14/03/2020
Number of participants: 3
Phd Student:
Stavnsbjerg, Camilla (Intern)
Supervisor:
Hansen, Anders Elias (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

Drug delivery of cancer immunotherapeutics
Department of Micro- and Nanotechnology
Period: 15/03/2017 → 14/03/2020
Number of participants: 3
Phd Student:
Weywadt, Matilda Felicia de Val (Intern)
Supervisor:
Hansen, Anders Elias (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

Micromachined 2D Transducers and Phantoms for 3D Super-resolution Ultrasound Imaging
Department of Micro- and Nanotechnology
Period: 15/03/2017 → 14/03/2020
Number of participants: 4
Phd Student:
Ommen, Martin Lind (Intern)
Supervisor:
Jensen, Jørgen Arendt (Intern)
Larsen, Niels Bent (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)

**Financing sources**
- Source: Internal funding (public)
- Name of research programme: Offentlig finansiering
- Project: PhD

**Characterisation of T cell responses induced following immunotherapy**

Department of Micro- and Nanotechnology
- Period: 01/03/2017 → 29/02/2020
- Number of participants: 3

Phd Student:
Hansen, Ulla Kring (Intern)

Supervisor:
Lassen, Ulrik (Ekstern)

Main Supervisor:
Hadrup, Sine Reker (Intern)

**Financing sources**
- Source: Internal funding (public)
- Name of research programme: Samfinansierede - Virksomhed
- Project: PhD

**Fabrication of biodegradable microcontainers for oral drug delivery**

Department of Micro- and Nanotechnology
- Period: 01/03/2017 → 29/02/2020
- Number of participants: 4

Phd Student:
Abid, Zarmeena (Intern)

Supervisor:
Boisen, Anja (Intern)

Petersen, Ritika Singh (Intern)

Main Supervisor:
Keller, Stephan Sylvest (Intern)

**Financing sources**
- Source: Internal funding (public)
- Name of research programme: Grundforskningsfonden
- Project: PhD

**Microfabrication Technology for X-ray Optical Elements**

Department of Micro- and Nanotechnology
- Period: 01/03/2017 → 29/02/2020
- Number of participants: 3

Phd Student:
Silvestre, Chantal (Intern)

Supervisor:
Jansen, Henri (Intern)

Main Supervisor:
Hansen, Ole (Intern)

**Financing sources**
- Source: Internal funding (public)
- Name of research programme: Samfinansieret - Andet
- Project: PhD
Ballistic graphene devices for electron optics and switches
Department of Micro- and Nanotechnology
Period: 01/02/2017 → 18/06/2020
Number of participants: 3
Phd Student:
Gejl, Aske Nørskov (Intern)
Supervisor:
Caridad, Jose (Intern)
Main Supervisor:
Bøggild, Peter (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Development of NanoBiosensor for Detection of Food Contaminants
Department of Micro- and Nanotechnology
Period: 01/02/2017 → 31/01/2020
Number of participants: 5
Phd Student:
Feng, Xiaotong (Intern)
Supervisor:
Bang, Dang Duong (Intern)
Wolff, Anders (Intern)
Zhang, Jingdong (Intern)
Main Supervisor:
Sun, Yi (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

Engineering biomimicking microenvironments for functional drug-safety screening
Department of Micro- and Nanotechnology
Period: 01/02/2017 → 31/01/2020
Number of participants: 4
Phd Student:
Christensen, Rie Kjær (Intern)
Supervisor:
Skafte-Pedersen, Peder (Intern)
Wilson, Sandra (Ekstern)
Main Supervisor:
Larsen, Niels Bent (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Industrial PhD
Project: PhD

Spin-valley physics and quantum transport in 2D materials
Department of Micro- and Nanotechnology
Period: 01/02/2017 → 31/01/2020
Number of participants: 4
Phd Student:
Handberg Juul Martiny, Johannes (Intern)
Supervisor:
Understanding the cellular and molecular cues of yo T cells

Department of Micro- and Nanotechnology
Period: 01/02/2017 → 31/01/2020
Number of participants: 3
Phd Student: Agerholm, Rasmus (Intern)
Supervisor: Lahl, Katharina (Intern)
Main Supervisor: Bekiaris, Vasileios (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Introduction to ESEM microscopy for the characterization of the wetting behavior of nanotextured surfaces

Center for Electron Nanoscopy
DTU Danchip
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering
Period: 02/01/2017 → 27/01/2017
Number of participants: 3
Project participant: Lyck Smitsghusyen, Thomas Erik (Ekstern)
Supervisor: Taboryski, Rafael J. (Intern)
Main Supervisor: Mateiu, Ramona Valentina (Intern)

Development of improved neoepitope vaccination through elucidation of patients naïve T-cell repertoire

Department of Micro- and Nanotechnology
Period: 01/01/2017 → 31/12/2019
Number of participants: 3
Phd Student: Petersen, Nadia Viborg (Intern)
Supervisor: Kringelum, Jens Vindahl (Intern)
Main Supervisor: Hadrup, Sine Reker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Industrial PhD
Project: PhD
Drug transport in in vitro intestine models

Department of Micro- and Nanotechnology
Period: 15/12/2016 → 14/12/2019
Number of participants: 4
Phd Student:
Jepsen, Morten Leth (Intern)
Supervisor:
Boisen, Anja (Intern)
Nielsen, Line Hagner (Intern)
Main Supervisor:
Dufva, Martin (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Grundforskningsfonden
Project: PhD

The Protein Corona of Liposomes for Drug Delivery

Department of Micro- and Nanotechnology
Period: 01/12/2016 → 30/11/2019
Number of participants: 4
Phd Student:
Lassen, Rasmus Mikkel Münter (Intern)
Supervisor:
Kristensen, Kasper (Intern)
Simonsen, Jens Bæk (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Targeted adjuvant delivery to antigen presenting cells

Department of Micro- and Nanotechnology
Period: 15/11/2016 → 14/11/2019
Number of participants: 3
Phd Student:
Christensen, Esben (Intern)
Supervisor:
Parhamifar, Ladan (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Activation and Migration characteristics of mucosal dendritic cell subsets

Department of Micro- and Nanotechnology
Period: 01/11/2016 → 31/10/2019
Number of participants: 3
Phd Student:
Garcia Lopez, Agnes (Intern)
Efficacy of multi-modal biomaterial scaffolds in a lab-on-a-chip model of Parkinson’s Diseases

Department of Micro- and Nanotechnology
Period: 01/11/2016 → 31/10/2019
Number of participants: 3
PhD Student: Kajtez, Janko (Intern)
Supervisor: Heiskanen, Arto (Intern)
Main Supervisor: Emnéus, Jenny (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Design, synthesis and development of biologically inspired polymeric nanomedicines for the treatment of advanced atherosclerosis

Department of Micro- and Nanotechnology
Period: 15/10/2016 → 14/10/2019
Number of participants: 4
PhD Student: Basak, Suman (Intern)
Supervisor: Almdal, Kristoffer (Intern)
Main Supervisor: Andresen, Thomas Lars (Intern)
Kamaly, Nazila (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)
Project: PhD

Metrology for electrical characterization of advanced materials

Department of Micro- and Nanotechnology
Period: 15/10/2016 → 14/10/2019
Number of participants: 4
PhD Student: Kalhauge, Kristoffer Gram (Intern)
Supervisor: Hansen, Ole (Intern)
Jepsen, Peter Uhd (Intern)
Main Supervisor: Petersen, Dirch Hjorth (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Cost and energy effective all-black solar cell panel | Black Si BIPV | Phase 2

The objective of the EUDP project is to develop and manufacture a novel type of solar panel based on a new type of solar cell (black silicon solar cell), which – apart from a high and preferably improved efficiency and an implementable and cheaper production method – should have several significant advantages in terms of building integration. The black solar cells will be further processed to make the front conducting grid completely black through an electrochemical deposition technology. The tabbing wires interconnecting the cells in the panel will be processed into non-reflecting black strings in a scalable, inorganic electrochemical process step securing a completely black appearance of the solar panel later produced. A compatible panel production process with traditional PV panel process will be demonstrated for the total black silicon BIPV module.

Department of Photonics Engineering
Diode Lasers and LED Systems
Department of Micro- and Nanotechnology
Silicon Microtechnology
Experimental Surface and Nanomaterials Physics
Department of Energy Conversion and Storage
Organic Energy Materials
Gaia Solar A/S
Institute for Product Development
SoliTek

Nines Photovoltaics
Period: 01/10/2016 → 30/09/2018
Number of participants: 7
BIPV, Black Silicon
Acronym: BS2
Project participant:
Thorsteinsson, Sune (Intern)
Davidsen, Rasmus Schmidt (Intern)
Iandolo, Beniamino (Intern)
Hansen, Ole (Intern)
Riedel, Nicholas (Intern)
Benatto, Gisele Alves dos Reis (Intern)
Project Manager, organisational:
Poulsen, Peter Behrensдорff (Intern)

Nanomechanical Sensors

Department of Micro- and Nanotechnology
Period: 01/10/2016 → 30/09/2019
Number of participants: 4
Phd Student:
Padmanabhan Rangacharya, Varadarajan (Intern)
Supervisor:
Larsen, Peter Emil (Intern)
Rindzevicius, Tomas (Intern)
Main Supervisor:
Boisen, Anja (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD
Nanomedicine Development for Combination with Ultrasound Mediated Brain Cancer Therapy

Department of Micro- and Nanotechnology
Period: 01/10/2016 → 30/09/2019
Number of participants: 3
Phd Student:
Sereti, Viktoria (Intern)
Supervisor:
Urquhart, Andrew (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Design, synthesis and development of hypoxia reactive drug delivery systems

Department of Micro- and Nanotechnology
Period: 15/09/2016 → 14/09/2019
Number of participants: 3
Phd Student:
Björk Sigurdardóttir, Sara (Intern)
Supervisor:
Kamaly, Nazila (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

Liposome based vaccines in cancer immunotherapy

Department of Micro- and Nanotechnology
Period: 15/09/2016 → 14/09/2019
Number of participants: 3
Phd Student:
Jæhger, Ditte Elisabeth (Intern)
Supervisor:
Parhamifar, Ladan (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

Micromachined Integrated 2D Transducers for Ultrasound Imaging

Department of Micro- and Nanotechnology
Period: 15/09/2016 → 14/09/2019
Number of participants: 3
Phd Student:
Havreland, Andreas Spandet (Intern)
Supervisor:
Jensen, Jørgen Arendt (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

**Mucoadhesive microcontainers for oral drug delivery**
Department of Micro- and Nanotechnology
Period: 15/09/2016 → 17/08/2020
Number of participants: 4
Phd Student:
Mosgaard, Mette Dalskov (Intern)
Supervisor:
Andersen, Alina Joukainen (Intern)
Müllertz, Anette (Ekstern)
Main Supervisor:
Boisen, Anja (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

**Postdoc**
Department of Micro- and Nanotechnology
Silicon Microtechnology
Period: 01/09/2016 → 31/03/2017
Number of participants: 1
Acronym: Postdoc
Project participant:
Crovetto, Andrea (Intern)

**Development of Surface-Enhanced Raman Scattering Sensors**
Department of Micro- and Nanotechnology
Period: 01/09/2016 → 31/08/2019
Number of participants: 4
Phd Student:
Viehrig, Marlitt (Intern)
Supervisor:
Rindzевичius, Tomas (Intern)
Schmidt, Michael Stenbæk (Intern)
Main Supervisor:
Boisen, Anja (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Fonde
Project: PhD

**Liposome based vaccines in cancer immunotherapy**
Department of Micro- and Nanotechnology
Period: 01/09/2016 → 31/08/2019
Number of participants: 3
Phd Student:
Novel methods for detection of contaminants in the environment

Department of Micro- and Nanotechnology
Period: 01/09/2016 → 31/08/2019
Number of participants: 4
PhD Student:
Noori, Jafar Safaa (Intern)
Supervisor:
Dimaki, Maria (Intern)
Mortensen, John (Ekstem)
Main Supervisor:
Svendsen, Winnie Edith (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Grundforskningsfonden
Project: PhD

Quantum transport and thermoelectric effects in nanostructures and two-dimensional materials

Department of Micro- and Nanotechnology
Period: 01/09/2016 → 31/08/2020
Number of participants: 3
PhD Student:
Walldorf, Nicklas (Intern)
Supervisor:
Kaasbjerg, Kristen (Intern)
Main Supervisor:
Jauho, Antti-Pekka (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

Remotely Adjustable Structural Plasmonic Colour

Department of Micro- and Nanotechnology
Optofluidics
Center for Nanostructured Graphene
Department of Photonics Engineering
Structured Electromagnetic Materials
Period: 01/07/2016 → 30/06/2018
Number of participants: 3
Acronym: Smart Colour
Project participant:
Keshavarz Hedayati, Mehdi (Intern)
Kristensen, Anders (Intern)
Establishing sampling- and analytical procedures for the quantification of nanoparticles in aerosols and condensing conditions

Department of Micro- and Nanotechnology
Period: 15/05/2016 → 14/05/2019
Number of participants: 4
Phd Student:
Brostrøm, Anders (Intern)
Supervisor:
Kling, Kirsten Inga (Intern)
Kling, Kirsten Inga (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Development of an integrated lab-on-a-chip system for point-of-care molecular diagnosis

Department of Micro- and Nanotechnology
Period: 01/05/2016 → 30/04/2019
Number of participants: 4
Phd Student:
Than Linh, Quyen (Intern)
Supervisor:
Bang, Dang Duong (Intern)
Sun, Yi (Intern)
Main Supervisor:
Wolff, Anders (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Micro four-point probe based metrology

Department of Micro- and Nanotechnology
Period: 01/05/2016 → 08/06/2019
Number of participants: 3
Phd Student:
Witthøft, Maria-Louise (Intern)
Supervisor:
Hansen, Ole (Intern)
Main Supervisor:
Petersen, Dirch Hjorth (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Room temperature ballistic graphene devices

Department of Micro- and Nanotechnology
3D Nanocarbon chips for microsupercapacitors and ultrasensitive detection

Department of Chemistry
NanoChemistry
Organic Chemistry

Department of Micro- and Nanotechnology
Period: 15/03/2016 → 14/05/2017
Number of participants: 2
Acronym: CapSens
Phd Student:
Halder, Arnab (Intern)
Hemanth, Suhith (Intern)

Additive Manufacturing and Characterization of Mini Devices for Oral Drug Delivery

Department of Micro- and Nanotechnology
Period: 01/03/2016 → 28/02/2019
Number of participants: 4
Phd Student:
Vaut, Lukas (Intern)

Supervisor:
Jensen, Kristian Ejlebjærg (Intern)
Tosello, Guido (Intern)
Main Supervisor:
Boisen, Anja (Intern)

Synthesis of Polymer Bound Flourescent Hydrogen Peroxide Sensors for Biomedical Application

Department of Micro- and Nanotechnology
Period: 01/03/2016 → 30/04/2019
Number of participants: 4
Phd Student:
Tjell, Anders Ørts (Intern)

Supervisor:
Koren, Klaus (Ekstern)
Kühl, Michael (Intern)
Main Supervisor:
Almdal, Kristoffer (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD
Formulation of Radionuclides and Organometallic Anticancer Compounds in Gels and Liposomes

Department of Micro- and Nanotechnology
Period: 15/02/2016 → 14/02/2019
Number of participants: 5
PhD Student:
Wang, Wenbo (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Elema, Dennis Ringkjøbing (Intern)
Jensen, Andreas Tue Ingemann (Intern)
Main Supervisor:
Henriksen, Jonas Rosager (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

MHC-directed expansion of antigen responsive T cells

Department of Micro- and Nanotechnology
Period: 01/02/2016 → 31/01/2019
Number of participants: 3
PhD Student:
Rafa, Vibeke Mindahl (Intern)
Supervisor:
Donia, Marco (Ekstern)
Main Supervisor:
Hadrup, Sine Reker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Nano-Imprinting on Chacogenide MIR-Fiber End-Facets to Reduce Coupling Losses

Department of Micro- and Nanotechnology
Period: 01/02/2016 → 31/01/2019
Number of participants: 3
PhD Student:
Lotz, Mikkel Rønne (Intern)
Supervisor:
Jakobsen, Mogens Havsteen (Intern)
Main Supervisor:
Taboryski, Rafael J. (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering

Relations
Activities:
DTU Patent Course
The 61st International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication
European School on Nanosciences &amp; Nanotechnologies
Next generation sepsis diagnosis
Sepsis is a potentially fatal condition that arises when the body’s response to an infection damages its own tissues and organs. It is mainly caused by bacteria and fungi, which spread through the blood circulation. It is one of the biggest public health issues in the EU and worldwide due to its high incidence, mortality, human and economic cost. Early diagnosis is crucial to the management of sepsis, as every hour of delay of appropriate antibiotic therapy increases mortality by 5-10%. Unfortunately, sepsis diagnosis remains one of the greatest clinical challenges in critical care. Current diagnostic methods, including blood culture and different nucleic acid based multiplex technologies, are impaired by the significant time-delay of 1-2 days and/or low sensitivity of 30-50%. Hence there is an urgent need to develop new diagnostic tools that can provide more accurate and earlier sepsis diagnosis, so that patients with sepsis can be administered with rapid and correct initial antimicrobial treatment.

The SMARTDIAGNOS project will advance sepsis diagnosis by simplifying clinical sample analysis methods and integrating the currently required numerous steps into a single streamlined device. This will be achieved by combining a number of innovative technologies: 1) 3-dimensional sample concentration to process large amount of raw sample; 2) direct PCR in the 3D microstructure to circumvent DNA extraction step; 3) solid-phase PCR to achieve unlimited multiplexing capability; 4) supercritical angle fluorescence (SAF) microlens array for enhanced fluorescence detection and precise quantification of sepsis-related pathogens.

The SMARTDIAGNOS system will go beyond the state of the art for shorter time (1-3 h), higher sensitivity (95%), higher selectivity (99%), multiplexing capability, antimicrobial resistance profiling, and automation. Fast and correct sepsis diagnosis will improve patient outcome, shorten intensive care stay and thus reduce health costs.

Department of Micro- and Nanotechnology

BioLabChip
Period: 01/02/2016 → 31/01/2020
Number of participants: 2
Acronym: Smartdiagnos
Project Manager, organisational:
Christiansen, Mette (Intern)
Project Coordinator:
Wolff, Anders (Intern)
Period: 15/01/2016 → 14/01/2019
Number of participants: 3
Phd Student:
Mazzoni, Chiara (Intern)
Supervisor:
Nielsen, Line Hagner (Intern)
Main Supervisor:
Boisen, Anja (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Transciptional and post-translational control of T lymphocytes

Department of Micro- and Nanotechnology
Period: 15/01/2016 → 14/01/2019
Number of participants: 3
Phd Student:
Rizk, John (Intern)
Supervisor:
Agace, William Winston (Intern)
Main Supervisor:
Bekiaris, Vasileios (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Carbon based micromechanical sensors

Department of Micro- and Nanotechnology
Period: 15/12/2015 → 14/12/2018
Number of participants: 4
Phd Student:
Nguyen, Quang Long (Intern)
Supervisor:
Boisen, Anja (Intern)
Schmid, Silvan (Intern)
Main Supervisor:
Keller, Stephan Sylv (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansierer virksomhed
Project: PhD

Theoretical Investigators of transport properties of ballistic graphene devices

Department of Micro- and Nanotechnology
Period: 15/12/2015 → 14/12/2018
Number of participants: 3
Phd Student:
Calogero, Gaetano (Intern)
Supervisor:
Bøggild, Peter (Intern)
Main Supervisor:
Brandbyge, Mads (Intern)

Financing sources
Source: Internal funding (public)  
Name of research programme: Forskningsrådsfinansiering  
Project: PhD

**Optofluidics for the Analysis of Turbid Liquids**
Department of Micro- and Nanotechnology  
Period: 01/12/2015 → 30/11/2018  
Number of participants: 4  
Phd Student: Matthiae, Moritz (Intern)  
Supervisor: Raza, Søren (Intern)  
Zhu, Xiaolong (Intern)  
Main Supervisor: Kristensen, Anders (Intern)

**Financing sources**
Source: Internal funding (public)  
Name of research programme: Offentlig finansiering  
Project: PhD

**Targeting Approaches to Oral Drug Delivery with Microcontainers**
Department of Micro- and Nanotechnology  
Period: 01/12/2015 → 30/11/2018  
Number of participants: 4  
Phd Student: Tentor, Fabio (Intern)  
Supervisor: Almdal, Kristoffer (Intern)  
Bose-Goswami, Sanjukta (Intern)  
Main Supervisor: Boisen, Anja (Intern)

**Financing sources**
Source: Internal funding (public)  
Name of research programme: Samfinansieret - Andet  
Project: PhD

**Biological Sample Preparation for Electron Microscopy**
Special Topic Course  
Center for Electron Nanoscopy  
DTU Danchip  
Department of Environmental Engineering  
Urban Water Engineering  
Department of Micro- and Nanotechnology  
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics  
Nanoprobes  
Amphiphilic Polymers in Biological Sensing  
National Food Institute  
Research Group for Bioactives – Analysis and Application  
Research Group for Nano-Bio Science  
Period: 16/11/2015 → 20/11/2015  
Number of participants: 6
**Low-cost polymer chip for antibiotic resistance detection in tuberculosis**

Department of Micro- and Nanotechnology  
Period: 15/11/2015 → 14/11/2018  
Number of participants: 2  
Phd Student:  
Garbarino, Francesca (Intern)  
Main Supervisor:  
Hansen, Mikkel Foug (Intern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme:  *Samfinansieret - Andet*  
Project: PhD

**Optical detection of Non-viable cells**

Department of Micro- and Nanotechnology  
Period: 15/11/2015 → 14/11/2018  
Number of participants: 4  
Phd Student:  
Preus, Susan Ibi (Intern)  
Supervisor:  
Larsen, Niels Agersnap (Intern)  
Svendsen, Winnie Edith (Intern)  
Main Supervisor:  
Dimaki, Maria (Intern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme:  *Industrial PhD*  
Project: PhD

**Liposome based nanomedicines for the treatment of diabetic retinopathy**

Department of Micro- and Nanotechnology  
Colloids and Biological Interfaces  
Period: 01/10/2015 → 30/09/2018  
Number of participants: 3  
Phd Student:  
Arta, Anthoula (Intern)  
Supervisor:  
Andresen, Thomas Lars (Intern)  
Main Supervisor:  
Urquhart, Andrew (Intern)

**Immune cell targeted drug delivery systems for combination with chemotherapy**

Department of Micro- and Nanotechnology
Period: 01/10/2015 → 30/09/2018
Number of participants: 3
Phd Student:
Madsen, Ditte Villum (Intern)
Supervisor:
Parhamifar, Ladan (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Immunotherapy and combined therapies for cancer treatment
Department of Micro- and Nanotechnology
Period: 01/10/2015 → 30/09/2018
Number of participants: 3
Phd Student:
Jørgensen, Jennifer Solgaard (Intern)
Supervisor:
Parhamifar, Ladan (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Novel nanomedicines for the treatment of diabetic retinopathy
Department of Micro- and Nanotechnology
Period: 01/10/2015 → 30/09/2018
Number of participants: 3
Phd Student:
Arta, Anthoula (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Main Supervisor:
Urquhart, Andrew (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Bridging first principles modelling with nanodevice TCAD simulations
Department of Micro- and Nanotechnology
Period: 01/09/2015 → 31/08/2018
Number of participants: 4
Phd Student:
Palsgaard, Mattias Lau Nøhr (Intern)
Supervisor:
Gunst, Tue (Intern)
Markussen, Troels (Intern)
Main Supervisor:
Brandbyge, Mads (Intern)

Financing sources
Carriers Containing Multiple Compartments for Lysosomal Storage Diseases

Department of Micro- and Nanotechnology
Period: 01/09/2015 → 31/08/2018
Number of participants: 3
Phd Student:
York-Durán, María José (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Main Supervisor:
Hosta-Rigau, Leticia (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Industrial PhD
Project: PhD

Extrusion coating of self-cleaning nano-structures - XNano

Department of Micro- and Nanotechnology
Period: 01/09/2015 → 31/08/2018
Number of participants: 3
Phd Student:
Okulova, Nastasia (Intern)
Supervisor:
Johansen, Peter L. (Ekstern)
Main Supervisor:
Taboryski, Rafael J. (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Industrial PhD
Project: PhD

Microcontainers for oral vaccine delivery

Department of Micro- and Nanotechnology
Period: 01/09/2015 → 31/08/2018
Number of participants: 4
Phd Student:
von Halling Laier, Christoffer (Intern)
Supervisor:
Nielsen, Line Hagner (Intern)
Rades, Thomas (Ekstern)
Main Supervisor:
Boisen, Anja (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Nanocarrier mediated transport of macromolecules across the blood brain barrier

Department of Micro- and Nanotechnology
Period: 01/09/2015 → 31/08/2018
Number of participants: 3
Phd Student:
Lund, Mette Aagaard (Intern)
Supervisor:
Kamaly, Nazila (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

**Prodrugs and Linker Systems for Degradation in Diseased Tissue as part of Liposomal Drug Delivery Systems**

Department of Micro- and Nanotechnology
Period: 01/09/2015 → 31/05/2019
Number of participants: 2
Phd Student:
Kræmer, Martin Kisha (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

**Ballistic Transport in van der Waals Heterostructure Devices**

Department of Micro- and Nanotechnology
Period: 15/08/2015 → 14/08/2018
Number of participants: 3
Phd Student:
Zultak, Johanna (Intern)
Supervisor:
Booth, Tim (Intern)
Main Supervisor:
Bøggild, Peter (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

**Evanescent wave absorption spectroscopy for hemolysis detection**

Department of Micro- and Nanotechnology
Period: 15/08/2015 → 14/08/2018
Number of participants: 3
Phd Student:
Zhou, Chen (Intern)
Supervisor:
Vannahme, Christoph (Intern)
Main Supervisor:
Kristensen, Anders (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD
**Cost and energy effective all-black solar cell panel | Black Si BIPV | Phase 1**

The project will aim at establish a method for proof-of-concept creation of working modules with black silicon cells and black front grid. A few prototype modules of medium quality will be fabricated and be used for probing the market interest for the all black silicon technology, and further verify the superior angular light absorption on the module level. The projects falls into the following work packages:

• Investigation of interconnection method  
• Investigation/proofof-concept of black electroplating methods to make the silver front fingers black  
• Design and production of Black Silicon cells with black fingers  
• Investigation of module technology supporting the all black silicon cell, proof-of-concept production and module characterization  
• Proof-of-Business of Black Silicon BIPV

The project is a major step in making the black silicon technology available to the Danish PV industry being strong in BIPV where the technology is very well suited.

**Department of Photonics Engineering**
Diode Lasers and LED Systems
Department of Micro- and Nanotechnology
Silicon Microtechnology
Experimental Surface and Nanomaterials Physics
Period: 01/07/2015 → 01/10/2016
Number of participants: 4
Acronym: Black-Si-BIPV
Project participant:
Thorsteinsson, Sune (Intern)
Davidsen, Rasmus Schmidt (Intern)
Hansen, Ole (Intern)
Project Manager, academic:
Poulsen, Peter Behrensdorff (Intern)

**Characterization of stromal cell subsets in the healthy and inflamed human intestine**

Department of Micro- and Nanotechnology
Period: 01/06/2015 → 13/09/2018
Number of participants: 3
Phd Student:
Jørgensen, Peter (Intern)
Supervisor:
Nielsen, Ole Haagen (Ekstern)
Main Supervisor:
Agace, William Winston (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

**Chemical/Biological sensing using CMUTs**

Department of Micro- and Nanotechnology
Period: 01/05/2015 → 21/06/2018
Number of participants: 4
Phd Student:
Mølgaard, Mathias Johannes Grøndahl (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Jakobsen, Mogens Havsteen (Intern)
Main Supervisor:
Nanostructuring of two-dimensional materials using disorder

Department of Micro- and Nanotechnology
Period: 01/05/2015 → 04/08/2018
Number of participants: 2
PhD Student:
Aktor, Thomas (Intern)
Main Supervisor:
Jauho, Antti-Pekka (Intern)

Tailored material properties of pyrolysed carbon microelectrodes

Department of Micro- and Nanotechnology
Period: 01/05/2015 → 30/04/2018
Number of participants: 6
PhD Student:
Hassan, Yasmin Mohamed (Intern)
Supervisor:
Caviglia, Claudia (Intern)
Main Supervisor:
Keller, Stephan Sylvest (Intern)
Examiner:
Dimaki, Maria (Intern)
Kassegne, Samuel Kinde (Ekstern)
Ruzgas, Tautgirdas (Ekstern)

Micromachined Integrated 2D Transducers for Ultrasound Imaging

Department of Micro- and Nanotechnology
Period: 01/04/2015 → 01/05/2018
Number of participants: 3
PhD Student:
Engholm, Mathias (Intern)
Supervisor:
Jensen, Jørgen Arendt (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
In-situ TEM Battery Studies
Department of Micro- and Nanotechnology
Period: 15/03/2015 → 14/03/2018
Number of participants: 7
Phd Student:
Yesibolati, Murat Nulati (Intern)
Supervisor:
Kasama, Takeshi (Intern)
Sun, Hongyu (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Wagner, Jakob Birkedal (Intern)
Dunin-Borkowski, Rafal E. (Intern)
Mirsaidov, Utkur M. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

SMS-Amplification: free Single Molecule mRNA Sequencing for digital quantification of cancer monomol residual disease markers
Department of Micro- and Nanotechnology
Period: 01/03/2015 → 03/01/2019
Number of participants: 4
Phd Student:
Busk, Marie Louise Laub (Intern)
Supervisor:
Dufva, Inge Høgh (Ekstern)
Kunding, Andreas Hjarne (Intern)
Main Supervisor:
Dufva, Martin (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Low-Temperature Growth of Graphene-based Passivating Coatings for Industrial Applications
Department of Micro- and Nanotechnology
Period: 15/01/2015 → 14/01/2018
Number of participants: 6
Phd Student:
Yu, Feng (Intern)
Supervisor:
Camilli, Luca (Intern)
Main Supervisor:
Beggild, Peter (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Daasbjerg, Kim (Ekstern)
Hofmann, Stephan (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD
SERS based Sensing and Centrifugal Microfluidics
Department of Micro- and Nanotechnology
Period: 15/01/2015 → 03/05/2018
Number of participants: 8
Phd Student:
Durucan, Onur (Intern)
Supervisor:
Matteucci, Marco (Intern)
Rindzevicius, Tomas (Intern)
Schmidt, Michael Stenbæk (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Smedsgaard, Jørn (Intern)
Golcuk, Kurtulus (Ekstern)
Hakonen, Aron (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet

Relations
Publications:
Surface-Enhanced Raman Spectroscopy Integrated Centrifugal Microfluidics Platform
Project: PhD

New technology for fast localization and characterization of faults in solar cell systems
The purpose is to develop and demonstrate a new efficient and flexible technology for fault localization/diagnosis in PV systems. The technology is aimed at the growing PV service market. Measurements can be carried out at the string level, and O&M costs are minimized. At the same time performance is optimized and the cost of energy is lowered.

Department of Photonics Engineering
Diode Lasers and LED Systems
Optical Microsensors and Micromaterials
Experimental Surface and Nanomaterials Physics
Department of Micro- and Nanotechnology
Silicon Microtechnology
EmaZys Technologies
Kenergy

Aalborg University
Period: 01/01/2015 → 31/01/2016
Number of participants: 4
Solar Cells, Solar Energy, Characterization
Project participant:
Poulsen, Peter Behrensdorff (Intern)
Thorsteinsson, Sune (Intern)
Schou, Jørgen (Intern)
Hansen, Ole (Intern)

Financing sources
Source: Public research programme (public)
Name of research programme: EUDP
Amount: 8,209,548.00 Danish Kroner
Project
Anti-fogging properties of nanostructured polymer surfaces

Department of Micro- and Nanotechnology
Period: 15/12/2014 → 20/02/2018
Number of participants: 5
Phd Student:
Telecka, Agnieszka (Intern)
Main Supervisor:
Taboryski, Rafael J. (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Nielsen, Bo Rud (Ekstern)
Pakkanen, Tapani (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)

Relations
Publications:
Fabrication of nanostructured functional surfaces on polymer and silicon using self-assembly lithographic methods
Project: PhD

Development of drug delivery systems for treatment of atherosclerosis

Department of Micro- and Nanotechnology
Period: 15/12/2014 → 14/12/2017
Number of participants: 6
Phd Student:
Petersen, Lars Ringgaard (Intern)
Supervisor:
Hansen, Anders Elias (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Bekiaris, Vasileios (Intern)
Boesch, Austin (Ekstern)
Christensen, Dennis (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Disc System for Cellular Studios

Department of Micro- and Nanotechnology
Period: 01/12/2014 → 07/03/2018
Number of participants: 7
Phd Student:
Morelli, Lidia (Intern)
Supervisor:
Rindzevicius, Tomas (Intern)
Zor, Kinga (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Svendsen, Winnie Edith (Intern)
Ducree, Jens (Ekstern)
Sandahl, Margareta (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering

**Relations**
Publications:
SERS-based detection methods for screening of genetically modified bacterial strains
Project: PhD

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**Miniaturized Broadband Energy Harvesting**
Department of Micro- and Nanotechnology
Period: 01/12/2014 → 30/11/2017
Number of participants: 3
Phd Student: Alcala, Lucia R. (Intern)
Supervisor: Lei, Anders (Intern)
Main Supervisor: Thomsen, Erik Vilain (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

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**Next-generation detection of antigen responsive T cells**
Department of Micro- and Nanotechnology
Period: 01/12/2014 → 12/10/2018
Number of participants: 2
Phd Student: Bentzen, Amalie Kai (Intern)
Main Supervisor: Hadrup, Sine Reker (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

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**Data-Analysis in Biomedical Research Based on Physical/Chemical Modeling: High-Throughput Drug Screening for Blood Coagulation and How to Overcome the Blood-Brain Barrier**
Department of Micro- and Nanotechnology
Period: 15/11/2014 → 07/03/2018
Number of participants: 6
Phd Student: Markovich, Dmitriy (Intern)
Supervisor: Mortensen, Kim (Intern)
Main Supervisor: Flyvbjerg, Henrik (Intern)
Examiner: Berg-Sørensen, Kirstine (Intern)
Brazhe, Alexey (Intern)
Söderberg, Bo (Ekstern)

**Financing sources**
Source: Internal funding (public)
Data Analysis in Experimental Biomedical Research
Project: PhD

3D printing of hydrogel scaffolds for 3D dependent cell culture
Department of Micro- and Nanotechnology
Period: 01/11/2014 → 07/02/2018
Number of participants: 5
PhD Student:
Zhang, Rujing (Intern)
Main Supervisor:
Larsen, Niels Bent (Intern)
Examiner:
Dufva, Martin (Intern)
Grijpma, Dirk Wybe (Ekstern)
von Guttenberg, Zeno (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)

Agglutination based Sensing and Centrifugal Microfluidics
Department of Micro- and Nanotechnology
Period: 01/11/2014 → 07/02/2018
Number of participants: 7
PhD Student:
Uddin, Rokon (Intern)
Supervisor:
Burger, Robert (Intern)
Donolato, Marco (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Wolff, Anders (Intern)
Kallio, Pasi J. (Ekstern)
Turner, Anthony P. F. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet

Industriens fond - højteknologisk innovation
Department of Civil Engineering
Section for Building Design
New nanomedicines for the treatment of diabetic retinopathy

Department of Micro- and Nanotechnology
Colloids and Biological Interfaces
Period: 01/10/2014 → 30/09/2017
Number of participants: 3
Phd Student: Eriksen, Anne Zebitcoin (Intern)
Supervisor: Andresen, Thomas Lars (Intern)
Main Supervisor: Urquhart, Andrew (Intern)

Conducting pyrolysed 3D carbon scaffolds (p3D-CS) for cell replacement therapy and tissue engineering

Department of Micro- and Nanotechnology
Period: 01/10/2014 → 11/01/2018
Number of participants: 7
Phd Student: Bunea, Ada-Ioana (Intern)
Supervisor: Keller, Stephan Sylvest (Intern)
Larsen, Niels Bent (Intern)
Main Supervisor: Emméus, Jenny (Intern)
Examiner: Kamaly, Nazila (Intern)
Gómez, Laura M. Lechuga (Ekstern)
Ruzgas, Tautgirdas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Fabrication of three-dimensional carbon microelectrodes for environmental sensing

Department of Micro- and Nanotechnology
Period: 01/10/2014 → 14/12/2017
Number of participants: 6
Phd Student: Hemanth, Suhith (Intern)
Supervisor:
Caviglia, Claudia (Intern)
Main Supervisor:
Keller, Stephan Sylvest (Intern)
Examiner:
Taboryski, Rafael J. (Intern)
Baeumner, Antje J. (Ekstern)
Martinez-Duarte, Rodrigo (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed

Relations
Publications:
Fabrication of three-dimensional carbon microelectrodes for electrochemical sensing
Project: PhD

Fabrication of Van-der-Waals Heterostructures by Chemical Vapour Deposition
Department of Micro- and Nanotechnology
Period: 01/10/2014 → 07/02/2018
Number of participants: 6
Phd Student:
Shivayogimath, Abhay (Intern)
Supervisor:
Booth, Tim (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Mølhave, Kristian (Intern)
Lemme, Max Christian (Ekstern)
Sun, Jie (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering

Relations
Publications:
Large-scale Fabrication of 2D Materials by Chemical Vapor Deposition
Project: PhD

Liquid Fiducial Markers for Potentiation of Radiotherapy
Department of Micro- and Nanotechnology
Period: 01/10/2014 → 30/09/2017
Number of participants: 6
Phd Student:
Larsen, Trine Bjørnbo (Intern)
Supervisor:
Hansen, Anders Elias (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Henriksen, Jonas Rosager (Intern)
Christensen, Dennis (Ekstern)
Cruz, Edgar (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Mutated sequences as targets for immune-reactivity against cancer - and their potential use in personalized therapy

Department of Micro- and Nanotechnology
Period: 01/10/2014 → 05/01/2019
Number of participants: 2
PhD Student:
Ramskov, Sofie (Intern)
Main Supervisor:
Hadrup, Sine Reker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Novel strategies for immune therapies in human cancer

Department of Micro- and Nanotechnology
Period: 01/10/2014 → 19/10/2018
Number of participants: 2
PhD Student:
Pedersen, Natasja Wulff (Intern)
Main Supervisor:
Hadrup, Sine Reker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansierede - Virksomhed
Project: PhD

Electrochemical/Agglutination based Sensing and Centrifugal Microfluidics

Department of Micro- and Nanotechnology
Period: 01/09/2014 → 11/01/2018
Number of participants: 7
PhD Student:
Sanger, Kuldeep (Intern)
Supervisor:
Heiskanen, Arto (Intern)
Zor, Kinga (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Taboryski, Rafael J. (Intern)
Turner, Anthony P. F. (Ekstern)
Zebgerle, Roland (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering

Relations
Publications:
Design and development of electrochemical polymer-based lab-on-a-disc devices for biological applications
Project: PhD

New nanomedicines for the treatment of diabetic retinopathy

Department of Micro- and Nanotechnology
Period: 01/09/2014 → 07/03/2018  
Number of participants: 6  
Phd Student: Eriksen, Anne Zebitz (Intern)  
Supervisor: Andresen, Thomas Lars (Intern)  
Main Supervisor: Urquhart, Andrew (Intern)  
Examiner: Kamaly, Nazila (Intern)  
Jensen, Henrik (Ekstern)  
Wilson, Clive George (Ekstern)  

Financing sources  
Source: Internal funding (public)  
Name of research programme: Institut stipendie (DTU)  
Project: PhD

**Micromachined Integrated Transducers for Ultrasound Imaging**  
Department of Micro- and Nanotechnology  
Period: 15/08/2014 → 28/07/2018  
Number of participants: 3  
Phd Student: Diederichsen, Søren Elmin (Intern)  
Supervisor: Jensen, Jørgen Arendt (Intern)  
Main Supervisor: Thomsen, Erik Vilain (Intern)  

Financing sources  
Source: Internal funding (public)  
Name of research programme: Offentlig finansiering  
Project: PhD

**Fabrication of Van der Waals Heterostructures by Chemical Vapour Deposition**  
Department of Micro- and Nanotechnology  
Period: 01/08/2014 → 07/02/2018  
Number of participants: 6  
Phd Student: Thomsen, Joachim Dahl (Intern)  
Supervisor: Booth, Tim (Intern)  
Main Supervisor: Bøggild, Peter (Intern)  
Examiner: Hansen, Ole (Intern)  
Helveg, Stig (Ekstern)  
Krasheninnikov, Arkady (Ekstern)  

Financing sources  
Source: Internal funding (public)  
Name of research programme: Anden EU-finansiering

Relations  
Publications:  
Measuring and Tailoring the Structure of Two-Dimensional Materials by Transmission Electron Microscopy  
Project: PhD
Low Cost polymer photonic crystal laser intra-cavity sensors

Department of Micro- and Nanotechnology
Period: 01/08/2014 → 03/05/2018
Number of participants: 6
Phd Student:
Sørensen, Kristian Tølbøl (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Lindvold, Lars René (Intern)
Lindvold, Lars René (Intern)
Mortensen, N. Asger (Intern)
Mortensen, N. Asger (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet

Relations
Publications:
Photonic Crystal Slab Sensors in Microfluidics
Project: PhD

Block Copolymer Precursors for Chemical Nanopatterning of Graphene

Department of Micro- and Nanotechnology
Period: 15/07/2014 → 07/12/2017
Number of participants: 6
Phd Student:
Wang, Zhongli (Intern)
Supervisor:
Almdal, Kristoffer (Intern)
Main Supervisor:
Ndori, Sokol (Intern)
Examiner:
Semenova, Elizaveta (Intern)
Jannasch, Patric (Ekstern)
Posselt, Dorthe (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet

Relations
Publications:
Nanopatterning of graphene guided by block copolymer self-assembly
Project: PhD

Microcontainers for Oral Vaccine Delivery
I propose the utilisation of biopolymer microcontainers as an oral vaccine delivery system. These microcontainers (MCs) will be filled with a particulate vaccine formulation and sealed with a mucoadhesive layer followed by a pH-sensitive lid. The MCs will provide: 1) protection of the vaccine against enzymatic degradation, 2) adherence to the desired site of action and 3) provision of a unidirectional drug release. In the design of such a system, it is intended that the vaccine will be released only upon reaching the intestine, in close proximity to the epithelial cell barrier, allowing for effective uptake of the antigen and the initiation of an immune response. The project will be based at DTU Nanotech with collaborations to KU Pharma, Denmark, Helmholtz Institute for Pharmaceutical Research Saarland, Saarbrücken, Germany and University of Otago, Dunedin, New Zealand.

Department of Micro- and Nanotechnology
Nanoprobes
Period: 01/07/2014 → 30/06/2017
Number of participants: 1
Oral vaccine delivery, Microcontainers, Triple Co-culture cell model, Targeted drug delivery
Project participant:
Nielsen, Line Hagner (Intern)
Documents:
Microcontainers for oral vaccine delivery
Project

PhD Scholarship in Nanoscale Imaging of the Aqueous Processes of Precipitation, Dispersion and Imbition
Department of Micro- and Nanotechnology
Period: 15/05/2014 → 13/09/2017
Number of participants: 7
Phd Student:
Lagana, Simone (Intern)
Supervisor:
Burrows, Andrew (Intern)
Stenby, Erling Halfdan (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Booth, Tim (Intern)
Davis, Zachary James (Intern)
Xu, Qiang (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Electron microscopy of electrochemical processes
Department of Micro- and Nanotechnology
Period: 15/04/2014 → 23/08/2017
Number of participants: 7
Phd Student:
Canepa, Silvia (Intern)
Supervisor:
Sun, Hongyu (Intern)
Wagner, Jakob Birkedal (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Hjelm, Johan (Intern)
Alloyeau, Damien (Ekstern)
Dahl, Søren (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering

Relations
Publications:
Quantifying Chemical and Electrochemical Reactions in Liquids by in situ Electron Microscopy
Project: PhD

Synthesis of biomaterials for use in drug delivery to the brain
Department of Micro- and Nanotechnology
Period: 15/04/2014 → 05/04/2018
Number of participants: 5
Phd Student:
Bak, Martin (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Berg, Rolf Henrik (Intern)
Linderoth, Lars (Intern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed

Relations
Publications:
Synthesis of Biomaterials for use in Drug Delivery to the Brain
Project: PhD

Cantilever sensor on a rotating disc
Department of Micro- and Nanotechnology
Period: 01/04/2014 → 23/08/2017
Number of participants: 7
Phd Student:
Casci Ceccacci, Andrea (Intern)
Supervisor:
Bosco, Filippo (Intern)
Cagliani, Alberto (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Davis, Zachary James (Intern)
Jeon, Sangmin (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Quantum Hall effects in nanostructured graphene
Department of Micro- and Nanotechnology
Period: 01/04/2014 → 14/06/2017
Number of participants: 6
Phd Student:
Gregersen, Søren Schou (Ekstern)
Supervisor:
Power, Stephen (Intern)
Main Supervisor:
Jauho, Antti-Pekka (Intern)
Examiner:
Willatzen, Morten (Intern)
Ferreira, Mauro (Ekstern)
Harju, Ari (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
The role of IRF4 dependent dendritic cells in the development of experimental T cell induced colitis

Department of Micro- and Nanotechnology
Period: 01/04/2014 → 30/06/2018
Number of participants: 5
Phd Student: Pool, Lieneke (Intern)
Main Supervisor: Agace, William Winston (Intern)
Examiner: Lahl, Katharina (Intern)
Lochner, Matthias (Ekstern)
Marsal, Jan (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Heterojunction Silicon Solar Cells
One of the most severe challenges man is facing today is to fulfill the need for energy without harmful environmental consequences. This complicated, grand challenge must be met by a wide range of solutions; among these are more efficient use of resources and replacement of fossil fuels by renewable energy sources. Any sustainable, renewable energy system must directly or indirectly rely on solar energy. Photovoltaic or solar cells are already efficient and reliable sources of electricity from solar light, but even though the cost has decreased significantly in recent years, solar cells are still far too costly for a competitive production of bulk grid power. The challenge within the solar cell field is thus to reduce the costs involved in solar cell production without sacrificing efficiency and reliability; actually, the efficiency should better improve towards 25% or more, since the cell efficiency strongly affects the overall economy of a solar cell power plant.

Currently, most of the solar cell market is based on 180-300 micrometer thick crystalline silicon wafers, and approximately 50% of the cost is due to the cost of the material. To reduce material costs thin film cells are promising alternatives, but a limitation in thin film solar cell technologies is that the absorbance of light is quite weak in particular for indirect band gap materials like silicon. This limitation may be lifted by application of photon trapping strategies that can increase the absorptivity of thin photo-absorbers by orders of magnitude at longer wavelengths. Another proved approach in solar cell optimization is carrier selective contacts, such as conventional amorphous silicon, or wide bandgap metal oxide semiconductor.

In this project, we will explore several new ideas for novel silicon-based solar cells to develop efficient solar cells that can be fabricated in a low thermal budget, low-cost fabrication procedure using only abundant elements. The main photo-absorber will be lightly doped p-type silicon (1.12 eV band gap) with a thin n-type TiO₂ (3.2 eV band gap) film on top. This structure forms a p-n heterojunction that effectively separates the photo-generated electron-hole pairs, since the titania and silicon conduction bands are aligned facilitating electron transport, while a ~2 eV energy barrier will prevent hole transport. The electrons transported through the titania to the surface will be conducted laterally by a metal grid or continuous transparent conductive oxides such as Aluminum Zinc Oxide (AZO) with high conductivity, highly transparent (loss 10 %) electrode layer. On the backside, silicon will be coated with complementary to TiO₂ thin film of NiO. NiO is p-type wide bandgap (3.6 eV) semiconductor. In connection to Si it will form p-p isotype heterojunction with excellent valence band matching, and creating hole conducting and electron blocking layer. A back contact will be formed using a high work-function metal to form additional a potential barrier against electron transport, while the holes are easily conducted to the metal. This basic structure will be combined with micro and nanostructuring of the silicon surface prior to fabrication to form a light trapping structure. All fabrication procedures may be done at temperatures close to room temperature with a maximum of ~200°C necessary in a single step, and thus the thermal budget becomes unusually low. At the same time, a high open circuit voltage for the structure is expected due to the efficient carrier separation in the structure.

The overall project will have four main research phases. In the first phase of the project, the basic TiO₂-Si heterostructure will be optimized on planar silicon wafers. Here the focus will be on the development of optimized fabrication procedures that results in high-performance junctions and efficient lateral transport. In this phase of the project, we also want to fabricate silicon alumina-titania heterostructures. Alumina has properties similar to titania: a wide bandgap and transparency to visible wavelengths, hole transport blocking and passivation of a silicon surface. In the process, alumina will be deposited on top of silicon and then the lithographic windows will be opened for titania deposition and formation of localized titania-silicon heterojunctions. On top of titania areas aluminum contacts will be introduced. It is planned to fabricate and test such structures since they have a potential to show both high open circuit voltage and short circuit current. Other metal with close by work function will be tested to minimize current blocking effects in diode structure.
In the second stage, NiO-Si isotype heterostructure will be tested and optimized to meet the best ohmic (hole conductive) properties. We will fabricate and characterize NiO-Si structure similar to TiO₂-Si structure. Next micro- and nanostructured silicon surfaces, including “Black silicon”, for light trapping will be developed and characterized. In this stage, nanostructured surfaces should be optimized to obtain the lowest surface recombination velocity in comparison to plain silicon. Then the optimized heterostructure cell fabrication procedure will be ported to these structures. Finally, after the previous three stages will be developed, different solar cell architectures will be tested for solar cell fabrication and characterization. We consider Pasha, HIT and IBC architecture as the most promising for solar cell test since they showed the world records of efficiencies for conventional silicon solar cells.

Department of Micro- and Nanotechnology
Silicon Microtechnology
Department of Physics
Experimental Surface and Nanomaterials Physics
Nanoprobes
Nanointegration
Period: 15/02/2014 → 15/02/2017
Number of participants: 4
Silicon Solar Cell, ALD, Carrier Selective Contacts, Transition Metal Oxides
Project ID: 3315
Project participant:
Plakhotnyuk, Maksym (Intern)
Supervisor:
Schmidt, Michael Stenbaek (Intern)
Booth, Tim (Intern)
Main Supervisor:
Hansen, Ole (Intern)

Relations
Activities:
6th Symposium on Carbon and Related Nanomaterials
Fraunhofer Center for Silicon Photovoltaics (CSP)
Discovering Challenges in Fabrication of Nanostructured c-Si Solar Cells with Metal Oxides Carrier Selective Contacts
European Advanced Material Congress
26th International Photovoltaic Science and Engineering Conference
Publications:
Phosphorous Doping of Nanostructured Crystalline Silicon
Low surface damage dry etched black silicon
Lifetime of Nano-Structured Black Silicon for Photovoltaic Applications
Graphene transfer on highly corrugated black silicon surface
TiO₂-Si solar cells with carrier selective contacts and low temperature processing
Behind the Nature of Titanium Oxide Excellent Surface Passivation and Carrier Selectivity of c-Si
Phosphorous Doping of Nanostructured Crystalline Silicon
Hole Selective NiO Contact for Silicon Solar Cells
Enhanced Passivation And Characterization Of Titania Silicon Heterojunction With Tunneling Oxide Interlayers
Discovering Challenges in Fabrication of Nanostructured c-Si Solar Cells with Metal Oxides Carrier Selective Contacts

Realization of Structurally Optimized Vascularized Bioartificial Organs
Department of Micro- and Nanotechnology
Period: 15/02/2014 → 18/07/2017
Number of participants: 7
Phd Student:
Pimentel Carletto, Rodrigo (Intern)
Supervisor:
Larsen, Layla Bashir (Intern)
Okkels, Fridolin (Intern)
Main Supervisor:
Dufva, Martin (Intern)
Examiner:
Urquhart, Andrew (Intern)
Fey, Stephen John (Ekstern)
Rouwkema, Jeroen (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)

**Relations**

**Publications:**
Vascularization of soft tissue engineering constructs
Project: PhD

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**Silicon heterostructure solar cells**

Department of Micro- and Nanotechnology
Period: 15/02/2014 → 15/08/2017
Number of participants: 7
Phd Student:
Plakhotnyuk, Maksym (Intern)
Supervisor:
Booth, Tim (Intern)
Schmidt, Michael Stenbæk (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Jørgensen, Anders Michael (Intern)
Isabella, Olindo (Ekstern)
Madsen, Morten (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

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**Hollow Cantilever-like sensors on a rotating disc**

Department of Micro- and Nanotechnology
Period: 01/02/2014 → 10/05/2017
Number of participants: 7
Phd Student:
Kurek, Maksymilian (Intern)
Supervisor:
Burger, Robert (Intern)
Schmid, Silvan (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Thomsen, Erik Vilain (Intern)
Seonghwan, Kim (Ekstern)
Tamayo, Javier (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering

**Relations**
Publications:
Photothermal IR spectroscopy with perforated membrane micromechanical resonators
Project: PhD

Liposome based chemopainting in cancer radiotherapy
Department of Micro- and Nanotechnology
Period: 15/01/2014 → 14/06/2017
Number of participants: 5
PhD Student:
Østrem, Ragnhild Garborg (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Henriksen, Jonas Rosager (Intern)
Moos, Torben (Ekstern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet

Relations
Publications:
Enzyme sensitive liposomes in chemotherapy and potentiation of immunotherapy
Project: PhD

New cancer drugs based on MMP sensitive drug delivery systems
Department of Micro- and Nanotechnology
Period: 15/11/2013 → 27/09/2017
Number of participants: 6
PhD Student:
Brogaard, Rikke Yding (Intern)
Supervisor:
Melander, Fredrik (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Kamaly, Nazila (Intern)
Foged, Camilla (Ekstern)
Cruz, Edgar (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering

Relations
Publications:
Protease-Sensitive Liposomes in Chemotherapy & Chemoradiotherapy: From Material Development to In Vivo Application in Tumor-Bearing Mice
Project: PhD

Bioabsorbable Materials for Use in Vena Cava Filters
Department of Micro- and Nanotechnology
Period: 01/11/2013 → 11/01/2017
Number of participants: 6
PhD Student:
Løvdal, Alexandra Liv Vest (Intern)
Supervisor:
Klausen, Kasper (Ekstern)
Main Supervisor:
Almdal, Kristoffer (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Hansen, Kristoffer Karsten (Intern)
Kleppinger, Ralf (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU

Relations
Publications:
Bioabsorbable materials for use in vena cava filters
Project: PhD

Lab-on-chip system for virus detection in water
Department of Micro- and Nanotechnology
Period: 01/10/2013 → 11/01/2017
Number of participants: 7
Phd Student:
Kirkegaard, Julie (Intern)
Supervisor:
Larsen, Lars Erik (Intern)
Svendsen, Winnie Edith (Intern)
Main Supervisor:
Rozlosnik, Noemi (Intern)
Examiner:
Emnéus, Jenny (Intern)
Heegaard, Niels H.H. (Ekstern)
Merkoçi, Arben (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering

Relations
Publications:
Aptasensor development for detection of virus in water
Project: PhD

Portable Automated Water Analyser for Viruses
Water-borne viral diseases pose high risks for public health worldwide. The urban wastewater contains large number of pathogen viruses, and even the most advanced wastewater treatment is not safe for full removal of virus particles. The conventional biological water quality indicators do not provide adequate information about the presence of pathogenic viruses. The currently available reliable virus test - based on molecular biology - is expensive, time consuming and labour intensive, thus limited to few laboratories with sophisticated facilities and well-trained personnel, even though the protection of water networks against pathogenic viruses is crucial.
In this project we aim to develop a novel, cost effective, portable, on-site detection system, which is capable for monitoring human enteric viruses in different freshwater bodies.
The method is based on disposable microfluidic chip, in which the virus particles can be up-concentrated and detected by electrical readout with a detection limit of 0.01-1 virus/L. We will focus on selective detection of norovirus, Hepatitis A and rotavirus (the most prevalent viruses), but the sensor is capable to detect any other virus with relevant functionalization. The ‘plug-and-play’ virus sensor chip will be integrated into a measurement unit, which will send the data to the monitoring station.
The project will include laboratory and field tests and validation of the monitoring unit, development an early warning system and epidemic risk assessment, provide with exploitation possibilities at the end-users, economical assessment for positive production capacity and preparation for future standardization.

Department of Micro- and Nanotechnology
Polymer Microsystems for Medical Diagnostics
Period: 01/10/2013 → 30/09/2016
Number of participants: 2
Acronym: Aquavir
Project Manager, organisational:
Bjerrum, Anders (Intern)
Project Coordinator:
Rozlosnik, Noemi (Intern)

Advanced surface characterization of nanostructures on curved polymer surfaces
Department of Micro- and Nanotechnology
Period: 15/09/2013 → 07/12/2016
Number of participants: 6
Phd Student:
Feidenhans'l, Nikolaj Agentoft (Intern)
Supervisor:
Petersen, Jan Conrad (Ekstern)
Main Supervisor:
Taboryski, Rafael J. (Intern)
Examiner:
Mortensen, N. Asger (Intern)
Bodermann, Bernd (Ekstern)
Kyhle, Anders (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU

Relations
Publications:
Optical Characterization of Nanostructured Surfaces
Project: PhD

CZTS Solar Cell Technology
Department of Micro- and Nanotechnology
Period: 01/09/2013 → 02/11/2016
Number of participants: 5
Phd Student:
Crovetto, Andrea (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Vesborg, Peter Christian Kjærgaard (Intern)
Scruggs, Jonathan J. S. (Ekstern)
Unold, Thomas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering

Relations
Publications:
\( \text{Cu}_2\text{ZnSnS}_4 \) solar cells: Physics and technology by alternative tracks
Project: PhD

Electromechanical sensors on a rotating disc
Department of Micro- and Nanotechnology
Period: 15/08/2013 → 10/05/2017
Number of participants: 7
Phd Student:
Andreasen, Sune Zoëga (Intern)
Supervisor:
Emnéus, Jenny (Intern)
Zor, Kinga (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Jönsson, Jan Åke (Ekstern)
Ruzgas, Tautgirdas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering

Relations
Publications:
Towards a fully automated lab-on-a-disc system integrating sample enrichment and detection of analytes from complex matrices
Project: PhD

Graphene Growth and Transfer - DAGATE
Department of Micro- and Nanotechnology
Period: 15/08/2013 → 08/03/2017
Number of participants: 7
Phd Student:
Whelan, Patrick Rebsdorf (Intern)
Supervisor:
Booth, Tim (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Hübner, Jörg (Intern)
Hübner, Jörg (Intern)
Sun, Jie (Ekstern)
Sun, Jie (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering

Relations
Publications:
Transfer and characterization of large-area CVD graphene for transparent electrode applications
Project: PhD

Surface Plasmon based sensors using nanopillar arrays
Department of Micro- and Nanotechnology
Period: 15/08/2013 → 08/02/2017
Number of participants: 7
Phd Student:
Thilsted, Anil Haraksingh (Intern)
Supervisor:
Rindzevicius, Tomas (Intern)
Schmidt, Michael Stenbæk (Intern)
Main Supervisor:  
Boisen, Anja (Intern)  
Examiner:  
Hübner, Jörg (Intern)  
Ariese, Freek (Ekstern)  
Pedersen, Jens Engholm (Intern)

Financing sources  
Source: Internal funding (public)  
Name of research programme: Institut, samfinansiering

Relations

Publications:  
Transparent Substrates for Plasmonic Sensing by Lithography-Free Fabrication  
Project: PhD

**Suspended Nanopatterned Graphene Devices**

Department of Micro- and Nanotechnology  
Period: 15/08/2013 → 07/12/2016  
Number of participants: 7  
Phd Student:  
Gammelgaard, Lene (Intern)  
Supervisor:  
Booth, Tim (Intern)  
Jauho, Anti-Pekka (Intern)  
Main Supervisor:  
Bøggild, Peter (Intern)  
Examiner:  
Brandbye, Mads (Intern)  
Hill, Ernest W. (Ekstern)  
Lemme, Max Christian (Ekstern)

Financing sources  
Source: Internal funding (public)  
Name of research programme: Anden EU-finansiering

Relations

Publications:  
2D Material Device Architectures: Process Optimisation and Characterisation  
Project: PhD

**Development of Novel Biomaterials for Potentiating Radiotherapy**

Department of Micro- and Nanotechnology  
Period: 01/08/2013 → 14/06/2017  
Number of participants: 5  
Phd Student:  
Bruun, Linda Maria (Intern)  
Main Supervisor:  
Andresen, Thomas Lars (Intern)  
Examiner:  
Kamaly, Nazila (Intern)  
Linderoth, Lars (Intern)  
Thompson, David H. (Ekstern)

Financing sources  
Source: Internal funding (public)  
Name of research programme: Institut, samfinansiering

Relations
Publications:
Development of Novel Biomaterials for Potentiation of Radiotherapy
Project: PhD

PhD scholarship in Model polymer Synthesis (EPMEF)
Department of Micro- and Nanotechnology
Period: 15/06/2013 → 14/06/2016
Number of participants: 7
PhD Student:
Dorokhin, Andriy (Intern)
Supervisor:
Hassager, Ole (Intern)
Mortensen, Kell (Intern)
Main Supervisor:
Almdal, Kristoffer (Intern)
Examiner:
Ndoni, Sokol (Intern)
Arleth, Lise (Intern)
Ryan, Anthony John (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering

Relations
Publications:
Entangled Polymer Melts in Extensional Flow: Synthesis, Rheology, Neutron Scattering
Project: PhD

Elucidating the transport behavior of HER2 targeted nanoparticles and their use in novel nanotherapies
Department of Micro- and Nanotechnology
Period: 01/06/2013 → 08/02/2017
Number of participants: 5
PhD Student:
Juul, Christian Ammitzbøll (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Berg, Rolf Henrik (Intern)
Moos, Torben (Ekstern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.

Relations
Publications:
Targeting HER2-positive cancer using multifunctional nanoparticles
Project: PhD

QUantum dot Energy level Engineering for laser applicationNs on InP and Si platforms
This project is dedicated to the research of quantum dot (QD) epitaxial growth on both indium phosphide (InP) and silicon (Si) based platforms with the aim of creating superior gain material emitting in the 1.5-1.6 μm wavelength range. The majority of the proposed research is quite fundamental but will have noticeable impact to device applications for our everyday life in the near future. Diverse areas like telecommunication, optical coherence tomography including medical applications, sensing, computer and network clock-distribution, THz generation, and metrology can benefit from the materials investigated.
The projected research covers two directions. The first is the development of QDs which possess desired electronic and optical properties in the InP based material system, i.e. tailoring the energy level structure and wave functions in the dots.
Manipulating the shape, chemical composition and surroundings of the nanostructures is the key to achieving the set goals. In the frame of the project I will implement two different approaches to design and grow high optical quality arrays of QDs. Those approaches are self-assembled quantum dot growth and selective area growth using block copolymer lithography. The second direction of the research is the deployment of the highly efficient QD gain material to a silicon platform. The development of epitaxial growth technology of III-V materials on Si combines the benefits of high optical quality III-V QD gain material with low cost silicon photonics, which is a key platform to push towards increased integration, higher speed and lower energy consumption.

Department of Photonics Engineering

Nanophotonic Devices

Center for Nanostructured Graphene

Department of Micro- and Nanotechnology

Amphiphilic Polymers in Biological Sensing

Center for Electron Nanoscopy

DTU Danchip

Period: 01/06/2013 → 31/08/2017

Number of participants: 9

Acronym: QUEENs

Number of related Ph.D. students: 2

Project participant:

Yvind, Kresten (Intern)

Almdal, Kristoffer (Intern)

Kadkhodazadeh, Shima (Intern)

Ottaviano, Luisa (Intern)

Willatzen, Morten (Intern)

Barettin, Daniele (Ekstern)

Phd Student:

Viazmitinov, Dmitrii (Intern)

Shikin, Artem (Intern)

Project Manager, academic:

Semenova, Elizaveta (Intern)

Project

Graphene based Coating for Tribocorrosive Protection of Stainless Steel

Department of Micro- and Nanotechnology

Period: 01/05/2013 → 11/01/2017

Number of participants: 6

Phd Student:

Stoot, Adam Carsten (Intern)

Supervisor:

Camilli, Luca (Intern)

Main Supervisor:

Bøggild, Peter (Intern)

 Examiner:

Mølhave, Kristian (Intern)

Bøhm, Sivasambu (Ekstern)

Jørgensen, Bjarke (Ekstern)

Financing sources

Source: Internal funding (public)

Name of research programme: Forskningsrådsfinansiering

Relations

Publications:

Protective coatings based on 2D-materials

Project: PhD
Understanding Optical Properties of nanopillar arrays
Department of Micro- and Nanotechnology
Period: 01/05/2013 → 17/08/2016
Number of participants: 6
Phd Student:
Wu, Kaiyu (Intern)
Supervisor:
Schmidt, Michael Stenbæk (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Hübner, Jörg (Intern)
Dmitriev, Alexander (Ekstern)
Duyne, Richard P. Van (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering

Relations
Publications:
Engineering Plasmonic Nanopillar Arrays for Surface-enhanced Raman Spectroscopy
Project: PhD

Liposome based radiosensitizer cancer therapy
Department of Micro- and Nanotechnology
Period: 15/04/2013 → 08/02/2017
Number of participants: 6
Phd Student:
Pourhassan, Houman (Intern)
Supervisor:
Hansen, Anders E. (Ekstern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Henriksen, Jonas Rosager (Intern)
Christensen, Dennis (Ekstern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering

Relations
Publications:
Liposome based radiosensitizer cancer therapy
Project: PhD

Characterization of cell-derived microparticles by nanotechnological methods
Department of Micro- and Nanotechnology
Period: 01/04/2013 → 15/06/2016
Number of participants: 6
Phd Student:
Cherré, Solène (Intern)
Supervisor:
Heegaard, Niels H.H. (Ekstern)
Main Supervisor:
Nano-Sensitizer Cancer Cell targeted Radiotherapy

Department of Micro- and Nanotechnology
Colloids and Biological Interfaces
Period: 01/04/2013 → 31/03/2018
Number of participants: 2
Acronym: NaSTaR
Project Manager, organisational:
Møller, Majken Lerche (Intern)
Project Manager, academic:
Andresen, Thomas Lars (Intern)
Project

SMARTDETECT: A portable system for rapid nucleic acid based detection of pathogens
The objectives of the SMARTDETECT project are focused on development of a new portable LOC platform suitable for “Point of Testing” of food borne pathogens in the food processing industry, initially in a large commercial pork producing company. The LOC will be able to detect multiple pathogens at one time by integrating two newly developed molecular detection methodologies, i.e. Solid Phase PCR (SP-PCR) and Supercritical Angle Fluorescence (SAF). Furthermore – in order to simplify the LOC design, reduce the cost of LOC fabrication and make it suitable for industrial mass production scale - a new PCR approach (“Direct PCR”) without the need for nucleic acid (DNA/RNA) isolation and purification in the sample preparation step will be developed and integrated within the SMARTDETECT system.

National Food Institute
Division of Food Microbiology
Department of Micro- and Nanotechnology
Scandinavian Micro Biodevice ApS
Danish Crown A/S
Dianova
Period: 01/03/2013 → 29/02/2016
Number of participants: 5
Acronym: SMARTDETECT
Project participant:
Bang, Dang Duong (Intern)
Bang-Berthelsen, Iben (Intern)
Wolff, Anders (Intern)
Sun, Yi (Intern)
Other:
Skiby, Jeffrey Edward (Intern)

Financing sources
Source: Public research council
Name of research programme: The Danish National Advanced Technology Foundation
Project
Dye-sensitized solar cell derived from nanoporous polymer

Department of Micro- and Nanotechnology
Period: 01/02/2013 → 20/01/2016
Number of participants: 6
Phd Student: Li, Tao (Intern)
Supervisor: Hansen, Ole (Intern)
Main Supervisor: Ndoni, Sokol (Intern)
Examiner: Almdal, Kristoffer (Intern)
Maurer, Frans H. J. (Ekstern)
Mortensen, Kell (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Evolvable Smartphone-based Point-of-Care Systems for In-Vitro Diagnostics

Department of Micro- and Nanotechnology
Period: 01/02/2013 → 02/11/2016
Number of participants: 7
Phd Student: Patou, François (Intern)
Supervisor: Dimaki, Maria (Intern)
Madsen, Jan (Intern)
Main Supervisor: Svendsen, Winnie Edith (Intern)
Examiner: Pop, Paul (Intern)
Romano-Rodriguez, Albert (Ekstern)
Shah, Pranjul Jaykumar (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)

Relations
Publications:
Evolvable Smartphone-Based Point-of-Care Systems For In-Vitro Diagnostics
Project: PhD

Micro and nanofluidics for genomic DNA Sequencing

Department of Micro- and Nanotechnology
Period: 01/02/2013 → 31/01/2016
Number of participants: 3
Phd Student: Eriksen, Johan (Intern)
Supervisor: Kristensen, Anders (Intern)
Main Supervisor: Marie, Rodolphe (Intern)

Financing sources
Reflektiv pulseoximetri på sternum

Department of Micro- and Nanotechnology
Period: 01/02/2013 → 30/09/2016
Number of participants: 7
PhD Student:
Chreiteh, Shadi (Intern)
Supervisor:
Belhage, Bo (Ekstern)
Hoppe, Karsten (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Hansen, Ole (Intern)
Greisen, Gorm (Ekstern)
Penders, Julien (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU

Relations
Publications:
Investigation of Sternal Photoplethysmography – Design of a Vital Sign Patch
Project: PhD

Micro punching of micro containers for oral drug delivery

Department of Mechanical Engineering
Manufacturing Engineering
Department of Micro- and Nanotechnology
Nanoprobes
Period: 21/01/2013 → 13/11/2014
Number of participants: 3
Project participant:
Petersen, Ritika Singh (Intern)
Mahshid, Rasoul (Intern)
Hansen, Hans Nørgaard (Intern)

Chalcogenide solar cells of CZTS-Copper Zinc Tin Sulphide. A new, high-efficiency material for low-tech solar cells of earthabundant and environmentally friendly elements

Solar cells of CZTS (Copper Zinc Tin Sulphide) can revolutionize the world. There is a global need for a drastic increase of energy production with low cost solar cells of environmentally friendly materials. The aim of the project is to understand the charge-carrier physics in thin films of the compound CZTS (Cu2ZnSnS4), to characterize and produce films of this material and to develop a prototype cell with a conversion efficiency of about 10 % - new world record - aiming at a longer term efficiency of ~ 20 %. The current choice with high efficiency approaching 20% is crystalline or polycrystalline silicon solar cells, which suffer from an expensive, complex production process or CIGS [CuIn(orGa)Se2], which unfortunately is limited by the decreasing availability and increasing cost of indium. The efficiency of CZTS has recently reached 8.4 %. Nevertheless, the physical properties of these thin film solar-cell materials including CIGS are not yet understood. In the project the photo-physical properties of thin films of CZTS will be systematically explored with the finite goal to produce high efficiency materials. The objective is to achieve a break-through of the underlying physics
of CZTS for highly-efficient solar cells of this inexpensive, environmentally friendly and abundant material. This can be done by a group with unique expertise in complex chemical compounds from Solid-Oxide-Fuel-Cell (SOFC) films, materials science, photo-physics, micro-, nanostructure-, terahertz physics and solvation chemistry together with an innovative Danish company.

Department of Photonics Engineering

Optical Microsensors and Micromaterials

Department of Micro- and Nanotechnology
Period: 01/01/2013 → 31/12/2016
Number of participants: 1
Acronym: CHALSOL
Project participant:
Canulescu, Stela (Intern)

Characterization and improvements of interface properties of fiber composites

Department of Micro- and Nanotechnology
Period: 01/01/2013 → 10/05/2017
Number of participants: 8
Phd Student:
Petersen, Helga Nørgaard (Intern)
Supervisor:
Brøndsted, Povl (Intern)
Kusano, Yukihiro (Intern)
Sørensen, Bent F. (Intern)
Main Supervisor:
Almdal, Kristoffer (Intern)
Examiner:
Jakobsen, Mogens Havsteen (Intern)
Gamstedt, Kristofer (Ekstern)
Hinge, Mogens (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering

Relations
Publications:
Investigation of sizing - from glass fibre surface to composite interface
Project: PhD

Charge Distribution and Electret Materials

Department of Micro- and Nanotechnology
Period: 15/12/2012 → 15/06/2016
Number of participants: 7
Phd Student:
Thyssen, Anders (Intern)
Supervisor:
Almdal, Kristoffer (Intern)
Gramtorp, Johan (Ekstern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Wolff, Anders (Intern)
Gerhard, Reimund (Ekstern)
Rombach, Pirmin (Intern)
Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU

Relations
Publications:
Charge distribution and stability in electret materials
Project: PhD

In-situ TEM Studies of Nanowire-based Batteries
Department of Micro- and Nanotechnology
Period: 15/12/2012 → 15/06/2016
Number of participants: 7
Phd Student:
Møller-Nilsen, Rolf Erling Robberstad (Intern)
Supervisor:
Norby, Poul (Intern)
Wagner, Jakob Birkedal (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Booth, Tim (Intern)
Alloyeau, Damien (Ekstern)
Tang, Peter Torben (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering

Relations
Publications:
In-situ SEM electrochemistry and radiolysis
Project: PhD

Tailoring transport in graphene with stable atomic kinks
Department of Micro- and Nanotechnology
Period: 15/12/2012 → 25/12/2017
Number of participants: 4
Phd Student:
Falkenberg, Jesper Toft (Intern)
Supervisor:
Bøggild, Peter (Intern)
Sevincli, Haldun (Intern)
Main Supervisor:
Brandbyge, Mads (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Nanomodulated graphene devices
Department of Micro- and Nanotechnology
Period: 15/11/2012 → 07/12/2016
Number of participants: 6
Phd Student:
Jessen, Bjarke Sørensen (Intern)
Supervisor:
Two-Dimensional Heterostructures: Fabrication & Characterization
Project: PhD

nanostructuring of solar cell surfaces
Department of Micro- and Nanotechnology
Period: 01/11/2012 → 15/06/2016
Number of participants: 7
Phd Student:
Davidsen, Rasmus Schmidt (Intern)
Supervisor:
Boisen, Anja (Intern)
Schmidt, Michael Stenbæk (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Jørgensen, Anders Michael (Intern)
Balling, Peter (Ekstern)
Marstein, Erik Stensrud (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Grundforskningsfonden
Project: PhD

SERS as tool for monitoring lung infections
Department of Micro- and Nanotechnology
Period: 01/11/2012 → 08/02/2017
Number of participants: 7
Phd Student:
Lauridsen, Rikke Kragh (Intern)
Supervisor:
Molin, Søren (Intern)
Rindzevicius, Tomas (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Bohr, Jakob (Intern)
Gilchrist, Francis J. (Ekstern)
Turner, Anthony P. F. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering

Relations
Developing 3D microstructures for tissue engineering
Department of Micro- and Nanotechnology
Period: 15/10/2012 → 16/03/2016
Number of participants: 7
Phd Student:
Mohanty, Soumyaranjan (Intern)
Supervisor:
Dufva, Martin (Intern)
Emnéus, Jenny (Intern)
Main Supervisor:
Wolff, Anders (Intern)
Examiner:
Keller, Stephan Sylvest (Intern)
Gadegaard, Nikolaj Hølledig (Intern)
Pennisi, Christian Pablo (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Fabrication of nanostructured polymer surface and characterization of their wetting properties
Department of Micro- and Nanotechnology
Period: 15/10/2012 → 07/12/2016
Number of participants: 6
Phd Student:
Andersen, Nis Korsgaard (Intern)
Supervisor:
Okkels, Fridolin (Intern)
Main Supervisor:
Taboryski, Rafael J. (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Kofod, Guggi (Intern)
Tadmor, Rafael (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)

Relations
Publications:
Fabrication of Nanostructured Polymer Surfaces and Characterization of their Wetting Properties
Project: PhD

Micro Fluidic System for Tissue Culturing an Live Monitoring of Analytes
Department of Micro- and Nanotechnology
Period: 01/10/2012 → 11/01/2017
Number of participants: 7
Phd Student:
Bakmand, Tanya (Intern)
Supervisor:
Svendsen, Winnie Edith (Intern)
Waagepeteren, Helle S. (Ekstern)  
Main Supervisor:  
Dimaki, Maria (Intern)  
Examiner:  
Keller, Stephan Sylvest (Intern)  
Svenningsen, Åsa Fex (Ekstern)  
Rodriguez-Trujillo, Romén (Intern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: Institut stipendie (DTU)

**Relations**  
Publications:  
Micro fluidic System for Culturing and Monitoring of Neuronal Cells and Tissue  
Project: PhD

**Fabrication of biopolymer micro-container for oral drug delivery**  
Department of Micro- and Nanotechnology  
Period: 15/09/2012 → 09/12/2015  
Number of participants: 6  
Phd Student:  
Petersen, Ritika Singh (Intern)  
Supervisor:  
Keller, Stephan Sylvest (Intern)  
Main Supervisor:  
Boisen, Anja (Intern)  
Examiner:  
Taboryski, Rafael J. (Intern)  
Lehr, Claus-Michael (Ekstern)  
Worgull, Matthias (Ekstern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet  
Project: PhD

**Microfluidics for single cell analysis**  
Department of Micro- and Nanotechnology  
Period: 15/09/2012 → 09/12/2015  
Number of participants: 6  
Phd Student:  
Jensen, Marie Pødenphant (Intern)  
Supervisor:  
Kristensen, Anders (Intern)  
Main Supervisor:  
Marie, Rodolphe (Intern)  
Examiner:  
Bruus, Henrik (Intern)  
Kutter, Jörg Peter (Intern)  
Laurell, Thomas (Ekstern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: Grundforskningsfonden  
Project: PhD
Development of a micromechanical Photothermal Spectrometer

Department of Micro- and Nanotechnology  
Period: 01/09/2012 → 16/03/2016  
Number of participants: 6  
Phd Student:  
Larsen, Peter Emil (Intern)  
Supervisor:  
Schmid, Silvan (Intern)  
Main Supervisor:  
Boisen, Anja (Intern)  
Examiner:  
Thomsen, Erik Vilain (Intern)  
Thundat, Thomas G. (Ekstern)  
Wiegerink, Remco John (Ekstern)

Financing sources  
Source: Internal funding (public)  
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet  
Project: PhD

Droplet technology for ultra rapid epitope mapping of allergens

Department of Micro- and Nanotechnology  
Period: 01/09/2012 → 20/01/2016  
Number of participants: 6  
Phd Student:  
Christiansen, Anders (Intern)  
Supervisor:  
Bøgh, Katrine Lindholm (Intern)  
Main Supervisor:  
Dufva, Martin (Intern)  
Examiner:  
Heegaard, Peter Mikael Helweg (Intern)  
Kristensen, Peter (Ekstern)  
Ohlin, Mats (Ekstern)

Financing sources  
Source: Internal funding (public)  
Name of research programme: Institut stipendie (DTU)  
Project: PhD

Investigations of drug transport phenomena through cell layers using lab-o-a-chip technologies

Department of Micro- and Nanotechnology  
Period: 01/09/2012 → 30/09/2016  
Number of participants: 7  
Phd Student:  
Tan, Hsih-Yin (Intern)  
Supervisor:  
Dufva, Martin (Intern)  
Kutter, Jörg Peter (Intern)  
Main Supervisor:  
Andresen, Thomas Lars (Intern)  
Examiner:  
Svendsen, Winnie Edith (Intern)  
Dittrich, Petra Stephanie (Ekstern)  
Nielsen, Carsten Uhd (Ekstern)

Financing sources  
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering

**Relations**

**Publications:**

- Development of microfluidic cell culture devices towards an in vitro human intestinal barrier model
  
  **Project:** PhD

**Lab-on-a-Chip Bioimpedance Monitoring System for Tissue Engineering**

- Department of Micro- and Nanotechnology
- **Period:** 01/09/2012 → 09/11/2015
- **Number of participants:** 7
- **Phd Student:** Canali, Chiara (Intern)
- **Supervisor:** Dufva, Martin (Intern)
- **Heiskanen, Arto (Intern)**
- **Main Supervisor:** Emnéus, Jenny (Intern)
- **Examiner:** Keller, Stephan Sylvest (Intern)
- **Filho, Pedro Bertemes (Ekstern)**
- **Ruzgas, Tautgirdas (Ekstern)**

**Financing sources**

- Source: Internal funding (public)

Name of research programme: Anden EU-finansiering

**Relations**

**Publications:**

- Micromachined Ultrasonic Transducer Arrays for 3D Imaging
  
  **Project:** PhD

**Micromachined Ultrasonic Transducer Arrays for 3D Imaging**

- Department of Micro- and Nanotechnology
- **Period:** 01/09/2012 → 18/09/2015
- **Number of participants:** 6
- **Phd Student:** Christiansen, Thomas Lehrmann (Intern)
- **Supervisor:** Jensen, Jørgen Arendt (Intern)
- **Main Supervisor:** Thomsen, Erik Vilain (Intern)
- **Examiner:** Jørgensen, Anders Michael (Intern)
- **Khuri-Yakub, Butrus T. (Ekstern)**
- **Ringgaard, Erling (Intern)**

**Financing sources**

- Source: Internal funding (public)

Name of research programme: Institut stipendie (DTU)

**Relations**

**Publications:**

- Micromachined Ultrasonic Transducers for 3-D Imaging
  
  **Project:** PhD

**Structural Colors in Plastic**

- Department of Micro- and Nanotechnology
- **Period:** 01/09/2012 → 16/03/2016
- **Number of participants:** 6
- **Phd Student:** Højlund-Nielsen, Emil (Intern)
Optical Detection for Polymer Based Bio-Sensor
In this thesis, an optofluidic chip was used for detection of fluorescently labeled streptavidin. The chip was fabricated from thiol-ene polymer, and incorporates an embedded waveguide in direct contact with the sample fluid. By using off-stoichiometric thiol-ene mixtures, the polymer was tailored to feature an excess of functional surface groups, enabling one-step site-specific functionalization with the binding molecule biotin. Utilizing the high affinity bond between biotin and streptavidin, fluorescently labeled streptavidin was immobilized on the waveguide surface, and excited by the evanescent field from the guided light in the waveguide. The biotin functionalization was optimized to provide the highest fluorescent signal, and the resulting calibration curve, revealed a linear correlation between streptavidin concentration and fluorescence intensity, with a limit of detection of 0.2 M.

Due to the lack of information on the optical properties of thiol-ene polymers, these were initially investigate to evaluate the use of thiol-ene in optofluidic chips. The refractive index was determined by refractive index matching, and shown to stay constant with a value of 1.57 for thiol-ene mixtures ranging from 150% excess alkene groups to 90% excess thiol groups, even though the mechanical properties and surface chemistry change considerably during this range. Thus, thiol-ene have a high refractive index compared to other lab-on-a-chip materials, which combined with its high optical transparency, make thiol-ene a promising material for optofluidic devices.

Department of Micro- and Nanotechnology

Polymer Micro & Nano Engineering

ChemLabChip

Fluidic Array Systems and Technology
Period: 27/08/2012 → 26/08/2013
Number of participants: 3
Project participant:
Feidenhans'l, Nikolaj Agentoft (Intern)
Supervisor:
Jensen, Thomas Glasdam (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Documents:
Master Thesis
Project
On-chip magnetic extraction of aptamers against virus particles

Department of Micro- and Nanotechnology
Period: 15/08/2012 → 09/11/2015
Number of participants: 6
Phd Student:
Henriksen, Anders Dahl (Intern)
Supervisor:
Rozlosnik, Noemi (Intern)
Main Supervisor:
Hansen, Mikkel Foug (Intern)
Examiner:
Thomsen, Erik Vilain (Intern)
Freitas, Paulo (Ekstern)
Gunnarsson, Klas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Surface chemistry for cantilever-like end SERS sensors for DVD-based platform

Department of Micro- and Nanotechnology
Period: 15/08/2012 → 09/12/2015
Number of participants: 7
Phd Student:
Frøhling, Kasper Bayer (Intern)
Supervisor:
Bache, Michael (Intern)
Boisen, Anja (Intern)
Main Supervisor:
Jakobsen, Mogens Havsteen (Intern)
Examiner:
Rozlosnik, Noemi (Intern)
Engelsen, Søren Balling (Ekstern)
Merkoçi, Arben (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Cantilever-like sensors for DVD Platform

Department of Micro- and Nanotechnology
Period: 01/08/2012 → 09/11/2015
Number of participants: 7
Phd Student:
Brøgger, Anna Line (Intern)
Supervisor:
Burger, Robert (Intern)
Schmidt, Michael Stenbæk (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Hübner, Jörg (Intern)
Bell, Steven E. J. (Ekstern)
Liz-Marzán, Luis Manuel (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet
Project: PhD

Computationel tools and studies of Graphene Nanostructures
Department of Micro- and Nanotechnology
Period: 01/08/2012 → 20/04/2016
Number of participants: 5
Phd Student:
Papior, Nick Rübner (Intern)
Main Supervisor:
Brandbyge, Mads (Intern)
Examiner:
Thygesen, Kristian Sommer (Intern)
Pecchia, Alessandro (Ekstern)
Stokbro, Kurt (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Grundforskningsfonden
Project: PhD

Development of radioisotope labeling methods for nanoparticle contrast agents
Department of Micro- and Nanotechnology
Period: 01/08/2012 → 16/03/2016
Number of participants: 6
Phd Student:
Frellsen, Anders Floor (Intern)
Supervisor:
Jensen, Andreas Tue Ingemann (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Henriksen, Jonas Rosager (Intern)
Cai, Weibo (Ekstern)
Herth, Matthias (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet
Project: PhD

Polymer Masks for Nanostructuring of Graphene
Department of Micro- and Nanotechnology
Period: 01/08/2012 → 09/12/2015
Number of participants: 7
Phd Student:
Shvets, Violetta (Intern)
Supervisor:
Almdal, Kristoffer (Intern)
Bøggild, Peter (Intern)
Main Supervisor:
Ndoni, Sokol (Intern)
Examiner:
Taboryski, Rafael J. (Intern)
Hinge, Mogens (Ekstern)
Papadakis, Christine M. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Grundforskningsfonden
Project: PhD

Udvikling af on-line målinger af nonopartikler i luft og eksponeringsmålinger i arbejdsmiljøet
Department of Micro- and Nanotechnology
Period: 15/07/2012 → 29/09/2015
Number of participants: 7
Phd Student:
Levin, Marcus (Intern)
Supervisor:
Jensen, Keld Aistrup (Ekstern)
Koponen, Ismo Kalevi (Ekstern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Schmid, Silvan (Intern)
Ketzel, Matthias (Ekstern)
Mäkelä, Jyrki Mikael (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

Development of stimuli triggered liposomes for controlled drug release in cancer therapy
Department of Micro- and Nanotechnology
Period: 01/06/2012 → 12/12/2013
Number of participants: 2
Phd Student:
Tassone, Chiara (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet
Project: PhD

Theory of nanoscale four-probe point (N4PP) spectroscopy of nanostructured graphene
Department of Micro- and Nanotechnology
Period: 15/04/2012 → 29/09/2015
Number of participants: 7
Phd Student:
Settnes, Mikkel (Intern)
Supervisor:
Petersen, Dirch Hjorth (Intern)
Power, Stephen (Intern)
Main Supervisor:
Jauho, Antti-Pekka (Intern)
Examiner:
Mortensen, N. Asger (Intern)
Peeters, Francois M. (Ekstern)
Pereira, Vítor Manuel (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Advanced metrology for magnetic tunnel junctions
Department of Micro- and Nanotechnology
Period: 01/04/2012 → 18/09/2015
Number of participants: 7
Phd Student:
Kjær, Daniel (Intern)
Supervisor:
Hansen, Ole (Intern)
Nielsen, Peter Folmer (Intern)
Main Supervisor:
Petersen, Dirch Hjorth (Intern)
Examiner:
Hansen, Mikkel Foug (Intern)
Bogdanowicz, Janusz (Ekstern)
Wells, Justin (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Microfluidic integration of different nanowires and nanotubes for NanoBioFETs
Department of Micro- and Nanotechnology
Period: 01/04/2012 → 16/03/2016
Number of participants: 7
Phd Student:
Pfreundt, Andrea (Intern)
Supervisor:
Andresen, Lars (Intern)
Dimaki, Maria (Intern)
Main Supervisor:
Svendsen, Winnie Edith (Intern)
Examiner:
Jakobsen, Mogens Havsteen (Intern)
Martinez, Karen (Ekstern)
Vellekoop, Michael Johannes (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)
Project: PhD
Immobilization of drug-releasing nanoparticles for improved drug screening

Department of Micro- and Nanotechnology
Period: 01/02/2012 → 30/09/2015
Number of participants: 5
Phd Student:
Faralli, Adele (Intern)
Main Supervisor:
Larsen, Niels Bent (Intern)
Examiner:
Rozlosnik, Noemi (Intern)
Everland, Hanne (Ekstern)
Luxenhofer, Robert (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

On-chip sample preparation and PCR detection of respiratory syncytial virus

Department of Micro- and Nanotechnology
Period: 01/02/2012 → 23/09/2015
Number of participants: 6
Phd Student:
Kistrup, Kasper (Intern)
Supervisor:
Wolff, Anders (Intern)
Main Supervisor:
Hansen, Mikkel Fougt (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Becker, Holger (Ekstern)
Gurevich, Leonid (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Implications of membrane interactions of acylated peptides in oral drug delivery

Department of Micro- and Nanotechnology
Period: 15/01/2012 → 08/02/2017
Number of participants: 7
Phd Student:
Trier, Sofie (Intern)
Supervisor:
Henriksen, Jonas Rosager (Intern)
Jensen, Simon Bjerringgaard (Ekstern)
Main Supervisor:
Andreensen, Thomas Lars (Intern)
Examiner:
Urquhart, Andrew (Intern)
Brayden, David J. (Ekstern)
Nielsen, Hanne Mørck (Ekstern)

Financing sources
Source: Internal funding (public)
Development of nanoparticles based delivery systems for sublingual Immunotherapy

Department of Micro- and Nanotechnology
Period: 01/01/2012 → 12/02/2016
Number of participants: 7
Phd Student:
Alija, Hava (Intern)
Supervisor:
Brimnes, Jens (Ekstern)
Rask, Carola S. (Ekstern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Urquhart, Andrew (Intern)
Christensen, Dennis (Ekstern)
Rådinger, Madeleine (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

High Throughput Systematic Single Cell Genomics using Micro/Nano-Fluidic Chips for Extracting, Pre-analysing, Selecting and Preparing Sequence-ready DNA

We propose a technology that will sit at the front-end of sequencing pipelines, present and future, and will significantly enhance the quality and throughput of DNA sequencing. Although much attention has been given to throughput/cost of the sequencing process itself, the same cannot be said for the preparation of samples. Identified bottlenecks are (1) sequencing technologies require days of upfront sample preparation which is further increased when sequencing selected parts of the genome; (2) genome assembly relies on computationally intensive comparisons to the reference genome because existing technologies produce short sequence reads; (3) it is difficult to begin with small amounts of sample material comprising micro-biopsies and single cells. The CELL-O-MATIC project will synergize efforts from SMEs, academics and large companies to address these bottlenecks by developing chip-based systems that process DNA from individual cells, ready for next generation high-throughput sequencing. Single cell analysis has numerous applications in systems biology but we will emphasize DNA isolation and sequencing from circulating tumour cells (CTC), which have a strong prognostic value in cancer management. A second innovation will be to develop methods that enable up to whole chromosome lengths of DNA to be contiguously mapped using nanofluidics. The inclusion of nanofluidics makes the project particularly distinctive and introduces European SMEs to an area that so far has been the domain of US companies. A modular prototype comprising, a chip, fluid and thermal control, sonication and optical detection will be developed. Samples prepared using CELL-O-MATIC technology will be benchmarked in a high throughput environment with samples prepared by existing methods. Finally, the information obtained from the CELL-O-MATIC processed sample material will be validated for its utility as an aid to clinical decision making.

Department of Micro- and Nanotechnology

Optofluidics
Period: 01/01/2012 → 31/12/2015
Number of participants: 2
Acronym: CELL-O-MATIC
Project Coordinator:
Kristensen, Anders (Intern)
Bjerrum, Anders (Intern)

Relations
Publications:
Integrated view of genome structure and sequence of a single DNA molecule in a nanofluidic device
Nanofluidic devices towards single DNA molecule sequence mapping
Novel Diagnostic methods and devices for personalised treatment of cancer

Department of Micro- and Nanotechnology
Period: 01/01/2012 → 18/09/2015
Number of participants: 6
Phd Student: Zulfiqar, Azeem (Intern)
Supervisor: Dimaki, Maria (Intern)
Main Supervisor: Svendsen, Winnie Edith (Intern)
Examiner: Jensen, Flemming (Intern)
Kjelstrup-Hansen, Jakob (Intern)
Prinz, Christelle (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)
Project: PhD

NANOFILM - Nanocomposite electrodes for monitoring and control of biofilm formation

Department of Micro- and Nanotechnology
Period: 15/12/2011 → 20/08/2015
Number of participants: 6
Phd Student: Fischer, Søren Vang (Intern)
Supervisor: Uthuppu, Basil (Intern)
Main Supervisor: Jakobsen, Mogens Havsteen (Intern)
Examiner: Almdal, Kristoffer (Intern)
Dossi, Eleftheria (Ekstern)
Toprak, Muhammet S. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering
Project: PhD

Manipulation of the extracellular microenvironment by micro- and nanotechnology approaches to improve the generation

Department of Micro- and Nanotechnology
Period: 01/11/2011 → 04/05/2016
Number of participants: 6
Phd Student: Rasmussen, Camilla Holzmann (Intern)
Supervisor: Hansson, Mattias (Ekstern)
Main Supervisor: Dufva, Martin (Intern)
Examiner: Larsen, Niels Bent (Intern)
Aspegren, Anders (Ekstern)
Brickman, Joshua M. (Ekstern)
Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Reconfigurable photonic crystals
Department of Micro- and Nanotechnology
Period: 01/10/2011 → 23/09/2015
Number of participants: 7
PhD Student:
Hermannsson, Pétur Gordon (Intern)
Supervisor:
Smith, Cameron (Intern)
Vannahme, Christoph (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Wubs, Martijn (Intern)
Gerken, Martina (Ekstern)
Svavarsson, Halldor Gudfinnur (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Degradation and mechanical characterization of polymers for drug delivery
Department of Micro- and Nanotechnology
Period: 01/09/2011 → 12/12/2014
Number of participants: 5
PhD Student:
Bose-Goswami, Sanjukta (Intern)
Main Supervisor:
Almdal, Kristoffer (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Boccaccini, Aldo Roberto (Ekstern)
Jeon, Sangmin (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Graphene on nanostructured surfaces
Department of Micro- and Nanotechnology
Period: 01/09/2011 → 30/06/2016
Number of participants: 4
PhD Student:
Tschammer, Lisa Katharina (Intern)
Supervisor:
Almdal, Kristoffer (Intern)
Ndoni, Sokol (Intern)
Main Supervisor:
Bøggild, Peter (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Imaging of nanostructures in cells
Department of Micro- and Nanotechnology
Period: 01/09/2011 → 12/12/2014
Number of participants: 6
Phd Student:
Købler, Carsten (Intern)
Supervisor:
Vogel, Ulla Birgitte (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Andresen, Thomas Lars (Intern)
Alexandra, Porter (Ekstern)
Martinez, Karen (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet
Project: PhD

Interactions in Graphene Antidot Lattices
Department of Micro- and Nanotechnology
Period: 01/09/2011 → 16/04/2012
Number of participants: 2
Phd Student:
Gregersen, Anders Heidemann (Intern)
Main Supervisor:
Jauho, Antti-Pekka (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Modifying polymers for optimal usage in microfluidic applications
Department of Micro- and Nanotechnology
Period: 01/09/2011 → 28/08/2015
Number of participants: 2
Phd Student:
Levinsen, Simon (Intern)
Main Supervisor:
Almdal, Kristoffer (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Development of peptide based non-viral gene tranfection Systems
Department of Micro- and Nanotechnology
Period: 15/08/2011 → 18/06/2015
Number of participants: 5
Phd Student:
Klauber, Thomas Christopher Bogh (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Berg, Rolf Henrik (Intern)
Moos, Torben (Ekstern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Devices for point of care nucleic acid tests for infectious diseases
Department of Micro- and Nanotechnology
Period: 15/08/2011 → 31/07/2015
Number of participants: 4
Phd Student:
Jørgensen, Karen Skotte (Intern)
Supervisor:
Harlow, Kenneth William (Ekstern)
Wolff, Anders (Intern)
Main Supervisor:
Hansen, Mikkel Foug (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

Electronic transport and atomic dynamics in graphene-based nanostructures - theory and simulation
Department of Micro- and Nanotechnology
Period: 15/08/2011 → 07/05/2015
Number of participants: 5
Phd Student:
Christensen, Rasmus Bjerregaard (Intern)
Main Supervisor:
Brandbyge, Mads (Intern)
Examiner:
Jacobsen, Karsten Wedel (Intern)
Paulsson, Magnus (Ekstern)
Solomon, Gemma (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Polymer Micro- and Nanotechnology for On-Chip Cell Selection
Department of Micro- and Nanotechnology
Period: 01/08/2011 → 15/11/2014
Number of participants: 5
Phd Student:
Hobæk, Thor Christian (Intern)
Main Supervisor:
Larsen, Niels Bent (Intern)
Examiner:
Dufva, Martin (Intern)
Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Injection molded self-cleaning surfaces

Department of Micro- and Nanotechnology
Period: 15/07/2011 → 18/03/2015
Number of participants: 6
Phd Student:
Søgaard, Emil (Intern)
Supervisor:
Smistrup, Kristian (Intern)
Main Supervisor:
Taboryski, Rafael J. (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Nielsen, Bo Rud (Ekstern)
Pakkanen, Tapani (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet
Project: PhD

NIRS systems for tissue oximetry

Department of Micro- and Nanotechnology
Period: 15/06/2011 → 18/03/2015
Number of participants: 6
Phd Student:
Petersen, Søren Dahl (Intern)
Supervisor:
Greisen, Gorm (Ekstern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Jørgensen, Anders Michael (Intern)
Larsen, Arne Nylandsted (Ekstern)
Paul, Oliver (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Large Area growth of graphene for transparent electrodes

Department of Micro- and Nanotechnology
Period: 01/06/2011 → 18/06/2015
Number of participants: 8
Phd Student:
Larsen, Martin Benjamin Barbour Spanget (Intern)
Supervisor:
Booth, Tim (Intern)
Hübner, Jörg (Intern)
Development of safer non-viral gene transfection vectors

Department of Micro- and Nanotechnology
Period: 01/05/2011 → 12/12/2014
Number of participants: 6
Phd Student:
Caviglia, Claudia (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)
Examiner:
Rozlosnik, Noemi (Intern)
Guiseppi-Elie, Anthony (Ekstern)
Ruzgas, Tautgirdas (Ekstern)

Financial sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Structural color effects on plastic surfaces

Department of Micro- and Nanotechnology
Period: 01/04/2011 → 20/08/2014
Number of participants: 6
Phd Student:
Christiansen, Alexander Bruun (Intern)
Supervisor:
Mortensen, N. Asger (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Lavrinenko, Andrei (Intern)
Ahopelto, Jouni Kullervo (Ekstern)
Sutherland, Duncan (Ekstern)

Financial sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Synthesis and Characterization of non-viral transfection systems

Department of Micro- and Nanotechnology
Period: 15/03/2011 → 07/06/2011
Number of participants: 2
Phd Student:
Jensen, Christina Mernøe (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

**Development and production of Lab-on-Chip systems for biotechnological applications**
Department of Micro- and Nanotechnology
Period: 01/03/2011 → 20/08/2014
Number of participants: 6
Phd Student:
Østergaard, Peter Friis (Intern)
Supervisor:
Harlow, Kenneth William (Ekstern)
Main Supervisor:
Taboryski, Rafael J. (Intern)
Examiner:
Rozlosnik, Noemi (Intern)
Kutter, Jörg Peter (Intern)
Wijngaart, Wouter van der (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

**Nano Live: Imaging Nanoelectronics Live by Transmission Electron Microscopy**
Department of Micro- and Nanotechnology
Period: 01/03/2011 → 18/09/2015
Number of participants: 6
Phd Student:
Alam, Sardar Bilal (Intern)
Supervisor:
Hansen, Ole (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Wagner, Jakob Birkedal (Intern)
Rubahn, Horst-Günter (Ekstern)
Thelander, Claes Anders (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

**Delivery of Biologics across the blood brain barrier through nanoencapsulation**
Department of Micro- and Nanotechnology
Period: 01/02/2011 → 20/08/2014
Number of participants: 5
Phd Student:
Bruun, Jonas (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Loading of micro-containers for oral drug delivery

Department of Micro- and Nanotechnology
Period: 01/02/2011 → 14/05/2014
Number of participants: 7
Phd Student: Marizza, Paolo (Intern)
Supervisor: Keller, Stephan Sylvest (Intern)
Müllertz, Anette (Ekstern)
Main Supervisor: Boisen, Anja (Intern)
Examiner: Skov, Anne Ladegaard (Intern)
Rantanen, Jukka Tapio (Ekstern)
Schneider, Marc (Ekstern)

Graphene Electrodes for Molecular Electronics

Department of Micro- and Nanotechnology
Period: 15/01/2011 → 26/09/2014
Number of participants: 7
Phd Student: Pizzocchero, Filippo (Intern)
Supervisor: Booth, Tim (Intern)
Mølhave, Kristian (Intern)
Main Supervisor: Bøggild, Peter (Intern)
Examiner: Brandbyge, Mads (Intern)
Hornekær, Liv (Ekstern)
Yurgens, August (Ekstern)

Magnetic microarrays

Department of Micro- and Nanotechnology
Period: 15/01/2011 → 16/04/2014
Number of participants: 6
Phd Student:
Design, fabrication and integration of tips for 3D atomic force microscopy
Department of Micro- and Nanotechnology
Period: 01/12/2010 → 17/11/2014
Number of participants: 5
Phd Student:
Yildiz, Izzet (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Jensen, Flemming (Intern)
Kjelstrup-Hansen, Jakob (Intern)
Regnier, Stéphane (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Advanced dry etching studies for micro- and nano-systems
Department of Micro- and Nanotechnology
Period: 01/11/2010 → 19/03/2014
Number of participants: 8
Phd Student:
Rasmussen, Kristian Hagsted (Intern)
Supervisor:
Jensen, Flemming (Intern)
Jørgensen, Anders Michael (Intern)
Keller, Stephan Sylvest (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Thomsen, Erik Vilain (Intern)
Franssila, Samuli Antero (Ekstern)
Stark, Robert Walther (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Molecular Dynamics of Nano-Conductors in the Presence of Electronic Current
Department of Micro- and Nanotechnology
Period: 01/10/2010 → 11/12/2013
Number of participants: 5
Phd Student:
Gunst, Tue (Intern)
Main Supervisor:
Brandbyge, Mads (Intern)
Examiner:
Thygesen, Kristian Sommer (Intern)
Nikolic, Branislav K. (Ekstern)
Stokbro, Kurt (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Opto-Thermal actuation in micro and fluidics
Department of Micro- and Nanotechnology
Period: 01/10/2010 → 15/01/2014
Number of participants: 6
Phd Student:
Lüscher, Christopher James (Intern)
Supervisor:
Marie, Rodolphe (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Mortensen, N. Asger (Intern)
Levy, Uriel (Ekstern)
Montelius, Lars (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Improved toughness in materials for micro devices
Department of Micro- and Nanotechnology
Period: 15/09/2010 → 27/02/2015
Number of participants: 5
Phd Student:
Mednova, Olga (Intern)
Main Supervisor:
Almdal, Kristoffer (Intern)
Examiner:
Ndoni, Sokol (Intern)
Fairclough, Patrick (Ekstern)
Hinge, Mogens (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Micropower
Department of Micro- and Nanotechnology
Period: 15/09/2010 → 14/05/2014
Number of participants: 5
Phd Student:
Larsen, Jackie Vincent (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Hansen, Ole (Intern)
Gauthier-Manuel, Bernard (Ekstern)
Mortensen, John (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Application of Microsystems and nanotechnology in the cytogenetic diagnosis of haematological malignancies
Department of Micro- and Nanotechnology
Period: 01/09/2010 → 11/12/2013
Number of participants: 7
Phd Student:
Kwasny, Dorota (Intern)
Supervisor:
Dimaki, Maria (Intern)
Tümer, Zeynep (Ekstern)
Main Supervisor:
Svendsen, Winnie Edith (Intern)
Examiner:
Kutter, Jörg Peter (Intern)
Castillo, Jaime (Intern)
Merkoci, Arben (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Multiphoton polymerization of immune cell scaffolds
Department of Micro- and Nanotechnology
Period: 01/09/2010 → 15/01/2014
Number of participants: 6
Phd Student:
Olsen, Mark Holm (Intern)
Supervisor:
Hjortø, Gertrud Malene (Intern)
Main Supervisor:
Larsen, Niels Bent (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Bastmeyer, Martin (Ekstern)
Ogilby, Peter (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Quantification of biomolecular interactions with soft material
Department of Micro- and Nanotechnology
Period: 01/09/2010 → 19/02/2014
Number of participants: 5
Phd Student:
Kristensen, Kasper (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Marie, Rodolphe (Intern)
Ipsen, John Hjorth (Intern)
Wimley, William C. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering
Project: PhD

Structural Optimization of Functional Surfaces
Department of Micro- and Nanotechnology
Period: 01/09/2010 → 18/10/2013
Number of participants: 7
Phd Student:
Cavalli, Andrea (Intern)
Supervisor:
Bøggild, Peter (Intern)
Taboryski, Rafael J. (Intern)
Main Supervisor:
Okkels, Fridolin (Intern)
Examiner:
Bruus, Henrik (Intern)
Foss, Morten (Ekstern)
Wang, Evelyn N. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

3D carbon-based electrodes for biofuel cells
Department of Micro- and Nanotechnology
Period: 01/08/2010 → 19/02/2014
Number of participants: 7
Phd Student:
Amato, Letizia (Intern)
Supervisor:
Heiskanen, Arto (Intern)
Keller, Stephan Sylvest (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)
Examiner:
Ndoni, Sokol (Intern)
Kassegne, Samuel Kinde (Ekstern)
Ruzgas, Tautgirdas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD
Structural optimization of Non-Newtonian Microfluidics

Department of Micro- and Nanotechnology
Period: 01/08/2010 → 23/09/2013
Number of participants: 6
Phd Student:
Jensen, Kristian Ejlebjerg (Intern)
Supervisor:
Szabo, Peter (Intern)
Main Supervisor:
Okkels, Fridolin (Intern)
Examiner:
Hassager, Ole (Intern)
Clasen, Christian (Ekstern)
Sahin, Mehmet (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Application of ALD Films for Small Energy Systems

Department of Micro- and Nanotechnology
Period: 01/07/2010 → 15/01/2014
Number of participants: 6
Phd Student:
Johansson, Anne-Charlotte Elisabeth Birgitta (Intern)
Supervisor:
Christensen, Leif Højslet (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Mølhave, Kristian (Intern)
Mortensen, John (Ekstern)
Ritala, Mikko Kaleervo (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

Early detection of Alzheimer's disease in polymeric microdevice

Department of Micro- and Nanotechnology
Period: 01/06/2010 → 19/02/2014
Number of participants: 6
Phd Student:
Christiansen, Nikolaj Ormstrup (Intern)
Supervisor:
Heegaard, Niels H.H. (Ekstern)
Main Supervisor:
Rozlosnik, Noemi (Intern)
Examiner:
Taboryski, Rafael J. (Intern)
Merkoçi, Arben (Ekstern)
Nielsen, Lars Pleth (Ekstern)

Financing sources
Construction of nanomachines for measuring molecular events inside living cells

Department of Micro- and Nanotechnology
Period: 01/05/2010 → 15/08/2013
Number of participants: 6
Phd Student: Ilieva, Mirolyuba (Intern)
Supervisor: Emnéus, Jenny (Intern)
Main Supervisor: Dufva, Martin (Intern)
Examiner: Gjetting, Torben (Intern)
Clausen, Christian (Intern)
Serrano, Alberto M. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Danish Centre for Composites Structures and Materials for Wind Turbines
Some of the most critical components of a wind turbine are the rotor blades, which are usually made of polymer matrix composites and are the largest rotating components of a wind turbine. Different types of damage can develop at different length scales in wind turbine rotor blades. Therefore, the Danish Centre for Composite Structures and Materials for Wind Turbines (DCCSM) aims to develop a coherent, multiscale-based understanding of the mechanical behaviour of composite materials and structures for wind turbine blades. The length scale goes from nano- and microscale (materials) to product scale (the whole blade, which currently can be more than 60 meters in length), and covers manufacturing, materials design, damage detection, modelling and prediction of damage evolution in wind turbine blades. A coherent multiscale understanding of composite materials and structures will enable full optimisation, viz., optimisation at all length scales.

The Centre aims for the creation of new knowledge (e.g. material models), new experimental methods and new modeling methods. The Centre spans wide thematically and disciplinarily. The specific PhD, Post Doc and research projects funded by DCCSM (Core and Shell activities) are focused at smaller, well-defined topics. Therefore, the Centre will coordinate the research activities in Denmark in the area of composite structures and materials for wind turbines. That includes the Core and Shell activities of DCCSM and research projects that are not funded by the DSF funds but are thematically covered by the Centre. Such projects are called "Crust" projects.

DSF Strategic Research Centre (sags. nr. 09-067212).

Department of Wind Energy
Composites and Materials Mechanics
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing
Wind Turbines
Solid Mechanics
Department of Mechanical Engineering
Department of Civil Engineering
Section for Structural Engineering
Period: 01/04/2010 → 31/03/2017
Number of participants: 11
Acronym: DCCSM
Project participant: Almdal, Kristoffer (Intern)
Mikkelsen, Lars Pilgaard (Intern)
Branner, Kim (Intern)
Mishnaevsky, Leon (Intern)
Legarth, Brian Nyvang (Intern)
Berggreen, Christian (Intern)
Stang, Henrik (Intern)
Phd Student:
Zike, Sanita (Intern)
Hansen, Jens Zangenberg (Intern)
Ashouri Vajari, Danial (Intern)
Approving authority:
Sørensen, Bent F. (Intern)

Relations
Publications:
From Measurements Errors to a New Strain Gauge Design
Micro-Scale Experiments and Models for Composite Materials with Materials Research
Correction of Gauge Factor for Strain Gauges Used in Polymer Composite Testing
Fatigue damage propagation in unidirectional glass fibre reinforced composites made of a non-crimp fabric
Determination of the minimum size of a statistical representative volume element from a fibre-reinforced composite based on point pattern statistics
Quantitative study on the statistical properties of fibre architecture of genuine and numerical composite microstructures
Methodology for characterisation of glass fibre composite architecture
Design of a fibrous composite preform for wind turbine rotor blades
The effects of fibre architecture on fatigue life-time of composite materials
A numerical study of the influence of microvoids in the transverse mechanical response of unidirectional composites

Nanomachines for kinetic studies of gene expression in living cells
Department of Micro- and Nanotechnology
Period: 01/04/2010 → 17/10/2013
Number of participants: 6
Phd Student:
Della Vedova, Paolo (Intern)
Supervisor:
Dufva, Martin (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Wolff, Anders (Intern)
Blair, Steve (Ekstern)
Han, Anpan (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Nanoparticles and Health
Department of Micro- and Nanotechnology
Period: 01/04/2010 → 15/06/2016
Number of participants: 6
Phd Student:
Yamada, Shoko (Intern)
Supervisor:
Schmid, Silvan (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Mølhave, Kristian (Intern)
Amiot, Fabien (Intern)
Jeon, Sangmin (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed

Relations
Publications:
Analyzing Engineered Nanoparticles using Photothermal Infrared Spectroscopy
Project: PhD

Polymer patch clamping chip (PolyPatch)
Department of Micro- and Nanotechnology
Period: 15/03/2010 → 23/09/2013
Number of participants: 6
Phd Student:
Tanzi, Simone (Intern)
Supervisor:
Kutchinsky, Jonatan (Intern)
Main Supervisor:
Taboryski, Rafael J. (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Christophersen, Palle (Ekstern)
Gillis, Kevin D. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Development of Biomimetic Membrane Array Sensors
Department of Micro- and Nanotechnology
Period: 01/03/2010 → 04/05/2016
Number of participants: 8
Phd Student:
Mech-Dorosz, Agnieszka (Intern)
Supervisor:
Dufva, Martin (Intern)
Heiskanen, Arto (Intern)
Hélix-Nielsen, Claus (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)
Examiner:
Taboryski, Rafael J. (Intern)
Guiseppi-Elie, Anthony (Ekstern)
Ruzgas, Tautgirdas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet
Project: PhD
In vivo trafficking of liposome labelled by novel [18F]-phospholipid probes

Department of Micro- and Nanotechnology
Period: 01/03/2010 → 18/12/2012
Number of participants: 6
Phd Student:
Jensen, Andreas Tue Ingemann (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Main Supervisor:
Rasmussen, Palle (Intern)
Examiner:
Lindvold, Lars René (Intern)
Goins, Beth A. (Ekstern)
Madsen, Jacob (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering
Project: PhD

Aptamer functionalized molecular imprinted conductive polymer electrodes for medical application

Department of Micro- and Nanotechnology
Period: 15/02/2010 → 21/06/2013
Number of participants: 6
Phd Student:
Dapra, Johannes (Intern)
Supervisor:
Almdal, Kristoffer (Intern)
Main Supervisor:
Rozlosnik, Noemi (Intern)
Examiner:
Jakobsen, Mogens Havsteen (Intern)
Ferapontova, Elena (Ekstern)
Ruzgas, Tautgirdas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Real-time monitoring of stem cell differentiation in brain tissue using microfluidic on-line culture systems

Department of Micro- and Nanotechnology
Period: 15/02/2010 → 15/10/2017
Number of participants: 7
Phd Student:
Shah, Fozia Jabeen (Intern)
Supervisor:
Dufva, Martin (Intern)
Heiskanen, Arto (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)
Examiner:
Hosta-Rigau, Leticia (Intern)
Ruzgas, Tautgirdas (Ekstern)
Svenningsen, Åsa Fex (Ekstern)

Financing sources
Source: Internal funding (public)
Development of Mechanical Biosensor for Metabolomics

Department of Micro- and Nanotechnology
Period: 01/02/2010 → 26/11/2013
Number of participants: 7
Phd Student:
Quan, Xueling (Intern)
Supervisor:
Heiskanen, Arto (Intern)
Tenje, Maria (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Emnéus, Jenny (Intern)
Ruzgas, Tautgirdas (Ekstern)
Thundat, Thomas G. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Planar Hall effect magnetic biosensors

Department of Micro- and Nanotechnology
Period: 15/01/2010 → 27/05/2013
Number of participants: 5
Phd Student:
Østerberg, Frederik Westergaard (Intern)
Main Supervisor:
Hansen, Mikkel Fougt (Intern)
Examiner:
Hansen, Ole (Intern)
Southern, Paul (Ekstern)
van IJzendoorn, L. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet
Project: PhD

Energy Harvesting Using Screen Printed PZT on Silicon

Department of Micro- and Nanotechnology
Period: 01/01/2010 → 15/08/2013
Number of participants: 5
Phd Student:
Lei, Anders (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Hansen, Mikkel Fougt (Intern)
Eriksen, Gert Friis (Intern)
Halvorsen, Einar (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Modulation response of semiconductor quantum dot nanolasers and nanoLEDs
To meet the continuously increasing need for progressively higher data transmission rates on the internet, faster signal modulation of the underlying semiconductor lasers or LEDs is required. High modulation bandwidth is a key quantity for the realization of high-speed data optical components, as it limits the maximum possible data rate. Recent developments in nanotechnology allow fabrication of new device types for lasers and LEDs with quantum dots embedded in optical microcavities which have the potential to outperform current devices. The nanolasers and nanoLEDs belong to this class of future optical communication devices. Conventional analysis methodology needs to be reassessed based on more realistic models which are appropriate for this type of semiconductor quantum dot based devices. The project will be carried out at DTU Fotonik which is involved in several projects in the field of micro- and nanostructured materials. This gives access to experimental results on devices as well as inside knowledge on technological developments. DTU Nanotech is also a partner and will contribute to this project.

Temperature Stable Mass Sensors
Department of Micro- and Nanotechnology
Period: 01/12/2009 → 21/02/2013
Number of participants: 6
Phd Student: Khan, Faheem (Intern)
Supervisor:
Schmid, Silvan (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Okkels, Fridolin (Intern)
Jeon, Sangmin (Ekstern)
Stemme, Göran (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Programbevilling
Project: PhD

Window Pane Coating for photon harvesting
Department of Micro- and Nanotechnology
Period: 15/11/2009 → 04/04/2013
Number of participants: 6
Phd Student:
Buss, Thomas (Intern)
Supervisor:
Smith, Cameron (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Petersen, Paul Michael (Intern)
Buchwald, Kristian (Ekstern)
Turnbull, Graham Alexander (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering
Project: PhD

Micro-scale temperature sensors for calorimetry and cantilever based sensing
Department of Micro- and Nanotechnology
Period: 01/10/2009 → 18/12/2012
Number of participants: 6
Phd Student:
Larsen, Tom (Intern)
Supervisor:
Schmid, Silvan (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Svendsen, Winnie Edith (Intern)
Finot, Eric (Ekstern)
Thundat, Thomas G. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Tackling challenges in food safety with lab-on-chip technologies
Department of Micro- and Nanotechnology
Period: 01/10/2009 → 04/04/2013
Number of participants: 6
Phd Student:
Topology Optimization of Fuel Cells and Magnetic Refrigerator design

Department of Micro- and Nanotechnology
Period: 01/10/2009 → 26/09/2013
Number of participants: 5
PhD Student:
Panagakos, Grigorios (Intern)
Main Supervisor:
Okkels, Fridolin (Intern)
Examiner:
Bonanos, Nikolaos (Intern)
Madsen, Mads Find (Ekstern)
Weber, André (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Acoustofluidics: Ultrasound manipulation of biomolecules and cells in microfluidic systems

Department of Micro- and Nanotechnology
Period: 01/09/2009 → 18/12/2012
Number of participants: 5
PhD Student:
Barnkob, Rune (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Bohr, Tomas (Intern)
Dual, Jürg (Ekstern)
Marmottant, Philippe (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Exploring the properties and possibilities of self-organizing nanotubes and nanoparticles for nano-bio sensors

Department of Micro- and Nanotechnology
Period: 01/09/2009 → 04/04/2013
Number of participants: 6
PhD Student:
Andersen, Karsten Brandt (Intern)
Nanotubes and other carbon based electrode surfaces for cell studies

Department of Micro- and Nanotechnology
Number of participants: 6
PhD Student:
Wierzbicki, Rafal Dominik (Intern)
Supervisor:
Bøggild, Peter (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Nygård, Jesper (Ekstern)
Prinz, Christelle (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Processing and characterisation of precision polymer on glass structures for wafer based fabrication of optical elements

Department of Micro- and Nanotechnology
Period: 01/09/2009 → 21/06/2013
Number of participants: 5
PhD Student:
Cech, Jiří (Intern)
Main Supervisor:
Taboryski, Rafael J. (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Mikkelsen, Niels Jørgen (Ekstern)
Rosén, Bengt-Göran (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 DTU-stip, 2/3 FUR/andet
Project: PhD

On-chip Backscattering Interferometry

Department of Photonics Engineering
Diode Lasers and LED Systems
Department of Micro- and Nanotechnology
Office for Innovation & Sector Services  
**Period:** 01/07/2009 → 30/06/2011  
**Number of participants:** 5  
**Acronym:** On-chip BSI  
**Project ID:** 70496  
**Project participant:**  
Jørgensen, Thomas Martini (Intern)  
Andersen, Peter E. (Intern)  
Larsen, Niels Bent (Intern)  
Hillestrøm, Adam (Intern)  

**Project Manager, organisational:**  
Sørensen, Henrik Schiøtt (Intern)  

**Financing sources**  
Source: Forskningsprojekter - Andre ministerier og styrelser  
Name of research programme: Forskningsprojekter - Andre ministerier og styrelser  
Amount: 750,000.00 Danish Kroner  

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**Syntese af Gurmarin Analoger**  
Department of Micro- and Nanotechnology  
**Period:** 01/07/2009 → 22/11/2012  
**Number of participants:** 6  
**Phd Student:**  
Eliasen, Rasmus (Intern)  

**Supervisor:**  
Berg, Rolf Henrik (Intern)  

**Main Supervisor:**  
Andresen, Thomas Lars (Intern)  

**Examiner:**  
Jakobsen, Mogens Havsteen (Intern)  
Bernkop Schnürch, Andreas (Ekstern)  
Jensen, Knud Jørgen (Intern)  

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: ErhvervsPhD-ordningen VTU  
Project: PhD  

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**Integrated platform for studying cellular dynamics using 3D Nanosensors**  
Department of Micro- and Nanotechnology  
**Period:** 01/06/2009 → 20/09/2012  
**Number of participants:** 7  
**Phd Student:**  
Sasso, Luigi (Intern)  

**Supervisor:**  
Castillo, Jaime (Intern)  

**Emnéus, Jenny (Intern)**  

**Main Supervisor:**  
Svendsen, Winnie Edith (Intern)  

**Examiner:**  
Rozlosnik, Noemi (Intern)  
Hauser, Charlotte (Ekstern)  
Wollenberger, Ulla (Ekstern)  

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: Anden EU-finansiering
Project: PhD

Virus fishing in a polymeric microdevice
Department of Micro- and Nanotechnology
Period: 01/05/2009 → 15/08/2013
Number of participants: 6
Phd Student: Kiilerich-Pedersen, Katrine (Intern)
Supervisor: Kledal, Thomas N (Intern)
Main Supervisor: Rozlosnik, Noemi (Intern)
Examiner: Dufva, Martin (Intern)
Divizia, Maurizio (Ekstern)
Merkoci, Arben (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Programbevilling
Project: PhD

Analysis and Improvement of the Gene Delivery Properties of Polyethylenimine - An In Vitro Study
Department of Micro- and Nanotechnology
Period: 15/04/2009 → 31/10/2012
Number of participants: 5
Phd Student: Mattebjerg, Maria Ahlm (Intern)
Supervisor: Andresen, Thomas Lars (Intern)
Main Supervisor: Larsen, Niels Bent (Intern)
Examiner: Gao, Jinming (Ekstern)
Moos, Torben (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

U-Solid Oxide Fuel Cell
Department of Micro- and Nanotechnology
Period: 15/04/2009 → 30/09/2011
Number of participants: 3
Phd Student: Andresen, Kristian (Intern)
Supervisor: Pryds, Nini (Intern)
Main Supervisor: Taboryski, Rafael J. (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD
Development of Enzymatically Triggered Polymersomes as Drug Delivering Systems for Treating Cancer

Department of Micro- and Nanotechnology
Period: 01/04/2009 → 21/06/2013
Number of participants: 5
Phd Student:
Bjerg, Lise Nørkjær (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Berg, Rolf Henrik (Intern)
Moos, Torben (Ekstern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Theory and design of the chip-based microfluidic system ProCell

Department of Micro- and Nanotechnology
Period: 01/04/2009 → 22/11/2012
Number of participants: 5
Phd Student:
Vedel, Søren (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Berg-Sørensen, Kirstine (Intern)
Mugele, Frieder (Ekstern)
Silberzan, Pascal (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Grundforskningsfonden
Project: PhD

Theory of electrokinetic power generation in portable nanofluidic devices

Department of Micro- and Nanotechnology
Period: 01/04/2009 → 19/06/2012
Number of participants: 5
Phd Student:
Andersen, Mathias Bækbo (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Jacobsen, Karsten Wedel (Intern)
Eijkel, Jan C. T. (Ekstern)
Yariv, Ehud (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 DTU-stip, 2/3 FUR/andet
Project: PhD

Electron Microscopy of Liquid Processes

Department of Micro- and Nanotechnology
Period: 01/03/2009 → 25/01/2013
Number of participants: 6
Phd Student:
Jensen, Eric (Intern)
Supervisor:
Burrows, Andrew (Intern)
Main Supervisor:
Mølhave, Kristian (Intern)
Examiner:
Frandsen, Cathrine (Intern)
Kjelstrup-Hansen, Jakob (Intern)
Ross, Frances M. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Energy harvesting for Microsystems
Department of Micro- and Nanotechnology
Period: 01/03/2009 → 21/08/2012
Number of participants: 6
Phd Student:
Xu, Ruichao (Intern)
Supervisor:
Thomsen, Erik Vilain (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Jensen, Flemming (Ekstern)
Eriksen, Gert Friis (Intern)
Halvorsen, Einar (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Stem cell and cancer research using chip-based microfluidic system ProCell
Department of Micro- and Nanotechnology
Period: 01/03/2009 → 21/08/2012
Number of participants: 7
Phd Student:
Hemmingsen, Mette (Intern)
Supervisor:
Bruus, Henrik (Intern)
Collas, Philippe (Ekstern)
Main Supervisor:
Dufva, Martin (Intern)
Examiner:
Mortensen, Uffe Hasbro (Intern)
Pedersen, Lars Hag (Intern)
Szita, Nicolas (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Grundforskningsfonden
Project: PhD
Chip for amperometric detection of neurotransmitter release from single cells - NeuroCAD

Department of Micro- and Nanotechnology
Period: 01/02/2009 → 18/12/2012
Number of participants: 5
Phd Student:
Larsen, Simon Tylsgaard (Intern)
Main Supervisor:
Taboryski, Rafael J. (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Kutchinsky, Jonatan (Intern)
Verpoorte, Elisabeth M. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Nanoengineered Graphene Devices

Department of Micro- and Nanotechnology
Period: 01/02/2009 → 27/05/2013
Number of participants: 5
Phd Student:
Klarskov, Mikkel Buster (Intern)
Supervisor:
Booth, Tim (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Craciun, Monica Felicia (Ekstern)
Kjelstrup-Hansen, Jakob (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Smart surfaces for guiding cellular behaviour

Department of Micro- and Nanotechnology
Period: 01/02/2009 → 23/05/2012
Number of participants: 5
Phd Student:
Lind, Johan Ulrik (Intern)
Supervisor:
Andresen, Thomas Lars (Intern)
Main Supervisor:
Larsen, Niels Bent (Intern)
Examiner:
Rozlosnik, Noemi (Intern)
Berggren, Magnus (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD
Synthesis and Characterization of Nanoparticle Sensors for Metabolite Quantification in Cells

Department of Micro- and Nanotechnology
Period: 01/01/2009 → 26/06/2012
Number of participants: 6
Phd Student:
Ek, Pramod Kumar (Intern)
Supervisor:
Almdal, Kristoffer (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Ndoni, Sokol (Intern)
Bechgaard, Klaus (Intern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Monitoring of immune system of lung transplanted patients

Department of Micro- and Nanotechnology
Period: 15/12/2008 → 21/08/2012
Number of participants: 5
Phd Student:
Vestergaard, Christian L. (Intern)
Main Supervisor:
Flyvbjerg, Henrik (Intern)
Examiner:
Bohr, Jakob (Intern)
Howard, Joe (Ekstern)
Jülicher, Frank (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 DTU-stip, 2/3 FUR/andet
Project: PhD

Capacitive Pressure Sensors

Department of Micro- and Nanotechnology
Period: 01/12/2008 → 22/03/2012
Number of participants: 8
Phd Student:
Fragiacomo, Giulio (Intern)
Supervisor:
Christensen, Carsten (Intern)
Hansen, Ole (Intern)
Kjærgaard, Claus (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Hansen, Mikkel Fougt (Intern)
Bouwstra, Siebe (Ekstern)
Stenberg, Lars Jørn (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering
**Cantilever-based sensors for explosives detection**

Department of Micro- and Nanotechnology  
Period: 01/11/2008 → 16/01/2012  
Number of participants: 5  
PhD Student:  
Bosco, Filippo (Intern)  
Main Supervisor:  
Boisen, Anja (Intern)  
Examiner:  
Kutter, Jörg Peter (Intern)  
Hegner, Martin (Ekstern)  
Thundat, Thomas G. (Ekstern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: Programbevilling  
Project: PhD

**Immunological sensors for on-line measurements of pesticides in water**

Department of Micro- and Nanotechnology  
Period: 15/10/2008 → 20/09/2012  
Number of participants: 7  
PhD Student:  
Uthuppu, Basil (Intern)  
Supervisor:  
Aamand, Jens (Ekstern)  
Jørgensen, Claus (Ekstern)  
Main Supervisor:  
Jakobsen, Mogens Havsteen (Intern)  
Examiner:  
Ndoni, Sokol (Intern)  
Dossi, Eleftheria (Ekstern)  
Svensmark, Bo (Intern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: Forskningsrådsfinansiering  
Project: PhD

**High frequency bulk resonators for bio/chemical diagnostics and monitoring applications**

Department of Micro- and Nanotechnology  
Period: 01/10/2008 → 16/01/2012  
Number of participants: 6  
PhD Student:  
Cagliani, Alberto (Intern)  
Supervisor:  
Davis, Zachary James (Intern)  
Main Supervisor:  
Boisen, Anja (Intern)  
Examiner:  
Hansen, Ole (Intern)  
Del Monte, Aránzazu U. (Ekstern)  
Roukes, Michael L. (Ekstern)

**Financing sources**
Modelling and Understanding Couplex Motion

Department of Micro- and Nanotechnology
Period: 01/10/2008 → 22/03/2012
Number of participants: 6
Phd Student: Gradinaru, Cristian (Intern)
Supervisor: Flyvbjerg, Henrik (Intern)
Main Supervisor: Mølhave, Kristian (Intern)
Examiner: Bohr, Jakob (Intern)
Gadegaard, Nikolaj Hølledig (Intern)
Lagerholm, B. Christoffer (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Statistical Analysis of stochastic fluorescence data in biology and biophysics

Department of Micro- and Nanotechnology
Period: 01/10/2008 → 24/11/2010
Number of participants: 5
Phd Student: Mortensen, Kim (Intern)
Main Supervisor: Flyvbjerg, Henrik (Intern)
Examiner: Ersbøll, Bjarne Kjær (Intern)
Frey, Erwin (Ekstern)
Gaub, Hermann E. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Laboratory Skin Patches and SmartCards based on foils and compatible with a smartphone* (contract number 224306 for Large-scale integrating project (IP))

LabOnFoil is the acronym chosen to designate the project named "Laboratory Skin Patches and SmartCards based on foils and compatible with a smartphone" (contract number 224306 for Large-scale integrating project (IP).

National Food Institute
Division of Food Microbiology
Department of Micro- and Nanotechnology
BioLabChip
Microsystems
Period: 01/09/2008 → 31/12/2011
Number of participants: 2
Acronym: LABONFOIL
Project participant:
Bang, Dang Duong (Intern)
Wolff, Anders (Intern)

**Financing sources**
Source: EU research programme (public)
Name of research programme: Large-scale integrating Project (IP)
Web address: http://www.labonfoil.eu
Amount: 7,100,000.00 Euro
Year of approval: 2008

**MEMS Optical Sensor Systems**
Department of Micro- and Nanotechnology
Period: 01/09/2008 → 14/12/2011
Number of participants: 6
Phd Student:
Reck-Nielsen, Kasper (Intern)
Supervisor:
Thomsen, Erik Vilain (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Yvind, Kresten (Intern)
Bouwstra, Siebe (Ekstern)
Müllenborn, Matthias (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

**Nanoimprint litografi for optofluidik**
Department of Micro- and Nanotechnology
Period: 01/09/2008 → 21/02/2012
Number of participants: 5
Phd Student:
Mikkelsen, Morten Bo Lindholm (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Larsen, Niels Bent (Intern)
Eijkel, Jan C. T. (Ekstern)
Montelius, Lars (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

**Nanophotonics for terabit communications : VKR centre of excellence - NATEC**
We propose to establish a Willum Kann Rasmussen Centre of Excellence that explores the fundamental physics and technology of nanophotonic materials and devices in order to reach data rates in the terabit per second regime. Following a brief introduction, the goals of the Centre, its organization, the main research activites, research plans and proposed budget are described.

Department of Photonics Engineering
Department of Mechanical Engineering
Department of Micro- and Nanotechnology
Center for Electron Nanoscopy
Period: 01/09/2008 → 31/08/2014
Number of participants: 13
Acronym: NATEC
Project participant:
Hvam, Jørn Marcher (Intern)
Yvind, Kresten (Intern)
Mortensen, N. Asger (Intern)
Jeppesen, Palle (Intern)
Oxenløwe, Leif Katsu (Intern)
Peucheret, Christophe (Intern)
Chung, Il-Sug (Intern)
Sigmund, Ole (Intern)
Jensen, Jakob Søndergaard (Intern)
Jauho, Anti-Pekka (Intern)
Burrows, Andrew (Intern)
Hübner, Jörg (Intern)
Project Manager, organisational:
Mørk, Jesper (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt

Optical transducer systems: Optical microphones, accelerometers and pressure transducers based on FBG (Fiber Bragg Grating) technology and optical detectors

Department of Micro- and Nanotechnology
Department of Photonics Engineering
Ibsen Photonics A/S
DPA Microphones A/S
Brüel & Kjær A/S
Period: 01/09/2008 → 31/08/2011
Number of participants: 6
Project ID: 70446
Contact person:
Jacobsen, Torben (Ekstern)
Project participant:
Rose, Bjarke (Ekstern)
Sørensen, Ole Brøsted (Ekstern)
Nielsen, Finn Kryger (Ekstern)
Hübner, Jörg (Intern)
Bang, Ole (Intern)

Financing sources
Source: Forsk. Andre offentlige og private - Nordiske
Name of research programme: Forsk. Andre offentlige og private - Nordiske
Amount: 2,909,370.00 Danish Kroner

Synthesis of Polymers for Liquid Core Waveguide Technology
Department of Micro- and Nanotechnology
Micro-calorimetric sensors for explosives detection
Department of Micro- and Nanotechnology
Period: 01/08/2008 → 28/09/2011
Number of participants: 5
Phd Student: Olsen, Jesper Kenneth (Intern)
Main Supervisor: Boisen, Anja (Intern)
Examiner: Hvilsted, Søren (Intern)
Bouwstra, Siebe (Ekstern)
P. Hernández-Rivera, Samuel (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Designing a Polymeric Microfluidic Platform for Neuronal Cell culture
Department of Micro- and Nanotechnology
Period: 15/07/2008 → 22/03/2012
Number of participants: 7
Phd Student: Vedarethinam, Indumathi (Intern)
Main Supervisor: Dimaki, Maria (Intern)
Heiskanen, Arto (Intern)
Examiner: Svendsen, Winnie Edith (Intern)
Almdal, Kristoffer (Intern)
Gramsbergen, Jan Bert P. (Ekstern)
Mir, Kalim U. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Biocompatibility studies of cells grown in close proximity of nanostructures in cell culture chips
Department of Micro- and Nanotechnology
Period: 01/07/2008 → 14/12/2011
Number of participants: 7
Phd Student:
Optofluidic Applications of Diblock Copolymer Derived Nanoporous Polymers

Department of Micro- and Nanotechnology
Period: 01/06/2008 → 14/09/2011
Number of participants: 7
Phd Student:
Gopalakrishnan, Nimi (Intern)
Supervisor:
Christiansen, Mads Brøkner (Intern)
Thomsen, Peter Theilade (Ekstern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Bruus, Henrik (Intern)
Balslev, Søren (Intern)
Marcel Joachim Mappes, Timo (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Time-resolved pH imaging in cancer cell compartments: Towards the development of new drug delivery systems for treatment of cancer

Department of Micro- and Nanotechnology
Period: 01/05/2008 → 09/02/2012
Number of participants: 5
Phd Student:
Søndergaard, Rikke Vicki (Intern)
Supervisor:
Almdal, Kristoffer (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Mølhave, Kristian (Intern)
Bechgaard, Klaus (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD
Microfluidic experiments, theory, and analysis of microsystems for real-time studies of cell kinetics

Department of Micro- and Nanotechnology
Period: 15/04/2008 → 24/08/2011
Number of participants: 6
Phd Student:
Skafe-Pedersen, Peder (Intern)
Supervisor:
Bruus, Henrik (Intern)
Main Supervisor:
Dufva, Martin (Intern)
Examiner:
Taboryski, Rafael J. (Intern)
Pedersen, Lars Hag (Intern)
Szita, Nicolas (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Simulation of the Cystic Fibrosis patient airway habitats using microfluidic devices

Department of Micro- and Nanotechnology
Period: 01/04/2008 → 23/11/2011
Number of participants: 9
Phd Student:
Skolimowski, Maciej (Intern)
Supervisor:
Dufva, Martin (Intern)
Geschke, Oliver (Intern)
Molin, Søren (Intern)
Sternberg, Claus (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)
Examiner:
Jelsbak, Lars (Intern)
Pedersen, Lars Hag (Intern)
Verpoorte, Elisabeth M. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Syntese og karakterisering af protease sensitive liposomer

Department of Micro- and Nanotechnology
Period: 15/03/2008 → 09/02/2012
Number of participants: 6
Phd Student:
Jølck, Rasmus Irming (Intern)
Supervisor:
Berg, Rolf Henrik (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Ndoni, Sokol (Intern)
Bechgaard, Klaus (Intern)
Thompson, David H. (Ekstern)
Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Celle Biologiske studier af protease aktiverede liposomale drug delivery
Department of Micro- and Nanotechnology
Period: 01/03/2008 → 19/04/2012
Number of participants: 6
Phd Student:
Johansen, Pia Thermann (Intern)
Supervisor:
Jensen, Simon S. (Ekstern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Pedersen, Susanne Brix (Intern)
Fichtner, Iduna (Ekstern)
Vogel, Ulla Birgitte (Intern)

Development of a LabChip system for point of care blood analysis
Department of Micro- and Nanotechnology
Period: 01/02/2008 → 30/09/2011
Number of participants: 7
Phd Student:
Musa, Arnaud Emmanuel (Intern)
Supervisor:
Schweitz, Kasper Oktavio (Ekstern)
von Gersdorff, Lars C. (Ekstern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Emnéus, Jenny (Intern)
Plocharski, Janusz (Ekstern)
Romano Rodriguez, Alberto (Ekstern)

Liposomal Drug Delivery of Radionuclides for Cancer Diagnostics and Therapy
Department of Micro- and Nanotechnology
Period: 01/02/2008 → 26/06/2012
Number of participants: 6
Phd Student:
Petersen, Anncatrine Luisa (Intern)
Supervisor:
Rasmussen, Palle H. (Ekstern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Jensen, Mikael (Intern)
Gabizon, Alberto A. (Ekstern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Syntese og karakterisering af lipidderivater til inkorporering i målrettede drug delivery systemer
Department of Micro- and Nanotechnology
Period: 15/01/2008 → 21/09/2011
Number of participants: 6
Phd Student:
Andersen, Simon (Intern)
Supervisor:
Jensen, Simon Skjøde (Ekstern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Berg, Rolf Henrik (Intern)
Larsen, Kim L. (Ekstern)
Thompson, David H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Design, fabrication and testing of support structures for biomimetic water filters
Department of Micro- and Nanotechnology
Period: 01/01/2008 → 20/04/2011
Number of participants: 7
Phd Student:
Vogel, Jörg (Intern)
Supervisor:
Geschke, Oliver (Intern)
Hélix-Nielsen, Claus (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)
Examiner:
Kristensen, Anders (Intern)
Thomsen, Peter Theilade (Ekstern)
Verpoorte, Elsabeth M. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Development of a novel concept for performing multiple assays on clinical samples using a fluidic device
Department of Micro- and Nanotechnology
Period: 01/01/2008 → 23/03/2011
Number of participants: 6
Phd Student:
Søe, Martin Jensen (Intern)
Supervisor:
Holmstrøm, Kim (Intern)
Main Supervisor:
Dufva, Martin (Intern)
Examiner:
Kutter, Jörg Peter (Intern)
Silahtaroglu, Asli Nilüfer (Ekstern)
Svahn, Helene Andersson (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Development of cantilever sensors for ion Detection
Department of Micro- and Nanotechnology
Period: 01/01/2008 → 23/02/2011
Number of participants: 6
Phd Student:
Fischer, Lee MacKenzie (Intern)
Supervisor:
Tenje, Maria (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Ulstrup, Jens (Intern)
Grutter, Peter H. (Ekstern)
Raiteri, Roberto (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Development of microfluidic water purification device
Department of Micro- and Nanotechnology
Period: 01/01/2008 → 22/03/2012
Number of participants: 7
Phd Student:
Pszon-Bartosz, Kamilla Justyna (Intern)
Supervisor:
Geschke, Oliver (Intern)
Hélix-Nielsen, Claus (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)
Examiner:
Dufva, Martin (Intern)
Kutchinsky, Jonatan (Intern)
Le Gac, Séverine (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

Epstein-Barr Virus encoded BILF1 is a constructively active G protein coupled receptor - Significance for EBV mediated cell transformation
Department of Micro- and Nanotechnology
Period: 01/01/2008 → 24/06/2009
Number of participants: 7
Phd Student:
Lyngaa, Rikke Birgitte (Intern)
Supervisor:
Kledal, Thomas N (Intern)
Rosenkilde, Mette Marie (Ekstern)
Main Supervisor:
Larsen, Niels Bent (Intern)
Examiner:
Rozlosnik, Noemi (Intern)
Kenney, Shannon C. (Ekstern)
Wiertz, Emmanuel J. H. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut/centerfinansieret
Project: PhD

Interface Structure and Strength in Model Composite Dental Resin
Department of Micro- and Nanotechnology
Period: 01/01/2008 → 23/03/2011
Number of participants: 6
Phd Student:
Nielsen, Mette Skovgaard (Intern)
Supervisor:
Sørensen, Bent F. (Intern)
Main Supervisor:
Almdal, Kristoffer (Intern)
Examiner:
Jakobsen, Mogens Havsteen (Intern)
Birkedal, Henrik (Ekstern)
Vallittu, Pekka Kalevi (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat ekstern
Project: PhD

Metamaterialer til lab-on-a-chip applikationer
Department of Micro- and Nanotechnology
Period: 15/12/2007 → 20/04/2011
Number of participants: 7
Phd Student:
Jeppesen, Claus (Intern)
Supervisor:
Boltasseva, Alexandra (Intern)
Mortensen, N. Asger (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Mørk, Jesper (Intern)
Bozhevolnyi, Sergey I. (Intern)
Levy, Uriel (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD
Development of Supported biomimetic membranes for insertion of aquaporin protein water channels for novel water filtration applications

Department of Micro- and Nanotechnology
Period: 01/11/2007 → 19/01/2011
Number of participants: 6
Phd Student:
Hansen, Jesper Søndergaard (Intern)
Supervisor:
Hélix-Nielsen, Claus (Intern)
Main Supervisor:
Emnéus, Jenny (Intern)
Examiner:
Kutter, Jörg Peter (Intern)
Martin, Donald Keith (Ekstern)
Nissen, Poul (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

On-Chip Electrogenic Cell handling and analysis

Department of Micro- and Nanotechnology
Period: 01/11/2007 → 25/05/2011
Number of participants: 6
Phd Student:
Vazquez Rodriguez, Patricia (Intern)
Supervisor:
Dimaki, Maria (Intern)
Main Supervisor:
Svendsen, Winnie Edith (Intern)
Examiner:
Jensen, Flemming (Ekstern)
Makohliso, Solomzi (Ekstern)
Prinz, Christelle (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Marie Curie (EU-stipendium)
Project: PhD

Development of new sensors for detection of organic chemicals

Department of Micro- and Nanotechnology
Period: 01/10/2007 → 25/05/2011
Number of participants: 6
Phd Student:
Bache, Michael (Intern)
Supervisor:
Taboryski, Rafael J. (Intern)
Main Supervisor:
Jakobsen, Mogens Havsteen (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Sutherland, Duncan (Ekstern)
Svensmark, Bo (Intern)
Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

Micromechanical Pathogen Sensor System
Department of Micro- and Nanotechnology
Period: 01/10/2007 → 24/11/2010
Number of participants: 6
Phd Student:
Noeth, Nadine-Nicole (Intern)
Supervisor:
Keller, Stephan Sylvest (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Mogensen, Klaus Bo (Intern)
Heinzelmann, Harry (Ekstern)
Ruano-Lopez, Jesus M. (Ekstern)

Synthesis and Characterization of Membrane Active Peptides - Towards the Development of Novel Drug Delivery Systems
Department of Micro- and Nanotechnology
Period: 01/09/2007 → 24/08/2011
Number of participants: 7
Phd Student:
Etzerodt, Thomas Povl (Intern)
Supervisor:
Clausen, Mads Hartvig (Intern)
Rasmussen, Palle (Intern)
Main Supervisor:
Andresen, Thomas Lars (Intern)
Examiner:
Berg, Rolf Henrik (Intern)
Thompson, David H. (Ekstern)
Westh, Peter (Ekstern)

Osmotically driven flows in micro and nanofluidic systems and their applications to sugar transport in plants
Department of Micro- and Nanotechnology
Period: 01/08/2007 → 20/04/2011
Number of participants: 6
Phd Student:
Jensen, Kaare Hartvig (Intern)
Supervisor:
Bohr, Tomas (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Brøns, Morten (Intern)
Eijkel, Jan C. T. (Ekstern)
Schulz, Alexander (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

All Polymer Electrochemical biosensor
Department of Micro- and Nanotechnology
Period: 01/07/2007 → 23/05/2012
Number of participants: 6
Phd Student:
Kafka, Jan Robert (Intern)
Supervisor:
Geschke, Oliver (Intern)
Skaarup, Steen (Intern)
Main Supervisor:
Larsen, Niels Bent (Intern)
Examiner:
West, Keld (Intern)
Wollenberger, Ulla (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

Functional Materials with Embedded Nano and Micro Struktures
The Danish Research and Innovation Government Agency (Forsknings- og Innovationsstyrelsen) has granted the innovation consortium "Functional Materials with Embedded Nano and Micro Struktures" (FINST) about 6 Mkr for the development of measuring techniques for industrial components and surfaces, which are modified on the nano and micro meter scale. Advanced measuring techniques are a necessary requisite for controlling the functionality of products on this scale. The metrological challenge is to develop normals and to make procedures for traceability of nano and micro scale industrial products. Together with COM, DTU, Department of Mathematics, DTU, is involved in modeling of measuring techniques based on optical diffraction of laser light from nano structured surfaces. Numerical simulations will constitute an integral part of the functionality of the measuring instruments under development.

Danish Institute of Fundamental Metrology
Department of Micro- and Nanotechnology
Department of Mathematics
Department of Photonics Engineering
FORCE Technology
CemeCon Scandinavia A/S
Ignis Photonyx A/S
SCF Technologies A/S
University of Southern Denmark
Period: 01/07/2007 → 30/06/2010
Number of participants: 9
Nano technology, Mathematical modelling, Optics, Metrology
Acronym: FINST
Project participant:
Bundgaard, Ole (Ekstern)
Mikkelsen, Niels Jørgen (Ekstern)
Holst, Jesper (Ekstern)
Bilenberg, Brian (Ekstern)
Bridging Flows: Microfluidic End-User Solutions

Department of Micro- and Nanotechnology
Period: 01/05/2007 → 22/09/2010
Number of participants: 6
Phd Student:
Sabourin, David (Intern)
Supervisor:
Snakenborg, Detlef (Intern)
Main Supervisor:
Dufva, Martin (Intern)
Examiner:
Gernaey, Krist V. (Intern)
Thomsen, Peter Theilade (Ekstern)
Verpoorte, Elisabeth M. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønned stipendie
Project: PhD

Development of Integrated Electronics for Readout of High Frequency Micro/Nano-mechanical Resonator

Department of Micro- and Nanotechnology
Period: 01/05/2007 → 23/03/2011
Number of participants: 5
Phd Student:
Tang, Meng (Intern)
Main Supervisor:
Davis, Zachary James (Intern)
Examiner:
Thomsen, Erik Vilain (Intern)
Andreani, Pietro (Intern)
Berini, Gabriel Abadal (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Highly sensitive scattering detection of sub-micron particles in microfluidic systems with integrated optics

Department of Micro- and Nanotechnology
Period: 01/05/2007 → 23/02/2011
Number of participants: 5
Phd Student:
Jensen, Thomas Glasdam (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Hübner, Jörg (Intern)
Ducrée, Jens (Ekstern)
Lading, Lars (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Nanobrane: Controlled Fabrication of 10 nm diameter Nanotubes on a Waferscale

Department of Micro- and Nanotechnology
Period: 15/04/2007 → 23/02/2011
Number of participants: 6
Phd Student:
Engstrøm, Daniel Southcott (Intern)
Supervisor:
Milne, William I. (Ekstern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Hübner, Jörg (Intern)
Campbell, Eleanor Elizabeth Bryce (Ekstern)
Papakonstantinou, Pagona (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Highly Sensitive Fluorescence Detection for Microfluidic Diagnostic Devices using Integrated Optics

Department of Micro- and Nanotechnology
Period: 15/03/2007 → 22/09/2010
Number of participants: 6
Phd Student:
Ohlsson, Pelle (Intern)
Supervisor:
Mogensen, Klaus Bo (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Brzózka, Zbigniew (Ekstern)
Roeraade, Johan (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Dynamical effects in molecular electronics

Department of Micro- and Nanotechnology
Period: 01/03/2007 → 01/09/2010
Number of participants: 6
Phd Student:
Engelund, Mads (Intern)
Electrical and Chemical Stimulation of Neuronal Cells in Microfluidic Systems

Department of Micro- and Nanotechnology
Period: 01/03/2007 → 01/09/2010
Number of participants: 7
PhD Student:
Alberti, Massimo (Intern)
Supervisor:
Dufva, Martin (Intern)
Snakenborg, Detlef (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Henneberg, Kaj-Åge (Intern)
Ewing, Andrew G. (Ekstern)
Spégel, Christer (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

3D nanolithography for self-aligned nano- and microstructures

Department of Micro- and Nanotechnology
Period: 01/02/2007 → 22/09/2010
Number of participants: 6
PhD Student:
Greve, Anders (Intern)
Supervisor:
Svendsen, Winnie Edith (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
De Grave, Arnaud (Intern)
Berger, Rüdiger (Ekstern)
Hierold, Christofer (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Electrical Interfaces for Organic Nanodevices

Department of Micro- and Nanotechnology
**Study of the catalytic activity of nano-particles using micro- and nanoreactors**

Department of Micro- and Nanotechnology  
Period: 01/02/2007 → 01/09/2010  
Number of participants: 5  
PhD Student:  
Henriksen, Toke Riishej (Intern)  
Main Supervisor:  
Hansen, Ole (Intern)  
Examiner:  
Taboryski, Rafael J. (Intern)  
Jensen, Klavs F. (Ekstern)  
Müllenborn, Matthias (Intern)  

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: DTU-lønnet stipendie  
Project: PhD

**Low Power miniaturized sensors for autonomic measurements of chronic diseases**

Department of Micro- and Nanotechnology  
Period: 15/01/2007 → 30/06/2010  
Number of participants: 7  
PhD Student:  
Haahr, Rasmus Grønbek (Intern)  
Supervisor:  
Branbjerg, Jens (Intern)  
Hoppe, Karsten (Intern)  
Main Supervisor:  
Thomsen, Erik Vilain (Intern)  
Examiner:  
Davis, Zachary James (Intern)  
Dirac, Paul Andreas Holger (Intern)  
Penders, Julien (Ekstern)  

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: DTU-lønnet stipendie  
Project: PhD
Microfluidic system for chromosome analysis system

Department of Micro- and Nanotechnology
Period: 15/01/2007 → 24/08/2011
Number of participants: 7
Phd Student:
Shah, Pranjul Jaykumar (Intern)
Supervisor:
Dimaki, Maria (Intern)
Okkels, Fridolin (Intern)
Main Supervisor:
Svendsen, Winnie Edith (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Becker, Holger (Ekstern)
Geschke, Oliver (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

All-Polymer Biosensors in Microfluidic System

Department of Micro- and Nanotechnology
Period: 01/01/2007 → 24/08/2011
Number of participants: 6
Phd Student:
Matschuk, Maria (Intern)
Supervisor:
Brusu, Henrik (Intern)
Main Supervisor:
Larsen, Niels Bent (Intern)
Examiner:
Kristensen, Anders (Intern)
Nørregaard, Jesper (Intern)
Schift, Helmut (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Photonic Crystal Detection for Nanofluidic Chemical Separation System

Department of Micro- and Nanotechnology
Period: 01/01/2007 → 01/09/2010
Number of participants: 7
Phd Student:
Rodrigues de Sousa Nunes, Pedro André (Intern)
Supervisor:
Mogensen, Klaus Bo (Intern)
Mortensen, N. Asger (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Andersen, Peter E. (Intern)
Jensen, Jacob Riis (Intern)
Franssila, Samuli Antero (Ekstern)

Financing sources
**Piezoelektrisk MEMS Ultralydssannerhoved**

Department of Micro- and Nanotechnology  
Period: 01/01/2007 → 01/09/2010  
Number of participants: 5  
Phd Student: Pedersen, Thomas (Intern)  
Main Supervisor: Thomsen, Erik Vilain (Intern)  
Examiner: Hübner, Jörg (Intern)  
Bouwstra, Siebe (Ekstern)  
Jensen, Henrik (Intern)

**Financing sources**

Source: Internal funding (public)  
Name of research programme: Forskningsrådsfinansiering  
Project: PhD

**Teaching, Studying and Learning : Undersøgælse af effekter og konsekvense af intensiv og aktiverende undervisning**

Department of Civil Engineering  
Office for Study Programmes and Student Affairs  
Administration  
Department of Mechanical Engineering  
Department of Micro- and Nanotechnology  
Department of Chemical and Biochemical Engineering  
Department of Management Engineering  
Period: 01/01/2007 → 31/03/2009  
Number of participants: 5  
Acronym: TeSt-Learn  
Project participant:  
Vigild, Martin Etchells (Intern)  
Horsewell, Andy (Intern)  
Thomsen, Erik Vilain (Intern)  
Szabo, Peter (Intern)  
Project Manager, organisational: Christensen, Hans Peter (Intern)

**Financing sources**

Source: Uddannelse. Statslige. Andre statslige  
Name of research programme: Uddannelse. Statslige. Andre statslige  
Amount: 95,000.00 Danish Kroner  
Project

**Advanced Characterization of Semiconductors using Microprobes**

Department of Micro- and Nanotechnology  
Period: 15/12/2006 → 20/01/2010  
Number of participants: 8  
Phd Student: Petersen, Dirch Hjorth (Intern)  
Supervisor: Hansen, Ole (Intern)
Nielsen, Peter Folmer (Intern)
Vandervorst, Wilfried (Ekstern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Thomsen, Erik Vilain (Intern)
Hofmann, Philip (Ekstern)
Koon, Daniel W. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

Pinched flow fractionation - Technology and Application
Department of Micro- and Nanotechnology
Period: 15/12/2006 → 30/06/2010
Number of participants: 5
Phd Student:
Vig, Asger Laurberg (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Kutter, Jörg Peter (Intern)
Nikolajeff, Fredrik (Ekstern)
Pedersen, Simon (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Piezoelektrisk MEMS Accelerometer
Department of Micro- and Nanotechnology
Period: 01/12/2006 → 26/05/2010
Number of participants: 5
Phd Student:
Hindrichsen, Christian Carstensen (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Hansen, Mikkel Foug (Ekstern)
Bouwstra, Siebe (Ekstern)
Müllenborn, Matthias (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

Nanofluidics for ssDNA analysis
Department of Micro- and Nanotechnology
Period: 15/11/2006 → 24/03/2010
Number of participants: 6
Phd Student:
Thamdrup, Lasse Højlund (Intern)
Supervisor:
Larsen, Niels Bent (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Berg-Sørensen, Kirstine (Intern)
Erickson, David (Ekstern)
Schweitz, Kasper Oktavio (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Integrated sorting of chromosomes
Department of Micro- and Nanotechnology
Period: 01/11/2006 → 16/06/2010
Number of participants: 6
Phd Student:
Clausen, Casper Hyttel (Intern)
Supervisor:
Dimaki, Maria (Intern)
Main Supervisor:
Svendsen, Winnie Edith (Intern)
Examiner:
Berg-Sørensen, Kirstine (Intern)
Allen, Stephanie (Ekstern)
Morgan, Hywel (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Isolation of human leukocytes and their chromosomes (part of the total chromosomal analysis system)
Department of Micro- and Nanotechnology
Period: 01/11/2006 → 26/05/2010
Number of participants: 6
Phd Student:
Moresco, Jacob Lange (Intern)
Supervisor:
Dufva, Martin (Intern)
Main Supervisor:
Svendsen, Winnie Edith (Intern)
Examiner:
Hellgren, Lars (Intern)
Pastorekova, Silvia (Ekstern)
Vellekoop, Michael Johannes (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Microtools for Automated Nanomanipulation
Department of Micro- and Nanotechnology
Period: 15/10/2006 → 03/03/2010
Number of participants: 7
Phd Student:
Sardan Sukas, Özlem (Intern)
Supervisor:
Mølhave, Kristian (Intern)
Sigmund, Ole (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Jensen, Jakob Søndergaard (Intern)
Nelson, Bradley J. (Ekstern)
Staufer, Urs (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Atomar skala kvante transport i kommende halvleder komponenter
Department of Micro- and Nanotechnology
Period: 01/09/2006 → 21/12/2009
Number of participants: 6
Phd Student:
Fürst, Joachim Alexander (Intern)
Supervisor:
Jauho, Antti-Pekka (Intern)
Main Supervisor:
Brandbyge, Mads (Intern)
Examiner:
Bøggild, Peter (Intern)
Palacios, Juan José (Ekstern)
Zozoulenko, Igor (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

Soft-ware Development for Automated Analysis and Intelligent Data Feed-back
Department of Micro- and Nanotechnology
Period: 01/09/2006 → 24/03/2010
Number of participants: 6
Phd Student:
Nielsen, Søren Skou (Intern)
Supervisor:
Arleth, Lise (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Emnéus, Jenny (Intern)
Nilsson, Johan Mikael (Ekstern)
Roessle, Manfred Werner (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Programbevilling
Project: PhD

Det elektroniske plaster
Integrering af molekylær elektronik i mikrosystemer ved hjælp af epitaxielt dyrkede nanotråde

Quantum Kinetics of charge carriers in quantum dots: applications to slow light and light amplification

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD
Modellering af transportegenskaber i Nanowires

Department of Micro- and Nanotechnology
Period: 01/03/2006 → 21/10/2009
Number of participants: 6
Phd Student: Markussen, Troels (Intern)
Supervisor: Jauho, Antti-Pekka (Intern)
Main Supervisor: Brandbyge, Mads (Intern)
Examiner: Mortensen, N. Asger (Intern)
Blase, Xavier (Ekstern)
Wacker, Andreas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Nanofluidic Devices for DNA Analysis

Department of Micro- and Nanotechnology
Period: 01/03/2006 → 24/06/2009
Number of participants: 5
Phd Student: Persson, Karl Fredrik (Intern)
Main Supervisor: Kristensen, Anders (Intern)
Examiner: Hassager, Ole (Intern)
Eijkel, Jan C. T. (Ekstern)
Mortensen, Kell (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

High Frequency Resonators for Liquid based Bio/Chemical Diagnostics and Monitoring Applications

Department of Micro- and Nanotechnology
Period: 01/02/2006 → 20/05/2009
Number of participants: 6
Phd Student: Hales, Jan Harry (Intern)
Supervisor: Boisen, Anja (Intern)
Main Supervisor: Davis, Zachary James (Intern)
Examiner: Krozer, Viktor (Intern)
Berini, Gabriel Abadal (Ekstern)
Brugger, Jürgen (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Continuous-Flow Microbioreactors for Bioprocessing and Cell Biology

Department of Micro- and Nanotechnology
Period: 15/01/2006 → 09/02/2007
Number of participants: 3
PhD Student:
Kirk, Timonthy Vernon (Ekstern)
Supervisor:
Bruus, Henrik (Intern)
Main Supervisor:
Szita, Nicolas (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Quantum dot structures enabling light slow-down and amplification

QUEST is a research project exploring the use of semiconductor quantum dot technology for realizing practical slow-light devices and integrated optical amplifiers. Such devices find important applications within information, communication and sensor technology and the project targets practical demonstrations within these areas, leading to possibilities of commercial exploitation. From a wider perspective, the proposed project contributes to the ongoing evolution of the information society. The project brings together three groups from the Technical University of Denmark (DTU) and The University of Southern Denmark (SDU) with strong and complementary research experience.

Nanophotonic Devices

Department of Photonics Engineering
Department of Micro- and Nanotechnology
Center for Nanoteknologi

University of Southern Denmark
Period: 01/01/2006 → 30/06/2012
Number of participants: 10
Acronym: QUEST
Project ID: 70319
Project participant:
Hvam, Jørn Marcher (Intern)
Yvind, Kresten (Intern)
Poel, Mike van der (Intern)
Hansen, Per Lunnemann (Intern)
Willatzen, Morten (Ekstern)
Wang, Linxiang (Ekstern)
Jauho, Antti-Pekka (Intern)
Houmark-Nielsen, Jakob (Intern)

Project Manager, organisational:
Mørk, Jesper (Intern)
Kamath, Hemant (Ekstern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 12,269,000.00 Danish Kroner
Project

Topology Optimization in Micro- and Nanofluidic Systems

Department of Micro- and Nanotechnology
Period: 01/01/2006 → 20/05/2009
Number of participants: 6
Phd Student:
Gregersen, Misha Marie (Intern)
Supervisor:
Hansen, Ole (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Brøns, Morten (Intern)
Hart, Steffen (Ekstern)
Ramos Reyes, Antonio (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Kvanteprikbaserede lyskilder til polymer lab-on-a-chip
Department of Micro- and Nanotechnology
Period: 15/12/2005 → 29/04/2009
Number of participants: 5
Phd Student:
Christiansen, Mads Brøkner (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Hvam, Jørn Marcher (Intern)
Eggleton, Benjamin John (Ekstern)
Nørregaard, Jesper (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Development of an Integrated MEMS (Micro Electro Mechanical System) based on DNA Analysis
Department of Micro- and Nanotechnology
BioLabChip
Department of Physics
Biophysics and Fluids
D'Appolonia S.p.A.
Delft University of Technology
Institut für Mikrotechnik Mainz GmbH
Uppsala University Hospital
Period: 01/12/2005 → 31/05/2009
Number of participants: 3
Acronym: SMART-BioMEMS
Project ID: IST-016554
Number of related Ph.D. students: 1
Project participant:
Wolff, Anders (Intern)
Brivo, Monica (Intern)
Bruus, Henrik (Intern)
**Relations**

Publications:
- A simple and efficient method for on-chip storage of reagents: towards lab-on-a-chip systems for point-of-care DNA diagnostics
- On-Chip integration of sample pretreatment and Multiplex polymerase chain reaction (PCR) for DNA analysis
- Dried reagents for multiplex genotyping by tag-array minisequencing to be used in microfluidic devices
- A simple and efficient method for reducing surface roughness of polymer microstructure
- Ultrasonic mixing in polymer microfluidics
- On-Chip Intergration of Sample Pretreatment and Multiplex Polymerase Chain Reaction (PCR) for DNA Analysis
- Development of a lab-on-a-chip device for point-of-care genetic diagnostics
- A Total Integrated Biochip System for Detection of SNP in Cancer

**Activation of SU8 Polymer Cantilever Systems for the Detection of Methicillin-Resistant Staphylococcus aureus (MRSA)**

Department of Micro- and Nanotechnology

Period: 15/11/2005 → 22/04/2009  
Number of participants: 6  
Phd Student: Chang, Chia-Wen (Intern)  
Supervisor: Pallesen, Lars (Ekstern)  
Main Supervisor: Boisen, Anja (Intern)  
Examiner: Larsen, Niels Bent (Intern)  
Ingmer, Hanne (Ekstern)  
Mckendry, Rachel (Ekstern)

**Financing sources**

Source: Internal funding (public)  
Name of research programme: DTU-lønnet stipendie  
Project: PhD

**Electromechanical Actuators for Hearing Aids**

Department of Micro- and Nanotechnology  
Period: 15/11/2005 → 25/02/2009  
Number of participants: 7  
Phd Student: Rasmussen, Torben Bygvraa (Intern)  
Supervisor: Larsen, Peter S. (Ekstern)  
Thomsen, Erik Vilain (Intern)  
Main Supervisor: Hansen, Ole (Intern)  
Examiner: Hansen, Mikkel Fougt (Intern)  
Bouwstra, Siebe (Ekstern)  
Ringgaard, Erling (Intern)

**Financing sources**

Source: Internal funding (public)  
Name of research programme: ErhvervsPhD-ordningen VTU  
Project: PhD

**MEMS-Teknologi i Nanoimprint Litografi**

Department of Micro- and Nanotechnology
Period: 01/10/2005 → 03/03/2010
Number of participants: 6
Phd Student:
Pedersen, Rasmus Haugstrup (Intern)
Supervisor:
Hansen, Ole (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Jensen, Flemming (Ekstern)
Bozhevolnyi, Sergey I. (Intern)
Scheer, Hella-Christin (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

SNP Detection Methods for a Lap-On-a-Chip System for Rapid Screening and Early Detection of Colon Cancer
Department of Micro- and Nanotechnology
Period: 01/10/2005 → 29/04/2009
Number of participants: 6
Phd Student:
Guðnason, Haukur (Intern)
Supervisor:
Dufva, Martin (Intern)
Main Supervisor:
Wolff, Anders (Intern)
Examiner:
Pedersen, Lars Hag (Intern)
25_NN_Studenter/Øvrige medarb. (Ekstern)
Nilsson, Mats (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Theory and Design of Polymer-Based Microfluidic Systems
Department of Micro- and Nanotechnology
Period: 01/10/2005 → 23/12/2008
Number of participants: 6
Phd Student:
Heller, Martin (Intern)
Supervisor:
Hassager, Ole (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Bohr, Tomas (Intern)
Hardt, Steffen (Ekstern)
Quéré, David (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD
**Stability of Magnetic Nanoparticles in Magnetic Beads**

The chemical stability of magnetic particles is of great importance for their applications in medicine and biotechnology. By use of Mössbauer spectroscopy and magnetization measurements we study the kinetics of transformation of nanoparticles of magnetite to maghemite during exposure to air under ambient conditions and during exposure to different chemical treatments.

Department of Physics
Department of Micro- and Nanotechnology
Technische Universität Clausthal
Period: 01/09/2005 → 30/06/2006
Number of participants: 4
Project ID: 20212
Project participant:
Chen, Wei (Intern)
Hansen, Mikkel Foug (Intern)
Peuker, Dr.- Ing. Urs (Ekstern)
Project Manager, organisational:
Mørup, Steen (Intern)

**Financing sources**
Source: Private funding (private)
Name of research programme: Uddannelse. Private. Fonde
Amount: 50,000.00 Danish Kroner

**Center for Individual Nanoparticle Functionality**

The main objective of the centre is to explore and understand the fundamental relations between surface morphology and reactivity on the nanometer scale. A combination of new experimental initiatives supported by theoretical approaches will be employed. The primary objectives of the center are: * To establish a close and unambiguous correlation between the morphology and the reactivity, ultimately of experimental approaches and methods. * To challenge the widely held belief that there are chemical reactions catalyzed by metal surfaces, which are structure insensitive, i.e. without a strong dependence on the detailed atomic structure of the surface. * To develop a new concept where nanodstructures can catalyze chemical reactions under non-thermal conditions, operating on entirely different physical principles than current technology.

Experimental Surface and Nanomaterials Physics
Department of Physics
Department of Micro- and Nanotechnology
Department of Chemical and Biochemical Engineering
Center for Individual Nanoparticle Functionality
Haldor Topsoe AS
Technical University of Munich
Eindhoven University of Technology
Chalmers University of Technology
Period: 01/08/2005 → 31/07/2010
Number of participants: 5
Acronym: CINF
Project ID: 20211
Project participant:
Nielsen, Jane Hvolbæk (Intern)
Quaade, Ulrich (Intern)
Schiøtz, Jakob (Intern)
Hansen, Ole (Intern)
Project Manager, organisational:
Chorkendorff, Ib (Intern)

**Financing sources**
**Development of a Lab-on-a-Chip system suitable for rapid screening and early detection of colon cancer**

Department of Micro- and Nanotechnology

BioLabChip

National Food Institute

Division of Food Microbiology

Period: 01/05/2005 → 30/04/2008

Number of participants: 3

Number of related Ph.D. students: 1

Project participant:

Wolff, Anders (Intern)

Bang, Dang Duong (Intern)

Guðnason, Haukur (Intern)

**Relations**

Publications:

- Immobilization of DNA to polymerized PDMS by direct UV-cross-linking
- Development of a lab-on-a-chip device for point-of-care genetic diagnostics
- Immobilisation of DNA to various substrates by direct UV linking
- DNA detection methods for a lab-on-a-chip system for rapid screening and early detection of colon cancer
- An inexpensive and simple method for thermally stable immobilization of DNA on an unmodified glass surface: UV linking of poly(T)10-poly(C)10-tagged DNA probes.
- Comparison of multiple DNA dyes for real-time PCR: effects of dye concentration and sequence composition on DNA amplification and melting temperature

**Project**

**Mass produced optical diagnostic labcards based on micro and nano SU8 layers**

OptoLabCard is the acronym chosen to designate the project named "Mass produced optical diagnostic labcards based on micro and nano SU8 layers" (contract number 016727 for specific targeted research or innovation project - Sixth framework programme / 2nd Joint call IST-NMP).

The project, co-ordinated by Ikerlan, a member of the IK4 research alliance and CIC microGUNE, aims the development of a quick, portable and low-cost pathogen detection device (Lab on a Card) that integrates optoelectronic, microfluidic and microbiological advances. The device consists of a hand held base unit and a disposable cartridge (labcard) made of a negative thick photoresist (SU8). This instrument will carry out a Real Time Polymerase Chain Reaction (PCR) automatically from sample preparation to an optical detection in 15 minutes.

National Veterinary Institute

Department of Micro- and Nanotechnology

BioLabChip

Microsystems

Period: 01/05/2005 → 31/08/2008

Number of participants: 2

**Lab-on-a-chip system**

Acronym: OPTOLABCARD

Project participant:

Bang, Dang Duong (Intern)

Wolff, Anders (Intern)

**Financing sources**

Source: EU research programme (public)

Name of research programme: Sixth framwork programme/2nd join call IST-NMP

Amount: 2,975,501.00 Euro
Autonomous Diagnostic Array for Biomedical Applications

Year of approval: 2005

Project

Department of Micro- and Nanotechnology
Period: 01/05/2005 → 29/08/2008
Number of participants: 6
Phd Student:
Keller, Stephan Sylvest (Intern)
Supervisor:
Häfliger, Daniel (Ekstern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Despont, Michel (Ekstern)
Grutter, Peter H. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Magnetisk Separation i Mikrofluide Systemer

Year of approval: 2005

Project

Department of Micro- and Nanotechnology
Period: 01/04/2005 → 29/08/2008
Number of participants: 6
Phd Student:
Lund-Olesen, Torsten (Intern)
Supervisor:
Dufva, Martin (Intern)
Main Supervisor:
Hansen, Mikkel Fougt (Intern)
Examiner:
Taboryski, Rafael J. (Intern)
Eijkel, Jan C. T. (Ekstern)
Laurell, Thomas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Micro and Nanomechanical Sensors Realised in Functionalised Polymers

Year of approval: 2005

Project

Department of Micro- and Nanotechnology
Period: 01/03/2005 → 29/08/2008
Number of participants: 5
Phd Student:
Lillemose, Michael (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Almdal, Kristoffer (Intern)
Berger, Rüdiger (Ekstern)
Gomez, Montserrat (Intern)

Financing sources
Source: Internal funding (public)
Development of micro-PIV techniques for applications in microfluidic systems

Department of Micro- and Nanotechnology
Period: 01/02/2005 → 29/05/2008
Number of participants: 7
Phd Student:
Hagsäter, Melker (Intern)
Supervisor:
Bruus, Henrik (Intern)
Westergaard, Carsten Hein (Ekstern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Berg-Sørensen, Kirstine (Intern)
Meinhart, Carl (Ekstern)
Nilsson, Johan Mikael (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 DTU-stip, 2/3 FUR/andet
Project: PhD

Design of functional nanomaterials
To establish a research collaboration encompassing all steps in the development of new functional nanomaterials: design, synthesis, characterization, and testing. The common aim of the proposal is the development of rational design strategies for nano-structured materials.

Department of Physics
Department of Chemistry
Administration
Department of Chemical and Biochemical Engineering
Department of Micro- and Nanotechnology
Rise National Laboratory for Sustainable Energy
Center for Individual Nanoparticle Functionality

Center for Nanoteknologi
Period: 01/01/2005 → 31/12/2008
Number of participants: 19
Project ID: 20195
Project participant:
Jacobsen, Karsten Wedel (Intern)
Chorkendorff, Ib (Intern)
Nielsen, Jane Hvolbæk (Intern)
Horch, Sebastian (Intern)
Schiøtz, Jakob (Intern)
Hansen, Jern Bindslev (Ekstern)
Quaade, Ulrich (Intern)
Christensen, Claus H. (Intern)
Ulstrup, Jens (Intern)
Johannessen, Tue (Intern)
Baggild, Peter (Intern)
Pedersen, Allan Schröder (Intern)
Linderoth, Søren (Intern)
Improved Miniaturized Chromatographic Separation Systems for Analysis of Biochemically Relevant Species

Department of Micro- and Nanotechnology
Period: 01/01/2005 → 24/06/2008
Number of participants: 5
PhD Student:
Gústafsson, Ómar (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Nielsen, Kristian Fog (Intern)
Culbertson, Christopher T. (Ekstern)
Nilsson, Staffan (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Nanopartikler af Antiferromagnetiske Materialer

Department of Physics

Department of Micro- and Nanotechnology
Period: 01/01/2005 → 31/12/2007
Number of participants: 2
Project ID: 20192
Project participant:
Hansen, Mikkel Fougt (Intern)
Project Manager, organisational:
Mørup, Steen (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 2,150,000.00 Danish Kroner
Project

Piezoresistivity for Microsystems

Department of Micro- and Nanotechnology
Period: 01/01/2005 → 29/05/2008
Number of participants: 7
PhD Student:
Richter, Jacob (Intern)
Supervisor:
Christensen, Carsten (Intern)
Hansen, Ole (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Boisen, Anja (Intern)
Gravesen, Peter (Ekstern)
Paul, Oliver (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

Polymer Based Nano Optics for Lab-On-A-Chip Micro System

Department of Micro- and Nanotechnology
Period: 15/12/2004 → 30/04/2008
Number of participants: 5
Phd Student:
Gersborg-Hansen, Morten (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Petersen, Paul Michael (Intern)
Drewsen, Michael (Ekstern)
Levy, Uriel (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Innovative PhD project for developing a Lap-on-a-chip Microsystem for detection of Campylobacter

Department of Micro- and Nanotechnology
Period: 15/11/2004 → 24/06/2008
Number of participants: 6
Phd Student:
Christensen, Troels Balmer (Intern)
Supervisor:
Bang, Dang Duong (Intern)
Main Supervisor:
Wolff, Anders (Intern)
Examiner:
Taboryski, Rafael J. (Intern)
Ducrée, Jens (Ekstern)
Barholm-Hansen, Claus (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: InnovationsPhD
Project: PhD

Quantum-limited measurement in mesoscopic

Department of Micro- and Nanotechnology
Number of participants: 6
Phd Student:
Flindt, Christian (Intern)
Density-matrix Renormalization Group Study of Nanoscale Transport Phenomena

Department of Micro- and Nanotechnology
Period: 01/08/2004 → 29/10/2007
Number of participants: 5
Phd Student:
Bohr, Dan (Intern)
Main Supervisor:
Jauho, Anti-Pekka (Intern)
Examiner:
Bruus, Henrik (Intern)
Jeckelmann, Eric (Ekstern)
Östlund, Stellan (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Multisensor til dataopsamlingsmærker for undersøgelser af fisks adfæerd

Department of Micro- and Nanotechnology
Period: 01/08/2004 → 30/04/2008
Number of participants: 7
Phd Student:
Hyldgård, Anders (Intern)
Supervisor:
Hansen, Ole (Intern)
Lundgren, Bo (Intern)
Main Supervisor:
Thomsen, Erik Vilain (Intern)
Examiner:
Hansen, Mikkel Foug (Intern)
Brand, Oliver (Ekstern)
Christensen, Carsten (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut/centerfinansieret
Project: PhD

Nano-Imprint-Lithography (NIL)

Department of Micro- and Nanotechnology
Period: 01/04/2004 → 31/07/2007
Number of participants: 2
Phd Student:
Olsen, Brian Bilenberg (Intern)
Main Supervisor:
Kristensen, Anders (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Nanoskala multi-punkts prober fabrikeret ved elektron-stråle litografi
Department of Micro- and Nanotechnology
Number of participants: 7
Phd Student:
Gammelgaard, Lauge (Intern)
Supervisor:
Boisen, Anja (Intern)
Petersen, Peter Rasmus Ebsen (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Horch, Sebastian (Intern)
Brugger, Jürgen (Ekstern)
Gravesen, Peter (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

Inelastisk Elektrontransport i nanosystemer
Department of Micro- and Nanotechnology
Period: 01/03/2004 → 29/05/2007
Number of participants: 6
Phd Student:
Frederiksen, Thomas (Intern)
Supervisor:
Jauho, Antti-Pekka (Intern)
Main Supervisor:
Brandbyge, Mads (Intern)
Examiner:
Schietz, Jakob (Intern)
Persson, Mats (Ekstern)
Todorov, Tchavdar N. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Integreteret Raman-Spektroskopi
Department of Micro- and Nanotechnology
Period: 01/03/2004 → 29/05/2007
Number of participants: 6
Phd Student:
Anhøj, Thomas Aarøe (Intern)
Supervisor:
Jørgensen, Anders Michael (Intern)
Main Supervisor:
Hübner, Jörg (Intern)
Examiner:
Svalgaard, Mikael (Intern)
Brugger, Jürgen (Ekstern)
Pedersen, Jens Engholm (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Packaging of Bioprobe Cantilevers
Department of Micro- and Nanotechnology
Period: 01/03/2004 → 05/02/2007
Number of participants: 5
Phd Student:
Johansson, Alicia Charlotte (Intern)
Supervisor:
Geschke, Oliver (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Staufer, Urs (Ekstern)
Thundat, Thomas G. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

Fabrication of Polymeric Cantilevers with Integrated Optical Read-Out
Department of Micro- and Nanotechnology
Period: 15/02/2004 → 28/06/2007
Number of participants: 7
Phd Student:
Tenje, Maria (Intern)
Supervisor:
Gomez, Montserrat (Intern)
Hübner, Jörg (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Kutter, Jörg Peter (Intern)
López, Jesús Miguel Ruano (Ekstern)
Nordin, Gregory P. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Biochip System til påvisning af mutationer ved Føllings syge
Department of Micro- and Nanotechnology
Period: 01/02/2004 → 27/10/2008
Number of participants: 8
Phd Student:
Poulsen, Lena (Intern)
Magnetisk Separation i mikrofluide Systemer

Department of Micro- and Nanotechnology
Period: 01/02/2004 → 29/05/2007
Number of participants: 7
PhD Student:
Smistrup, Kristian (Intern)
Supervisor:
Bruus, Henrik (Intern)
Krühne, Ulrich (Intern)
Tang, Peter Torben (Intern)
Main Supervisor:
Hansen, Mikkel Fougt (Intern)
Examiner:
Jacobsen, Claus Schelde (Intern)
Gjøs, Martinus A. M. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Polymer-Microsystems Frabcated in Cyclic Oliefine Copolymer (COC)

Department of Micro- and Nanotechnology
Period: 01/11/2003 → 01/03/2007
Number of participants: 6
PhD Student:
Bundgaard, Frederik (Intern)
Supervisor:
Christensen, Leif Højset (Intern)
Main Supervisor:
Geschke, Oliver (Intern)
Examiner:
Hansen, Hans Nørgaard (Intern)
Khan-Malek, Chantal G. (Ekstern)
Velten, Thomas (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut/centerfinansieret
Project: PhD
Carbon Nanotube Force Sensors Integrated in Microcantilevers

Department of Micro- and Nanotechnology
Period: 01/10/2003 → 30/01/2007
Number of participants: 6
Phd Student: Kjelstrup-Hansen, Jakob (Intern)
Supervisor: Brandbyge, Mads (Intern)
Main Supervisor: Bøggild, Peter (Intern)
Examiner: Kristensen, Anders (Intern)
Lindelof, Poul Erik (Intern)
Waizer, Karsten (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Nanoimprint Lithography

Department of Micro- and Nanotechnology
Period: 01/10/2003 → 31/07/2007
Number of participants: 3
Phd Student: Nielsen, Theodor (Intern)
Supervisor: Bruus, Henrik (Intern)
Main Supervisor: Kristensen, Anders (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Nano Systems Engineering: Et nationalt instrumentcenter på DTU for nanolitografi

Department of Photonics Engineering
Department of Micro- and Nanotechnology
Rise National Laboratory for Sustainable Energy
University of Copenhagen
Period: 01/10/2003 → 30/09/2006
Number of participants: 9
Acronym: NANOS
Project ID: 70233
Project participant:
Kristensen, Martin (Intern)
Birkedal, Dan (Intern)
Menon, Aric Kumaran (Intern)
Telleman, Pieter (Intern)
Samuelson, Lars (Ekstern)
Bechgaard, K. (Ekstern)
Larsen, N. B. (Ekstern)
Lindelof, P. E. (Ekstern)
Project Manager, organisational: Hvam, Jørn Marcher (Intern)
Investigation of Nano-resonators for Mass Detection

Department of Micro- and Nanotechnology
Period: 01/09/2003 → 30/03/2007
Number of participants: 6
Phd Student:
Dohn, Søren (Intern)
Supervisor: Hansen, Ole (Intern)
Main Supervisor: Boisen, Anja (Intern)
Examiner: Sigmund, Ole (Intern)
Bouwstra, Siebe (Ekstern)
Lægsgaard, Erik (Ekstern)

Polymer-based Optical Detection Elements for Miniaturized Total Analysis Systems

Department of Micro- and Nanotechnology
Period: 01/09/2003 → 30/01/2007
Number of participants: 7
Phd Student: Snakenborg, Detlef (Intern)
Supervisor: Hübner, Jörg (Intern)
Main Supervisor: Kutter, Jörg Peter (Intern)
Examiner: Conrad, Finn (Intern)
Nilsson, Johan Mikael (Ekstern)
Zengerle, Roland (Ekstern)

Theory and simulation of Electromagnetic Control of Fluids and Suspensions in Micro- and Nanofluidic Systems

Department of Micro- and Nanotechnology
Number of participants: 5
Phd Student: Olesen, Laurits Højgaard (Ekstern)
Main Supervisor: Bruus, Henrik (Intern)
Examiner: Hassager, Ole (Intern)
Bazant, Martin Zdenek (Ekstern)
Ramos Reyes, Antonio (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

HYDROsurf
Department of Micro- and Nanotechnology
microFAB Bremen GmbH
Europlasma NV
Sonion MEMS A/S
Tehnic Tecom S.R.L.
Universität Bremen
Period: 31/07/2003 → 31/12/2005
Number of participants: 1
Project ID: 65117
Project participant:
Menon, Aric Kumaran (Intern)

Financing sources
Source: Forsk. EU - Rammeprogram
Name of research programme: Forsk. EU - Rammeprogram
Amount: 2,362,500.00 Danish Kroner
Project

Fast Integration of Carbon Nanotubes in Microsystems
Department of Micro- and Nanotechnology
Period: 01/04/2003 → 19/01/2007
Number of participants: 6
Phd Student:
Gjerde, Kjetil (Ekstern)
Supervisor:
Nielsen, Michael Brorson (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Hansen, Ole (Intern)
Gravesen, Peter (Ekstern)
Silva, S. Ravi P. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Microfluidic Systems for drug delivery
Department of Micro- and Nanotechnology
Period: 01/04/2003 → 06/09/2006
Number of participants: 7
Phd Student:
Bitsch, Lennart (Intern)
Supervisor:
Kutter, Jörg Peter (Intern)
Storgaard-Larsen, Torben (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Hansen, Hans Nørgaard (Intern)
Drese, Klaus Stefan (Ekstern)
Tegenfeldt, Jonas O. Jörgensson (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Polymere Bølgeledere til Mikrosystemer
Department of Micro- and Nanotechnology
Period: 01/04/2003 → 28/08/2006
Number of participants: 7
Phd Student:
Wang, Zhenyu (Intern)
Supervisor:
Bang, Dang Duong (Intern)
Kutter, Jörg Peter (Intern)
Main Supervisor:
Wolff, Anders (Intern)
Examiner:
Hansen, Flemming G. (Intern)
Gravesen, Peter (Ekstern)
Morgan, Hywel (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Design, fabrication and implementation of a highly Versatile High Resolution Mass Sensor
Department of Micro- and Nanotechnology
Period: 15/02/2003 → 06/09/2006
Number of participants: 5
Phd Student:
Grigorov, Alexander Vladimirov (Ekstern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Hansen, Ole (Intern)
Berini, Gabriel Abadal (Ekstern)
Montelius, Lars (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Polymere bølgeledere til mikrosystemer
Department of Micro- and Nanotechnology
Period: 06/02/2003 → 31/12/2006
Number of participants: 1
Project ID: 56107
Project Manager, organisational:
Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 1,700,000.00 Danish Kroner
Project

Polymer Dye Micro-Cavity Lasers
Department of Micro- and Nanotechnology
Period: 01/02/2003 → 31/05/2006
Number of participants: 5
Phd Student:
Balslev, Søren (Intern)
Main Supervisor:
Kristensen, Anders (Intern)
Examiner:
Mørk, Jesper (Intern)
Lading, Lars (Intern)
Turnbull, Graham Alexander (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådensfinsansiering
Project: PhD

Polymeric cantilever for bio-chemical sensing
Department of Micro- and Nanotechnology
Period: 13/01/2003 → 31/08/2006
Number of participants: 1
Project ID: 65104
Project Manager, organisational:
Boisen, Anja (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 1,800,000.00 Danish Kroner
Project

Microfluidic Motherboard including Optical, Electrical and Fluidic Interconnections
Department of Micro- and Nanotechnology
Period: 01/01/2003 → 31/05/2006
Number of participants: 5
Phd Student:
Perozziello, Gerardo (Intern)
Main Supervisor:
Geschke, Oliver (Intern)
Examiner:
Thomsen, Erik Vilain (Intern)
Branebjerg, Jens (Intern)
Zengerle, Roland (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD
Mikro celle kulturkamre på bio-chips

Department of Micro- and Nanotechnology
Period: 01/12/2002 → 10/05/2006
Number of participants: 5
Phd Student:
Stangegaard, Michael (Intern)
Main Supervisor:
Dufva, Martin (Intern)
Examiner:
Pedersen, Lars Hag (Intern)
Gold, Julie Myra (Ekstern)
Guldberg, Per (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Integrated Arrays (Øresund IT Academy)

Department of Micro- and Nanotechnology
Øresund IT Academy
Period: 28/11/2002 → 31/12/2004
Number of participants: 1
Project ID: 65101
Project participant:
Christensen, Claus Bo Vöge (Intern)

Financing sources
Source: Forskningsprojekter - Udenrigsministeriet (Danida)
Name of research programme: Forskningsprojekter - Udenrigsministeriet (Danida)
Amount: 810,000.00 Danish Kroner
Project

Center for mikrosystems for chemical and bio-chemical analysis based on polymers (µKAP)
The objective project is to establish a research based Danisc center of competence regarding industrialisation of micro-fluidic systems and chemical/bio-chemical lab-on-a-chip sensors based on polymers. The project represents a shift from a traditional silicon-based technology to polymer technologies. The project will cover the entire proces chain from design and product development to production and final product. The role of IPL is to develop solutions for inserts for injection moulding of micro structures based on electroforming.

Department of Management Engineering
Department of Micro- and Nanotechnology
Teknologisk Institut
Period: 01/10/2002 → 01/06/2006
Number of participants: 4
Project participant:
Hansen, Hans Nørgaard (Intern)
Christensen, Leif Højslet (Ekstern)
Tellemans, Pieter (Ekstern)
Project Manager, organisational:
Tang, Peter Torben (Intern)

Financing sources
Source: Forskningsprojekter - Andre ministerier og styrelser
Name of research programme: Forskningsprojekter - Andre ministerier og styrelser
Amount: 1,200,000.00 Danish Kroner
Project
Investigation and realigation of a Mass Sensor with NanoElectroMechanicalSystem (NEMS)

Department of Micro- and Nanotechnology
Period: 01/10/2002 → 30/03/2006
Number of participants: 6
Phd Student: Mateiu, Ramona Valentina (Intern)
Supervisor: Bøggild, Peter (Intern)
Main Supervisor: Boisen, Anja (Intern)
Examiner: Hansen, Ole (Intern)
Berini, Gabriel Abadal (Ekstern)
Brugger, Jürgen (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Center for mikrosystemer til Kemisk og Biokemisk analyse baseret på Polymerer

Department of Micro- and Nanotechnology
Department of Management Engineering
Radiometer Medical ApS
Nunc A/S
Scandinavian Micro Biodevice ApS
Danfoss A/S
VIR A/S
Sensor Technology Center A/S
DELTA
Teknologisk Institut
Number of participants: 3
Project ID: 56099
Project participant: Tang, Peter Torben (Intern)
Hansen, Hans Nørgaard (Intern)
Project Manager, organisational: Geschke, Oliver (Intern)

Financing sources
Source: Forsk. Andre offentlige og private - Udenlandske
Name of research programme: Forsk. Andre offentlige og private - Udenlandske
Amount: 4,414,800.00 Danish Kroner
Project

Simulation and Development of Microfluidic

Department of Micro- and Nanotechnology
Period: 01/09/2002 → 05/12/2005
Number of participants: 6
Phd Student: Brask, Anders (Intern)
Supervisor: Kutter, Jörg Peter (Intern)
Main Supervisor: 
Bruus, Henrik (Intern)
Examiner: 
Hassager, Ole (Intern)
J. Kirby, Brian (Ekstern)
Zengerle, Roland (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

**Theory and Simulation of Interface Dynamics in NANO Fluids**
Department of Micro- and Nanotechnology
Period: 01/09/2002 → 25/11/2005
Number of participants: 5
Phd Student: 
Jensen, Mads Jakob (Intern)
Main Supervisor: 
Bruus, Henrik (Intern)
Examiner: 
Bohr, Tomas (Intern)
Clanet, Christophe (Ekstern)
Hardt, Steffen (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

**Polymer farvestof mikrokavitets lasere**
Department of Micro- and Nanotechnology
Period: 26/07/2002 → 31/07/2005
Number of participants: 1
Project ID: 65096
Project participant: 
Kristensen, Anders (Intern)

**Financing sources**
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 1,500,000.00 Danish Kroner
Project:

**Fabrication and Characterization of Nano-Resonators for Mass Detection**
Department of Micro- and Nanotechnology
Period: 01/07/2002 → 23/01/2006
Number of participants: 4
Phd Student: 
Forsén, Esko Sebastian (Intern)
Main Supervisor: 
Boisen, Anja (Intern)
Examiner: 
Andreani, Pietro (Intern)
Tamayo, Javier (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Magnetic Beads in Microfluidic Systems
Department of Micro- and Nanotechnology
Period: 01/07/2002 → 06/09/2006
Number of participants: 6
Phd Student: Ejsing, Louise Wellendorph (Intern)
Supervisor: Menon, Aric Kumaran (Intern)
Main Supervisor: Hansen, Mikkel Fougt (Intern)
Examiner: Bruus, Henrik (Intern)
Johansson, Christer (Ekstern)
Muhammed, Mamoun (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Udvikling af Mikromekanisk Multifunktionssensor med Fokus på Sensorer til Flowmåling af Vand
Department of Micro- and Nanotechnology
Period: 01/06/2002 → 26/09/2005
Number of participants: 5
Phd Student: Pedersen, Casper (Intern)
Supervisor: Christensen, Carsten (Intern)
Main Supervisor: Thomsen, Erik Vilain (Intern)
Examiner: Hansen, Ole (Intern)
Brand, Oliver (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervsPhD-ordningen VTU
Project: PhD

Micro Electro Mechanical Devices for Controlling ligt
Department of Micro- and Nanotechnology
Period: 01/02/2002 → 26/09/2005
Number of participants: 7
Phd Student: Larsen, Kristian Pontoppidan (Intern)
Supervisor: Menon, Aric Kumaran (Intern)
Ravnkilde, Jan Tue (Intern)
Main Supervisor: Hansen, Ole (Intern)
Examiner: Quaade, Ulrich (Intern)
Bouwstra, Siebe (Ekstern)
Müllenborn, Matthias (Intern)
Programable Wavelength Selective MDEMS Devices

Department of Micro- and Nanotechnology
Period: 01/02/2002 → 16/05/2005
Number of participants: 5
Phd Student:
Nilsson, Johan Daniel Göran (Intern)
Supervisor:
Kristensen, Anders (Intern)
Main Supervisor:
Menon, Aric Kumaran (Intern)
Examiner:
Hansen, Ole (Intern)
Torres, Clivia Marfa Sotomayor (Ekstern)

Fluid Control and Manoliter Dispensing in a Chip for Single Cell Array Analysis

Department of Micro- and Nanotechnology
Period: 01/11/2001 → 19/05/2005
Number of participants: 6
Phd Student:
Bouaidat, Salim (Intern)
Supervisor:
Jonsmann, Jacques (Intern)
Main Supervisor:
Wolff, Anders (Intern)
Examiner:
Kristensen, Anders (Intern)
Gravesen, Peter (Ekstern)
Manz, Andreas (Ekstern)

Nanoresonators with integrated circuitry for high sensitivity and high resolution mass detection

Department of Micro- and Nanotechnology
Universidad Autonoma de Barcelona
Consejo Superior de Investigaciones Cientificas
Lund University
Number of participants: 1
Project ID: 65080
Project participant:
Boisen, Anja (Intern)
Detection of single ion channel activity in neurons with multipoint probes

Department of Micro- and Nanotechnology
Period: 01/10/2001 → 22/04/2005
Number of participants: 5
Phd Student:
Dimaki, Maria (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Christensen, Claus H. (Intern)
Morgan, Hywel (Ekstern)
Nygård, Jesper (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Reagentless dissolved Oxygen-sensor for Microfluidic Applications (water/blood analysis)

Department of Micro- and Nanotechnology
Period: 01/10/2001 → 20/12/2004
Number of participants: 6
Phd Student:
Jensen, Martin Frøhling (Intern)
Supervisor:
Christensen, Leif Hejslet (Intern)
Main Supervisor:
Geschke, Oliver (Intern)
Examiner:
Hansen, Hans Nørregaard (Intern)
Drese, Klaus Stefan (Ekstern)
Schou, Jørgen (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Erhvervsforskerordningen
Project: PhD

Optiske bistabilitet i integreret optik

Department of Micro- and Nanotechnology
Period: 01/09/2001 → 29/08/2005
Number of participants: 6
Phd Student:
Sandberg, Rasmus Kousholt (Intern)
Supervisor:
Svendsen, Winnie Edith (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Hansen, Ole (Intern)
Berger, Rüdiger (Ekstern)
Gomez, Montserrat (Intern)

Financing sources
Transport in nanostructures

Department of Micro- and Nanotechnology
Period: 01/09/2001 → 27/10/2004
Number of participants: 6
Phd Student: Donarini, Andrea (Intern)
Supervisor: Novotny, Tomas (Ekstern)
Main Supervisor: Jauho, Antti-Pekka (Intern)
Examiner: Mørk, Jesper (Intern)
Armour, Andrew D. (Ekstern)
Platero, Gloria (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Flexible micromechanical structures for bio/chemical detection

Department of Micro- and Nanotechnology
Period: 01/05/2001 → 31/12/2001
Number of participants: 2
Phd Student: Mortensen, Michael Wrang (Intern)
Main Supervisor: Boisen, Anja (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt EU-finansieret
Project: PhD

Nanostructuring with Bonding

Department of Micro- and Nanotechnology
Period: 01/05/2001 → 15/06/2006
Number of participants: 6
Phd Student: Poulsen, Mette (Intern)
Supervisor: Feidenhans'l, Robert Krarup (Intern)
Main Supervisor: Jensen, Flemming (Intern)
Examiner: Thomsen, Erik Vilain (Intern)
David, Christian (Ekstern)
Reus, Roger De (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Risø (Løn)
Project: PhD
Fabrication and Manipulation of Electromechanical Nanometer-Scale Manipulation Tools

Department of Micro- and Nanotechnology
Period: 01/04/2001 → 10/02/2005
Number of participants: 5
Phd Student:
Mølhave, Kristian (Intern)
Main Supervisor:
Bøggild, Peter (Intern)
Examiner:
Horsewell, Andy (Intern)
Milne, Bill (Ekstern)
Olin, Håkan (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Inductively Coupled Plasma Etching for Microsystems

Department of Micro- and Nanotechnology
Period: 01/04/2001 → 22/09/2004
Number of participants: 5
Phd Student:
Jensen, Søren (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Hübner, Jörg (Intern)
Christensen, Carsten (Intern)
Franssila, Samuli Antero (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Design af digitale optiske filtre

Department of Micro- and Nanotechnology
Period: 01/02/2001 → 29/08/2005
Number of participants: 6
Phd Student:
Mikkelsen, Christian Ingemann (Intern)
Supervisor:
Hansen, Mikkel Fougt (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Brøns, Morten (Intern)
Rasmussen, Jens Juul (Intern)
Schönfeld, Friedhelm (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD
Micro Total Analysis Systems
Fluid Mechanics
Department of Mechanical Engineering
Department of Micro- and Nanotechnology
Period: 08/01/2001 → 01/08/2005
Number of participants: 1
Project ID: 75180
Project Manager, organisational:
Sørensen, Jens Nørkær (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 815,000.00 Danish Kroner

Nucleic acid Reactions Investigated by Cantilever Based Sensors
Department of Micro- and Nanotechnology
Period: 01/01/2001 → 12/05/2004
Number of participants: 5
Phd Student:
Marie, Rodolphe (Intern)
Supervisor:
Christensen, Claus Bo Vöge (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Pedersen, Lars Hag (Intern)
Gómez, Laura M. Lechuga (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Nanohand - manipulation, imaging, and measurement of nanosize objects
Department of Micro- and Nanotechnology
Period: 19/12/2000 → 31/12/2004
Number of participants: 1
Acronym: NanoHand
Project ID: 56070
Project Manager, organisational:
Bøggild, Peter (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 3,000,000.00 Danish Kroner

Multiplex detection of "Single Nucleotide Polymorphisms". På en Polymer based platform med integrerede mikrofluidstrukturer
Department of Micro- and Nanotechnology
Period: 01/12/2000 → 25/05/2004
Number of participants: 6
Phd Student:
Nørholm, Mikkel (Intern)
Organiske og Biologiske molekullag på funktionelle sensor-overflader studeret med atomic force mikroskopi

Department of Micro- and Nanotechnology
Period: 01/12/2000 → 05/03/2004
Number of participants: 7
PhD Student:
Hansen, Maria Svendsmark (Intern)
Supervisor:
Garnæs, Jørgen (Ekstern)
Kyhle, Anders (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Ulstrup, Jens (Intern)
Pedersen, Lars Hag (Intern)
Williams, Philip Michael (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Erhvervsforskerordningen
Project: PhD

Electronical interconnections through CMOS Wafers

Department of Micro- and Nanotechnology
Period: 01/11/2000 → 10/02/2004
Number of participants: 8
PhD Student:
Rasmussen, Frank Engel (Intern)
Supervisor:
Heschel, Matthias (Intern)
Petersen, Anders E. (Intern)
Skindhøj, Jørgen (Ekstern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Birkedal, Dan (Intern)
Brand, Oliver (Ekstern)
Branebjerg, Jens (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samarbejdsaftalefinans
Project: PhD
Sample Preparation and Pre-Treatment Technologies on Microfabricated Analytic Devices

Department of Micro- and Nanotechnology
Number of participants: 5
Phd Student:
Petersen, Daria (Intern)
Supervisor:
Kutter, Jörg Peter (Intern)
Main Supervisor:
Geschke, Oliver (Intern)
Examiner:
Olsson, Lisbeth (Intern)
Verpoorte, Elisabeth M. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Cantilever-based sensors for surface stress measurements

Department of Micro- and Nanotechnology
Period: 01/08/2000 → 10/02/2004
Number of participants: 4
Phd Student:
Rasmussen, Peter Andreas (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Schaeper, Patrick Richard (Intern)
Vettiger, Peter (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Assembler Tool for Molecular Structures

Department of Micro- and Nanotechnology
University of Twente
University of Cambridge
Hebrew University of Jerusalem
International Business Machines Corp.
Period: 03/07/2000 → 31/05/2003
Number of participants: 1
Project ID: 65003
Project participant:
Bøggild, Peter (Intern)

Financing sources
Source: Forsk. EU - Rammeprogram
Name of research programme: Forsk. EU - Rammeprogram
Amount: 2,515,144.00 Danish Kroner
Project

Interplay between simulation, modelling and fabrication for miniaturized total analysis system

Department of Micro- and Nanotechnology
Period: 01/05/2000 → 12/01/2004
Number of participants: 6
Phd Student:
Goranovic, Goran (Intern)
Supervisor:
Michelsen, Jess (Intern)
Main Supervisor:
Bruus, Henrik (Intern)
Examiner:
Bohr, Tomas (Intern)
Ajdari, Armand (Ekstern)
Eggers, Jens (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Microtools for Cell Sample Preparations
Department of Micro- and Nanotechnology
Period: 11/04/2000 → 30/04/2003
Number of participants: 1
Project ID: 65001
Project participant:
Wolff, Anders (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 2,999,600.00 Danish Kroner
Project

Integrated Frequency Selective Micro-Electro-Mechanical Devices
Department of Micro- and Nanotechnology
Period: 01/04/2000 → 18/11/2003
Number of participants: 5
Phd Student:
Yalcinkaya, Arda Deniz (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Andreani, Pietro (Intern)
Bouwstra, Siebe (Ekstern)
Gravesen, Peter (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut, samfinansiering
Project: PhD

Micro Total Analysis Systems
Department of Micro- and Nanotechnology
Department of Energy Engineering
Period: 24/03/2000 → 31/03/2005
Number of participants: 1
Acronym: MTAS
Project ID: 65000
Project Manager, organisational:
Kutter, Jörg Peter (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 16,166,711.00 Danish Kroner
Project

Development of rapid mass screening techniques for the detection campylobacter in poultry production
Department of Micro- and Nanotechnology
Period: 01/03/2000 → 26/02/2004
Number of participants: 6
Phd Student:
Keramas, Georgios (Intern)
Supervisor:
Telleman, Pieter (Intern)
Main Supervisor:
Christensen, Claus Bo Vöge (Intern)
Examiner:
Westermann, Peter (Intern)
Fussing, Vivian (Ekstern)
Grewal, Harleen (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Development of an immunological biochip assay for the analysis of pesticides in groundwater and water supply systems
Department of Micro- and Nanotechnology
Period: 01/03/2000 → 19/09/2003
Number of participants: 7
Phd Student:
Belleville, Erik (Intern)
Supervisor:
Petersen, Jon Wulff (Intern)
Telleman, Pieter (Intern)
Main Supervisor:
Christensen, Claus Bo Vöge (Intern)
Examiner:
Albrechtsen, Hans-Jørgen (Intern)
Joos, Thomas O. (Ekstern)
Koch, Claus (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Micromachined Tools for Cell Handling
Department of Micro- and Nanotechnology
Period: 01/03/2000 → 30/07/2003
Number of participants: 7
Phd Student:
El-Ali, Jamil (Intern)
Supervisor:
Hansen, Ole (Intern)
Telleman, Pieter (Intern)
Main Supervisor:
Wolff, Anders (Intern)
Examiner:
Hübner, Jörg (Intern)
Gravesen, Peter (Ekstern)
Mello, Andrew de (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

**Microtools for cell handling**
Department of Micro- and Nanotechnology
Period: 01/03/2000 → 27/08/2003
Number of participants: 7
Phd Student:
Perch-Nielsen, Ivan R. (Intern)
Supervisor:
Hansen, Ole (Intern)
Telleman, Pieter (Intern)
Main Supervisor:
Wolff, Anders (Intern)
Examiner:
Nicolaisen, Ejner (Intern)
Rasmussen, Finn Berg (Ekstern)
Stemme, Göran (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Blandet Finansiering
Project: PhD

**Microtools for cell handling - Sample preparation for simple cell PCR -**
Department of Micro- and Nanotechnology
Period: 01/03/2000 → 19/09/2003
Number of participants: 6
Phd Student:
Poulsen, Claus R. (Intern)
Supervisor:
Telleman, Pieter (Intern)
Main Supervisor:
Wolff, Anders (Intern)
Examiner:
Hansen, Flemming G. (Intern)
Bjørnholm, Thomas (Intern)
Fritzsche, Wolfgang (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Blandet Finansiering
Project: PhD

**Self-assembly of functional nanoscale elements for intramolecular electronics**
Department of Micro- and Nanotechnology
University of Cambridge
Chalmers University of Technology
Université de Mons-Hainaut

Period: 15/02/2000 → 31/12/2002
Number of participants: 1
Project ID: 56029
Project Manager, organisational: Stokbro, Kurt (Intern)

Financing sources
Source: Program. Andre statslige danske - Bioteknologi
Name of research programme: Program. Andre statslige danske - Bioteknologi
Amount: 1,357,249.00 Danish Kroner

Project

Konduktansmålinger af overflader og tynde film på mikroskala

Department of Micro- and Nanotechnology
Period: 01/02/2000 → 28/05/2003
Number of participants: 5
Phd Student: Hansen, Torben Mikael (Intern)
Main Supervisor: Bøggild, Peter (Intern)
Examiner: Quaade, Ulrich (Intern)
Bengtsson, Stefan (Ekstern)
Hofmann, Philip (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Nanoresonators for high resolution mass detection

Department of Micro- and Nanotechnology
Period: 01/02/2000 → 30/06/2003
Number of participants: 6
Phd Student: Davis, Zachary James (Intern)
Supervisor: Hansen, Ole (Intern)
Main Supervisor: Boisen, Anja (Intern)
Examiner: Sigmund, Ole (Intern)
Brand, Oliver (Ekstern)
Brugger, Jürgen (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden EU-finansiering
Project: PhD

Development of Immunological assays for Analysis of Pesticides (Immunalize)

Department of Micro- and Nanotechnology
Department of Environmental Science and Engineering
Geological Survey of Denmark and Greenland

Statens Serum Institut

Exiqon A/S
Period: 04/01/2000 → 31/10/2003
Number of participants: 2
Acronym: GEUS
Project ID: 65025
Project Manager, organisational:
Telleman, Pieter (Intern)
Christensen, Claus Bo Vöge (Intern)

Financing sources
Source: Program. Andre statslige danske - Andre prog.midler
Name of research programme: Program. Andre statslige danske - Andre prog.midler
Amount: 1,602,500.00 Danish Kroner

Project

Sensor Encapsulation by Silicon Bonding
Department of Micro- and Nanotechnology

SensoNor AS
Okmetc Oy
Celsius Consultants AB
Danfoss A/S
Chalmers University of Technology
Université de Neuchâtel
Period: 04/01/2000 → 31/12/2002
Number of participants: 1
Project ID: 65026
Project participant:
Jensen, Flemming (Intern)

Financing sources
Source: Forsk. EU - Rammeprogram
Name of research programme: Forsk. EU - Rammeprogram
Amount: 3,163,919.00 Danish Kroner

Project

Teori og modellering af elektrisk ledning igennem atomare/molekyære systemer
Department of Micro- and Nanotechnology
Period: 31/12/1999 → 31/08/2003
Number of participants: 2
Project ID: 56077
Project participant:
Brandbyge, Mads (Intern)
Stokbro, Kurt (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 1,000,000.00 Danish Kroner

Project

Samarbejdsprojekt om Udvikling af Mikrosystemprojekter
Department of Micro- and Nanotechnology
Period: 07/12/1999 → 30/06/2003
Number of participants: 1
Project ID: 56024
Project Manager, organisational:
Thomsen, Erik Vilain (Intern)

Financing sources
Source: Forskningsrådene - Andre
Name of research programme: Forskningsrådene - Andre
Amount: 5,916,000.00 Danish Kroner

Microfabricated Devices for Advanced Cuerial Separations
Department of Micro- and Nanotechnology
Period: 15/11/1999 → 24/01/2003
Number of participants: 6
Phd Student:
Petersen, Nickolaj Jacob (Intern)
Supervisor:
Telleman, Pieter (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Hansen, Elo Harald (Intern)
25_NN_Studenter/Øvrige medarb. (Ekstern)
Verpoorte, Elisabeth M. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Integrated optics for micro total analysis systems
Department of Micro- and Nanotechnology
Period: 01/10/1999 → 09/01/2003
Number of participants: 6
Phd Student:
Mogensen, Klaus Bo (Intern)
Supervisor:
Hansen, Ole (Intern)
Main Supervisor:
Kutter, Jörg Peter (Intern)
Examiner:
Kristensen, Martin Lykke (Intern)
Berg, Albert van den (Ekstern)
Gravesen, Peter (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Optisk Tryktransducer
Department of Micro- and Nanotechnology
Period: 01/10/1999 → 26/06/2003
Number of participants: 8
Phd Student:
Kitchen, Steven Richard (Intern)
Supervisor:
Dam-Hansen, Carsten (Intern)
Hanson, Steen Grüner (Intern)
Nielsen, Lars Jakob (Ekstern)
Main Supervisor:
Menon, Aric Kumaran (Intern)
Examiner:
Yamaguchi, Ichirou (Ekstern)
Dinesen, Palle Geltzer (Intern)
Skettrup, Torben (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Erhvervsforskerordningen
Project: PhD

Multilayered coatings by electrodeposition
Multilayered coatings produced by the dual bath electrodeposition technique are interesting microstructurally and with respect to mechanical properties including hardness and wear resistance. CuNi coatings are being investigated.

Department of Manufacturing Engineering
Department of Micro- and Nanotechnology

Optical detection in Bio/Chemical Microsystems
Department of Micro- and Nanotechnology
Period: 01/08/1999 → 13/03/2003
Number of participants: 7
Phd Student:
Jørgensen, Anders Michael (Intern)
Supervisor:
Hansen, Ole (Intern)
Kutter, Jörg Peter (Intern)
Main Supervisor:
Geschke, Oliver (Intern)
Examiner:
Svalgaard, Mikael (Intern)
Mastrangelo, Carlos H. (Ekstern)
Verpoorte, Elisabeth M. J. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-ønnet stipendie
Project: PhD

Nanocantilevers for mass detection
Cantilevers with dimensions in the submicron regime can be used as very sensitive mass sensors by detecting changes in the resonant frequency of the cantilever. The objective of the project is to fabricate nanometer sized resonating cantilevers with integrated read-out. The cantilevers will be fabricated using AFM and laser lithography on aluminium and the cantilever deflection will be detected by integrated capacitive read-out using a built in CMOS circuit.

Department of Micro- and Nanotechnology
Period: 01/07/1999 → 01/03/2000
Number of participants: 4
Project participant:
Hansen, Ole (Intern)
Kuhn, Oliver (Intern)
Grey, Francois (Intern)
Project Manager, organisational:
Boisen, Anja (Intern)

Fabrication, characterization and implementation of cantilevers for biochemical sensing
Department of Micro- and Nanotechnology
Period: 01/01/1999 → 16/11/2001
Number of participants: 7
Phd Student:
Thaysen, Jacob (Intern)
Supervisor:
Bouwstra, Siebe (Ekstern)
Grey, Francois (Intern)
Main Supervisor:
Boisen, Anja (Intern)
Examiner:
Frans de Rooij, Nicolaas (Ekstern)
Brugger, Jürgen (Ekstern)
Sigmund, Ole (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Micromachined loudspeaker for hearing instrument application
Department of Micro- and Nanotechnology
Period: 01/01/1999 → 20/08/2002
Number of participants: 6
Phd Student:
Rehder, Jörg (Intern)
Supervisor:
Rombach, Pirmin (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Poulsen, Torben (Intern)
Benecke, Wolfgang (Ekstern)
Gravesen, Peter (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Erhvervsforskerordningen
Project: PhD

Molecular Dynamics Simulations of Proteins, Biomembrane Systems, and Interfaces
Department of Micro- and Nanotechnology
Period: 01/01/1999 → 30/08/2002
Number of participants: 5
Phd Student:
Jensenius, Henriette (Intern)
EURAY: A DNA array technology platform
Following strong requests from Danish research institutes and industry, Mikro-elektronik Centret (MiC) has recently formed a consortium with the Danish biotechnology companies Exiqon, Display Systems Biotech and Hvidovre Hospital for developing a flexible, Danish DNA chip technology platform. Exiqon holds strategic patents in photoimmobilization and nucleotide analogs that are keys to improving existing DNA chip technology. MiC in turn has access to equipment for producing and using custom DNA chips e.g. nano-dispensing equipment and laser scanning equipment. "Bioarrays or biochips" are complex, miniaturized platforms that can perform hundreds to thousands of assays simultaneously and will be the research and diagnostic platform for the future. These bioarrays are going to automate complicated diagnostic tests, measuring multiple parameters at the same time. The result will be significant lower cost per analysis combined with a substantial increase in knowledge behind every diagnosis. Currently, the development of such bioarrays is focused on the analysis of genetic material but the future will see increased demands for systems that can combine protein based diagnostics with genetic diagnostics in order to enhance the detection, interpretation and treatment of complex disease patterns. Using a generic covalent coupling method that has been developed by our collaborator, Exiqon, arraying of oligonucleotides, cDNA and proteins on various different polymer types and glass slides has been demonstrated. LNA (Locked Nucleic Acids), another proprietary technology from Exiqon, is a novel class of oligonucleotide analogues which exhibit unprecedented thermal stabilities of duplexes towards complementary DNA and RNA. Using this technology we expect to be able to circumvent the need to use several oligonucleotide sequences per gene (redundancy) in order to even out differences in hybridization efficiencies, without compromising the specificity.

Department of Micro- and Nanotechnology
Period: 01/11/1998 → …
Number of participants: 1
Project Manager, organisational:
Telleman, Pieter (Intern)
Project

Component production/SCOOP
Within the SCOOP project, a number of different optoelectronic devices will be designed, processed and experimentally evaluated. These devices can be divided into 3 groups: Electroabsorbers (EAs): Modulation of the reverse bias of the...
active region in a semiconductor waveguide will modulate the optical absorption. This can be exploited to use the EAs as de-multiplexers where a high bit-rate signal can be reduced to a lower frequency signal that can be easily detected by electronics. Interferometric devices: In a non-linear media like semiconductors, the refractive index depends on the carrier density. This can be utilised to change the phase in one optical arm in an interferometer to alter between constructive and destructive interference. By using a low frequency optical pulse to create the phase change these devices can be used as de-multiplexers. The first generation devices will consist of interferometric structures of Michelson or Mach-Zender type. Lasers: A range of lasers for mode-locked operation are being processed. The devices comprise of a ~350 mm long gain section and a shorter (~30 mm) absorber section. By inserting the laser into an external cavity and modulating the driving current for either the gain or the absorption regions, the mode-locked regime can be reached where the laser output consists of short optical pulses. All the devices are being processed using in the facilities of GIGA. The material is Indium Phosphide based wafers with operating wavelengths of about 1.5 mm. The waveguides are ridge waveguide structures where a slab of semiconductor (high index) material on top of the active region will increase the effective refractive index around the active region. The slab is created by masking 2-3 mm wide stripes and dry etch ~2 mm of the material away around the stripe. After defining the electrical contacts, the wafer is cleaved into single devices and an anti-reflection coating can be deposited on the facet.

Department of Micro- and Nanotechnology

GIGA A/S
Period: 01/10/1998 → 31/12/1999
Number of participants: 3
Project participant:
Skovgaard, Peter M. W. (Intern)
Romstad, Francis (Intern)
Project Manager, organisational:
Hvam, Jørn Marcher (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 6,400,000.00 Danish Kroner

Development of interconnect substrates in silicon with flexible regions for multichip microsystems

Department of Micro- and Nanotechnology
Period: 01/10/1998 → 29/10/2002
Number of participants: 6
Phd Student:
Lisby, Torben (Intern)
Supervisor:
Branebjerg, Jens (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Sigmund, Ole (Intern)
Dyrbye, Karsten (Ekstern)
Schweitz, Jan-Åke (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Erhvervsforskerordningen
Project: PhD

STM Study of Molecules on Semiconductor Surfaces

Department of Micro- and Nanotechnology
Period: 01/10/1998 → 03/12/2001
Number of participants: 6
Phd Student:
Lin, Rong (Intern)
Supervisor:
Quaade, Ulrich (Intern)
MicroChem: A miniaturized chemical sensing system

The objective of the European funded MicroChem project is to develop a new chemical sensing system for monitoring and process control of waste water, recipients and drinking water. The proposed sensing system is based on a micro analysis system with a rugged and reliable design and it will perform multiple analyses of small ions at concentration levels typically ranging from 10 ppb to 10 ppm for drinking water applications and 100 ppb to 100 ppm for waste water applications. The sensing system will take its origin from existing products for measuring phosphate, ammonia and nitrate in waste water. These sensors are sophisticated systems fabricated from a high number of fine mechanics and fluidic mechanics parts. Recent developments in Micro System Technology (MST), in particular micro fluidics and micro optics presents obvious possibilities for substantial improvements. The research effort of the MicroChem project will provide new knowledge on micro system durability and reliability, which will be of general importance to future microsystem developments. European partners: Danfoss A/S (DK), University of Neuchâtel (CH), Dublin City University (IRL), Gesellschaft für Silizium-Mikrosysteme mbH (D), and Suez Lyonnaise des Eaux (F).

Spatio-temporal dynamics of localized excitons in semiconductor nanostructures

We have constructed equipment for spatially resolved optical investigation of semiconductor nanostructures, notably a low-temperature microphotoluminescence system and a high resolution imaging spectrometer. The combination of microphotoluminescence and high spectral resolution opens up new possibilities in studying localized carriers in semiconductor nanostructures. The initial focus will be on localized excitonic states in narrow quantum wells and quantum wires. Interface roughness and chemical inhomogeneities in the semiconductor heterostructure introduce fluctuations in the energy landscape, which lead to the localization of low energy excitons. These excitons form quantum-dot-like states with well defined transition energies and extremely sharp photoluminescence lines. Using the microphotoluminescence technique, such lines may be studied individually and statistical information about the constituents of the luminescent system can be obtained. To gain more information about carrier dynamics and relaxation in these types of nanostructures the high spatial resolution must be combined with spectroscopic techniques having high temporal resolution. One useful technique is based on coherent control that utilizes phase-locked laser pulses. With a newly built actively stabilized Mach-Zender interferometer we can probe coherence times of individual quantum dot states as an example. In this context we can follow the time evolution of a wavepacket composed of quantum dot states reflecting the atomic-like optical properties of this solid state system. Since disorder in nanostructures complicates the physics it is important to find simpler model systems. One avenue for doing this is to produce coupled quantum dots using various electron beam processing and etching techniques. With dots in controllable distances we are pursuing the possibility to study individual dot-dot couplings that are believed to be dominated by dipole-dipole interactions and migration effects.
Electron transport through molecules
Development of electronic components of atomic dimensions which use quantum effects has fascinated researchers in many years. Back in 1974 Arieh Aviram and Mark Ratner proposed a model for a molecular rectifier[1], but at that time it seemed impossible to realise and contact such electronic molecular components. However, new developments in chemical synthesis and lithographic techniques made it possible for researchers in 1998 to build the first molecular field effect transistor of a carbon nanotube[2], and in 1999 an irreversible molecular flip-flop was realised for a Rotane molecule[3]. To build new molecular devices it is important to understand the transport mechanism through single molecules. The purpose of the molecular electronics project at MIC is to understand this charge transport through a combined theoretical and experimental effort, and use the understanding to propose and realise new molecular devices.


Microcantilevers as biosensors
Microcantilevers are very sensitive to small changes of mass or surface stress. The resulting bending of the cantilever can be detected by changes in a piezoresistor integrated on the cantilever. The objective of this project is to use such microcantilevers as biosensors, to detect attachment of specific biomolecules on a cantilever that has been pre-coated with a suitable reactive species.
Micro-four-point probe

A micro-four point probe has been fabricated using silicon microtechnology. The probes are metal-silicon oxide cantilevers. The cantilever spacing has been made as small as 4 micrometers. At this scale, the conductivity of single crystal grains in polycrystalline material can be investigated, as well as conduction on step-free regions of clean crystalline surfaces. A number of systems have been studied so far, including molecular monolayers and clean silicon surfaces in ultra-high vacuum. The goal of the project is to establish the usefulness of the micro-four-point probe as a general surface analysis technique, and extend its resolution to the nanometer scale.

Department of Micro- and Nanotechnology
Period: 01/01/1998 → 01/01/2002
Number of participants: 3
Project participant:
Petersen, Christian Leth (Intern)
Bøggild, Peter (Intern)
Project Manager, organisational:
Grey, Francois (Intern)

Modelling/SCOOP (Semiconductor COmponents for Optical signal Processing)

The SCOOP project has the goal of developing novel semiconductor devices for ultrafast optical signal processing in broadband optical networks. The modelling activity has to formulate mathematical models for the different device types and develop tools that can be used for analysing measurement results and designing/optimizing the devices. This requires a number of tasks to be considered: Materials dynamics: Models that accurately describe the materials (gain and index) dynamics down to a time scale of at least 1 picosecond need to be developed. Since the solution of microscopic (Semiconductor Bloch) equations are too demanding computationally, simpler models have to be derived. This is particularly challenging in the case of electro-absorption modulators, which are quantum well structures whose absorption can be changed by applying an electrical field. The transport of electrons across the structure and the sweep-out from the quantum well are known to limit the device speed and needs to be carefully modelled. Interferometric devices: By incorporating active semiconductor waveguides into interferometric structures of the Michelson or Mach-Zehnder type, it is possible to switch signals at very high bit rates. Computer simulation tools are needed in order to help interpret measurements on actual devices. In particular it is interesting to understand the mechanisms that limit the bandwidth. The tools need to be detailed enough to allow for optimization of the device designs as well as exploration of new ideas. Subsystem modelling: Device models are combined with models of signal sources, the transmission path and detectors to help understand the behaviour and limitations of the system as a whole. Presently, dispersion compensation of high-bit rate pulse trains using mid-span spectral inversion (phase conjugation) in a semiconductor laser amplifier has been analysed. The calculated results compare well with measurements.

Department of Micro- and Nanotechnology
GIGA A/S
Period: 01/01/1998 → 31/12/1999
Number of participants: 4
Project participant:
Mørk, Jesper (Intern)
Bischoff, Svend (Intern)
Højfeldt, Sune (Intern)
Project Manager, organisational:
Hvam, Jørn Marcher (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 3,600,000.00 Danish Kroner

Silicon to Silicon Wafer Bonding for Microsystems Packaging and Formation

Department of Micro- and Nanotechnology
Period: 01/01/1998 → 25/07/2000
Number of participants: 2
Phd Student:
Weichel, Steen (Intern)
Main Supervisor:
Reus, Roger De (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Center for Microinstruments (CfM)
CfM is a collaboration between the Department of Information Technology and the Microelectronics Centre, and is headed by professor Jørgen Staunstrup. CfM is established with a donation from the Thomas B. Thriges fund, while an associated graduate school financially supported by the Research Academy. CfM is supported by a range of Danish companies. The research activities of CfM focus on: - Computer Aided Engineering for micromechanical transducers - Smart transducers: design of sensors and actuators with integrated signal processing - Low power design for digital signal processors The tools and technologies developed within CfM are demonstrated in two main applications: - system level design of transducers, interfaces and digital circuit processors for hearing aids, and - topology optimized microactuators.

Department of Micro- and Nanotechnology
Department of Information Technology
Department of Informatics and Mathematical Modeling

Michigan Microsensor Inc.
Period: 01/12/1997 → 01/01/2003
Number of participants: 9
Project participant:
Hansen, Ole (Intern)
Jonsmann, Jacques (Intern)
Vestergaard, Ras Kaas (Intern)
Najafi, Khalil (Intern)
Ginnerup, Morten (Intern)
Crary, Selden (Ekstern)
Staunstrup, Jørgen (Intern)
Sparsø, Jens (Intern)
Project Manager, organisational:
Bouwstra, Siebe (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 10,000,000.00 Danish Kroner
Source: Unknown
Name of research programme: Ukendt
Amount: 10,000,000.00 Danish Kroner

Stacked Intelligent Transducers
The objective is to develop a generic concept for integrating high-performance ASICs with transducer functions, such as sensing sound and dispensing ink. The focus will be on stacking of silicon chips much like a multi-chip module (MCM) known from memory and telecommunication devices. The advantages of such a system are its minimum volume, which is important for a space-constrained system, and its high level of integration allowing the electronics to be close to the action in a smart system. For this, stacking technologies are developed, including electrical connections through wafers, and fluxless solder bump bonding on waferscale. The concept provides, furthermore, the possibility to combine different technologies and to protect the system more efficiently against harsh environmental conditions.

Department of Micro- and Nanotechnology
Microtronic A/S
DELTA
baltea Handelsgesellschaft mbH
LETI
Integrreret optisk detektion til miniature kemisk analysesystem

Department of Micro- and Nanotechnology
Period: 01/09/1997 → 28/05/2002
Number of participants: 6
Phd Student:
Friis, Peter (Intern)
Supervisor:
Hansen, Ole (Intern)
Main Supervisor:
Telleman, Pieter (Intern)
Examiner:
Sanders, Giles H. W. (Ekstern)
Bjarklev, Anders Overgaard (Intern)
Larsen, Jørgen K. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-Su Stipendium, Eksperiment
Project: PhD

Scanning Near-field Optical Microscopy

Scanning near-field optical microscopy (SNOM) allows one to realise optical imaging of surface structures with spatial resolutions on the nanometer scale, i.e., beyond the classical diffraction limit. Imaging in SNOM is based on the detection of near-field, or non-propagating, field components with an optical probe scanned close to the inspected sample surface. This is a new but already recognised and widely used technique. It represents an optical member of the family of scanning probe microscopies, which also includes well known scanning tunneling (STM) and atomic force (AFM) microscopies. A reflection SNOM arrangement has been set up and investigated in collaboration with DME - Danish Micro Engineering A/S. Imaging characteristics of the microscope and underlying principles of image formation have been experimentally studied and theoretically analyzed. High resolution (~50 nm) polarization- and wavelength-resolved imaging of different samples, e.g. single quantum wells, has been demonstrated. Polarization sensitivity better than 10-3 has been achieved in near-field imaging. Future research activities involve application of this technique for near-field imaging of surface anisotropy and its extension in the domain of nonlinear optics.

Department of Photonics Engineering
Scanning Near-field Optical Microscopy

Scanning near-field optical microscopy (SNOM) allows one to realise optical imaging of surface structures with spatial resolutions on the nanometer scale, i.e., beyond the classical diffraction limit. Imaging in SNOM is based on the detection of near-field, or non-propagating, field components with an optical probe scanned close to the inspected sample surface. This is a new but already recognised and widely used technique. It represents an optical member of the family of scanning probe microscopies, which also includes well known scanning tunneling (STM) and atomic force (AFM) microscopies. A reflection SNOM arrangement has been set up and investigated in collaboration with DME - Danish Micro Engineering A/S. Imaging characteristics of the microscope and underlying principles of image formation have been experimentally studied and theoretically analyzed. High resolution (~50 nm) polarization- and wavelength-resolved imaging of different samples, e.g. single quantum wells, has been demonstrated. Polarization sensitivity better than 10^-3 has been achieved in near-field imaging. Future research activities involve application of this technique for near-field imaging of surface anisotropy and its extension in the domain of nonlinear optics.
Liquid phase separations in micromachined structures
A fast growing field of application for microstructures is analytical chemistry. The goals are to enhance and improve existing methods and techniques by implementing them on microchips, and to develop new concepts to keep up with the pace of current technologies in synthetic and pharmaceutical chemistry, where combinatorial libraries produce enormous amounts of reaction products, which need to be checked and investigated. Similar tasks are encountered in biochemistry and biomedicine, where a high through-put of sample is necessary, with, at the same time, only tiniest amounts available. Manipulations of liquids in a micromachined channel manifold can be performed in a precise and efficient way using the phenomenon of the electroosmotic flow. By applying computer-controlled voltages at the terminals of the channels, it is possible to perform such basic operations as injecting and mixing of liquids. In appropriately designed microchips various liquid handling protocols can be implemented for sample pre-treatment procedures as well as elaborate separation techniques. Amongst the most promising techniques are solid-phase extraction for sample concentration and clean-up, and a suite of electrophoretic and chromatographic methods for the separation of complex sample mixtures. We are developing several modules, which will help to arrive at fully integrated miniaturized chemical analysis systems. The focus is on the introduction of novel chromatographic phase materials to the microchips, the application of sophisticated liquid handling protocols, the combination of several aspects of the analytical process on a single device, and the realization of two-dimensional separation techniques.

Nanolithography on aluminium thin films
It has been found that thin aluminium films on silicon can be modified by a focused laser beam or by an Atomic Force Microscope (AFM), to form either a positive or negative mask for lithographic processing of silicon. The objective of this research is to develop alternatives to electron beam lithography for rapid prototyping of micro- and nanomechanical devices. With a 7nm thick aluminum film, structures with 100nm resolution have been defined by AFM, and larger scale structures can be connected to these by laser processing of the aluminium. The specific advantage of aluminium is that it is an excellent mask for Reactive Ion Etching of high-aspect ratio structures, and that it is CMOS compatible.
Numerical simulation of magnetic separation of particles in a rectangular microchannel

Sorting of paramagnetically labelled cells or particles in microsystems is an important application for biological and biomedical use. Typically the magnetic separation process consists of magnetic trapping of particles on the channel surface followed by flushing the trapped particles out of the separator system. However, in our micromachined magnetic cell sorter, two buffer streams center a sample containing flow stream. Cells of interest are drawn into the acceptor buffer stream by magnetic deflection and separated from negative cells by splitting the flow channel in 2 outlets. The lack of information on the behaviour of magnetically labelled cells or particles in microfluidic structures has prevented us from improving the design of our sorter chip. Thus far, improvements were based on trial and error. In this project we are developing a numerical model for the motion of magnetically labelled cells exposed to a magnetic force. The objective of our model is to investigate the relations between magnetic gradient, magnetic properties of the cell, volume flow rate and the channel dimensions. Our model assumes that cells can be regarded as small spheres and therefore uses the equation of Maxey and Riley to describe cell motion. The equation of motion with inclusion of magnetic force is solved using the Runge-Kutta method. Results will be presented in the form of cell trajectories, deflection as function of volume flow rate and magnetic susceptibility of the cell. These results will allow a rational approach to the optimisation of the design of micromachined magnetic cell sorter.

Department of Micro- and Nanotechnology
Period: 01/04/1997 → …
Number of participants: 1
Project Manager, organisational:
Telleman, Pieter (Intern)
Project
Medical A/S, the Center for Fast Ultrasound Imaging, Ørsted*DTU, Mikroelektronikcentret, 3D Lab, Århus Kommunehospital, the IT University in Copenhagen, the Royal Veterinary and Agricultural University and the Research School in Microelectronics, which has co-funded 5 Ph.D. projects via a grant from the Danish Research Training Council (FUR). In total, the activities of the centre have involved funding and running 8 Ph.D. projects and a series of related activities, and the overall budget has been 10 million Danish crowns. The research has focused on two areas: (1) Digital integrated circuits and computer-based systems with focus on optimization of speed, energy consumption and effective use of resources, and (2) design and manufacturing techniques for micro-electro-mechanical systems (MEMS).

Department of Information Technology
Department of Micro- and Nanotechnology

Period: 01/04/1997 → 31/12/2003
Number of participants: 13

Project participant:
Pedersen, Steen (Intern)
Madsen, Jan (Intern)
Paker, Ozgun (Intern)
Holten-Lund, Hans Erik (Intern)
Larsen, Ken (Intern)
Jensen, Jørgen Arendt (Intern)
Bazaz, Khawaja Shafaat Ahmed (Intern)
Bouwstra, Siebe (Intern)
Hansen, Ole (Intern)
Vestergaard, Ras Kaas (Intern)
Jonsmann, Jacques (Intern)
Ginnerup, Morten (Intern)
Project Manager, organisational:
Sparsø, Jens (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 5,000,000.00 Danish Kroner
Source: Unknown
Name of research programme: Ukendt
Amount: 2,500,000.00 Danish Kroner
Source: Unknown
Name of research programme: Ukendt
Amount: 2,000,000.00 Danish Kroner

Project

CMOS kompatible multilag metalliske mikrostrukturer for intelligente transducere

Department of Micro- and Nanotechnology

Period: 01/03/1997 → 21/06/2001
Number of participants: 5

Phd Student:
Ravnkilde, Jan Tue (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Sigmund, Ole (Intern)
Gravesen, Peter (Ekstern)
Wagner, Bernd (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-Su Stipendium, Eksperiment
Project: PhD
Ultrafast dynamics after optical pulse excitation in semiconductor waveguide structures

Short optical pulse excitation is a direct tool in order to investigate ultrafast non-linear changes in the gain and refractive index in semiconductor optical amplifiers. We use two different techniques: single pulse propagation and pump-probe. In the first case, after injection of a single pulse into the amplifier, we measure the total energy of the pulse at the output of the device, the profile in frequency and real time and the pulse chirp. The technique has been tested on a InGaAsP bulk amplifier operating at 1.53mm. The measurements of the output energy indicate saturation of the gain for intense input pulses, and a non-linear gain compression dominating for pulse duration lower than 10ps. The pulse profile in time and frequency and the pulse chirp reveal strong non linear effects giving rise to a break-up of the pulse for very high (~100pJ) input energy, related to self-phase modulation occurring in the strong saturation regime. The second technique is a pump-probe experiment in heterodyne detection scheme to directly measure non-linear gain compression coefficients and ultrafast carrier dynamics in the amplifier. The technique has been tested on the bulk device. Pump-probe measurements have been also performed on InAs quantum dot (QD) amplifiers showing new interesting results on the carrier dynamics of these devices, like an ultrafast carrier capture time (Department of Micro- and Nanotechnology)
MQW and quantum dots (QD) based optical amplifiers. The QD devices show new and interesting results on the ultrafast carrier dynamics such as a substantially decreased carrier relaxation time of the inverted material. We have also been able, for the first time, to measure the optical dephasing time of InAs QDÆEs at room temperature.

Department of Photonics Engineering
Department of Micro- and Nanotechnology
British Telecom
Period: 01/03/1997 → 31/12/2002
Number of participants: 10
Project participant:
Birkedal, Dan (Intern)
Hvam, Jørn Marcher (Intern)
Mørk, Jesper (Intern)
Romstad, Francis (Intern)
Langbein, Wolfgang Werner (Intern)
Scaffetti, Stefano (Intern)
Bimberg, Dieter (Ekstern)
Martelli, F. (Ekstern)
Kelly, T. (Ekstern)
Project Manager, organisational:
Borri, Paola (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 1,000,000.00 Danish Kroner
Source: Unknown
Name of research programme: Ukendt
Amount: 45,000.00 Danish Kroner
Source: Unknown
Name of research programme: Ukendt
Amount: 20,000.00 Danish Kroner

Metal AFM Probes with Integrated Force Actuator
This project aims at the realisation of conductive Atomic Force Probes with an integrated capacitive force actuator. The device is designed for use in basic studies of the behaviour of metallic nano-wires. The present device is very complicated to fabricate, but this complication is offset by the tremendous advantages gained in the complicated design, e.g. the electrical connections to the device is not on the same side of the device as the tip is. Hence, it is significantly easier to use, does not have to be tilted etc.

Department of Micro- and Nanotechnology
Period: 01/02/1997 → …
Number of participants: 1
Project Manager, organisational:
Hansen, Ole (Intern)

A Microchip Based Conductance Particle Counter (µCPC)
The microchip based conductance particle counter (µCPC) is a micro device employing the Coulter principle1 for counting and sizing of particles (blood cells, bacteria, particles in milk etc) in liquid media. The particles are injected into an electrolyte, hydrodynamically focused into a single particle stream and passed through a small orifice in a non-conductive plate. When a comparatively non-conductive particle passes through the orifice, the conductivity in the electrolyte measured from one side of the orifice to the other falls. Counting and sizing of particles by the Coulter principle is used for many different purposes2 and is a substantial part of the medical diagnostics taking place today. The µCPC has been employed into a planar silicon structure and sealed with a glass lid, which enables detailed observation during operation3. The µCPC could give rise to many new approaches within medical diagnostics: By sizing down the instrument could be made portable and cutting down the price of the instrument may allow for decentralised and instant diagnostics or quality control. Making the device in a silicon structure also allows for integration of other functions such as sorting and optical detection4. The µCPC employs a variable aperture that allows for hydrodynamically adjusting the sensitivity for a specific type of particles. This idea has previously been approached in a mechanical way5. The µCPC is currently being redesigned utilising a 3D-flow simulation tool. After fabricating the µCPC the activities in this project will include setting up
Cell sorting in micromachined silicon structures
Cell sorting has become increasingly important in basic research and medical diagnostics. We have demonstrated that magnetic activated sorting and fluorescent activated sorting can also be envisaged in microfluidic silicon structures. In these structures we take advantage of the laminar flow in microstructures. Paramagnetic particles sheeted by two buffer streams are separated from non-magnetic particles by deflection in a magnetic field gradient. Particles labelled with a fluorochrome are sheeted by two buffer streams, excited and detected by a photo multiplier tube. The photo multiplier tube switches a valve on one of the outlets of the sorter microstructure and selects a particle by forcing it to the collecting outlet. Sorting in these structures is now being optimised with paramagnetic and fluorescent beads, but ultimately it is our intention to sort living cells. One of the major advantages of microfluidic structures is the capability of integrating various functional modules. Simultaneously with optimising our sorter structures, we are investigating various levels of system integration that may improve the performance of the structure.

Developing enzyme microreactor based on immobilization of enzyme on silicon surface inside of microreactor
By exploiting the inherent specificity of an enzyme, it is possible to develop very specific analytical systems. For this purpose immobilized enzymes are to be preferred rather than solubilized enzymes since the immobilization generally offers increased stability of the enzyme in addition to the advantage of being able to reuse the enzyme [Nielsen et al., 1990; Nielsen, 1992]. In this study, glucose oxidase is immobilized on silicon surface inside of microreactor. The enzyme microreactor where GOD is immobilized has been employed in Flow Injection Analysis (FIA) system, and used for measurement of glucose. The glucose analysis method is based on an enzymatic reaction using glucose oxidase, which converts glucose to glucono-lactone with formation of hydrogen peroxide. Finally H2O2 is detected by a chemiluminescence reaction where luminol is oxidized by H2O2, and light with maximum intensity at 430 nm is emitted. The light is followed by PMP detector, and recorded by PC. The optimum of concentration of chemicals, flow rate of sample and reagents, and the control voltage of PMP are obtained. The sensitivity and stability of enzyme microreactor have been tested. Comparison the traditional enzyme reactors, which are rather 1). Packed-bed reactor (PBR), with the enzyme immobilized on controlled pore glass, or 2). Wall-coated tubular reactor (WCTR) with the enzyme immobilized on the inside of a nylon tube, the great advantages of enzyme microreactor over the traditional enzyme reactor are high conversion, low dispersion and small sample volume. Therefore, the enzyme microreactor is a good method for measurement of bio/chemical sample with a very small volume. References: Nielsen, J.; Nikolajsen, K.; Benthin, S. and Villadsen, J. (1990) Anal. Chim Acta, 237(1990)165-175. Nielsen, J. (1992) Process Control and Quality, 1992, 2(4)371-384.

Frictional drag in coupled mesoscopic systems
In frictional drag experiments, a pair of independently contacted mesoscopic systems (quantum wells, quantum wires etc) are placed a few hundred Å apart. Current is driven through one subsystem and, due to the proximity of the systems, the coupling forces cause a measurable voltage build-up, or an induced current, in the other subsystem. This provides a unique opportunity for a transport measurement to probe interparticle interactions, and it gives important insights to the
properties of the dimensionally restricted interacting electron systems. K. Flensberg and Ben Hu showed that, at intermediate temperatures, collective modes of the coupled electron system can enhance the Coulomb drag rate by almost an order of magnitude over previous predictions. Together with M. C. Bønsager (then a student at MIC), KF, APJ and BH theoretically studied the complex magnetic-field dependence of the drag transresistivity, including large enhancements and effects due to the interplay of the Landau level quantization and screening of the inter-well interaction. Lastly, BH, MCB, KF, AMD have studied the role of phonons mediating the drag, and we have proposed that a coupled transresistivity, which may explain the anomalously large magnitude of the experimental observations of phonon-mediated drag. We are continuing to study various aspects of frictional drag, such as the search for a theory to explain the observation by J. Eisenstein (Cal Tech) of a nonvanishing frictional drag to $T = 0$ in $u = 2$ fractional quantum hall effect samples, which seems to contradict currently accepted theoretical models. Another example is mesoscopic Coulomb drag: we expect that the finite size will give rize to interesting fluctuation properties. Niels Asger Mortensen is looking at this problem as a part of his ph.d study, supervised by APJ and KF.

**Department of Micro- and Nanotechnology**

**Period:** 01/01/1997 → 31/12/2000

**Number of participants:** 2

**Project participant:**

- **Hu, Ben Yu-Kuang (Intern)**
- **Jauho, Antti-Pekka (Intern)**

**Graduate School in Microelectronics**

The Graduate School in Microelectronics was started in 1997 and its aim was to enhance (quantitatively and qualitatively) the Ph.d.-education in the area of Microelektronics. The Graduate School was funded by the Danish Research Training Council (in Danish: Forskeruddannelsesrådet) with 1 M kr. per year. The graduate school has co-funded summer schools, visiting professors and Ph.d.-scholarships. In total 8 Ph.d.-projects has been funded jointly by the Graduate School, private companies and research projects. The projects are hosted by MIC, Ørsted*DTU and IMM and the companies involved are: B-K Medical, Dicon, GN ReSound, NOKIA, Oticon, Sensor Technology Center and SonionMEMS.

**Department of Information Technology**

**Department of Informatics and Mathematical Modeling**

**Department of Electrical Engineering**

**Department of Micro- and Nanotechnology**

**Period:** 01/01/1997 → 31/12/2001

**Number of participants:** 15

**Project participant:**

- **Paker, Ozgun (Intern)**
- **Larsen, Ken (Intern)**
- **Holten-Lund, Hans Erik (Intern)**
- **Pedersen, Steen (Intern)**
- **Madsen, Jan (Intern)**
- **Jensen, Jørgen Arendt (Intern)**
- **Tomov, Borislav Gueorguiev (Intern)**
- **Andreani, Pietro (Intern)**
- **Wang, Xiaoyan (Intern)**
- **Hansen, Ole (Intern)**
- **Yalcinkaya, Arda Deniz (Intern)**
- **Menon, Aric Kumaran (Intern)**
- **Nielssson, Daniel (Ekstern)**
- **Larsen, Kristian Pontoppidan (Intern)**

**Project Manager, organisational:**

- **Sparsø, Jens (Intern)**

**Financing sources**

**Source:** Unknown

**Name of research programme:** Ukendt

**Amount:** 1,000,000.00 Danish Kroner
Isolation of foetal cells from the blood of pregnant women

Background Many pregnant women wish to have their foetus tested for genetic defects as e.g. Down's Syndrome so they have the possibility of having the pregnancy terminated. However, the methods used for prenatal genetic diagnostics today i.e. amniocentesis and chorionic villus sampling are invasive procedures that carry a substantial risk of pregnancy loss (0.5-1%) or even harming the foetus [1]. Therefore, new diagnostic methods desired that will allow prenatal diagnosis without the risk of harming the foetus. It has been reported that a small number of cells of foetal origin are present in mothers' blood (about 1:106-107) [2]. The aim of the project is to develop a simple and cheap method to isolate these few foetal cells from a blood sample from the mother. The system A new method for isolating foetal cells from a blood sample from the mother is being developed at the Microelectronic Centre in collaboration with Rigshospitalet. In this method, antibodies against the foetal cells are applied. In one end these antibodies are attached to small paramagnetic particles so when they are mixed with the blood sample the foetal cells become paramagnetic. The foetal cells are separated from the mother cells in a channel system on a silicon chip. The channel system has two outlets and the non-magnetic mother cells are led out of one outlet whereas the paramagnetic foetal cells are led to the other outlet using magnets. This system should make it possible to isolate foetal cells faster and cheaper and the system can be made disposable which eliminates the risk of cross contamination from one sample to the next.

Department of Micro- and Nanotechnology
Period: 01/01/1997 → …
Number of participants: 1
Project Manager, organisational:
Blankenstein, Gert (Intern)

Microscopic modeling of ballistic transport in gated structures

We have recently launched a project whose goal is to understand in detail magnetotransport measurements on gated 2-dimensional electron systems. The motivation is twofold: first, standard interpretation of experiments, based on simple semiclassical electron trajectory concepts, has led to a number of apparent contradictions, and, second, numerical techniques have been refined so as to be able to treat realistic sample geometries. A significant step, achieved by our Russian collaboration partners, has been the reduction of computational labor so that supercomputing is no longer necessary. We expect to apply these techniques to the analysis of several recent experiments, and can offer exciting projects and theses topics to students.

Department of Micro- and Nanotechnology
Period: 01/01/1997 → …
Number of participants: 1
Project Manager, organisational:
Jauho, Antti-Pekka (Intern)

Non-equilibrium response in strongly driven systems

Ben Hu and K. Johnsen are studying the response of strongly periodically driven time-dependent systems, such as the optical properties of semiconductors driven by free-electron lasers fields. We are attempting to derive relatively straightforward methods to calculate the statistical distribution of the occupation of the Floquet states and the linear-response properties of these strongly driven systems. In a joint project with experimental researchers from U.S.C.B and Japan K. Johnsen and Antti-Pekka Jauho have analyzed optical absorption in a strongly driven multiple quantum well system. The characteristic features of the measured absorption spectrum, as a function of photon energy or flux intensity, can be understood in terms of an interplay of (excitonic) dynamic Franz-Keldysh effect (introduced by A.-P-J and K.J in 1996), and an Stark Effect. Work is in progress to analyze non-linear mixing signals, and superlattice effects.

Department of Micro- and Nanotechnology
Period: 01/01/1997 → …
Number of participants: 3
Project participant:
Hu, Ben Yu-Kuang (Intern)
Johnsen, Kristinn (Intern)
Project Manager, organisational:
Jauho, Antti-Pekka (Intern)

OADM devices

The basic function of an Optical Add/Drop Multiplexer (OADM) device is to add and drop one wavelength in a multi-wavelength network. All the wavelengths enter the input port. They exit the output port except the one which exits at the drop port. The same wavelength, but carrying another signal, may then enter the add port and exits the output port. Hence
the signal carried by one channel is dropped and a new channel can be added to the network. Gratings define the filter function of the OADM device. Using an excimer laser 10 mm long Bragg gratings were simultaneously written in both arms of a Mach-Zehnder interferometer. After fabrication, part of the signal at the Bragg wavelength is back-reflected to the input port indicating that the signals reflected by the two gratings are experiencing different optical paths. This phase difference can be cancelled by UV-trimming i.e. by inducing a permanent increase of the refractive index in one arm of the Mach-Zehnder interferometer. UV trimming is realised with a continuous wave frequency doubled argon ion laser delivering 244 nm light. The back-reflected light at the input port is recorded while trimming. The tuning is stopped when minimum power is reached. In order to keep the phase balance, another UV-trimming is realised on the other arm of the Mach-Zehnder interferometer. MIC has fabricated and characterised two fibre pigtailed OADM prototypes for the EU project METON. For 400 GHz spacing applications, the isolation of the adjacent channel is better than 30 dB. The transmission dip is better than 50 dB, representing a world record for OADM devices! Its strength determines the isolation between the drop and the add channels, the so-called intra-channel crosstalk. The insertion loss is below 2 dB.

Phased-Array WDM Devices
Power combiners may be used to add optical signals with different wavelengths into a single optical fibre. Separating these signals requires a wavelength dispersive component or WDM. Most WDM's are based on a phased-array which can be thought of as a diffraction grating made from channel waveguides. It consists of an array of single mode waveguides, which are connected between two focusing slab waveguides. The input and output waveguides are connected at the ends of the slabs. The ends of the input and output waveguides as well as the array waveguide ends are arranged on an arc.

Each of the array waveguides is longer than its neighbour by a constant length. For the centre wavelength of the array, the path length difference between the adjacent waveguides is a multiple of that wavelength. As the fields from the array waveguides propagate through the second slab region, they are gradually converted into a single wavefront. The new wavefront will converge to one point and will be efficiently coupled into one of the output waveguides. If a plurality of wavelengths is sent into the device, each wavelength will exit the array waveguides with a slightly different angle and enter one particular exit waveguide. The centre wavelength of the array, lambda0, may be defined according to n c ^ L = m lambda 0 where m is the diffraction order of the grating. MIC has fabricated two fibre pigtailed WDM prototypes for the EU project METON. We recorded the transmission spectra from the input port to each of the four output ports. After pigtailing we obtained 6-8 dB loss and better than -26 dB crosstalk.

Theory of charge transport in superlattices
Antti-Pekka Jauho and Andreas Wacker (now at TU-Berlin) have developed microscopic theories for charge transport in superlattices and multiple quantum wells. Their approach allows a detailed description of various physical mechanisms, such as surface roughness scattering or disorder caused due to doping impurities. Impurity bands have been shown to play a significant role in photon-assisted transport for low doped samples. Recently, a quantum theory of transport was proposed, which reduces to earlier theories in the appropriate limits, but, more importantly, allows one to define the limits of validity of standard theories, and to treat hitherto unaccessible regions in parameter space. The the quantum theory has been extended to include inelastic scattering, e.g., due to acoustic phonons, and compared to corresponding Boltzmann equation simulation. The next challenge will be to address the time-dependent situation, i.e., develop a fully quantum mechanical theory of photon-assisted transport in superlattices.
Time-dependent effects in mesoscopic transport
We are applying nonequilibrium Green function techniques to a number of problems in nonstationary transport in mesoscopic semiconductor structures. Examples include a proposed phase-measurement of photon-assisted transport through a quantum dot (collaboration with N.S.Wingreen, NEC Research Institute), and analysis of resonant tunneling assisted by nonequilibrium phonons (collaboration with P. Kral, U. of Toronto).

Department of Micro- and Nanotechnology
Period: 01/01/1997 → 31/12/1997
Number of participants: 1
Project Manager, organisational: Jauho, Antti-Pekka (Intern)

A micro conductance particle counter
The microchip-based micro conductance particle counter (µCPC) is a device employing the Coulter principle for counting and sizing of cells in liquid media. The µCPC has been fabricated as a planar silicon structure and sealed with a glass lid, which enables detailed observation during operation. The µCPC employs a variable aperture that allows for hydrodynamically adjusting the sensitivity for a specific type of particles. Furthermore, microtechnology gives us complete freedom over how to implement the counting orifice in a system of channels. Furthermore, making the device in silicon allows for integration of various functions such as sorting and optical detection. All in all, the µCPC could give rise to many new approaches in medical diagnostics e.g. low cost, portable equipment for decentralised health care.

Department of Micro- and Nanotechnology
Period: 01/09/1996 → ...
Number of participants: 2
Project participant: Larsen, Ulrik Darling (Intern)
Project Manager, organisational: Telleman, Pieter (Intern)

X-ray studies of silicon bonded interfaces.
The interface between two fusion-bonded silicon wafers has been investigated by synchrotron X-ray diffraction at the ESRF and HASYLAB, in close collaboration with the X-ray diffraction experts at Risø National Laboratory. The objective of this research is to study the interface structure and find applications for the unique nanostructures that occur at the interface. The fusion-bonded wafers were prepared with different twist angles between the crystals, leading to a highly ordered twist-boundary. Superstructure reflections due to the resulting regular network of dislocations at the interface were observed, and a correlation between the intensity and width of these reflections and the twist angle of the wafers has been investigated.

Department of Micro- and Nanotechnology
Risø National Laboratory for Sustainable Energy
Topsil A/S
Period: 01/09/1996 → 01/01/2002
Number of participants: 5
Project participant: Benemara, Mourad (Intern)
Vedde, Jan (Intern)
Rasmussen, Kurt (Intern)
Weichel, Steen (Intern)
Project Manager, organisational: Grey, Francois (Intern)

Dyrkning af Si 1-x Ge x heterostrukture med UHV-CVD
Department of Micro- and Nanotechnology
Period: 01/08/1996 → 01/01/1998
Number of participants: 4
Phd Student: Madsen, Niels H. (Intern)
Magnetically induced chemical analysis (MICA)
This project aims at the development of new methods that allow for the use of advanced analytical biochemistry directly in physicians offices (clinical 'point of care' systems). One of the new approaches is a method that performs a chemical analysis by moving reagent coated microparticles between different reagents and samples by secondary forces (no convection in the liquid - just particle movement!). By using secondary forces such as magnetism, centrifugation or dielectrophoresis one circumvents the application of pumps and valves for the reagent handling; a fact that makes the method cheaper, more robust and suitable for the doctors office. Magnetically Induced Chemical Analysis (MICA) uses a magnetic field as the secondary force that can manipulates reagent coated paramagnetic particles. In the right magnetic field a particle with a diameter of 3 micron can obtain velocities higher that 1 mm/s, which illustrates the potential for fast reagent handling and chemical analysis. From the chemical point of view methods like MICA has been devised for the automation of immunoassays and DNA-hybridisations.

Department of Micro- and Nanotechnology
Period: 01/08/1996 → …
Number of participants: 2
Project participant:
Østergaard, Steen (Intern)
Project Manager, organisational:
Telleman, Pieter (Intern)

Poling of silica glass
Project goal: The goal is to realize a fast optical switch for use in optical networks. The switch is operated, through the electro-optic effect, by applying a voltage to the glass. Compared to existing electro-optic switches, the glass-based switch is potentially much cheaper and is easier to integrate with optical fibers. Project description: Using glass to build an electro-optic component is in principle not possible, as glasses do not show electro-optic effects. The underlying reason for this is the disordered structure of glass. If some kind of order is introduced in the glass an electro-optic effect will also be induced. One way to introduce order is by poling. Poling glass means to apply a very high voltage to the material and simultaneously heat it or expose it to laser radiation. After poling the glass shows electro-optic effects. Project status: We have induced stable electro-optic effects in silica glass. No decay of the induced effect was observed after 14 months. The induced effects are large enough to make us believe that the project goal is reachable within 2 years. Effort is also put into understanding the physical processes taking place during poling, as these are not yet clear.

Department of Micro- and Nanotechnology
Period: 01/07/1996 → 31/12/1999
Number of participants: 2
Project participant:
Arentoft, Jesper (Intern)
Project Manager, organisational:
Kristensen, Martin (Intern)

Teknologiudvikling for mikroakruatorer
Department of Micro- and Nanotechnology
Period: 01/07/1996 → 17/07/2000
Number of participants: 4
Phd Student:
Jonsmann, Jacques (Intern)
Supervisor:
Sigmund, Ole (Intern)
Integrated optics for bio/chemical microsystems

Miniaturization of analytical bio/chemical systems opens the possibility of increasing the speed with which analyses are made, reducing the necessary sample size and the consumption of costly reagents. Furthermore, the integration of the chemical system and the detection circuitry can improve reliability and functionality. Thus, by combining optical waveguide photodetector systems with micro channel structures made by means of advanced silicon technology, it should be possible to fabricate miniature integrated systems for chemical analysis which are fast, robust, and potentially inexpensive. The primary objective for this work is to establish a processing technology which makes possible the integration of optical detection circuits and biochemical microsystems and to demonstrate the use of this technology in the fabrication of useful systems formed on a single substrate. In this research, consideration is also given to developing integrated packaging of these systems in parallel with the development of the processing technology.

Department of Micro- and Nanotechnology

Add-on Metallic Microstructures for CMOS

This project aims at further development of the microlithography and electroplating process to allow released multilayer metallic structures for sensor purposes to be fabricated. In the process development compatibility with CMOS processing is emphasized, as compatibility will allow for monolithic smart sensors with integrated signal processing. We have realized very well defined released multilayer structures in pure Nickel and are trying to realize the same high quality structures in Nickel Iron alloys, that allow fabrication of high performance magnetic transducers. However, we have solved the problems with the stress control in the deposited Nickel Iron alloys. This work is also related to the SOI-CMOS project at MIC. To further the development in the project, Leif Steen Johansen worked for 4 months at Frauenhofer Institut fur Silizium Technologie, Berlin.

Department of Micro- and Nanotechnology

Studies of surface electronic properties with a micro-point probe

Department of Micro- and Nanotechnology
Ultra-high Vacuum Bonding of Silicon Wafers.
Oxide-free silicon surfaces can exist for significant lengths of time under ultra-high vacuum (UHV) conditions. Therefore, if the two flat, dust-free silicon surfaces can be brought into contact in UHV, then direct interaction between silicon dangling bonds on the two surfaces should result in strong bonding even at low temperatures. This is an interesting alternative route to low-temperature silicon wafer bonding. In the project, centimeter-sized silicon chips have been bonded in UHV at temperatures as low as 450°C, and the interface mechanical and electronic properties have been investigated.

Active Waveguides
In integrated optics many functions (e.g. splitting of signals) will result in a reduction of the output signal level of the component. One of the roles of active waveguides is to compensate for this loss. Amplification in the 1530-1560 nm wavelength range can be achieved by doping the waveguides with Er3+-ions, then optically pumping these ions into the metastable 4I13/2 state using an external laser source. A weak signal sent through the waveguide will then cause stimulated emission (to the ground state, 4I15/2) from these excited ions, resulting in amplification. The challenge is to incorporate the Er3+-ions into the host material (here a silica matrix) without having them clustering together, as this undesirable effect reduces the population of the metastable state and hence the amplification. In 1996 extensive studies of co-doping the Er-doped silica matrix with La and/or Al in order to reduce the degrading effects of Er-clustering have been performed. The lanthanum acts by mixing with the erbium and thus keeping these ions apart in the clusters, whereas the aluminum increases the solubility of Er in silica. Adequate levels of La to sufficiently separate the Er-ions in the clusters were not obtained in the studies, however the aluminum co-doping proved to be particular effective. This was verified by Transmission-Electron-Microscopy studies and in an optical characterisation set-up especially made for determination of clustering degrees in waveguides. A vital key to the success of active waveguides is the ability to combine sections of amplifying waveguides with passive waveguides (in which other functionality are performed) on the same chip. Development work on this aspect has been initiated in 1996. This, together with work initiated with NMRC, Ireland aiming at hybridising 980 nm laser diodes (the external laser source) are important steps towards highly complex and compact photonic devices.

Counting cells with a Microchip based Coulter Counter
A particle counter using the Coulter principle has been developed. In a micro system the Coulter principle can be used for counting cells in a fluid flow but also for determining the size of each cell. In the original Coulter principle a coaxial flow of
a sample containing cells and a sheathed electrolyte is passed through an orifice. When a cell passes the orifice it changes the resistance of the electrolyte from one side of the orifice to the other due to the volume displacement of the electrolyte. The Microchip Coulter counter is based on the original Coulter principle with a few changes added to the design, in order to obtain a wide range of sensitivity and long time stability. Many different Coulter counter designs have been fabricated with varying channel and orifice dimensions. Different kind of improvements have been suggested such as an adjustment of the sensitivity to the cell size and the integration of a four-point probe which could be used to improve the sensitivity of the recorded signal. The first Coulter counters have been tested with pure electrolyte to determine the electrical characteristics of the devices. Experiments with electrolyte containing calibration beads are under preparation and will be carried out during the next couple of months.

Department of Micro- and Nanotechnology
Period: 01/01/1996 → …
Number of participants: 3
Project participant:
Larsen, Ulrik Darling (Intern)
Branebjerg, Jens (Intern)
Project Manager, organisational:
Blankenstein, Gert (Intern)

Design of a 4 x 4 optical re-routing switch
Optical 4x4 switches have been designed and processed. These switches are used in optical telecommunication networks to alter the path of signals carried by light. A 4x4 switch thus has 4 optical input ports and 4 optical output ports and couples an optical signal from any of the input ports to any of the output ports in such a way that no two input signals from separate input ports are coupled to the same output port. The basic element in our 4x4 switch is the 2x2 thermo-optic switch. This switch is based on a symmetric Mach-Zender interferometer equipped with a thermo-optic phase shifter in one arm and was successfully demonstrated earlier by Dan Zauner and Lars-Ulrik Andersen at MIC. The thermo-optic switch is slow with a response time around 0.5 msec, and each 2x2 switch consumes typically around 0.5 Watt of electrical power. The general functionality requirement for a 4x4 switch results in 24 possible switching combinations. To achieve that number and maintain channel uniformity, 6 2x2 thermo-optic switches arranged in a 2x3 matrix are required. The design work involved primarily 3 dB couplers and crossing waveguides. Measurements on processed wafers so far show that it is possible to achieve switches with low insertion losses (a few dB). Future work will concentrate on reducing the crosstalk from the crossing waveguides and on developing more process tolerant designs for the 3-dB couplers.

Department of Micro- and Nanotechnology
Period: 01/01/1996 → 31/12/1999
Number of participants: 4
Project participant:
Pedersen, Jens Engholm (Intern)
Kromann, Rasmus (Intern)
Zenh, Karin (Intern)
Project Manager, organisational:
Kristensen, Martin (Intern)

Direct writing of planar waveguides with ultraviolet light
Irradiating germanium doped silica - the building block of modern fiber optical communication - with intense ultraviolet (UV) light can permanently increase the refractive index of the glass. The index changes are sufficiently large to permit direct UV writing of planar waveguides on silicon wafers using a focused UV laser beam by translating the sample on high precision, computer controlled stages. We show that this technique permits fabrication of a wide variety of waveguide devices such as directional couplers and power splitters for use in the telecommunications industry. In the past year we have focussed on problems of direct relevance to possible industrial implementation of the direct UV writing technique. The results obtained in the past year include: 1) Low insertion loss waveguides: the total optical loss experienced across UV written waveguides has been lowered substantially by optimizing the glass structure used for UV writing. Insertion losses down to 0.1 dB across 3 cm long waveguides have been demonstrated. 2) Thermal stability: a major concern regarding UV written waveguide devices is that they might not be stable enough for real-life telecom applications where highly stable operation over 25 year lifetimes is often required. The reason for this concern is that part of a UV induced index change is unstable at any given temperature where it may slowly be erased. We have verified that UV written devices can fulfill stringent industrial stability requirements. In addition, we have also explored other possible applications of UV written waveguides beyond the telecommunications industry. In co-operation with other researchers at MIC we have succeeded in integrating UV written waveguides with silicon based microfluid analysis systems, thereby opening up for many new possibilities in a very rapidly expanding field.

Department of Micro- and Nanotechnology
Electric field effects in scanning tunneling microscopy

We have developed a theory for tunneling between a surface and a model probe tip, including the effect of a finite electric field between the tip and the surface, and applied the theory to understand STM experiments of the hydrogen passivated Si(100) surface. The theoretical model is based on first principles electronic structure calculations and has no adjustable parameters. We have applied the theory to obtain theoretical STM images at relatively high voltages (2-3V) of the monohydrate Si(100) surface with missing hydrogen defects, and found excellent agreement with experimental images. However, our main goal is to use the theory to understand experimental measurements of current and voltage dependence in STM induced desorption of hydrogen. We have found that experimental measured iso-lines of constant desorption probability in the I-V plane coincide with iso-lines of constant electric field, indicating a strong dependence of the desorption mechanism upon the electric field between the tip and the sample.

Department of Micro- and Nanotechnology
Period: 01/01/1996 → 31/12/1999
Number of participants: 4
Project participant:
Stokbro, Kurt (Intern)
Grey, Francois (Intern)
Quaade, Ulrich (Intern)
Project Manager, organisational:
Jauho, Antti-Pekka (Intern)

Fiber Termination of Waveguide Components

Planar, silica-on-silicon based optical waveguide components have received much attention recently, especially as components for dense WDM systems. An important requirement for these components to be commercially useful, is that fibre termination of the waveguides must be possible in a simple way. The fibre termination has to be stable and has to ensure an efficient coupling. Ideally, the fibre termination should not create additional losses or back reflection compared to conventional fibre splicing. Processes have been developed to fabricate planar waveguide components with fibre guiding grooves integrated in the substrate. A groove is positioned at the end of each waveguide, with the center of the groove matched to the center of the waveguide. The fibre termination is performed by placing fibres in the grooves so that the position of the fibre cores and the waveguide cores are matched precisely. The fibres are fixed in the grooves with an index matched, UV-curable epoxy. We have demonstrated fibre terminations of conventional planar waveguides with coupling loss below 0.4 dB and back reflected power below -40 dB. We have also demonstrated fibre termination to UV written waveguides with excess loss due to misalignment of the fibres down to 1.1dB.

Department of Micro- and Nanotechnology
Period: 01/01/1996 → 31/12/1999
Number of participants: 2
Project participant:
Andersen, Bo Asp Møller (Intern)
Project Manager, organisational:
Kristensen, Martin (Intern)

Five Wavelength DFB Fiber Laser Source

Stable single mode laser sources with narrow linewidth are key components in high capacity wavelength division multiplexed (WDM) optical communication systems. Distributed feedback (DFB) [1,2,3] and distributed Bragg reflection (DBR) [4] fiber lasers are compact devices which are able to provide stable single mode operation. They are inherently fiber compatible and cascadable [2]. We present a multiwavelength laser source consisting of 5 fiber DFB lasers spliced together and pumped by a single 60 mW 1480 nm semiconductor laser. Each laser is fabricated individually using 5 cm erbium doped fiber spliced to dispersion shifted fiber and equipped with standard pigtails using angled connectors. The erbium doped fiber has a dopant concentration of 1.5x10^25 m^-3, core diameter of 4 mm and a numerical aperture of 0.27. It is kindly supplied by Lycom A/S. The Bragg gratings are photoinduced using a KrF excimer laser illuminating a 5 cm
long phasemask (fabricated by QPS) with 248 nm light. The fluence on the fiber is around 0.4 J/cm² per pulse. After around 3000 pulses the 4.2 cm long gratings had a peak reflectivity of 99% corresponding to a grating strength kL of around three. A phase shift was then induced in the central part of the grating by additional UV exposure. The lasers show high temperature stability. Longitudinal and polarization single mode operation without mode hopping has been verified continuously from room temperature up to 200°C as well as at -196°C. After UV writing the lasers, the angled pigtails are cut off and the lasers are spliced together and pumped with the same 60 mW semiconductor laser operating at 1480 nm.

Integrated optics in micro systems
Integrated optics have several applications in mTAS (micro Total Analysis Systems) e.g. flow cytometry and absorbency measurements. Normally integrated optical detection is based upon evanescent wave detection of surface plasmon resonance. This has the disadvantage of only detecting fluidic parameters a few microns from the walls of the flow channels when measuring on flows. One of the reasons most systems are limited to this type of detecting is that the optical transport systems are difficult to integrate fully with the flow channels. A novel fabrication technique based on UV (Ultra Violet)-writing of integrated optical waveguides in fluidic micro systems for application in mTAS has been developed. This new method is compared with classic buried channel waveguides. Waveguides can be used as evanescent wave detectors at the surface of the flow channel or as direct absorbency detectors across the centre. This enables detection of fluid near the mass flow maximum. The waveguides are fully compatible with micro fabrication of liquid handling systems. Furthermore, the waveguide fabrication technique developed is based upon direct UV-writing, which is ideal for fast prototyping and eliminates the problems associated with planarisation.

Liquid handling in micro chemical analysis systems
Liquid handling systems have been developed that contain pumps, switching valves, filters and mixers. These microsystems have a number of advantages over conventional systems: the problem of external interconnections is avoided, consumption of reagents is drastically reduced, and the mixing of reagents is highly predictable, reproducible, and fast. The main effort in 1996 was to improve fluidic interconnections in microsystems. It is important to connect external liquids and pneumatically controlled pumps and valves in the micro system without any leakage at the liquid inlets. Several solutions have been developed and the final solution consists of adding a second glass plate that has been machined and bonded to the sandwich that now consists of glass/silicon/glass. Fluidic channels and feed-through connections are etched through the 500 μm thick glass plate. This process is based on unique etching techniques developed in this project. By making the feed-through connections and fluidic channels in the glass plate and bonding it hermetically to silicon, all inlets of the system are equally distributed over the microsystem surface. Each inlet is interconnected by a tube and individually sealed. This concept has also made it possible to integrate an optical patch in the system in which optical absorption measurements can be done inside the liquid channels in the microsystems. Future work will focus on improvements of the liquid handling system and research on chemical reactions in these systems.
**Micro channel systems for bio/chemical analysis**

A modular concept for micro liquid handling in chemical and biochemical analysis was developed. All devices presented are based on monolithic structures manufactured with the same simple micro fabrication techniques. The devices are designed to be tolerant to particle containing samples allowing novel applications in biochemical and cellular analysis. This basic strategy has been used in the design of sorters/injectors, immobilisation reactors, Coulter counter, mixers, valves, dialysis membranes and flow sensors. All devices have been fabricated using a single silicon wafer with channels etched on both sides. A separating membrane was selectively perforated to connect the channels at over crossing regions.

Example: A micro fluidic injection valve was developed allowing a reproducible the injection of minute amount of liquids on a continuous flow stream down to 0.1 nl. For demonstration the flow switch in chemical analysis a chemilumino metric glucose assay was used. For this a simple flow injection analysis system was designed using the flow switch for both, sample injection and reagent addition. The experimental results showed excellent reproducibility (r. s. d. 0.5 - 2.5 %, n=10) in the linear range of 0.1 mM to 10 mM, reflecting the stability and reliability of the injection system. By using the flow chip simultaneously for reagent addition and sample injection the system becomes very simple.

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**Micro fabricated flow system for magnetic cell/particle separation**

In this project a micro channel-based system for continuous separation of magnetic particles was developed, with possible application in cell and particle separation, immunoassay, receptor assays or affinity purification. The system offers the novel possibility to handle, entrap and sort small volumes of cell samples in a continuous or stopped-flow regime. By using a micro fabricated flow chip with integrated permanent or electromagnets, magnetic particles can be sorted in a one-step procedure. The magnetic field has not to be removed and no washing steps have to be implemented. The micro channels of the flow chip are etched into silicon and covered with a transparent glass plate, which allows an external optical observation and detection of the liquids inside the micro channels using a microscope. In that respect the opto magnetic flow cytometry system combines both, optical characterisation of cells and magnetic separation. An apparatus for magnetic separation including a system of valves, syringe pumps and the flow chip has been designed and used for initial experiments. The simple and portable auto-sorting system has been atomised for magnetic particle separation. The suitability of the flow chip is demonstrated by separation of paramagnetic particles and living cells. Enrichment rates of more than 300-fold can be achieved.
Micro fabricated flow system for manipulation and sorting of living cells

A novel micro machined system for manipulation, analysis and sorting of particles and living cells has been designed. The micro tool was developed for imaging cytometry allowing both micro liquid handling (sample pre treatment: filtration, reagent addition and rapid mixing) and optical detection. Micro channels (200 mm x 50 mm) are etched in a silicon wafer and covered with a boron glass plate, which allows the external observation and detection of the sample inside the micro channels using a microscope system. Due to the small channel dimensions (500 mm x 100 mm, 200 mm x 50 mm) the flow is laminar with negligible influence of inertia forces. With the design of a totally closed system laboratory contamination is avoided. Cells and particles were detected by fluorescence using a CCD camera and a PMT system. Additionally electrical counting and characterisation of the sample were performed inside the micro system using the Coulter principle. In this study we describe results of fluorescence and “coulter” measurements on fluorescent-labelled particles and cells in suspension (T-lymphocytes). Examples of cell sorting will be presented to illustrate the potential of micro fluid systems in cellular analysis. By using a fluidic separation method sorting frequencies up to 2,000 events/sec can be realised. The novel sorting method allows an enrichment of rare cells with negligible dilution of the sorted cells. The presented micro flow device is a versatile tool for cell manipulation: Besides rapid cell sorting, kinetic assays or stimulation studies can be performed. The perspectives of micro fabricated instrumentation in analytical cytology and medicine are discussed.

Department of Micro- and Nanotechnology
Period: 01/01/1996 → …
Number of participants: 3
Project participant:
Larsen, Ulrik Darling (Intern)
Branebjerg, Jens (Intern)
Project Manager, organisational:
Blankenstein, Gert (Intern)
Project

Micro flow systems for isolation, manipulation and analysis of foetal cells in blood

Content of this project is to develop a system for separation and analysis of foetal cells in whole blood by using and integrated automated micro flow system. Sorting of foetal cells in maternal blood provides a non-invasive alternative to prenatal diagnostic procedures, such as amniocentesis of chorionic villus sampling. In this context a magnetic separation system, developed at MIC, could be a tool for rare event isolation of foetal cells. Separation of foetal cells from the maternal blood is based on specific surface markers and/or physical specification, e.g. cell volume and cell size. The project has started in collaboration with Chromosomal Laboratory at the Rigshospital. Experiments with maternal blood samples are under preparation and will be carried out during the next couple of months.

Department of Micro- and Nanotechnology
Period: 01/01/1996 → …
Number of participants: 2
Project participant:
Hougaard, Charlotte (Intern)
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Blankenstein, Gert (Intern)
Project

Multi-functional waveguide structures

When designing planar waveguides it is of great interest to be able to separate different functions physically. One very important example is in the design of erbium doped planar waveguide devices. The rare earth element erbium is incorporated in the core of the waveguides to provide optical gain and compensate for losses. Furthermore, the incorporation of erbium also makes possible the fabrication of integrated lasers. However, if all of the waveguides in such a device are erbium doped it becomes impossible to maintain population inversion throughout the whole of the device when realistic laser diode pump power levels are considered. This sets a strict limit on the splitting ratio that can be obtained in loss-less splitters. To overcome this problem the device must be designed with two different types of glass in the core: passive and active (erbium doped). Other examples are the integration of ordinary waveguides with UV-written waveguides, as well as the integration of glasses with different refractive indices. The latter can be used for device miniaturisation. The glass deposition method used is planar which ensures that when depositing a layer, e.g. core layer, the properties of the glass are constant over the entire wafer. Thus, in order to incorporate two different types of core glasses some sort of multilevel integration will be necessary. However, true multilevel integration might not be the best solution. The reason for this is the losses experienced due to mismatch of the phase velocity when coupling between the layers. It is impossible to obtain good phase matching, particularly when two different wavelengths must be coupled between layers with different properties. At MIC we have therefore developed new advanced processes for meeting the challenge of integrating two or more different glasses in the same plane.

Department of Micro- and Nanotechnology
Optical absorption in mesoscopic structures in intense THz-fields
We have theoretically studied the effect of THz radiation on the linear optical absorption spectra of semiconductor structures. A general theoretical framework, based on nonequilibrium Green functions, is formulated and applied to the calculation of linear optical absorption spectrum for several nonequilibrium mesoscopic structures. We show that a blue-shift occurs and sidebands appear in bulk-like structures (the dynamical Franz-Keldysh effect). The properties of the calculated side-band intensities and energies appear to resolve problems in the interpretation of data obtained with the Free Electron Laser at UCSB. An analytical calculation leads to the prediction that in the case of superlattices distinct stable steps appear in the absorption spectrum when conditions for dynamical localization are met.

Planar Optical Add/ Drop multiplexer
The capacity of optical networks can be increased significantly by propagating several wavelengths simultaneously through the optical fibres. An Optical Add/Drop Multiplexer (OADM) is one of the key components in such multi-wavelength transmission systems because of its ability to extract or add a certain wavelength at a node of the network. One of the most promising designs of an OADM device is based on a Mach-Zehnder interferometer with Bragg gratings written in the arms. A Mach-Zehnder interferometer is a four-port element made of two identical 3dB-couplers linked by straight waveguides. The glass deposited on the silicon is photosensitive. It means that when exposed to UV-light the refractive index of the glass increases. When positioning a phase mask between the UV-beam and the waveguide, an interference pattern can be generated resulting in the inscription of Bragg gratings in the arms of the Mach-Zehnder interferometer. These gratings reflect one wavelength and are transparent to all the other wavelengths. Several wavelengths (usually 4) enter the device at the input port. They all exit the Mach-Zehnder interferometer at the output port except the one which is reflected by the Bragg gratings. This wavelength exit the device at the drop port. An identical wavelength, but carrying different information, may be inserted at the add port and will exit the component together with the other wavelengths.

Quantum Kinetics in Transport and Optics of Semiconductors
Nanoscale miniaturization and femtosecond laser-pulse spectroscopy require a quantum mechanical description of the carrier kinetics that goes beyond the conventional semiclassical Boltzmann theory. On these extremely short lengths and time scales the electrons behave like partially coherent waves. This monograph deals with the quantum kinetics for transport in low-dimensional microstructures and for ultrashort laser pulse spectroscopy. The nonequilibrium Green function theory is described and used for the derivation of the quantum kinetic equations. Numerical methods for the solution of the retarded quantum kinetic equations are discussed and results are presented for quantum high-field transport and for mesoscopic transport phenomena. Quantum beats, polarization decay, and non-Markovian behaviour are treated for femtosecond spectroscopy on a microscopic basis. A new, updated and expanded version of the book is under preparation (the first two printings are sold out).
Sampled Gratings in Planar Ge-Doped Waveguides

We have UV-induced sampled gratings with a reflectivity up to 99.9% in planar Ge-doped waveguides. Sampled gratings are formed by modulating the amplitude of a conventional grating with an amplitude mask. The transmission spectrum of a sampled grating structure can be obtained from coupled mode theory. The result is a series of equally spaced peaks centered around a wavelength close to that of the unsampled grating. The spacing between the peaks is given by where c is the speed of light, navel the average refractive index in the sampled grating and Z0 is the sampling period. This spacing is controlled very accurately by the amplitude mask which determines Z0. The shape of the convolution curve below the peaks can also be controlled in a simple way by the duty cycle of the amplitude mask (ratio between grating and no grating). The experimental transmission spectrum of a sampled grating is shown above. Sampled gratings with multiple reflection peaks are interesting candidates for wavelength selective elements in integrated optical devices. Particularly in WDM-networks which are based on simultaneous transmission of several equally spaced wavelengths.

Department of Micro- and Nanotechnology

Self-organised growth on structured substrates

The mechanism of ordering of germanium islands grown on relaxed silicon-germanium thin films has been elucidated. The growth experiments are carried out by the MBE group at Århus, and the results are analysed by atomic force microscopy at MIC. An objective of this research is to develop techniques for fabrication of monodisperse nanostructures that can serve as quantum dot structures for electronic or optical applications. The Ge islands were observed to grow along dislocations in the relaxed SiGe layers, on regions where the lattice was relaxed and there was a smaller mismatch with Ge. Work has been started to control the lattice relaxation of the substrate by prefabrication of mesa structures using laser.

Department of Micro- and Nanotechnology

Single atom manipulation on silicon.

The mechanism of a single atom switch on silicon has been elucidated by a combination of detailed experiments and first principles theory. The objective of this research is to find ways to make simple atom-scale devices that work at room temperature and on silicon. The experiments were carried out on hydrogen-passivated silicon in ultra-high vacuum using a scanning tunneling microscope. By suitable choice of the voltage and current between the metal tip of the STM and the surface, it is possible to move a single hydrogen atom back and forth between two neigbouring silicon dangling bonds in a controlled fashion. The mechanism is a current-induced excitation of a surface resonance which lowers the barrier for diffusion between the two sites.

Department of Micro- and Nanotechnology
Transmission phases in time-dependent transport
Recent pioneering measurements by a group headed by M. Heiblum have shown that it is possible to directly probe the quantum mechanical phase of a quantum dot. Surprisingly, the experiments show that in the vicinity of a Coulomb oscillation peak a single-particle description is possible, even though the quantum dot has strong interparticle correlations. We point out that a time-dependent gate voltage, applied on the plunger gate controlling the occupation in the quantum dot, should yield a wealth of new information on the phase-relaxation mechanisms within a strongly interacting quantum system. We are in the process of extending our qualitative considerations to realistic experimental systems: the full two-dimensional potential landscape will be discretized and solved on a computer.

Wafer scale hybrid integration of transducers and circuits
Department of Micro- and Nanotechnology
Period: 01/01/1996 → 22/09/1999
Number of participants: 3
PhD Student:
Heschel, Matthias (Intern)
Main Supervisor:
Bouwstra, Siebe (Ekstern)
Examiner:
Rasmussen, Karsten Bo (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Mic-Finansieret-SU
Project: PhD

Avanceret packaging af mikromekaniske systemer eksponeret til affressive medier.
Department of Micro- and Nanotechnology
Period: 01/09/1995 → 07/03/1999
Number of participants: 3
PhD Student:
Christensen, Carsten (Intern)
Supervisor:
Petersen, Jon Wulff (Intern)
Main Supervisor:
Bouwstra, Siebe (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Mic-Finansieret-SU
Project: PhD
STM induced hydrogen desorption on Si(100)-H(2x1)

With an STM tip it is possible to remove single hydrogen atoms from a hydrogen passivated surface. This is the ultimate limit in a lithographic process, and opens new possibilities for constructing nanoscale devices. To understand the desorption mechanism we have measured the dependence of the desorption rate on current and sample bias. We find that it is possible to desorp H at both bias conditions and the dependence on current follows a powerlaw. This indicates that the physical mechanism is vibrational heating of the hydrogen atom, due to inelastic tunneling electrons. The experimental data is modeled with a new first principles theory for inelastic tunneling between a real surface and a model probe tip, and we find quantitative agreement between the first principles calculation and the experimental data. At positive sample bias the mechanism is inelastic scattering of tunneling electrons with the Si-6sigma* resonance. At negatives sample bias eletrons tunnel from the surface towards the tip, leaving a hole behin. This process can be described by a tunneling hole, and the desorption is due to inelastic scattering of the hole with the Si-H 5sigma resonance.

Department of Micro- and Nanotechnology
Period: 01/09/1995 → 01/01/1998
Number of participants: 4
Project participant:
Hu, Ben Yu-Kuang (Intern)
Stokbro, Kurt (Intern)
Quaade, Ulrich (Intern)
Project Manager, organisational:
Grey, Francois (Intern)

Teori for Quantum Devices
Department of Micro- and Nanotechnology
Period: 01/09/1995 → 10/08/1999
Number of participants: 4
Phd Student:
Johnsen, Kristinn (Intern)
Main Supervisor:
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Examiner:
Jacobsen, Karsten Wedel (Intern)
Smith, Henrik (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Mic-Finansieret-SU
Project: PhD

Mikroelektronik til mikrosystemer
Department of Micro- and Nanotechnology
Period: 01/08/1995 → 17/07/2000
Number of participants: 3
Phd Student:
Johansen, Leif (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Gravesen, Peter (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Center-Finansieret-SU
Project: PhD

Lithography by Atomic Force Microscope and Laser.
Two techniques for lithographic patterning of silicon have been succesfully combined. An atomic-force microscope is used to oxidize hydrogen-passivated silicon on the nanometer scale. A focussed laser is used to perform the same oxidation on the micrometer and millimeter scale. The resulting combined oxide pattern acts as a mask in a subsequent etch procedure, which transfers the pattern into the underlying silicon. A nanowire connected by micrometer-wide wires to
Biocompatible Microelectrode Arrays

We have developed a microelectrode array for stimulation of Rat Hippocampus slices, and detection of the electrical response from the cells. The microelectrode array is designed for studies of the Long Term Potentiation effect (LTP), which is possibly related to memory. For the LTP studies, it is necessary to keep the Hippocampus slice alive on the array for a very long time, during which localized, reproducible stimulus and signal pick-up must be performed at regular intervals. Hence, biocompatibility is a very important issue. The present array have 200 electrodes for stimulation and detection and is very biocompatible, as the cells can live there for months. Preliminary results were presented at the Micro-Bio Seminar at DTU in 1996. The results were presented at the 27th Annual Meeting of the Society for Neuroscience, New Orleans oct. 1997.
Waveguide Gratings
The increasing demand for high bit-rate telecommunication links is met by transmitting data at several wavelengths simultaneously through a single optical fiber. To add and separate these different wavelengths, special wavelength selective elements are required. The rapidly increasing demand for highly wavelength selective elements can be met by inducing Bragg gratings directly in the core of optical waveguides using UV light at a wavelength around 248 nm and a diffractive optical element called a phase mask. The goal of this research project is to implement an advanced UV writing facility which can induce almost any given index modulation in a waveguide structure with the aid of highly accurate computer controlled translation stages. The first part of the project including characterization of the index change versus fluence showed very promising results. To control the translation stages and the different UV laser sources an advanced software package is currently being developed. It includes algorithms based on a phenomenological model developed at MIC to translate a desired index profile into a UV light fluence profile. In 1998 we have also carried out a thorough investigation of the nature of the single mode laser output of distributed feedback (DFB) fiber lasers developed earlier in the project. We find that the birefringence of the UV induced phase-shift is responsible for the extremely stable single polarization-mode output of the laser. Progress in the active waveguide program enabled demonstration of planar germanosilicate distributed Bragg reflector (DBR) lasers. In this project the mirrors were UV induced directly in a planar erbium doped waveguide. By shifting the maximum wavelength of reflection between the two gratings in the laser resonator, mode selection was obtained leading to stable single mode laser output.

Department of Micro- and Nanotechnology

Ultrafast sampling techniques
As semiconductor devices approach THz operation frequencies and device sizes enter the submicron regime, new tools for investigating their performance are required. For this purpose we developed an ultrafast scanning tunneling microscope (USTM). The technique relies on gating of the signal in the tunneling current circuit with a photoconductive switch. The switch is activated for 1 ps upon illumination with a 100 fs probe laser pulse. By exciting the sample with a pump laser beam from the same source, a short transient is generated. The only requirement for this transient is that it can be picked up by the tunneling tip either through a physical or an electrical change of the tunneling junction. As is common to all ultrafast sampling techniques, the time resolution is achieved by varying the optical delay between pump and probe beams. Our experiments on transmission lines have clarified the operation principle of the USTM. When measuring a picosecond pulse on a coplanar transmission line, the signal is picked up through the geometrical capacitance formed by the tunneling junction. The spatial resolution is, therefore, determined by the tip radius and is not given by the tunneling region. We also demonstrated the first spatially and temporally resolved measurements with this instrument. Electrical pulses on transmission lines can be mapped out in great detail with a temporal resolution of 2 ps. The ability to measure the field distribution in the 100 GHz to 1 THz range, will be essential for the integration of active devices operating in this frequency range. The more established techniques like photoconductive sampling and electro-optic sampling complement our USTM-measurements. The temporal resolution limit of electro-optic sampling is 200 fs and the spatial resolution is about 3 µm. We measure response times down to 800 fs and pulse amplitudes up to 3 V.

Department of Micro- and Nanotechnology
Microsystems packaging
The purpose of the project, which is supported by the MUPPI frame program "Advanced Packaging" and the centerkontrakt "Microsystem Centre", is to develop technology for advanced packaging of silicon transducers applied in hostile media. This is of paramount importance in many applications of these transducers. We follow the approach of doing as much as possible of the packaging on a wafer-scale, so that the dicing and the more expensive handling of individual chips is pushed further down the process sequence. The technologies will also lead to a modular but wafer-scale approach of integration of different functions, in particular the integration of transducers and circuits. Thin film materials are developed and tested for their passivation capabilities, such as silicon carbide, diamond-like-carbon, diffusion barrier alloys. These materials are required to be chemically resistant to the media, to form a diffusion barrier, and have to be pinhole free. They also have to be a window which is transparent for the desired interaction with the environment. Preliminary experimental results are promising. Also, technologies are developed for wafer-scale bonding to interface substrates, which form the physical interface to the measurand (e.g. a pressure port), or the communication interface to a host system (e.g. circuit for signal conditioning). The project involves two demonstrators: a pressure sensor exposed to aggressive media, and a microphone for hearing aids. Technologies are developed for electrical interconnections between the wafers, hermetic sealing with electrical feedthroughs, and for lithography in deep anisotropically etched holes in silicon. Current investigations include eutectic bonding using a metal thin film, anodic bonding using a glass thin film, and electrophoresis for photolithography in deep holes. Methods for accelerated testing of passivation and with high sensitivities are developed, as well as methods for determining sealing capabilities.

Department of Micro- and Nanotechnology

Grundfos A/S

Danfoss A/S
Period: 01/10/1994 → 01/10/1999
Number of participants: 16
Project participant:
Christensen, Carsten (Intern)
Petersen, Jon Wulff (Intern)
Henke, Sascha (Intern)
Kuhmann, Jochen Friedrich (Intern)
Heschel, Matthias (Intern)
Reus, Roger De (Intern)
Pedersen, Eddie Hjelm (Intern)
Weichel, Steen (Intern)
Dyrbye, Karsten (Ekstern)
Janting, Jakob (Ekstern)
Gravesen, Peter (Ekstern)
Søndergaard, Ole (Ekstern)
Krogh, Jens Peter (Ekstern)
Birkelund, Karen (Ekstern)

Project Manager, organisational:
Bouwstra, Siebe (Intern)
Romedahl, Tina (Ekstern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 650,000.00 Danish Kroner

Source: Unknown
Name of research programme: Ukendt
Amount: 4,000,000.00 Danish Kroner
Source: Unknown
Name of research programme: Ukendt
Amount: 1,500,000.00 Danish Kroner
SOI-CMOS Process
We have developed a SOI-CMOS process based on a commercially available Silicon on Insulator on Silicon (SOI) substrate. An SOI-CMOS process yields very high performance MOS devices with significantly reduced parasitics compared to bulk CMOS devices. The improved device performance is realized in spite of a significant reduction in the number of processing steps needed for fabrication. This makes SOI-CMOS processes a strong candidate for monolithic smart sensors, where improved system yield can be expected due to the decrease in complexity of the fabrication process. We have finished two successful runs of the process. In 1997 the process will be further optimized to include more metal layers and a possible integration of electroplated metallic microstructures for smart sensor purposes.

Department of Micro- and Nanotechnology
Period: 01/09/1994 → …
Number of participants: 3
Project participant:
Johansen, Leif (Intern)
Ravnkilde, Jan Tue (Intern)

Thick Photoresist and Electroplating
As a part of a MUPII programme at IPT we have a cooperative effort on development of a microfabrication technology for metallic microstructures using a combination of microlithography and electroplating. In the project, techniques for structuring very thick photoresist moulds, which are subsequently filled with low stress electroplated metal has been developed. The process development work is still continuing e.g. in order to be able to use new materials in the process. During the project several novel micromechanical devices have been fabricated, among these the first all-metal microfabricated AFM-probe (AFM: Atomic Force Microscope). The probe have a number of interesting potential applications. First of all it can be applied for a combined AFM and STM (STM: Scanning Tunnelling Microscope) measurement. Secondly it can be used for nanolithography, where it is expected to be more rugged than the usual metal coated nitride cantilevers. The probe is being commercialized by DME A/S. The work on the all metal cantilevers is accepted for presentation at Transducers 97. Whereas the technology development was presented at 83th AESF Annual Technical Conference SUR/FIN >96. (P.T.Tang, M.E. Benzon J.P.Rasmussen, and F.S. Fontenay: Important parameters and applications for Nickel Electroforming in Proc. Of 83th AESF Annual Technical Conference SUR/FIN >96 (AESF, Cleveland Ohio, 1996) )

Department of Micro- and Nanotechnology
Department of Manufacturing Engineering
Period: 01/09/1994 → …
Number of participants: 4
Project participant:
Rasmussen, Jan Pihl (Intern)
Møller, Per (Intern)
Tang, Peter Torben (Intern)

Growth and Characterisation of InAlGaAs Quantum wires
In the research of future semiconductor lasers, one important goal is to reduce the dimensionality of the active region - that is to minimise the number of degrees of freedom for the motion of electrons and holes. This will lead to lasers with lower threshold currents, higher differential gain and less temperature dependence. This project aims at fabricating and optimising one-dimensional semiconductor structures, quantum wires. The structures are grown with molecular beam epitaxy (MBE), using the cleaved edge overgrowth (CEO) technique: First, a number of quantum wells are grown on the [100]-direction, and secondly the quantum wells are cleaved in ultra high vacuum and overgrown with a single quantum well in the [110]-direction. At the T-shaped intersections of two quantum wells a bound quantum wire state is formed, with a typical size of 8 nm x 20 nm. The energy difference between the quantum wire state and the lowest quantum well state in the structure, the confinement energy, should be as large as possible to avoid thermal activation out of the quantum wires at room temperature. A world record confinement energy of 52 meV and the first four-wave mixing study of T-shaped quantum wires have been achieved by the III-V Components Group at COM, using a so-called asymmetric structure in the AlGaAs material system. Future research aims at achieving higher confinement, e.g. by taking advantage of strain effects in the InAlGaAs material system, and laser structures for electrical and optical pumping are being processed. Furthermore, time dependent studies have been initiated, in order to investigate carrier diffusion and capture in the structures. The
Growth and characterisation of InAlGaAs quantum wires. 

In the research of future semiconductor lasers, one important goal is to reduce the dimensionality of the active region - that is to minimise the number of degrees of freedom for the motion of electrons and holes. This will lead to lasers with lower threshold currents, higher differential gain and less temperature dependence. This project aims at fabricating and optimising one-dimensional semiconductor structures, quantum wires. The structures are grown with molecular beam epitaxy (MBE), using the cleaved edge overgrowth (CEO) technique: First, a number of quantum wells are grown on the [100]-direction, and secondly the quantum wells are cleaved in ultra high vacuum and overgrown with a single quantum well in the [110]-direction. At the T-shaped intersections of two quantum wells a bound quantum wire state is formed, with a typical size of 8 nm × 20 nm. The energy difference between the quantum wire state and the lowest quantum well state in the structure, the confinement energy, should be as large as possible to avoid thermal activation out of the quantum wires at room temperature. A world record confinement energy of 52 meV and the first four-wave mixing study of T-shaped quantum wires have been achieved by the Optoelectronics Group at MIC, using a so-called asymmetric structure in the AlGaAs material system. Future research aims at achieving higher confinement, e.g. by taking advantage of strain effects in the InAlGaAs material system, and laser structures for electrical and optical pumping are being processed. Furthermore, time dependent studies have been initiated, in order to investigate carrier diffusion and capture in the structures. The fabrication of the quantum wires takes place at the III-V NANOLAB, a collaboration between MIC and the NBI at the University of Copenhagen. The wires are characterised at MIC, using both photoluminescence as well as more sophisticated techniques like spatially and time resolved photoluminescence and four-wave mixing.
Optically Active Materials in Fibers and Silica-on-Silicon Integrated Photonics Circuits

The MUP2 frame program "Optically Active Materials in Fibers and Silica-on-Silicon Integrated Photonics Circuits" aims to develop photonics components for local networks and high speed optical communication systems. This requires development of new, optically active and non-linear materials. In particular, the program has initiated activities within the following areas: - Development of processes for erbium doping PECVD grown silica films - development of erbium doped silica planar waveguides with gain - development of erbium doped loss-less functional devices - development of high-concentration erbium doped fibers for fiber lasers - development of erbium doped polarisation maintaining fiber - development of low-concentration distributed erbium doped fiber for distributed optical amplifiers - development of fiber lasers for high-speed systems - development of techniques for fiber termination of integrated photonic devices - development of models for high-concentration erbium doped waveguides - development of models for erbium doped fiber lasers

Electromagnetic Systems

Department of Electrical Engineering

IONAS A/S

Lucent Technologies Denmark A/S

Period: 15/06/1994 → 30/06/1998

Number of participants: 1

Project Manager, organisational:

Bjarklev, Anders Overgaard (Intern)

Financing sources

Name of research programme: Ukendt
Amount: 1,351,000.00 Danish Kroner

Active Waveguides

Planar active waveguides are made of glass doped primarily with erbium. These waveguides possess strongly non-linear optical properties, which allow a pump laser to amplify weak signals passing through the waveguide. In 1998, glass compositions were further developed, which resulted in the first measurement of net amplification through a six cm long waveguide. A gain factor of 0.35 dB/cm was measured, which is more than sufficient to compensate for typical waveguide insertion losses. By UV-inducing Bragg-gratings in these amplifying planar waveguides a number of lasers have been produced, which showed state-of-the-art performance. We regard these results as major breakthroughs for the group and for the technology employed. Moreover, in 1998 the first steps were taken towards a hybridisation of diode pump lasers with planar silica waveguides. This together with the already successful integration of doped with non-doped glass will greatly add to the flexibility of the technology. In parallel with these achievements, glass compositions and properties are researched on a more fundamental level. Particularly interesting is our discovery of self-organisation of erbium-precipitates at high temperatures. Moreover, a theoretical modelling, primarily based on density-functional-theory, of the chemical structure of Er/Al-doped silica has been initiated in 1998.

Department of Micro- and Nanotechnology

Period: 01/04/1994 → 31/12/1999

Number of participants: 5

Project participant:

Sckerl, Mads W. (Intern)
Laurent-Lund, Christian (Intern)
Guldberg-Kjaer, Søren Andreas (Intern)
Laegsgaard, Jesper (Intern)

Project Manager, organisational:

Poulsen, Mogens Rysholt (Intern)
AFM probes
The primary goal is to develop a technology for versatile shapes of tips integrated with AFM cantilevers, so-called passive probes with external read-out. For this we have developed a process sequence for direct tips, where tips are obtained by etching the surrounding material, and a process sequence for indirect tips, formed by electroplating in etched holes, where the substrate is subsequently etched. In the direct method we have developed a novel tip shape, which we have named rocket-tips. The different tip shapes integrated with cantilevers have been demonstrated on several test samples. The second goal is to develop a demonstrator active probe, i.e. with integrated read-out, for a wide range of applications. After comparing different transduction principles we have chosen for piezoresistive read-out, using single-crystalline silicon piezoresistors on oxide. Modelling has yielded a design for optimum signal-to-noise ratio. A process sequence has been developed. A demonstrator is now under construction. For ultrahigh-vacuum applications an AFM probe with capacitive read-out is under development. The fabrication technology is based on electroplating in anisotropically etched cavities in silicon.

Department of Micro- and Nanotechnology

DME - Danish Micro Engineering A/S

Aarhus University
Period: 01/04/1994 → …
Number of participants: 6
Project participant:
Boisen, Anja (Intern)
Hansen, Ole (Intern)
Johansen, Leif (Intern)
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Thaysen, Jacob (Intern)
Project Manager, organisational:
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Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 180,000.00 Danish Kroner

Spm-probes

Department of Micro- and Nanotechnology
Period: 01/04/1994 → …
Number of participants: 2
Phd Student:
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Main Supervisor:
Bouwstra, Siebe (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Erhvervsforskerordningen
Project: PhD

Silicon Microphone

Department of Micro- and Nanotechnology
Period: 01/03/1994 → 08/08/1997
Number of participants: 4
Phd Student:
Bay, Jesper (Intern)
Main Supervisor:
Bouwstra, Siebe (Ekstern)
Examiner:
Bruun, Erik (Intern)
Laser Microfabrication for fast prototyping

The laser direct-write system is based on a 20 W Ar-ion laser, on-axis optics, A/O beam modulation, and precision stages. The system is interfaced to a commercial 3-D CAD program by in-house developed software. Investigated applications of the system include photoresist exposure, membrane cutting, via hole etching, and the generation of truly 3-D structures such as microoptic and microfluidic components. 3-D structures are produced by sectioning CAD generated objects and subsequent layer-by-layer removal. To ensure writing uniformity and to reduce writing time, the system works on the fly, so that stage acceleration and deceleration is performed before and after writing, respectively. The main effort has been put into the application of the etching of silicon by chlorine, which is initiated by locally melting the silicon substrate with a focused laser beam. The removal rate is as high as 105 mm3/s and sub-micrometer resolution has been demonstrated. 3-D structures, generated by CAD, have been etched with resolutions ranging from 0.5 to 8 mm. Examples are microlens arrays for photonic devices and diffuser/nozzle elements for valve-less pumps in microfluidic systems. Post-processing on prepatterned substrates, e.g. in deep holes, 3-D machining, and the short turn-around time between device design and realization, have demonstrated the unique capabilities of laser microfabrication in prototype processing. The application of laser-machined 3-D structures in the production of molds and stamps for replication, is another promising field to be investigated.
Growth and processing of GaAs/AlGaAs heterostructures

III-V NANOLAB is a laboratory, or instrument center, that is run jointly by COM and the Niels Bohr Institute, Copenhagen University (NBI), where it is also located. It is supported by the Danish Research Councils and its purpose is to grow and process semiconductor heterostructures on a nanometer scale for the basic and strategic research programs at NBI and COM. GaAs/AlGaAs heterostructures of excellent quality are grown by molecular beam epitaxy (MBE) on (001)-oriented substrates to produce two-dimensional electron gasses of high mobility. These structures are vital for the processing of components on a nanometer scale for the studies of mesoscopic electron transport taking place at the NBI. Multiple quantum wells and superlattices of GaAs/AlGaAs are grown for the studies of linear and nonlinear optical properties of quasi two-dimensional quantum systems. Optimization of MBE epitaxial growth on higher index surfaces, (110) in particular, has also been performed. A cleaved edge overgrowth technique has been implemented by which one-dimensional quantum wire systems is being grown. Growth of low-temperature GaAs has been optimized in order to produce a photoconductive material with a very short carrier lifetime for use in ultrafast photoconductive switching and sampling. III-V NANOLAB also produces custom designed samples on a commercial basis, e.g. quantum-Hall effect samples for resistance standards and quantum well samples for GaAs diode lasers.

Department of Photonics Engineering
Department of Micro- and Nanotechnology

University of Copenhagen
Period: 01/02/1993 → 31/12/2001
Number of participants: 5
Project participant:
Jensen, Jacob Riis (Intern)
Gislason, Hannes (Intern)
Serensen, Claus B. (Ekstern)
Lindelof, Poul Erik (Ekstern)
Project Manager, organisational:
Hvam, Jørn Marcher (Intern)
Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 2,000,000.00 Danish Kroner

Growth and processing of GaAs/AlGaAs heterostructures
III-V NANOLAB is a laboratory, or instrument center, that is run jointly by MIC and the Niels Bohr Institute, Copenhagen University (NBI), where it is also located. It is supported by the Danish Research Councils and its purpose is to grow and process semiconductor heterostructures on a nanometer scale for the basic and strategic research programs at NBI and MIC. GaAs/AlGaAs heterostructures of excellent quality are grown by molecular beam epitaxy (MBE) on (001)-oriented substrates to produce two-dimensional electron gasses of high mobility. These structures are vital for the processing of components on a nanometer scale for the studies of mesoscopic electron transport taking place at the NBI. Multiple quantum wells and superlattices of GaAs/AlGaAs are grown for the studies of linear and nonlinear optical properties of quasi two-dimensional quantum systems. Optimization of MBE epitaxial growth on higher index surfaces, (110) in particular, has also been performed. A cleaved edge overgrowth technique has been implemented by which one-dimensional quantum wire systems is being grown. Growth of low-temperature GaAs has been optimized in order to produce a photoconductive material with a very short carrier lifetime for use in ultrafast photoconductive switching and sampling. III-V NANOLAB also produces custom designed samples on a commercial basis, e.g. quantum-Hall effect samples for resistance standards and quantum well samples for GaAs diode lasers.

Department of Micro- and Nanotechnology
Niels Bohr Institute
Period: 01/02/1993 → 31/12/1999
Number of participants: 4
Project participant:
Sørensen, Claus Birger (Intern)
Gislason, Hannes (Intern)
Lindelof, Poul Erik (Ekstern)
Project Manager, organisational:
Hvam, Jørn Marcher (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 1,000,000.00 Danish Kroner

Ultrafast exciton dynamics in GaAs/AlGaAs semiconductor nanostructures
The initial scattering of excitations in semiconductor nanostructures, such as quantum wells and superlattices, occurs on a femtosecond time scale. The general features of the coherent nonlinear response have been investigated by spectrally and temporally resolved transient FWM experiments which have focused on the investigation excitons and biexcitons in III-V nanostructures. The decay time of the FWM signal, in real and/or delay time, is a measure of the loss of coherence of the excited transitions. The effect of the excitation intensity on the exciton nonlinear response has been investigated on GaAs/AlGaAs quantum wells of different thickness and consequently different inhomogeneous broadening. A density dependent exciton dephasing time is found, that acts also as a source of FWM signal. The character of this extra nonlinearity as a function of the inhomogeneous broadening has been analyzed. The temperature dependence of the exciton dephasing time has been measured in InGaAs/GaAs single quantum wells. A well width dependence of the exciton-acoustic phonon interaction is obtained, according to a reduced confinement of the excitonic wavefunction, strongly penetrating into the GaAs barrier, in InGaAs thin quantum wells. An important source of optical nonlinearities in semiconductor nanostructures is the biexciton formation. The influence of biexcitons on the optical properties of semiconductor nanostructures is enhanced, compared to that of the bulk semiconductor, due to the confinement of the electronic state in these structures. We have investigated the formation, binding energy, and dephasing of biexcitons in InGaAs and GaAs quantum wells as well as in GaAs quantum wires. A new technique to measure the coherence of optical excitations in solids, such as excitons, has been developed, which makes use of the random interference of scattered light.

Department of Micro- and Nanotechnology
Niels Bohr Institute
Period: 01/02/1993 → 31/12/1999
Number of participants: 12
Project participant:
Birkedal, Dan (Intern)
Ultrafast exciton dynamics in GaAs/AlGaAs semiconductor nanostructures
The initial scattering of excitations in semiconductor nanostructures, such as quantum wells and superlattices, occurs on a femtosecond time scale. The general features of the coherent nonlinear response have been investigated by spectrally and temporally resolved transient FWM experiments which have focused on the investigation excitons and biexcitons in III-V nanostructures. The decay time of the FWM signal, in real and/or delay time, is a measure of the loss of coherence of the excited transitions. The effect of the excitation intensity on the exciton nonlinear response has been investigated on GaAs/AlGaAs quantum wells of different thickness and consequently different inhomogeneous broadening. A density dependent exciton dephasing time is found, that acts also as a source of FWM signal. The character of this extra nonlinearity as a function of the inhomogeneous broadening has been analyzed. The temperature dependence of the exciton dephasing time has been measured in InGaAs/GaAs single quantum wells. A well width dependence of the exciton-acoustic phonon interaction is obtained, according to a reduced confinement of the excitonic wavefunction, strongly penetrating into the GaAs barrier, in InGaAs thin quantum wells. An important source of optical nonlinearities in semiconductor nanostructures is the bie exciton formation. The influence of bie excitons on the optical properties of semiconductor nanostructures is enhanced, compared to that of the bulk semiconductor, due to the confinement of the electronic state in these structures. We have investigated the formation, binding energy, and dephasing of bie excitons in InGaAs and GaAs quantum wells as well as in GaAs quantum wires. A new technique to measure the coherence of optical excitations in solids, such as excitons, has been developed, which makes use of the random interference of scattered light.

Department of Photonics Engineering
Department of Micro- and Nanotechnology
Period: 01/02/1993 → 31/12/2000
Number of participants: 10
Project participant:
Hvam, Jørn Marcher (Intern)
Borri, Paola (Intern)
Vadim, Lyssenko (Intern)
Sayed, Karim El (Intern)
Mizeikis, Vygantas (Ekstern)
Singh, Jai (Ekstern)
Wagner, Hans-Peter (Ekstern)
Woggon, Ulrike (Ekstern)
Zimmermann, Roland (Ekstern)
Sørensen, Claus B. (Ekstern)

Project Manager, organisational:
Birkedal, Dan (Intern)
Si 1-x Ge x epitaxielle film på silicium til heterojunction bipolære transistorer

Department of Micro- and Nanotechnology
Period: 01/04/1992 → …
Number of participants: 3
Phd Student:
Thomsen, Erik Vilain (Intern)
Main Supervisor:
Hansen, Ole (Intern)
Examiner:
Helwigh, Hans Eggert (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Gammel ordning u/skema-SU
Project: PhD

Silicon Germanium HBT's
Substituting the base of a Silicon bipolar junction transistor with a thin, strained Silicon-Germanium layer potentially improves the dynamic device performance significantly, because the Silicon-Germanium film has a lower band gap than Silicon has. In this project we develop the technology for growth of the strained Silicon-Germanium layers on silicon, and the post growth processing needed for fabrication of Silicon-Germanium Hetero Junction Bipolar Transistors (HBT's). This is a rather difficult task, as very strict control of the vertical dimensions of the device is needed in order to realise the potential advantages of the technology. The devices we fabricate has a grown Boron doped Silicon-Germanium base thickness of only 20nm, and the post growth process must not cause the Boron profile in the base to widen more than 1nm, hence, the thermal budget for the process has to be very low. We have successfully fabricated HBT's with good static and dynamic properties.

Department of Micro- and Nanotechnology
Period: 01/04/1992 → …
Number of participants: 3
Project participant:
Thomsen, Erik Vilain (Intern)
Vestergaard, Ras Kaas (Intern)
Project Manager, organisational:
Hansen, Ole (Intern)

LIS - New Light Sources, Integrated Optics and Ultrafast Switching

Department of Physics
Department of Micro- and Nanotechnology
Tele Danmark Research
Aarhus University
Period: 01/01/1992 → 30/11/1996
Number of participants: 2
Project participant:
Skettrup, Torben (Intern)
Project Manager, organisational:
Buchhave, Preben (Intern)

Financing sources
MCM

The Department of Electromagnetic Systems has participated in the MCM-project by developing numerical models for design of integrated optical components for use in telecommunications. This has been done for a number of passive integrated components: S-bends, power splitters like an Y-splitter and a MMI-type splitter and a directional coupler. Here a finite difference beam propagation method has been used as numerical tool except in the case for the MMI-type splitter. Further design of a ring resonator has been carried out and the influence of non-quadratic core dimensions (trapeze shaped) in a 3-dB coupler has been modelled and investigated.

Department of Electromagnetic Systems

Department of Micro- and Nanotechnology

NKT Research & Innovation A/S

Brüel & Kjær A/S

Topsil A/S

Grundfos A/S

Danfoss A/S

Period: 01/01/1992 → 31/12/1996

Number of participants: 2

Project participant:

Lauridsen, Vibeke Claudia (Intern)

Project Manager, organisational:

Nicolaisen, Ejner (Intern)

Financing sources

Source: Unknown

Name of research programme: Ukendt

Amount: 412,000.00 Danish Kroner

MCM Micromechanics

The MCM Micromechanics project was completed successfully in 1996. An overview of the work was presented on a seminar November 13th 1996 in several oral presentations and a poster session. More than 50 people from Danish industry and universities participated in the seminar. The final report has been sent to the ministry of industry for evaluation. A large effort was put in the development of dedicated processes and demonstrator devices for the MCM Micromechanics project (accelerometers and pressure sensors). Pressure sensors for harsh environments are of major importance in industry, and have even bigger potential if their price can be reduced. In this project, this is done by using silicon-based micromachining to integrate the sensor and its packaging on-chip. All effort in the MCM acoustics program in 1996 was focused on fabrication of micromechanical accelerometers. There has been worked on two different types: 1. a piezoelectric accelerometer based on sputtered zinc oxide films 2. an electron tunnelling accelerometer.

Department of Micro- and Nanotechnology

Danfoss A/S

Grundfos A/S

Brüel & Kjær A/S

Period: 01/01/1992 → 31/12/1996

Number of participants: 6

Project participant:

Reus, Roger De (Intern)

Pheasant, Nicholas James (Intern)

Egginton, Paul Nicholas (Intern)

Jensen, Flemming (Intern)

Hansen, Ejner Mose (Intern)

Project Manager, organisational:
**Bouwstra, Siebe (Intern)**

**Financing sources**
- Source: Unknown
- Name of research programme: Ukendt
- Amount: 30,000,000.00 Danish Kroner

**Project**
- A study of metal semiconductor contacts to inp
  - Department of Micro- and Nanotechnology
  - Period: 01/02/1991 → 01/01/1994
  - Number of participants: 2
  - PhD Student: Clausen, Thomas (Intern)
  - Main Supervisor: Leistiko, Otto (Intern)

**Financing sources**
- Source: Internal funding (public)
- Name of research programme: Gammel ordning u/skema-SU

**Project**
- Udvikling af apparatur og metode til ekstern, kontinuerlig måling af radioaktivt mærkede farmakas absorptionsmønstre
  - Department of Micro- and Nanotechnology
  - Period: 01/09/1990 → 12/11/1993
  - Number of participants: 2
  - PhD Student: Baadegaard, Niels (Intern)
  - Main Supervisor: Leistiko, Otto (Intern)

**Financing sources**
- Source: Internal funding (public)
- Name of research programme: ATV-Gammel ordning

**Activities:**

**Detection of Glyphosate Using Disposable Sensors for Fast, Inexpensive and Reliable Measurements by Electrochemical Technique**
- Period: 16 Apr 2018
- Jafar Safaa Noori (Other)
- Jan Romano-deGea (Other)
- Maria Dimaki (Guest lecturer)
- John Mortensen (Other)
- Winnie Edith Svendsen (Guest lecturer)

**Department of Micro- and Nanotechnology**

**Nano Bio Integrated Systems**

**Description**
Pesticides have been intensively used in agriculture to control weeds, insects, fungi, and pest. One of the most commonly used pesticides is glyphosate. Glyphosate has the ability to attach to the soil colloids and degraded by the soil microorganisms. As glyphosate led to the appearance of resistant species, the pesticide was used more intensively. As a consequence of the heavy use of glyphosate, residues of this compound are increasingly observed in food and water. Recent studies reported a direct link between glyphosate and chronic effects such as teratogenic, tumorigenic and hepatorenal effects although the exposure was below the lowest regulatory limit. Today, pesticides are detected in water by complicated and costly manual procedures conducted by highly skilled personnel. It can take up to several days to get an answer regarding the pesticide content in water. An alternative to this demanding procedure is offered by electrochemical measuring techniques. Electrochemistry is an emerging technology that has the potential of identifying
and quantifying several compounds in few minutes. It is currently not possible to detect glyphosate directly in water samples, and intensive research is underway to enable direct selective and quantitative detection of glyphosate in water. This study focuses on developing and modifying a sensor chip that has the ability to selectively measure glyphosate and minimize the signal interference from other compounds. The sensor is a silicon-based chip that is fabricated in a cleanroom facility with dimensions of 10×20 mm. The chip is comprised of a three-electrode configuration. The deposited electrodes consist of a 20 nm layer chromium and 200 nm gold. The working electrode is 4 mm in diameter. The working electrodes are modified by creating molecularly imprinted polymers (MIP) using electrodeposition technique that allows the chip to selectively measure glyphosate at low concentrations. The modification included using gold nanoparticles with a diameter of 10 nm functionalized with 4-aminothiophenol. This configuration allows the nanoparticles to bind to the working electrode surface and create the template for the glyphosate. The chip was modified using electrodeposition technique. An initial potential for the identification of glyphosate was estimated to be around -0.2 V. The developed sensor was used on 6 different concentrations and it was able to detect glyphosate down to 0.5 mgL⁻¹. This value is below the accepted pesticide limit of 0.7 mgL⁻¹ set by the US regulation. The current focus is to optimize the functionalizing procedure in order to achieve glyphosate detection at the EU regulatory limit of 0.1 µgL⁻¹. To the best of our knowledge, this is the first attempt to modify miniaturized sensor electrodes with functionalized nanoparticles for glyphosate detection.

Degree of recognition: International

Related event

20th International Conference on Water Management
16/04/2018 → 17/04/2018
Activity: Talks and presentations › Conference presentations

3D printed system for testing intestinal drug transport
Period: 21 Mar 2018
Morten Leth Jepsen (Other)
Line Hagner Nielsen (Other)
Kristoffer Almdal (Other)
Anja Boisen (Other)
Martin Dufva (Other)
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Department of Applied Mathematics and Computer Science

Related event

11th World Meeting on Pharmaceutics, Biopharmaceutics and Pharmaceutical Technology
21/03/2018 → …
Granada, Spain
Activity: Talks and presentations › Conference presentations

Loading of poorly soluble drugs by supercritical CO2 impregnation into microcontainers for oral drug delivery
Period: 19 Mar 2018 → 22 Mar 2018
Chiara Mazzoni (Other)
Anastasia Antalaki (Other)
Rasmus Due Jacobsen (Other)
Jacob Mortensen (Other)
Fabio Tentor (Other)
Roman Slipets (Other)
Oleksii Ichenko (Other)
Stephan Sylvest Keller (Other)
Line Hagner Nielsen (Other)
Anja Boisen (Other)
Department of Micro- and Nanotechnology
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Nanoprobes

Department of Applied Mathematics and Computer Science

Related event

11th World Meeting on Pharmaceutics, Biopharmaceutics and Pharmaceutical Technology
21/03/2018 → …
Granada, Spain
Activity: Talks and presentations › Conference presentations

An automated flow-injection enzyme-linked immunosorbent assay for the detection of Zearalenone
Period: 7 Feb 2018 → 9 Feb 2018
Jongjit Jantra (Other)
Kinga Zor (Other)
Martin Hedström (Other)
Bo Mattiasson (Other)
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Department of Micro- and Nanotechnology
Nanoprobes

Description
Pure and Applied Chemistry International Conference 2018 (PACCON 2018), Hat Yai, Songkhla, Thailand, 7th-9th February 2018
Degree of recognition: International

Related event

Pure and Applied Chemistry International Conference 2018
07/02/2018 → 09/02/2018
Hat Yai, Thailand
Activity: Talks and presentations › Conference presentations

3D printed system for based on hydrogels for drug transport
Period: 29 Jan 2018
Morten Leth Jepsen (Other)
Line Hagner Nielsen (Other)
Kristoffer Almdal (Other)
Anja Boisen (Other)
Martin Dufva (Other)
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Department of Applied Mathematics and Computer Science

Description
3D printed system for based on hydrogels for drug transport

Related external organisation

University of Southern Denmark
Odense, Denmark
Activity: Talks and presentations › Conference presentations
Loading of poorly soluble drugs by supercritical CO2 impregnation into microcontainers for oral drug delivery
Period: 29 Jan 2018 → 31 Jan 2018
Chiara Mazzoni (Speaker)
Anastasia Antalaki (Other)
Rasmus Due Jacobsen (Other)
Jacob Mortensen (Other)
Fabio Tentor (Other)
Roman Slipets (Other)
Oleksii Ilchenko (Other)
Stephan Sylvest Keller (Other)
Line Hagner Nielsen (Other)
Anja Boisen (Other)
Department of Micro- and Nanotechnology
Office for Study Programmes and Student Affairs
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics

Related event
Northern Pharma Network Meeting
29/01/2018 → 31/01/2018
Odense, Denmark
Activity: Talks and presentations › Conference presentations

Microcontainers for oral vaccine delivery
Period: 29 Jan 2018 → 31 Jan 2018
Line Hagner Nielsen (Guest lecturer)
Department of Applied Mathematics and Computer Science
Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics

Description
Oral presentation
Documents:
Odense meeting_Microcontainers for oral vaccine delivery

Related event
Northern Pharma Network Meeting
29/01/2018 → 31/01/2018
Odense, Denmark
Activity: Talks and presentations › Conference presentations

Smart Nanomaterials for Biomedical Applications
Period: 5 Jan 2018
Arnab Halder (Invited speaker)
Department of Micro- and Nanotechnology
Degree of recognition: International

Related external organisation
Centre for Development of Advanced Computing (C-DAC, Kolkata)
Plot - E-2/1, Block-GP, Sector-V, Salt Lake Electronics Complex, Bidhannagar, 700091, Kolkata, India
Extensional flow and structure in branched model polymer (polystyrene) melts
Period: 18 Dec 2017
Kristoffer Almdal (Invited speaker)
Department of Micro- and Nanotechnology

Description
Seminar at the Department of Chemistry and Chemical Biology, Rensselaer Polytechnic Institute

Related external organisation
Rensselaer Polytechnic Institute
United States

Extensional flow and structure in branched model polymer (polystyrene) melts
Period: 11 Dec 2017
Kristoffer Almdal (Invited speaker)
Department of Micro- and Nanotechnology

Description
Seminar at ExxonMobile Corporate Research Center, Annandale, New Jersey, USA

Related external organisation
ExxonMobile Corporate Research Center
1545 Route 22 East, 08801, Annandale, New Jersey, United States

DTU Sustain 2017
Period: 6 Dec 2017
Steffen Foss Hansen (Organizer)
Kristian Mølhave (Organizer)
Department of Environmental Engineering
Environmental Chemistry
Department of Micro- and Nanotechnology
Molecular Windows

Description
Steering group member of DTU Sustain 2017
Degree of recognition: National

Links:
http://www.sustain.dtu.dk (Conference website)

Related event
DTU Sustain 2017
06/12/2017 → 06/12/2017
Kgs. Lyngby, Denmark
Activity: Attending an event › Participating in or organising a conference

Photovoltaic subretinal implants for blind patients
Period: 6 Dec 2017
Rasmus Schmidt Davidsen (Guest lecturer)
Department of Micro- and Nanotechnology
Silicon Microtechnology

**Description**
Labtop presentation and abstract in proceedings at Sustain 2017 conference, DTU
Documents:
Sustain2017abstract

**Related event**

**Sustain 2017**
06/12/2017 → 06/12/2017
Kgs. Lyngby, Denmark
Activity: Talks and presentations › Conference presentations

**Extensioinal flow and structure in branched model polymer (polystyrene) melts.**
Period: 20 Nov 2017 → 23 Nov 2017
Kristoffer Almdal (Invited speaker)
Department of Micro- and Nanotechnology

**Description**
Degree of recognition: International

**Related external organisation**

**Niels Bohr Institute**
Copenhagen, Denmark
Activity: Talks and presentations › Conference presentations

**sisl + TBtrans + TranSiesta workshop**
Nick Rübner Papior (Organizer)
Mads Brandbyge (Organizer)
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics
Center for Nanostructured Graphene

**Description**
This 3-day workshop concentrates on the TBtrans/TranSiesta implementation of the nonequilibrium Green function techniques. The focus will be tutorials and hands-on experience with the transport utility TBtrans and the self-consistent method TranSiesta.

Our workshop will start by introducing the Green function method to a required level of understanding for the remainder of the workshop. Tutorials starts with simple tightbinding models created by Python scripts using Sisl. The input options for TBtrans will be explored and details regarding the TBtrans utility will be emphasised. Simultaneously, data-analysis will be presented using Python. Succeeding the TBtrans tutorials we will concentrate on self-consistent non-equilibrium calculations using TranSiesta. We will showcase how to perform N electrode calculations using TranSiesta.

Degree of recognition: International
Links:
http://www.nanotech.dtu.dk/English/Transiesta (Workshop homepage)

**Related event**

**sisl + TBtrans + TranSiesta workshop**
25/10/2017 → 27/10/2017
Kgs. Lyngby, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.
A nanofiltration technique for analyte extraction from complex matrix and surface enhanced Raman spectroscopy based sensing

**Period:** 20 Sep 2017

Onur Durucan (Guest lecturer)
Tomas Rindzevicius (Other)
Michael Stenbæk Schmidt (Other)
Oleksii Ilchenko (Other)
Anja Boisen (Other)

Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Department of Micro- and Nanotechnology
Nanoprobes

**Description**

Our novel proof-of-concept centrifugal microfluidics sensing platform (Fig.1), allows to perform fast and facile purification (nanofiltration) of the complex sample by incorporating inertial (centrifugal) and capillary forces. Furthermore, integrated in the platform, highly uniform Au capped Si nanopillar (NP) substrates for surface enhanced Raman spectroscopy (SERS) are capable to detect analyte molecules in trace amounts [1]. However, in most of the cases SERS based sensing applications are accompanied with complicated sample manipulation and external purification steps. This can be addressed to various experimental difficulties of SERS based measurements when handling real-life complex samples. Therefore, we believe that combination with the nanofiltration technique would sufficiently increase sensitivity and applicability of SERS based sensors. In addition to that, the nanofiltration of the sample and SERS based sensing of analyte is carried out on the same chip (Au NP surface) which provides robustness to the platform.

Degree of recognition: International
In this work, we present the use of nanomechanical string resonators as accurate and reliable tools to study plasmonic heating in gold nanoparticles (AuNPs).

Degree of recognition: International

Documents:
Varadarajan MNE abstract_final1

Related event

43rd International conference on Micro and Nano Engineering
18/09/2017 → 22/09/2017
Braga, Portugal
Activity: Talks and presentations › Conference presentations

43rd International conference on Micro and Nano Engineering
Period: 18 Sep 2017 → 22 Sep 2017
Mikkel Rønne Lotz (Participant)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering

Description
Oral Presentation
Degree of recognition: International

Related event

43rd International conference on Micro and Nano Engineering
18/09/2017 → 22/09/2017
Braga, Portugal
Activity: Attending an event › Participating in or organising a conference

Microcontainers for oral vaccine delivery
Period: 18 Sep 2017 → 22 Sep 2017
Line Hagner Nielsen (Guest lecturer)
Department of Applied Mathematics and Computer Science
Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics

Description
Oral presentation
Documents:
MNE2017 Microcontainers for oral vaccine delivery

Related event

43rd International conference on Micro and Nano Engineering
18/09/2017 → 22/09/2017
Braga, Portugal
Activity: Talks and presentations › Conference presentations

Challenges in Achieving Controlled Structure and Function Simultaneously.
Period: 17 Sep 2017 → 23 Sep 2017
Kristoffer Almdal (Invited speaker)
Department of Micro- and Nanotechnology

Description
Invited talk

Related event
International Symposium on Ionic Polymerization 2017
17/09/2017 → 23/09/2017
Durham, United Kingdom
Activity: Talks and presentations › Conference presentations

European School on Nanosciences & Nanotechnologies
Period: 27 Aug 2017 → 16 Sep 2017
Mikkel Rønne Lotz (Participant)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering

Description
ESONN Summer School 2017
Degree of recognition: International

Related event
European School on Nanosciences & Nanotechnologies
27/08/2017 → 16/09/2017
Grenoble, France
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Electrospraying Chitosan Particles for Oral Vaccine Delivery
Period: 16 Jul 2017 → 19 Jul 2017
Line Hagner Nielsen (Guest lecturer)
Department of Applied Mathematics and Computer Science
Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics

Description
Poster presentation
Documents:
Abstract CRS 2017_electrospray

Related event
44th Annual Meeting & Exposition of the Controlled Release Society
16/07/2017 → 19/07/2017
Boston, United States
Activity: Talks and presentations › Conference presentations

Microcontainers as an Oral Drug Delivery System
Period: 16 Jul 2017 → 19 Jul 2017
Line Hagner Nielsen (Guest lecturer)
Department of Applied Mathematics and Computer Science
Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics

Description
Poster presentation
Documents:
Abstract CRS 2017_microcontainers

Related event
**1st Summer School on Complex Fluid-Flows in Microfluidics**

**Period:** 14 Jul 2017  
**Kristian Ejlebjærg Jensen (Speaker)**  
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics  
Department of Micro- and Nanotechnology  
Nanoprobes  
Links:  
http://galindorosales.com/SummerSchool2017/Programme.html

**Related external organisation**

**Campus da Faculdade de Engenharia da Universidade do Porto**  
Portugal  
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

**Functional diblock copolymers and ABC stars: synthesis, properties and potential applicability**

**Period:** 7 Jul 2017  
**Kristoffer Almdal (Speaker)**  
Sergey Chernyy (Other)  
Lars Schulte (Other)  
Jacob Judas Kain Kirkensgaard (Other)  
Kell Mortensen (Other)  
Center for Nanostructured Graphene  
Department of Micro- and Nanotechnology  
Amphiphilic Polymers in Biological Sensing  
Self-Organized Nanoporous Materials  
Degree of recognition: International  
Documents:  
[kral_Abstract_EPF_2017_2](#)

**Related event**

**European Polymer Federation Congress 2017**  
02/07/2017 → 07/07/2017  
Lyon, France  
Activity: Talks and presentations › Conference presentations

**Structural aspects of hydrates – insight into phase transformations using nanomechanical sensors**

**Period:** 28 Jun 2017 → 30 Jun 2017  
**Peter Ouma Okeyo (Guest lecturer)**  
Peter Emil Larsen (Guest lecturer)  
Oleksii Ilchenko (Guest lecturer)  
Tomas Rindzevicius (Guest lecturer)  
Roman Slipets (Guest lecturer)  
Anja Boisen (Guest lecturer)  
Thomas Rades (Guest lecturer)  
Jukka Rantanen (Guest lecturer)  
Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Degree of recognition: International

Related event

11th annual meeting of the Pharmaceutical Solid State Research Cluster
28/06/2017 → 30/06/2017
Graz, Austria
Activity: Talks and presentations › Conference presentations

Pulsed laser deposition (PLD) of the CZTS absorber for thin solar cells with up to 5.2-% -efficiency
Period: 26 Jun 2017 → 30 Jun 2017
Jørgen Schou (Guest lecturer)
Andrea Carlo Cazzaniga (Other)
Stela Canulescu (Other)
Andrea Crovetto (Other)
Rebecca Bolt Ettlinger (Other)
Nini Pryds (Guest lecturer)
Ole Hansen (Other)
Chang Yan (Other)
Kaiwen Sun (Other)
Xiaojing Hao (Other)

Department of Photonics Engineering
Optical Microsensors and Micromaterials
Department of Physics
Experimental Surface and Nanomaterials Physics
Silicon Microtechnology
Department of Energy Conversion and Storage
Electrofunctional materials
Department of Micro- and Nanotechnology

Description
Collaborative Conference on Materials Research (CCMR) 2017
Documents:
Abstract Korea

Related external organisation

Kwangwoon University
Korea, Republic of
Activity: Talks and presentations › Conference presentations

Integration of Nanopillar SERS Substrates in a Microfluidic Platform for Analyte Separation and Quantitative Sensing
Period: 11 Jun 2017 → 17 Jun 2017
Onur Durucan (Guest lecturer)
Lidia Morelli (Guest lecturer)
Kaiyu Wu (Guest lecturer)
Marlitt Viehrig (Guest lecturer)
Oleksii Ilichenko (Guest lecturer)
Kinga Zor (Guest lecturer)
Marco Matteucci (Guest lecturer)
Tommy Sonne Alstrøm (Guest lecturer)
Tomas Rindzevicius (Guest lecturer)
Michael Stenbæk Schmidt (Guest lecturer)
Anja Boisen (Guest lecturer)

Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics

Related event

9th International Conference on Advanced Vibrational Spectroscopy
11/06/2017 → 17/06/2017
Victoria, Canada
Activity: Talks and presentations › Conference presentations

SERS combiner for high-speed and high-sensitive quantitative analysis
Period: 11 Jun 2017 → 17 Jun 2017
Oleksii Ilchenko (Guest lecturer)
Tomas Rindzevicius (Guest lecturer)
Onur Durucan (Guest lecturer)
Michael Stenbæk Schmidt (Guest lecturer)
Roman Slipets (Other)
Lidia Morelli (Guest lecturer)
Anja Boisen (Guest lecturer)

Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics

Related event

9th International Conference on Advanced Vibrational Spectroscopy
11/06/2017 → 17/06/2017
Victoria, Canada
Activity: Talks and presentations › Conference presentations

SERS combiner for high-speed and high-sensitive quantitative analysis
Period: 11 Jun 2017 → 17 Jun 2017
Oleksii Ilchenko (Guest lecturer)
Tomas Rindzevicius (Guest lecturer)
Michael Stenbæk Schmidt (Guest lecturer)
Roman Slipets (Guest lecturer)
Onur Durucan (Guest lecturer)
Lidia Morelli (Guest lecturer)
Anja Boisen (Guest lecturer)

Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics

Related event

9th International Conference on Advanced Vibrational Spectroscopy
Solving 2D/3D Heat Conduction Problems by Combining Topology Optimization and Anisotropic Mesh Adaptation
Period: 8 Jun 2017
Kristian Ejlebjerg Jensen (Guest lecturer)
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Department of Micro- and Nanotechnology
Nanoprobes
Documents:
paperID62_KristianE

Related event
12th World Congress of Structural and Multidisciplinary Optimization
05/06/2017 → 09/06/2017
Braunschweig, Germany
Activity: Talks and presentations › Conference presentations

The 61st International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication
Period: 29 May 2017 → 2 Jun 2017
Mikkel Rønne Lotz (Participant)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering
Description
Thermal Nanoimprinting of Mid-IR Antireflective Moth-eye Nanostructures on Chalcogenide Glass Windows

Related event
The 61st International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication
29/05/2017 → 02/06/2017
Orlando, United States
Activity: Attending an event › Participating in or organising a conference

EMRS Spring meeting 2017
Period: 23 May 2017
Jørgen Schou (Participant)
Andrea Carlo Cazzaniga (Participant)
Stela Canulescu (Organizer)
Rebecca Bolt Ettlinger (Participant)
Nini Pryds (Participant)
Ole Hansen (Organizer)
Andrea Crovetto (Organizer)
Chang Yan (Participant)
Kaiwen Sun (Participant)
Xiaojing Hao (Participant)
Department of Photonics Engineering
Photovoltaic Materials and Systems
Optical Microsensors and Micromaterials
Department of Energy Conversion and Storage
Electrofunctional materials
Pulsed laser deposition (PLD) of the CZTS absorber for thin solar cells with up to 5.2%-efficiency

Related event

EMRS Spring meeting 2017
22/05/2017 → 26/05/2017
Strasbourg, France
Activity: Attending an event › Participating in or organising a conference

Interface engineering to boost the open circuit voltage of Cu2ZnSnS4 solar cells
Period: 18 Apr 2017
Andrea Crovetto (Speaker)

Related event

2017 MRS Spring Meeting
17/04/2017 → 21/04/2017
Phoenix, United States
Activity: Talks and presentations › Conference presentations

Materials Research Society Spring Meeting 2017
Period: 17 Apr 2017 → 21 Apr 2017
Jørgen Schou (Organizer)
Andrea Carlo Cazzaniga (Participant)
Andrea Crovetto (Participant)
Rebecca Bolt Ettlinger (Participant)
Sara Lena Josefin Engberg (Participant)
Stela Canulescu (Participant)
Nini Pryds (Participant)
Description
Pulsed laser deposition (PLD) of a CZTS-absorber for thin solar cells with up to 5.2 % efficiency
Degree of recognition: International
Documents:
MRS 2017_poster_JS_2

Related event
Materials Research Society Spring Meeting 2017
17/04/2017 → 21/04/2017
Phoenix, United States
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Graphene 2017
Period: 28 Mar 2017 → 31 Mar 2017
Thomas Aktor (Organizer)
Center for Nanostructured Graphene
Department of Micro- and Nanotechnology
Theoretical Nanotechnology
Degree of recognition: International

Related event
Graphene 2017
28/03/2017 → 31/03/2017
Barcelona, Spain
Activity: Attending an event › Participating in or organising a conference

International Conference on Frontiers of Characterization and Metrology for Nanoelectronics 2017
Period: 21 Mar 2017 → 23 Mar 2017
Maria-Louise Witthoff (Participant)
Department of Micro- and Nanotechnology

Description
Precision of Micro Hall Effect Measurements in Scribe Line Test Pads of B-doped Si
Degree of recognition: International
Documents:
Poster_FCMN_2017
Related event

International Conference on Frontiers of Characterization and Metrology for Nanoelectronics 2017
Period: 21/03/2017 → 23/03/2017
Monterey, CA, United States
Activity: Attending an event › Participating in or organising a conference

Non-Invasive Delivery of Macromolecules Conference
Period: 23 Feb 2017
Chiara Mazzoni (Guest lecturer)
Department of Micro- and Nanotechnology
Nanoprobes
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Description
MICROCONTAINERS FOR INTESTINAL DRUG DELIVERY: in vivo and ex vivo study
Degree of recognition: International
Documents:
Abstract_Mazzoni

Related event

Non-Invasive Delivery of Macromolecules Conference
Period: 21/02/2017 → 24/02/2017
San Diego, United States
Activity: Talks and presentations › Conference presentations

DTU Patent Course
Period: 16 Jan 2017 → 20 Jan 2017
Mikkel Rønne Lotz (Participant)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering
Description
DTU Patent Course

Related event

DTU Patent Course
Period: 16/01/2017 → 20/01/2017
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Sustain-ATV Conference 2016
Period: 30 Dec 2016
Anders Brostrøm (Speaker)
Department of Micro- and Nanotechnology
Molecular Windows
Description
Gav en mundtlig præsentation om "Automated Scanning Electron Microscopy Analysis of Sampled Aerosol"
Documents:
Sustain Abstract

Related event

Sustain-ATV Conference 2016
Period: 30/11/2016 → 30/11/2016
Kgs. Lyngby, Denmark
Activity: Talks and presentations › Conference presentations
Introduction to LabVIEW and computer-based measurements hands-on  
Period: 7 Dec 2016  
Mikkel Rønne Lotz (Participant)  
Department of Micro- and Nanotechnology  
Polymer Micro & Nano Engineering

Related event

Introduction to LabVIEW and computer-based measurements hands-on: Acquiring Measurements With LabVIEW & DAQ HO  
07/12/2016 → 07/12/2016  
2800 Kongens Lyngby, Denmark  
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Contributed Talk: 2D materials as protective coatings  
Period: 30 Nov 2016  
Adam Carsten Stoot (Speaker)  
Department of Micro- and Nanotechnology  
Nanocarbon  
Documents:  
Sustain2016abstract

Related event

Sustain-ATV Conference 2016  
30/11/2016 → 30/11/2016  
Kgs. Lyngby, Denmark  
Activity: Talks and presentations › Conference presentations

Discovering Challenges in Fabrication of Nanostructured c-Si Solar Cells with Metal Oxides Carrier Selective Contacts  
Period: 30 Nov 2016  
Maksym Plakhotnyuk (Speaker)  
Department of Micro- and Nanotechnology  
Description  
A photovoltaic cell provides direct conversion of solar into electrical energy. Most modern solar cells are based on silicon due to well-developed technology, high efficiency, and high reliability and relatively low cost. In this research, our approach is based on nano-texturing of the crystalline silicon (black c-Si) with reactive ion etching (RIE) and KOH techniques, ALD deposition of titanium oxide (TiO2) and RF magnetron sputtering of nickel oxide (NiO) films as carrier selective contacts

Related event

ATV Sustain conference  
30/11/2016 → 30/11/2016  
Activity: Talks and presentations › Conference presentations

DTU Sustain 2016  
Period: 30 Nov 2016  
Steffen Foss Hansen (Organizer)  
Kristian Mølhave (Organizer)  
Department of Environmental Engineering  
Environmental Chemistry  
Department of Micro- and Nanotechnology
Lattice-matched Cu2ZnSnS4/CeO2 solar cell with open circuit voltage boost
Period: 17 Nov 2016
Andrea Crovetto (Speaker)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Effects on cells on differentiation.
Period: 11 Nov 2016
Martin Dufva (Lecturer)
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology

1st Nordic Ellipsometry Workshop
Period: 1 Nov 2016
Andrea Crovetto (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event

1st Nordic Ellipsometry Workshop
01/11/2016 → 01/11/2016
Linköping, Sweden
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Dielectric function measurement of emerging semiconductors
Period: 1 Nov 2016
Andrea Crovetto (Invited speaker)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event

1st Nordic Ellipsometry Workshop
01/11/2016 → 01/11/2016
Linköping, Sweden
Activity: Talks and presentations › Conference presentations

26th International Photovoltaic Science and Engineering Conference
Period: 27 Oct 2016
Maksym Plakhotnyuk (Speaker)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
Poster Presentation "Phosphorous Doping of Nanostructured Crystalline Silicon"

Participation in conference
Documents:
Doping effect on bSi
Poster-PVSEC26_M. Plakhotnyuk_final

Related event

26th International Photovoltaic Science and Engineering Conference
24/10/2016 → 28/10/2016
Singapore, Singapore
Activity: Talks and presentations › Conference presentations

26th International Photovoltaic Science and Engineering Conference
Period: 26 Oct 2016
Maksym Plakhotnyuk (Speaker)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
Oral Presentation "Behind the Nature of Titanium Oxide Excellent Surface Passivation and Carrier Selectivity of c-Si"

Participation in conference
Documents:

Related event
26th International Photovoltaic Science and Engineering Conference  
24/10/2016 → 28/10/2016  
Singapore, Singapore  
Activity: Talks and presentations › Conference presentations

6th International Symposium on Transparent Conductive Materials  
Andrea Crovetto (Participant)  
Department of Micro- and Nanotechnology  
Silicon Microtechnology  
Related event

6th International Symposium on Transparent Conductive Materials  
Chania, Greece  
Activity: Attending an event › Participating in or organising a conference

Nanostructured Heterojunction c-Si Solar cells with Carrier Selective Contacts  
Period: 4 Oct 2016  
Maksym Plakhotnyuk (Invited speaker)  
Department of Micro- and Nanotechnology  
Description  
Invited talk at the Fraunhofer CSP, Halle (Salle), Germany  
Related external organisation

Unknown external organisation  
Activity: Talks and presentations › Conference presentations

Fraunhofer Center for Silicon Photovoltaics (CSP)  
Maksym Plakhotnyuk (Visiting researcher)  
Department of Micro- and Nanotechnology  
Description  
Short-term visiting researcher  
Conducted passivation experiments on black silicon samples and further their lifetime studies  
Activity: Visiting an external institution › Visiting another research institution

11th Central European Symposium on Pharmaceutical Technology  
Period: 23 Sep 2016 → 24 Sep 2016  
Fabio Tentor (Speaker)  
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics  
Department of Micro- and Nanotechnology  
Nanoprobes  
Description  
Poster session at the 11th Central European Symposium on Pharmaceutical Technology (Belgrade, Serbia)  
Documents:  
MICROCONTAINERS FOR INTESTINAL DRUG DELIVERY  
Related event

11th Central European Symposium on Pharmaceutical Technology  
Central European Symposium on Pharmaceutical Technology  
**Period:** 23 Sep 2016  
Chiara Mazzoni (Speaker)  
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics  
Department of Micro- and Nanotechnology  
Nanoprobes  
**Description**  
MICROCONTAINERS AS EFFECTIVE DRUG DELIVERY VEHICLES: ADVANCES IN THE DRUG LOADING  
Oral presentation  
Documents:  
MICROCONTAINERS AS EFFECTIVE DRUG DELIVERY VEHICLES: ADVANCES IN THE DRUG LOADING

Related event  
Central European Symposium on Pharmaceutical Technology  
22/09/2016 → 24/09/2016  
Belgrade, Serbia  
Activity: Talks and presentations › Conference presentations

42nd International conference on Micro and Nano Engineering  
**Period:** 19 Sep 2016 → 23 Sep 2016  
Mikkel Rønne Lotz (Participant)  
Department of Micro- and Nanotechnology  
Polymer Micro & Nano Engineering  
**Related event**  
42nd International conference on Micro and Nano Engineering  
19/09/2016 → 23/09/2016  
Vienna, Austria  
Activity: Attending an event › Participating in or organising a conference

Perforated SiN membrane resonators for nanomechanical IR spectroscopy  
**Period:** 19 Sep 2016 → 23 Sep 2016  
Maksymilian Kurek (Speaker)  
Department of Micro- and Nanotechnology  
Nanoprobes  
**Description**  
Poster together with Matthias Carnoy, Anja Boisen and Silvan Schmid  
Poster  
Documents:  
Perforated SiN membrane resonators for nanomechanical IR spectroscopy poster

Related event  
42nd International conference on Micro and Nano Engineering  
19/09/2016 → 23/09/2016  
Vienna, Austria  
Activity: Talks and presentations › Conference presentations
Roll-to-roll extrusion coating process for high-speed replication of micron-sized periodic patterns
Period: 19 Sep 2016 → 23 Sep 2016
Nastasia Okulova (Speaker)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering
Degree of recognition: International
Documents:
Abstract_MNE2016

Related event

42nd International conference on Micro and Nano Engineering
19/09/2016 → 23/09/2016
Vienna, Austria
Activity: Talks and presentations › Conference presentations

European Microscopy Congress 2016
Period: 1 Sep 2016
Aske Nørskov Gejl (Speaker)
Department of Micro- and Nanotechnology
Nanocarbon
Description
Oral presentation

Related event

The 16th European Microscopy Congress
28/08/2016 → 02/09/2016
Lyon, France
Activity: Talks and presentations › Conference presentations

European Advanced Material Congress
Period: 25 Aug 2016
Maksym Plakhotnyuk (Speaker)
Department of Micro- and Nanotechnology
Description
Enhanced Passivation And Electrical Characterization Of TiO2-Si Heterojunction With Tunneling Oxide Interlayers
Oral Presentation

Related event

European Advanced Material Congress
23/08/2016 → 25/08/2016
Stockholm, Sweden
Activity: Talks and presentations › Conference presentations

European Advanced Material Congress
Period: 24 Aug 2016
Maksym Plakhotnyuk (Speaker)
Department of Micro- and Nanotechnology
Silicon Microtechnology
Description
Hole Selective NiO Contact for Silicon Solar Cells
Oral presentation
Related event

**European Advanced Material Congress**
Stockholm, Sweden
Activity: Talks and presentations › Conference presentations

**Carbonhagen 2016**
Adam Carsten Stoot (Participant)
Department of Micro- and Nanotechnology
Nanocarbon

Related event

**Carbonhagen 2016: 7th Symposium on Carbon and Related Nanomaterials**
17/08/2016 → 18/08/2016
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Polynano Summer School 2016**
Mikkel Rønne Lotz (Participant)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering

Related event

**Polynano Summer School 2016**
08/08/2016 → 26/08/2016
2800 Kongens Lyngby, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Characterisation of fine particles using opto-magnetic measurement**
Period: 17 Jul 2016
Jeppe Fock (Speaker)
Department of Micro- and Nanotechnology
Magnetic Systems

Related event

**The International Conference on Fine Particle Magnetism**
13/06/2016 → 17/07/2016
Gaithersburg, United States
Activity: Talks and presentations › Conference presentations

**The XIVth International Conference on Electrified Interfaces**
Period: 3 Jul 2016 → 8 Jul 2016
Murat Nulati Yesibolati (Participant)
Department of Micro- and Nanotechnology

Related event

**The XIVth International Conference on Electrified Interfaces**
03/07/2016 → 08/07/2016
Singapore, Singapore
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.
Micromechanical pyrolytic carbon string resonators
Maksymilian Kurek (Speaker)
Department of Micro- and Nanotechnology
Nanoprobes

Description
Presented work done together with Frederik Kjær Larsen, Peter Emil Larsen, Silvan Schmid, Anja Boisen and Stephan Sylvester Keller
Documents:
Micromechanical Pyrolytic Carbon String Resonators

Related event
13th International Workshop on Nanomechanical Sensing
22/06/2016 → 24/06/2016
Delft, Netherlands
Activity: Talks and presentations › Conference presentations

32nd European Photovoltaic Solar Energy Conference and Exhibition
Maksym Plakhotnyuk (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
Presented recent results of crystalline silicon nano-structuring with RIE techniques and its lifetime study for photovoltaic applications as a poster "Lifetime of ALD Al2O3 Passivated Black Silicon Nanostructured for Photovoltaic Applications"

Participated in a conference
Documents:
Conference Proceedings "LIFETIME OF NANO-STRUCTURED BLACK SILICON FOR PHOTOVOLTAIC APPLICATIONS"
Poster "LIFETIME OF NANO-STRUCTURED BLACK SILICON FOR PHOTOVOLTAIC APPLICATIONS"

Related event
32nd European Photovoltaic Solar Energy Conference and Exhibition
20/06/2016 → 24/06/2016
Munich, Germany
Activity: Attending an event › Participating in or organising a conference

Modelling and experiments in drug delivery systems
Kristian Ejlebjærg Jensen (Speaker)
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Department of Micro- and Nanotechnology
Nanoprobes

Documents:
Geometric Optimization of Microcontainers for Oral Drug Delivery
Links:

Related event
Modelling and experiments in drug delivery systems
20/06/2016 → 22/06/2016
Coimbra, Portugal
Activity: Talks and presentations › Conference presentations

**N>1 NEGF calculations & molecular projected transport**
Nick Rübner Papior (Guest lecturer)
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics
Center for Nanostructured Graphene
Degree of recognition: International

**Related event**
**Towards reality in modelling of molecular electronics**
13/06/2016 → 17/06/2016
San Sebastian, Spain
Activity: Talks and presentations › Conference presentations

**Design, fabrication and characterization of optical planar waveguide components**
Mikkel Rønne Lotz (Participant)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering

**Related event**
**Design, fabrication and characterization of optical planar waveguide components: 34539**
06/06/2016 → 24/06/2016
2800 Kongens Lyngby, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Biosensors 2016**
Period: 25 May 2016 → 27 May 2016
Jeppe Fock (Participant)
Department of Micro- and Nanotechnology
Magnetic Systems

**Description**
Comparison of optomagnetic and AC susceptibility readouts in a magnetic nanoparticle agglutination assay for detection of C-reactive protein

**Documents:**
Comparison of optomagnetic and AC susceptibility readouts in a magnetic nanoparticle agglutination assay for detection of C-reactive protein

**Related event**
**Biosensors 2016: 26th Anniversary World Congress on Biosensors**
25/05/2016 → 27/05/2016
Gothenburg, Sweden
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Biosensors 2016**
Period: 25 May 2016 → 27 May 2016
Kuldeep Sanger (Participant)
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Nanoprobes

Description
Poster presentation
Documents:
Biosensors_poster

Related event
Biosensors 2016: 26th Anniversary World Congress on Biosensors
25/05/2016 → 27/05/2016
Gothenburg, Sweden
Activity: Attending an event › Participating in or organising a conference

Generalizing the correlation between electrical and structural properties in sputtered ZnO:Al
Period: 4 May 2016
Andrea Crovetto (Speaker)
Department of Micro- and Nanotechnology
Silicon Microtechnology
Documents:
Talk

Related event
EMRS Spring Meeting 2016
02/05/2016 → 06/05/2016
Lille, France
Activity: Talks and presentations › Conference presentations

EMRS Spring Meeting 2016
Period: 2 May 2016 → 6 May 2016
Andrea Crovetto (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event
EMRS Spring Meeting 2016
02/05/2016 → 06/05/2016
Lille, France
Activity: Attending an event › Participating in or organising a conference

University of New South Wales
Period: 29 Feb 2016 → 30 Apr 2016
Andrea Crovetto (Visiting researcher)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
Junior Visiting Research Fellow
Activity: Visiting an external institution › Visiting another research institution

Waveguide Optics
Period: 1 Feb 2016 → 30 May 2016
Mikkel Rønne Lotz (Participant)
Related event

**Waveguide Optics: 34041**
Period: 01/02/2016 → 30/05/2016
2800 Kongens Lyngby, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Approaches for Brushless Block Copolymer Nanolithography**
Period: 29 Nov 2015 → 4 Dec 2015
Sokol Ndoni (Lecturer)
Center for Nanostructured Graphene
Department of Micro- and Nanotechnology
Self-Organized Nanoporous Materials

**Description**
Authors of lecture: Tao Li, Violetta Shvets, Zhonglii Wang, Sozaraj Rasappa, Lars Schulte, Sokol Ndoni

Related event

**2015 MRS Fall Meeting and Exhibit**
Period: 29/11/2015 → 04/12/2015
Boston, United States
Activity: Talks and presentations › Conference presentations

**High throughput & facile graphene nanomesh production by block copolymer nanolithography**
Period: 29 Nov 2015 → 4 Dec 2015
Tao Li (Lecturer)
Department of Micro- and Nanotechnology
Self-Organized Nanoporous Materials

**Description**
Authors of lecture: Tao Li and Sokol Ndoni.

Related event

**2015 MRS Fall Meeting and Exhibit**
Period: 29/11/2015 → 04/12/2015
Boston, United States
Activity: Talks and presentations › Conference presentations

**6th European Kesterite Workshop**
Period: 18 Nov 2015 → 20 Nov 2015
Andrea Croveto (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event

**6th European Kesterite Workshop**
Period: 18/11/2015 → 20/11/2015
Newcastle Upon Tyne, United Kingdom
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.
**Pure-sulfide CZTS solar cells by pulsed laser deposition**
Period: 18 Nov 2015
Andrea Crovetto (Speaker)
Department of Micro- and Nanotechnology
Silicon Microtechnology

**Related event**

**6th European Kesterite Workshop**
18/11/2015 → 20/11/2015
Newcastle Upon Tyne, United Kingdom
Activity: Talks and presentations › Conference presentations

**IEEE Sensor 2015**
Period: 4 Nov 2015
Anders Thyssen (Speaker)
Department of Micro- and Nanotechnology
MEMS-AppliedSensors

**Description**
Held an oral presentation, title: Electret Stability Related to the Crystallinity in Polypropylene

Held an oral presentation
Documents:
Electret Stability Related to the Crystallinity in Polypropylene

**Related event**

**IEEE Sensor 2015**
01/11/2015 → 04/12/2015
Busan, Korea, Democratic People's Republic of
Activity: Talks and presentations › Conference presentations

**Contributed Talk**
Period: 29 Oct 2015
Adam Carsten Stoot (Speaker)
Department of Micro- and Nanotechnology
Nanocarbon

**Description**
Graphene Coatings in Acidic Media

**Related event**

**RPGR 2015: Recent Progress in Graphene (and Two-dimensional Materials) Research**
25/10/2015 → 29/10/2015
Lorne, Australia
Activity: Talks and presentations › Conference presentations

**World Customs Organization Technology and Innovation Forum**
Jens Kristian Munk (Participant)
Department of Micro- and Nanotechnology
Surface Engineering
Department of Applied Mathematics and Computer Science

**Description**
World Customs Organization Technology and Innovation Forum 2015

Related event

World Customs Organization Technology and Innovation Forum
26/10/2015 → 29/10/2015
Rotterdam, Netherlands
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Microfluidics Congress 2015
Maria Dimaki (Participant)
Department of Micro- and Nanotechnology
Nano Bio Integrated Systems

Description
Poster presentation at Microfluidics Congress

Related event

Microfluidics Congress 2015
20/10/2015 → 21/10/2015
London, United Kingdom
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

11th Workshop on Biosensors and Bioanalytical Microtechniques in Environmental, Food and Clinical Analysis
Period: 26 Sep 2015 → 30 Sep 2015
Kuldeep Sanger (Participant)
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Department of Micro- and Nanotechnology
Nanoprobes

Description
Poster presentation
Documents:
Kuldeep_BBMEC

Related event

11th Workshop on Biosensors and Bioanalytical Microtechniques in Environmental, Food and Clinical Analysis: International Biosensor Conference
26/09/2015 → 30/09/2015
Regensburg, Germany
Activity: Attending an event › Participating in or organising a conference

Block copolymers as precursors for nanoporous membranes and templating at sub-10 nm feature size
Period: 24 Sep 2015 → 26 Sep 2015
Sokol Ndoni (Lecturer)
Center for Nanostructured Graphene
Department of Micro- and Nanotechnology
Self-Organized Nanoporous Materials

Description
Authors of lecture: Sozaraj Rasappa, Tao Li, Zhongli Wang, Violetta Shvets, Lars Schulte and Sokol Ndoni

Related event

Nanoscience and Technology – 2015, BIT's 5th Annual World Congress
41st International conference on Micro and Nano Engineering
Period: 21 Sep 2015 → 24 Sep 2015
Kuldeep Sanger (Participant)

Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Nanoprobes
Department of Micro- and Nanotechnology

Description
Conference abstract
Links:

Related event
41st International conference on Micro and Nano Engineering : MNE 2015
21/09/2015 → 24/09/2015
The Hague, Netherlands
Activity: Attending an event › Participating in or organising a conference

CRIM-TRACK: Sensor system for detection of criminal chemical substances
Period: 20 Sep 2015
Jens Kristian Munk (Speaker)

Department of Micro- and Nanotechnology
Surface Engineering
Department of Applied Mathematics and Computer Science

Related event
SPIE Security + Defence 2015
21/09/2015 → 24/09/2015
Toulouse, France
Activity: Talks and presentations › Conference presentations

20th International Conference on Commercializing Micro- and Nanotechnology
Period: 13 Sep 2015 → 16 Sep 2015
Kasper Kistrup (Participant)

Department of Micro- and Nanotechnology
Magnetic Systems

Description
The upcoming edition will be hosted in Kraków (Cracov), Poland from 13-16 September 2015.
The COMS 2015 consists of tracks about entrepreneurship, and about science, applications and market opportunities for enabling micro- and nanotechnologies.
The Conference consists of three main streams:
- Presentation of scientific/research latest results with possible commercialization potential or great impact on state-of-the-art in the field of micro/nanosystems and sensors. Poster presentations will be preferred
- A review of marketable solutions, methods and effects of commercialization of micro/nanosystems and sensors. Exhibition and oral presentations are welcome.
- Visions and future discussion. Several aspects of expected rapid exponential growth of micro/nanosystems and sensors markets will be discussed by recognized world-class specialists. Invited oral talks only.
Links:
http://coms2015.eu/ (Conference website)
http://www.mancef.org/ (Micro and Nanotechnology Commercialization Education Foundation (MANCEF) is a global membership association focused on the commercialization of small technologies. As an educational non-profit, their goal is to facilitate connections and educate those bringing emerging technologies to market. COMS is an international conference owned and hosted by members of MANCEF.)

Related event

20th International Conference on Commercializing Micro- and Nanotechnology
13/09/2015 → 16/09/2015
Kraków, Poland
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

The International Conference on the Applications of the Mössbauer Effect
Period: 13 Sep 2015 → 18 Sep 2015
Jeppe Fock (Participant)
Department of Micro- and Nanotechnology
Magnetic Systems

Description
The International Conference on the Applications of the Mössbauer Effect (ICAME)

Related event

The International Conference on the Applications of the Mössbauer Effect
13/09/2015 → 18/09/2015
Hamburg, Germany
Activity: Attending an event › Participating in or organising a conference

International Summer School on Photovoltaics and New Concepts of Quantum Solar Energy Conversion
Period: 6 Sep 2015 → 13 Sep 2015
Maksym Plakhotnyuk (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
QUANTSOL

Related event

International Summer School on Photovoltaics and New Concepts of Quantum Solar Energy Conversion
07/09/2014 → 14/09/2014
Hirschegg, Austria
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

A Smart Mobile Lab-on-Chip-Based Medical Diagnostics System Architecture Designed For Evolvability
Period: 27 Aug 2015
François Patou (Speaker)
Department of Micro- and Nanotechnology
Nano Bio Integrated Systems
Department of Applied Mathematics and Computer Science

Description
Oral presentation

Related event
6th Symposium on Carbon and Related Nanomaterials
Maksym Plakhotnyuk (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology
Description
Graphene transfer on highly corrugated black silicon surface
Documents:
Abstract. Graphene transfer to highly corrugated black silicon surface. Carbonhagen 2015
Links:
http://www.carbonhagen.com/abstracts-1/posters/maksymplakhotnyukgraphenetransferonhighlycorrugatedblacksiliconsurface

Related event
6th Symposium on Carbon and Related Nanomaterials
13/08/2015 → 14/08/2015
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

6th Symposium on Carbon and Related Nanomaterials
Thomas Aktor (Participant)
Department of Micro- and Nanotechnology
Center for Nanostructured Graphene
Theoretical Nanotechnology
Documents:
CarbonhagenPoster2015v2

Related event
6th Symposium on Carbon and Related Nanomaterials
13/08/2015 → 14/08/2015
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

Statistical analysis of large areas of Raman mapped DNA functionalized gold coated silicon nanopillar SERS substrates
Period: 14 Jul 2015
Kasper Bayer Frohling (Speaker)
Department of Micro- and Nanotechnology
Surface Engineering
Description
Oral presentation given at ICAVS8

Related event
8th International Conference on Advanced Vibrational Spectroscopy
12/07/2015 → 17/07/2015
Vienna, Austria
Activity: Talks and presentations › Conference presentations
11th International Conference on Cerebral Vascular Biology
Jonas Bruun (Participant)
Department of Micro- and Nanotechnology
Colloids and Biological Interfaces

Description
Conference: CVB Paris 2015
Documents:
CVB Paris 2015 abstract (2)
CVB_Paris_2015_abstract (2)

Related event
11th International Conference on Cerebral Vascular Biology
06/07/2015 → 09/07/2015
Paris, France
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Introductory course on MRAM
Period: 1 Jul 2015 → 3 Jul 2015
Alberto Cagliani (Participant)
Center for Nanostructured Graphene
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event
Introductory course on MRAM
01/07/2015 → 03/07/2015
Grenoble, France
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Electrical impedance spectroscopy with optimised electrode configurations for 3D tissue engineering applications
Chiara Canali (Speaker)
Department of Micro- and Nanotechnology
Bioanalytics
Documents:
Canali_BES

Related event
XXIII International Symposium on Bioelectrochemistry and Bioenergetics
14/06/2015 → 18/06/2015
Malmö, Sweden
Activity: Talks and presentations › Conference presentations

XXIII International Symposium on Bioelectrochemistry and Bioenergetics
Period: 8 Jun 2015 → 18 Jun 2015
Ada-Ioana Bunea (Organizer)
Bioanalytics
Department of Micro- and Nanotechnology
Description
Student helper

Links:
http://www.bes2015.se/

Related event

XXIII International Symposium on Bioelectrochemistry and Bioenergetics
14/06/2015 → 18/06/2015
Malmö, Sweden
Activity: Attending an event › Participating in or organising a conference

World Congress on Medical Physics and Biomedical Engineering 2015
Period: 7 Jun 2015 → 12 Jun 2015
Chiara Canali (Participant)
Department of Micro- and Nanotechnology
Bioanalytics

Description
"On-line monitoring of 2D and 3D cell cultures: electrode configurations for impedance based sensors"

Oral presentation
Documents:
Canali_2_IUPESM15

Related event

World Congress on Medical Physics and Biomedical Engineering 2015
07/06/2015 → 12/06/2015
Toronto, Canada
Activity: Attending an event › Participating in or organising a conference

World Congress on Medical Physics and Biomedical Engineering 2015
Period: 7 Jun 2015 → 12 Jun 2015
Chiara Canali (Speaker)
Department of Micro- and Nanotechnology
Bioanalytics

Description
"Enhanced multielectrode configurations in miniaturized 3D electrical impedance spectroscopy and tomography - monitoring the overall process of tissue engineering with spatial sensing for future challenges in microfluidics"

Oral presentation
Documents:
Canali_1_IUPESM15

Related event

World Congress on Medical Physics and Biomedical Engineering 2015
07/06/2015 → 12/06/2015
Toronto, Canada
Activity: Talks and presentations › Conference presentations

BreakThrough Leadership
Period: 1 Jun 2015 → 18 Sep 2015
Alberto Cagliani (Participant)
Department of Micro- and Nanotechnology

Description
Leadership course from Harvard Business School
Related event

**BreakThrough Leadership: Harvard Business School**
01/06/2015 → 18/09/2016
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Electronic Structure library coding workshop**
Period: 1 Jun 2015 → 6 Jun 2015
Nick Rübner Papior (Participant)
Center for Nanostructured Graphene
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Description
Adding new tools and extending already begun tools for the Electronic Structure Library as a community driven library
Links:
http://esl.cecam.org (ESL home page)

Related event

**Electronic Structure library coding workshop**
01/06/2015 → 06/06/2015
Lausanne, Switzerland
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**DTU Nanotech Work & Collaboration Committee (External organisation)**
Period: May 2015 → May 2016
Maksym Plakhotnyuk (Participant)
Department of Micro- and Nanotechnology

Description
Representative from PhD students

Related external organisation

**DTU Nanotech Work & Collaboration Committee**
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

**Fabrication and loading of biopolymer microcontainers for oral drug delivery using hot punching**
Period: 19 May 2015
Ritika Singh Petersen (Speaker)
Department of Micro- and Nanotechnology
Nanoprobes

Related external organisation

**Unknown external organisation**
Activity: Talks and presentations › Conference presentations

**Brushless rapid self-assembly of PS-b-PDMS for lithographic applications**
Sozaraj Rasappa (Lecturer)
Center for Nanostructured Graphene
Department of Micro- and Nanotechnology
Self-Organized Nanoporous Materials
Description
Authors of lecture: Sozaraj Rasappa, Lars Schulte, Sokol Ndoni

Related event
2015 E-MRS Spring Meeting
11/05/2015 → 15/05/2015
Lille, France
Activity: Talks and presentations › Conference presentations

European Materials Research Society (E-MRS) Spring Meeting 2015
Andrea Crovetto (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event
European Materials Research Society (E-MRS) Spring Meeting 2015
11/05/2015 → 15/05/2015
Lille, France
Activity: Attending an event › Participating in or organising a conference

Nanoporous metal oxides deprived from gyroid block copolymer
Tao Li (Lecturer)
Department of Micro- and Nanotechnology
Self-Organized Nanoporous Materials

Description
Authors of lecture: Tao Li, Sokol Ndoni

Related event
2015 E-MRS Spring Meeting
11/05/2015 → 15/05/2015
Lille, France
Activity: Talks and presentations › Conference presentations

Microfabrication of containers for oral drug delivery
Period: 10 Apr 2015
Ritika Singh Petersen (Invited speaker)
Department of Micro- and Nanotechnology
Nanoprobes

Description
IDUN Center of Excellence opening ceremony

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Graphene 2015
Period: 10 Mar 2015 → 13 Mar 2015
Adam Carsten Stoot (Participant)
Department of Micro- and Nanotechnology
Nanocarbon

Related event

**Graphene 2015**  
10/03/2015 → 13/03/2015  
Bilbao, Spain  
Activity: Attending an event › Participating in or organising a conference

Detection of small organics in water: The MUSE project  
**Period:** 29 Jan 2015  
**Kasper Bayer Frøhling (Speaker)**  
Department of Micro- and Nanotechnology  
Surface Engineering  
Nanoprobes  
Documents:  
K Frøhling DTU Nanotech  
Links:  
http://danishwaterforum.dk/Research/Annual%20meeting%202015/Presentations/Session-4/K%20Fr%C3%B8hling%20DTU%20Nanotech.pdf

Related event

Danish Water Forum: 9th Annual Water Research Meeting  
29/01/2015 → …  
Copenhagen, Denmark  
Activity: Talks and presentations › Conference presentations

Characterization of degradation properties of polymers using micromechanical resonators  
**Period:** 13 Jan 2015  
**Kristoffer Almdal (Invited speaker)**  
Department of Micro- and Nanotechnology  
Amphiphilic Polymers in Biological Sensing  
**Description**  
40 minute lecture

Related external organisation

Unknown external organisation  
Activity: Talks and presentations › Conference presentations

Electronic transport, nanostructuring and disorder in graphene  
**Period:** 9 Jan 2015  
**Stephen Power (Invited speaker)**  
Department of Micro- and Nanotechnology  
Theoretical Nanotechnology  
**Description**  
Invited in mini-symposium "B12 Quantum transport modeling and simulation for atomic scale two-dimensional materials" at ICCP9  
Links:  

Related event
BioLabChip

**Description**

Fluorinated coatings are widely used for non-stick cooking utensils, as spray-on for stain prevention on fabrics and for single laboratory utensils such as sample tubes and pipette tips. In the latter examples, the superhydrophobic surface is of high importance since it ensures high dosing precision and reduces waste due to the high contact angle between the sample and the fluorinated coating. Unfortunately, the applicability of fluorinated compounds is limited due to the acute or long term toxic effects when inhaled[1], [2] or ingested[3]. Alternatively, a superhydrophobic Cassie-Baxter state can be achieved by introducing micro- and nano-structures on a hydrophobic substrate[4]. However, no micro- and nano structuring methods for modifying commercial relevant mould materials, such as tool steel, exist.

We have developed a patent pending method for selective 3D-structuring conventional moulds for polymer injection moulding such that injection moulded pieces possess localised superhydrophobic wetting properties. We have demonstrated our technology in several aluminium alloys, as well as tool steel, that are typical for mould making - and superhydrophobic polymer pieces have been injection moulded.


Den fulde forfatterliste til projektet er Carl Esben Poulsen Kasper Kistrup Nis Korsgaard Andersen Rafael Taborsky Mikkel Fougt Hansen Anders Wolff Alle er fra DTU Nanotech og bedes angivet online. Tak for hjælpen.
Andrea Crovetto (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event
Danish Innovation Fund Conference
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

Plasmon enhanced silver quantum cluster fluorescence for biochemical applications
Period: 13 Nov 2014 → 14 Nov 2014
Klaus Bo Mogensen (Speaker)
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology

Related event
Annual meeting for the Optical Society of Denmark
13/11/2014 → 14/11/2014
Denmark
Activity: Talks and presentations › Conference presentations

Single-molecule tracking: optimizing localization and diffusion analysis
Period: 6 Nov 2014
Henrik Flyvbjerg (Invited speaker)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Description
Invited seminar, Department of Molecular Biophysics & Biochemistry, Yale University

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Mapping Single DNA Molecules to the Human Genome in a Nanofluidic Device
Period: 4 Nov 2014
Rodolphe Marie (Lecturer)
Department of Micro- and Nanotechnology
Optofluidics

Description
Invited talk at Single Molecule Biology and Genome Editing Europe, November 4 2014, Cambridge, UK

Related event
Single Molecule & Genome Engineering/Editing Europe 2014 Meeting
03/11/2014 → 04/11/2014
Cambridge, United Kingdom
Activity: Talks and presentations › Conference presentations

Mapping Single DNA Molecules to the Human Genome in a Nanofluidic Device
Period: 4 Nov 2014
Rodolphe Marie (Lecturer)
Department of Micro- and Nanotechnology

Optofluidics

**Description**
Marie, R., Pedersen, J. N., L. Bauer, D., Rasmussen, K. H., Yusuf, M., Volpi, E., U Mir, K., Flyvbjerg, H. and Kristensen, A

Invited talk.

**Related event**

Single Molecule & Genome Engineering/Editing Europe 2014 Meeting
03/11/2014 → 04/11/2014
Cambridge, United Kingdom
Activity: Talks and presentations › Conference presentations

59th Annual Conference on Magnetism and Magnetic Materials
Period: 3 Nov 2014 → 7 Nov 2014
Daniel Kjær (Participant)

Department of Micro- and Nanotechnology
Silicon Microtechnology

**Related event**

59th Annual Conference on Magnetism and Magnetic Materials
03/11/2014 → 07/11/2014
Honolulu, United States
Activity: Attending an event › Participating in or organising a conference

Nanoimprinted distributed feedback dye laser sensor for real-time imaging of small molecule motion
Period: 2 Nov 2014 → 5 Nov 2014
Christoph Vannahme (Speaker)

Department of Micro- and Nanotechnology
Optofluidics

**Description**
Conference talk

**Related event**

IEEE Sensors 2014
02/11/2014 → 05/11/2014
Valencia, Spain
Activity: Talks and presentations › Conference presentations

Electron-phonon coupling in molecular junctions: Signals and effects in electron and heat currents
Period: Oct 2014
Mads Brandbyge (Other)

Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

**Description**
Invited talk.

**Related event**

International Workshop on Controlled Charge and Heat Transport at the Molecular Scale
29/09/2014 → 01/10/2014
Konstanz, Germany
Electron transport and current-induced dynamics at the nano-scale from first principles
Period: Oct 2014
Mads Brandbyge (Other)
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Description
Invited key-note lecture at “Trends in NanoTechnology” Int. Conference (TNT2014), Barcelona by associate professor Mads Brandbyge Spain.

Related event
International Conference on Trends in Nanotechnology
27/10/2014 → 30/10/2014
Barcelona, Spain
Activity: Talks and presentations › Conference presentations

18th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Klaus Bo Mogensen (Organizer)
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology

Description
Links:
http://www.microtas2014.org/general/technical.html

Related event
18th International Conference on Miniaturized Systems for Chemistry and Life Sciences
26/10/2014 → 30/10/2014
San Antonio, United States
Activity: Attending an event › Participating in or organising a conference

5th International Symposium on Transparent Conductive Materials
Andrea Crovetto (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
Participation in the conference on transparent conductive materials TCM 2014, Crete (Greece)

Related event
5th International Symposium on Transparent Conductive Materials
12/10/2014 → 17/10/2014
Chania, Greece
Activity: Attending an event › Participating in or organising a conference

Annual Meeting of the Danish Electrochemical Society
Chiara Canali (Participant)
Department of Micro- and Nanotechnology

Bioanalytics

**Description**
"Impedance-based detection for facing new challenges in biotechnology: enhanced 3d sensing, conductometry and electrode functionalization"

Oral presentation
Documents:
DEF14-CanaliChiara

**Related event**

**Annual Meeting of the Danish Electrochemical Society**
09/10/2014 → 10/10/2014
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

**Microfabrication of containers for oral drug delivery**
Period: 1 Oct 2014
Ritika Singh Petersen (Invited speaker)
Department of Micro- and Nanotechnology

**Nanoprobes**

**Description**
Department Days, DTU Nanotech, Technical University of Denmark

**Related external organisation**

**Unknown external organisation**
Activity: Talks and presentations › Conference presentations

**Optimal estimation of diffusion coefficients from single-particle trajectories**
Period: 22 Sep 2014 → 26 Sep 2014
Henrik Flyvbjerg (Invited speaker)
Department of Micro- and Nanotechnology

**Stochastic Systems and Signals**

**Description**
Given a theoretical model for a self-propelled micro-organism, how does one optimally determine the parameters of the model from experimental data in the form of a time-lapse recorded trajectory? For very long trajectories, one has very good statistics, and optimality may matter little. However, for biological micro-organisms, one may not control the duration of recordings, and then optimality may matter. Especially if one is interested in individuality and hence does not wish to improve statistics by taking population averages over many trajectories. One can learn much about this problem by studying its simplest case, pure diffusion with no self-propagation. This turns out to be an interesting problem also in its own right and for the very same reasons. I address this latter issue in my talk [1] and will indicate which conclusions are valid also for self-propelled particles [2].

So now the question is: How does one optimally determine the diffusion coefficient of a diffusing particle from a single time-lapse recorded trajectory of the particle? We answer this question with an explicit, unbiased, and practically optimal covariance-based estimator (CVE). This estimator is regression-free and is far superior to commonly used methods based on measured mean squared displacements. In experimentally relevant parameter ranges, it also outperforms the analytically intractable and computationally more demanding maximum likelihood estimator (MLE). For the case of diffusion on a flexible and fluctuating substrate, the CVE is biased by substrate motion. However, given some long time series and a substrate under some tension, an extended MLE can separate particle diffusion on the substrate from substrate motion in the laboratory frame. This provides benchmarks that allow removal of bias caused by substrate fluctuations in CVE. The resulting unbiased CVE is optimal also for short time series on a fluctuating substrate. We have applied our estimators to human 8-oxoguanine DNA glycolase proteins diffusing on flow-stretched DNA, a fluctuating substrate, and found that diffusion coefficients are severely overestimated if substrate fluctuations are not accounted for [1].
Related event

27th Marian Smoluchowski Symposium on Statistical Physics
22/09/2014 → 26/09/2014
Zakopane, Poland
Activity: Talks and presentations › Conference presentations

Current-induced forces in nano-junctions: Exciting atomic motion
Period: 16 Sep 2014 → 18 Sep 2014
Mads Brandbyge (Lecturer)
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Related event

Beilstein Nanotechnology Symposium 2014: Molecular machines and devices
16/09/2014 → 18/09/2014
Potsdam, Germany
Activity: Talks and presentations › Conference presentations

Pyrolysed 3D-carbon scaffolds induce spontaneous differentiation of human neural stem cells and facilitate real-time dopamine detection
Period: 14 Sep 2014
Letizia Amato (Lecturer)
Department of Micro- and Nanotechnology
Nanoprobes

Description

Related event

1st International Conference on Carbon Micro Electromechanical Systems
14/09/2014 → 16/09/2014
Irvine, United States
Activity: Talks and presentations › Conference presentations

Period: 8 Sep 2014 → 11 Sep 2014
Nick Rübner Papior (Lecturer)
Center for Nanostructured Graphene
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Description
Lecturer in the usage of the transiesta DFT+NEGF code.

Related event

08/09/2014 → 11/09/2014
Tel Aviv, Israel
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

International Summer School on Photovoltaics and New Concepts of Quantum Solar Energy Conversion
Period: 7 Sep 2014 → 14 Sep 2014
Electron transport and current-induced excitations at the nano-scale: Insights from first principles calculations
Period: 3 Sep 2014 → 5 Sep 2014
Mads Brandbyge (Lecturer)
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Optimal estimation of diffusion coefficients from single-particle trajectories
Henrik Flyvbjerg (Invited speaker)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Description
Given a theoretical model for a self-propelled micro-organism, how does one optimally determine the parameters of the model from experimental data in the form of a time-lapse recorded trajectory? For very long trajectories, one has very good statistics, and optimality may matter little. However, for biological micro-organisms, one may not control the duration of recordings, and then optimality may matter. Especially if one is interested in individuality and hence does not wish to improve statistics by taking population averages over many trajectories. One can learn much about this problem by studying its simplest case, pure diffusion with no self-propagation. This turns out to be an interesting problem also in its own right and for the very same reasons. I address this latter issue in my talk [1] and will indicate which conclusions are valid also for self-propelled particles [2].

So now the question is: How does one optimally determine the diffusion coefficient of a diffusing particle from a single time-lapse recorded trajectory of the particle? We answer this question with an explicit, unbiased, and practically optimal covariance-based estimator (CVE). This estimator is regression-free and is far superior to commonly used methods based on measured mean squared displacements. In experimentally relevant parameter ranges, it also outperforms the analytically intractable and computationally more demanding maximum likelihood estimator (MLE). For the case of diffusion on a flexible and fluctuating substrate, the CVE is biased by substrate motion. However, given some long time series and a substrate under some tension, an extended MLE can separate particle diffusion on the substrate from substrate motion in the laboratory frame. This provides benchmarks that allow removal of bias caused by substrate fluctuations in CVE. The resulting unbiased CVE is optimal also for short time series on a fluctuating substrate. We have applied our estimators to human 8-oxoguanine DNA glycolase proteins diffusing on flow-stretched DNA, a fluctuating substrate, and found that diffusion coefficients are severely overestimated if substrate fluctuations are not accounted for [1].

Mini-colloquium entitled “Statistical Challenges in Single-Particle Tracking”

Related event
European Condensed Matter Physics conference
24/08/2014 → 29/08/2014
Paris, France
5th Symposium on Carbon Nanomaterials  
Adam Carsten Stoot (Participant)  
Department of Micro- and Nanotechnology  
Nanointegration

**Related event**

5th Symposium on Carbon Nanomaterials  
21/08/2014 → 22/08/2014  
Copenhagen, Denmark

Academic research in higher education  
Period: 20 Aug 2014  
Duc-The Ngo (Invited speaker)  
Department of Energy Conversion and Storage  
Imaging and Structural Analysis  
Department of Micro- and Nanotechnology  
Molecular Windows

**Description**  
A keynote lecture at Vietnam Summer School of Science  
Vietnam Summer School of Science

**Related external organisation**

Unknown external organisation

**Activity: Talks and presentations › Conference presentations**

Rheological properties of poly(vinylpyrrolidone) as a function of molecular weight  
Sokol Ndoni (Lecturer)  
Department of Micro- and Nanotechnology  
Self-Organized Nanoporous Materials

**Description**  

**Related event**

23rd Nordic Rheology Conference  
13/08/2014 → 14/08/2014  
Reykjavik, Iceland

15th International Symposium on Electrets  
Anders Thyssen (Participant)  
Department of Micro- and Nanotechnology  
MEMS-AppliedSensors
Related event

15th International Symposium on Electrets
10/08/2014 → 13/08/2014
Baltimore, United States
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Electron-phonon scattering, self-heating, and current-induced forces in nano-conductor
Period: Jul 2014
Mads Brandbyge (Lecturer)
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Related event

QuantumHagen: Workshop on Modeling of Electronic Devices and Materials at the Nanoscale
01/07/2014 → 03/07/2014
Copenhagen, Denmark
Activity: Talks and presentations › Conference presentations

Superhydrophobic Surfaces with High Stability and Varying Degree of Nanostructure Regularity
Period: 28 Jul 2014 → 1 Aug 2014
Rafael J. Taboryski (Invited speaker)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering

Related event

8th International Conference on Material Technologies and Modeling
28/07/2014 → 01/08/2014
Ariel, Israel
Activity: Talks and presentations › Conference presentations

EMBL Conference: Microfluidics 2014
Kasper Kistrup (Participant)
Department of Micro- and Nanotechnology
Magnetic Systems
Links:
http://www.embl.de/training/events/2014/MCF14-01/ (Official homepage)

Related event

EMBL Conference: Microfluidics 2014
23/07/2014 → 25/07/2014
Heidelberg, Germany
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Period: 1 Jul 2014 → 30 Jun 2017
Henrik Flyvbjerg (Editor)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals
Description
“Physical Review” is the world's leading physics journal

As remote associate editor, I handle 50% of the journal's manuscripts on biological physics.

Related journal

Physical Review E
2470-0045
Central database
Activity: Research › Journal editor

Growth and division of E-coli under Cipro exposure
Period: 27 Jun 2014
Henrik Flyvbjerg (Lecturer)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Description
Talk at meeting in Austin Lab, Physics Department, Princeton University

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Visualizing Structural Variations Of Single DNA Molecules In A Nanofluidic Device
Period: 24 Jun 2014
Rodolphe Marie (Lecturer)
Department of Micro- and Nanotechnology
Optofluidics

Description
Marie, R., Pedersen, J. N., L. Bauer, D., Rasmussen, K. H., Yusuf, M., Volpi, E., U Mir, K., Flyvbjerg, H. and Kristensen, A

Related event

4th International Workshop on Analytical Miniaturization and NANOtechnologies
23/06/2014 → 24/06/2014
Copenhagen, Denmark
Activity: Talks and presentations › Conference presentations

4th International Workshop on Analytical Miniaturization and NANOtechnologies
Period: 23 Jun 2014 → 24 Jun 2014
Klaus Bo Mogensen (Organizer)
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology

Description
Organizing committee of The Fourth International Workshop on Analytical Miniaturization and NANOtechnologies, WAM-NANO 2014
Links:
http://www.wamnano2014.dk/About_the_conference (Workshop homepage)

Related event

4th International Workshop on Analytical Miniaturization and NANOtechnologies
23/06/2014 → 24/06/2014
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

### 4th International Workshop on Analytical Miniaturization and NANOtechnologies
**Period:** 23 Jun 2014 → 24 Jun 2014

Maria Dimaki (Participant)
Department of Micro- and Nanotechnology
Nano Bio Integrated Systems

**Description**
Lab-on-a-chip system for virus detection in water, Poster

**Related event**

### 4th International Workshop on Analytical Miniaturization and NANOtechnologies
**Period:** 23 Jun 2014 → 24 Jun 2014

Sanjukta Bose-Goswami (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

**Description**
Poster Presentation

**Related event**

### 4th International Workshop on Analytical Miniaturization and NANOtechnologies
**Period:** 23 Jun 2014 → 24 Jun 2014

Violetta Shvets (Lecturer)
Department of Micro- and Nanotechnology
Self-Organized Nanoporous Materials

**Description**
Oral presentation by: Violetta Shvets, Lars Schulte, Sokol Ndoni.

Violetta Shvets, Lars Schulte, Sokol Ndoni
Documents:
ABSTRACT_Canada_ViSh

**Related event**

### 7th International Symposium NANOPOROUS MATERIALS-7
**Period:** 22 Jun 2014 → 25 Jun 2014
Niagara Falls, Canada
Activity: Talks and presentations › Conference presentations
DTU 2014 Summit Workshop on Photonics Technologies
Period: 19 Jun 2014 → 20 Jun 2014
Cameron Smith (Invited speaker)
Department of Photonics Engineering
Department of Micro- and Nanotechnology

Description
Exciting channel-plasmons in tailored, UV-lithography-defined V-grooves.

Links:
http://www.photonicsworkshop.com/summit2014/

Related event

DTU 2014 Summit Workshop on Photonics Technologies: An ESOF2014 Satellite Event
19/06/2014 → 20/06/2014
Lyngby, Denmark
Activity: Talks and presentations › Conference presentations

Optimal estimation of diffusion coefficients from single-particle trajectories
Period: 12 Jun 2014 → 14 Jun 2014
Henrik Flyvbjerg (Invited speaker)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Description
Given a theoretical model for a self-propelled micro-organism, how does one optimally determine the parameters of the model from experimental data in the form of a time-lapse recorded trajectory? For very long trajectories, one has very good statistics, and optimality may matter little. However, for biological micro-organisms, one may not control the duration of recordings, and then optimality may matter. Especially if one is interested in individuality and hence does not wish to improve statistics by taking population averages over many trajectories. One can learn much about this problem by studying its simplest case, pure diffusion with no self-propagation. This turns out to be an interesting problem also in its own right and for the very same reasons. I address this latter issue in my talk [1] and will indicate which conclusions are valid also for self-propelled particles [2].

So now the question is: How does one optimally determine the diffusion coefficient of a diffusing particle from a single time-lapse recorded trajectory of the particle? We answer this question with an explicit, unbiased, and practically optimal covariance-based estimator (CVE). This estimator is regression-free and is far superior to commonly used methods based on measured mean squared displacements. In experimentally relevant parameter ranges, it also outperforms the analytically intractable and computationally more demanding maximum likelihood estimator (MLE). For the case of diffusion on a flexible and fluctuating substrate, the CVE is biased by substrate motion. However, given some long time series and a substrate under some tension, an extended MLE can separate particle diffusion on the substrate from substrate motion in the laboratory frame. This provides benchmarks that allow removal of bias caused by substrate fluctuations in CVE. The resulting unbiased CVE is optimal also for short time series on a fluctuating substrate. We have applied our estimators to human 8-oxoguanine DNA glycolase proteins diffusing on flow-stretched DNA, a fluctuating substrate, and found that diffusion coefficients are severely overestimated if substrate fluctuations are not accounted for [1].

Wilhelm and Else Heraeus Seminar on «Statistical Physics of Self-Propelled Particles: Theory and Experiment»

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

15th International Conference on Electroanalysis
Period: 11 Jun 2014 → 15 Jun 2014
Xueling Quan (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

Description
Poster

Documents:
Characterization of Electromechanical Behavior of an Electrochemical Cantilever System

Related event

15th International Conference on Electroanalysis
11/06/2014 → 15/06/2014
Malmö, Sweden
Activity: Attending an event › Participating in or organising a conference

10th International Conference on the Scientific and Clinical Applications of Magnetic Carriers
Period: 10 Jun 2014 → 14 Jun 2014
Kasper Kistrup (Participant)
Department of Micro- and Nanotechnology
Magnetic Systems
Links:
http://magneticmicrosphere.com/meeting-tenth (Official homepage)

Related event

10th International Conference on the Scientific and Clinical Applications of Magnetic Carriers
10/06/2014 → 14/06/2014
Dresden, Germany
Activity: Attending an event › Participating in or organising a conference

A magnetic nanoparticle-clustering biosensor for blu-ray based optical detection of small-molecules
Period: 27 May 2014 → 30 May 2014
Mikkel Fougt Hansen (Lecturer)
Department of Micro- and Nanotechnology
Magnetic Systems

Description


Related event

24th Anniversary World Congress on Biosensors
27/05/2014 → 30/05/2014
Melbourne, Australia
Activity: Talks and presentations › Conference presentations

E-MRS spring meeting 2014
Period: 26 May 2014 → 30 May 2014
Andrea Crovetto (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
Poster presentation.
Related event
E-MRS spring meeting 2014: Symposium A "Thin film chalcogenide photovoltaic materials"
26/05/2014 → 30/05/2014
Lille, France
Activity: Attending an event › Participating in or organising a conference

2014 Workshop on Micromachined Ultrasonic Transducers (MUT 2014)
Period: 20 May 2014
Thomas Lehmann Christiansen (Speaker)
Department of Micro- and Nanotechnology
MEMS-AppliedSensors
Documents:
Presentation_MUT2014_tlehr
Presentation_MUT2014_tlehr.pdf

Related event
13th International Workshop on Micromachined Ultrasonic Transducers
20/05/2014 → 21/05/2014
Kgs. Lyngby, Denmark
Activity: Talks and presentations › Conference presentations

Stem Cell Niche 2014
Period: 18 May 2014 → 22 May 2014
Mette Hemmingsen (Participant)
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology

Related event
Stem Cell Niche 2014
18/05/2014 → 22/05/2014
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

Micronano System Workshop
Period: 15 May 2014 → 16 May 2014
Klaus Bo Mogensen (Organizer)
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology

Description
http://www2.teknik.uu.se/mst/MSW2014/Welcome.asp

MicroNano system workshop, MSW2014 program committee member

Related event
Micronano System Workshop
15/05/2014 → 16/05/2014
Uppsala, Sweden
Activity: Attending an event › Participating in or organising a conference

Minimal Model of Motility Assays
Period: 6 May 2014
Henrik Flyvbjerg (Invited speaker)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Description
Talk at group meeting in Spudich Lab, Biochemistry Department, Stanford School of Medicine.

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Graphene 2014
Period: 5 May 2014 → 9 May 2014
Adam Carsten Stoot (Participant)
Department of Micro- and Nanotechnology
Nanointegration
Documents:
Poster - Toulouse

Related event

Graphene 2014
06/05/2014 → 09/05/2014
Toulouse, France
Activity: Attending an event › Participating in or organising a conference

IEEE International Magnetics Conference 2014
Period: 4 May 2014 → 8 May 2014
Daniel Kjær (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event

IEEE International Magnetics Conference 2014
04/05/2014 → 08/05/2014
Dresden, Germany
Activity: Attending an event › Participating in or organising a conference

Polymer coated gold nanoparticles for tracing the mobility of engineered nanoparticles in the subsurface
Period: 1 May 2014
Mogens Havsteen Jakobsen (Lecturer)
Department of Micro- and Nanotechnology
Surface Engineering

Related event

European Geosciences Union General Assembly 2014
27/04/2014 → 02/05/2014
Vienna, Austria
Activity: Talks and presentations › Conference presentations

11th International Workshop on Nanomechanical Sensing
Period: 30 Apr 2014 → 2 May 2014
Xueling Quan (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

Description
Poster

Related event
11th International Workshop on Nanomechanical Sensing
30/04/2014 → 02/05/2014
Madrid, Spain
Activity: Attending an event › Participating in or organising a conference

11th International Workshop on Nanomechanical Sensing
Period: 30 Apr 2014 → 2 May 2014
Sanjukta Bose-Goswami (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

Description
Poster Presentation

Related event
11th International Workshop on Nanomechanical Sensing
30/04/2014 → 02/05/2014
Madrid, Spain
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Isotopic Block Copolymers and Branched Molecules for the Study of Extensional Flow
Period: 12 Apr 2014
Kristoffer Almdal (Invited speaker)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing

Related event
Frank S. Bates And Timothy P. Lodge Honorary Symposium - Minnesota Block Polymers 2014
12/04/2014 → …
United States
Activity: Talks and presentations › Conference presentations

Instituto Superior Técnico
Period: 7 Apr 2014 → 11 Apr 2014
Adam Carsten Stoot (Visiting researcher)
Department of Micro- and Nanotechnology
Nanointegration

Description
Electrochemical methods for graphene research
Testing electrochemical characterisation techniques for graphene coatings and transfer samples. Techniques including SVET, LEIS, SECM, EIS.
Activity: Visiting an external institution › Visiting another research institution

Speaker at the Gordon Research Conference - Antibody Biology & Engineering: "High-Throughput Sequencing Enhanced Phage Display"
Period: 26 Mar 2014
Anders Christiansen (Speaker)
Department of Micro- and Nanotechnology
Fluidic Array Systems and Technology

Related event

Gordon Research Conference - Antibody Biology & Engineering: Understanding Antibody Structure, Function, Diversity, and Pathology to Improve Disease Treatment
23/03/2014 → 28/03/2014
Barga, Italy
Activity: Talks and presentations › Conference presentations

Visualizing Structural Variations Of Single DNA Molecules In A Nanofluidic Device’
Period: 10 Mar 2014 → 11 Mar 2014
Rodolphe Marie (Lecturer)
Department of Micro- and Nanotechnology
Optofluidics

Description
Marie, R., Pedersen, J. N., L. Bauer, D., Rasmussen, K. H., Yusuf, M., Volpi, E., U Mir, K., Flyvbjerg, H. and Kristensen, A

Invited talk at the Single Cell Analysis Europe on March 10-11 2014 in Berlin, Germany.

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

APS March Meeting 2014
Period: 6 Mar 2014
Simon Levinsen (Speaker)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing

Description
Synthesis of amphiphilic diblock copolymer for surface modification of Ethylene-Norbornene Copolymers

Documents:
Abstract APS 2014 Levinsen

Related event

APS March Meeting 2014
03/03/2014 → 07/03/2014
Denver, CO, United States
Activity: Talks and presentations › Conference presentations

58th Annual Conference on Magnetism and Magnetic Materials
Period: 4 Nov 2013 → 8 Nov 2013
Daniel Kjær (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event

58th Annual Conference on Magnetism and Magnetic Materials
04/11/2013 → 08/11/2013
Denver, United States
Activity: Attending an event › Participating in or organising a conference
Phonons in the presence of current: Exciting atomic motion
Period: 31 Oct 2013
Mads Brandbyge (Invited speaker)
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics
Department of Physics

Description
Invited talk at 543 WE-Heraeus-Seminar, Physikzentrum Bad Honnef, Germany.

Related event
543th Wilhelm und Else Heraeus Seminar: Electron Transport through Atoms, Molecules and Nanowires: Advances in Theory and Experiments
27/10/2013 → 31/10/2013
Bad Honnef, Germany
Activity: Talks and presentations › Conference presentations

Block Copolymer Self-Assembly based nanopattern creation for sub-16 nm device fabrication
Sozaraj Rasappa (Speaker)
Department of Micro- and Nanotechnology
Self-Organized Nanoporous Materials

Description
Conference talk at Nanotech Dubai 2013.
Documents:
Nanotech Dubai-2013-Raj

Related event
SETCOR International Conference on Nanotechnology Dubai 2013
28/10/2013 → 30/10/2013
Dubai, United Arab Emirates
Activity: Talks and presentations › Conference presentations

9th Annual Workshop of Biofilms – Research Center for Biointerfaces
Period: 4 Oct 2013
Paula Soares Martins Antunes (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

Description
Poster

Related event
9th Annual Workshop of Biofilms – Research Center for Biointerfaces
03/10/2013 → 04/10/2013
Malmo, Sweden
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Four invited lectures at Moscow State University: Faculty of Chemistry
Period: 2 Oct 2013 → 3 Oct 2013
Henrik Flyvbjerg (Lecturer)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Description
1) Single-Molecule Denaturation-Mapping of DNA in Nanofluidic Channels,
2) Visualizing structural variations of single DNA molecules in a nanofluidic device,
3) Optimized localization-analysis for single-molecule tracking and super-resolution microscopy,
4) Precise and accurate estimation of orientations and relative positions of two fluorophores close to each other: Proof-of-principle of a new tool for determination of biological structure.

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

39th International Conference on Micro and Nano Engineering
Period: 16 Sep 2013 → 19 Sep 2013
Kristian Hagsted Rasmussen (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
Dry etching of TOPAS® in oxygen based plasma, Kristian Hagsted Rasmussen, Ole Hansen, Flemming Jensen, Stephan S. Keller, and Anders M. Jorgensen

Related event

39th International Conference on Micro and Nano Engineering
16/09/2013 → 19/09/2013
London, United Kingdom
Activity: Attending an event › Participating in or organising a conference

Enhancing the Performance of Distributed Feedback Dye Lasers and Plasmonic V-grooves for Lab-on-a-chip Systems
Period: 12 Sep 2013
Cameron Smith (Invited speaker)
Department of Micro- and Nanotechnology
Optofluidics

Description
The ability to perform laboratory operations in compact systems is not only advantageous for the development of diagnostics tools and their production, but also provides unique opportunities to explore the natural world on the micro- and nanoscale. To this end, we focus on two optical schemes: 1) polymer-based distributed feedback (DFB) dye lasers, and 2) plasmonic V-grooves. Regarding the first, DFB dye lasers are well suited to serve as compact, minimal analyte volume and highly sensitive refractive index sensors, where changes occurring in an analyte result in readily measurable shifts of the laser emission wavelength. We provide a framework for designing optimized DFB laser sensors comprising a thin TiO2 guiding layer. Regarding the second, plasmonic V-grooves offer a means to control the trade-off between e-field confinement and propagation length by varying the V-shape profile, opening new prospects for unobtrusive particle and single molecule manipulation. We demonstrate a broad capability to tailor the properties of the plasmonic modes by subtly tuning the underlying Silicon V-groove geometry using conventional SiO2 growth. The approaches of 1) and 2) are considered with respect to the advantages they bring to lab-on-a-chip systems.
Links:

Related event

Lab-on-a-Chip World Congress
12/09/2013 → 13/09/2013
San Diego, CA, United States
Activity: Talks and presentations › Conference presentations
Biennial Graduate School in Electronic-structure methods
Period: 8 Sep 2013 → 13 Sep 2013
Nick Rübner Papior (Participant)
Center for Nanostructured Graphene
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Description
Density functional theory using the Quantum Espresso, Wannier90 and yambo codes.

Related event
Biennial Graduate School in Electronic-structure methods
08/09/2013 → 13/09/2013
Oxford, United Kingdom
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Overview of DTU Fotonik
Period: 2 Sep 2013 → 3 Sep 2013
Lars-Ulrik Aaen Andersen (Lecturer)
Department of Photonics Engineering
Department of Micro- and Nanotechnology

Related event
2nd Sino-Danish Photonics Days: Technologies for the future
02/09/2013 → 03/09/2013
Hong Kong
Activity: Talks and presentations › Conference presentations

4th Symposium on Carbon Nanomaterials
Period: 19 Aug 2013 → 20 Aug 2013
Adam Carsten Stoot (Participant)
Department of Micro- and Nanotechnology
Nanointegration

Description
Carbonhagen 2013: Graphene conference.

Related event
4th Symposium on Carbon Nanomaterials
19/08/2013 → 20/08/2013
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

inMRAM 2013
Period: 1 Jul 2013 → 3 Jul 2013
Daniel Kjær (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event
inMRAM 2013
01/07/2013 → 03/07/2013
Grenoble, France
Optimizing Single-Molecule Localization and Single-Molecule Force Spectroscopy
Period: 20 Jun 2013
Henrik Flyvbjerg (Invited speaker)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Related event

Gladstone Institutes seminar
20/06/2013 → 20/06/2013
San Francisco, United States
Activity: Talks and presentations › Conference presentations

Detection of glass transition of polymer by micro resonator
Period: 17 Jun 2013
Sanjukta Bose-Goswami (Speaker)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing

Related event

European Polymer Federation Congress 2013
16/06/2013 → 21/06/2013
Pisa, Italy
Activity: Talks and presentations › Conference presentations

Strongly non-linear extensional stress in polystyrene melts undergoing large steady rate extensional flows combined with structural characterization by neutron scattering measurements
Period: 16 Jun 2013 → 21 Jun 2013
Kristoffer Almdal (Speaker)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing

Description
Work sponsored by the FNU project "Entangled Polymer Melts in Extensional Flow". Talk co-authored by Ole Hassager, Kell Mortensen, Anders Bach, Henrik Kobitz Rasmussen, Wim Pyckhout-Hintzen
Documents:
Almdal_Kristoffer_EPMEF_20130124.pdf

Related event

European Polymer Federation Congress 2013
16/06/2013 → 21/06/2013
Pisa, Italy
Activity: Talks and presentations › Conference presentations

22nd Nordic Rheology Conference
Period: 12 Jun 2013
Kristian Ejlebjærg Jensen (Participant)
Theoretical Microsystems Optimization
Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics
Documents:
Modeling and Optimization with Viscoelastic Differential Constitutive Models

Related event
22nd Nordic Rheology Conference
12/06/2013 → 14/06/2013
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

10th World Congress on Structural and Multidisciplinary Optimization
Period: 23 May 2013
Kristian Ejlebjærg Jensen (Speaker)
Department of Micro- and Nanotechnology
Theoretical Microsystems Optimization
Description
Optimization of Bistable Viscoelastic Systems
Oral presentation
Documents:
 Optimization of Bistable Viscoelastic Systems
Related event
10th World Congress on Structural and Multidisciplinary Optimization
19/05/2013 → 24/05/2013
Orlando, FL, United States
Activity: Talks and presentations › Conference presentations

10th International Workshop on Nanomechanical Sensing
Period: 1 May 2013 → 3 May 2013
Sanjukta Bose-Goswami (Participant)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing
Description
Poster Presentation
Related event
10th International Workshop on Nanomechanical Sensing
01/05/2013 → 03/05/2013
San Francisco, CA, United States
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Electron-phonon coupling and molecular dynamics in the presence of current
Period: 1 May 2013
Mads Brandbyge (Lecturer)
Department of Physics
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics
Description
Invited talk at "Workshop on Controlled Atomic Dynamics on Solid Surfaces: Atom and Molecular Manipulation (UEBA13)"., San Sebastian, Spain.
Related event
Workshop on Controlled Atomic Dynamics on Solid Surfaces: Atom and Molecular Manipulation
13/05/2013 → 16/05/2013
San Sebastián, Spain
Activity: Talks and presentations › Conference presentations
Gold Nanoparticle Doped Polymer Materials for Micro- and Nanofabrication
Period: 18 Mar 2013
Søren Vang Fischer (Speaker)
Department of Micro- and Nanotechnology
Surface Engineering
Documents:
Gold Nanoparticle Doped Polymer

Related event

4th International Conference on Metamaterials, Photonic Crystals and Plasmonics, META’13
18/03/2013 → 22/03/2013
Sharjah, United Arab Emirates
Activity: Talks and presentations › Conference presentations

Optimal estimation of diffusion coefficients from noisy single-particle trajectories
Period: 11 Mar 2013
Henrik Flyvbjerg (Invited speaker)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Related event

Physics Department Condensed Matter Seminar
11/03/2013 → …
Princeton, United States
Activity: Talks and presentations › Conference presentations

Electron-phonon coupling and molecular dynamics in the presence of current
Period: 7 Mar 2013
Mads Brandbyge (Lecturer)
Department of Physics
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Description
Invited talk at CECAM workshop “Molecular electronics: Quo vadis?”, Bremen, Germany.
Links:
http://www.cecam.org/workshop-4-801.html?presentation_id=8754

Related event

CECAM Workshop Molecular electronics: Quo vadis?
04/03/2013 → 08/03/2013
Bremen, Germany
Activity: Talks and presentations › Conference presentations

12th Joint MMM-Intermag Conference
Period: 14 Jan 2013 → 18 Jan 2013
Daniel Kjær (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event
Optimal estimation of diffusion coefficients from noisy single-particle trajectories
Period: 6 Jan 2013 → 11 Jan 2013
Henrik Flyvbjerg (Speaker)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Description
Talk given.

Related event
7th biennial workshop on Single Molecule Biophysics
06/01/2013 → 11/01/2013
Aspen, Colorado, United States
Activity: Talks and presentations › Conference presentations

Medical technology
Period: 5 Jan 2013 → 19 Jan 2013
Henrik Flyvbjerg (Invited speaker)
Department of Micro- and Nanotechnology
Stochastic Systems and Signals

Description
Four invited lectures for students in medical technology: 1) Something about modeling, 2) Kinetics of self-assembling microtubules: An inverse problem in biochemistry. (a tour-de-force in data-driven modeling), 3) Modeling motility of microorganisms and motor molecules, 4) Cell Motility as Persistent Random Motion: theories from experiments. Or: How to read the body language of motile cells.

Panum Institute

Related external organisation
University of Copenhagen
Thorvaldensesvej 40, DK-1871 Frederiksberg C, Copenhagen, Denmark
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

American Physical Society (External organisation)
Period: 2012 → …
Duc-The Ngo (Participant)
Department of Energy Conversion and Storage
Imaging and Structural Analysis
Department of Micro- and Nanotechnology
Molecular Windows
Degree of recognition: International

Related external organisation
American Physical Society
United States
Activity: Membership › Membership of research networks or expert groups
Description
I work quite regularly as a reviewer for Applied Physics Letters in the topic of nanomagnetism and spintronics from 2012

Related journal
Applied Physics Letters
0003-6951

Central database
Activity: Research › Peer review of manuscripts

World Engineering Education Forum 2012
Søren Vang Fischer (Organizer)
Department of Micro- and Nanotechnology
Surface Engineering

Related event
15/10/2012 → 18/10/2012
Buenos Aires, Argentina
Activity: Attending an event › Participating in or organising a conference

Global Student Forum 2012
Period: 12 Oct 2012 → 18 Dec 2012
Søren Vang Fischer (Organizer)
Department of Management Engineering
Department of Micro- and Nanotechnology
Surface Engineering

Related event
Global Student Forum 2012: Engineering Education for Sustainable Development and Social Inclusion
12/10/2012 → 18/10/2012
Buenos Aires, Argentina
Activity: Attending an event › Participating in or organising a conference

222th Electrochemical Society meeting
Xueling Quan (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

Description
Oral
Related event

222th Electrochemical Society meeting
07/10/2014 → 12/10/2014
Honolulu, HI, United States
Activity: Attending an event › Participating in or organising a conference

38th International Conference on Micro and Nano Engineering
Period: 16 Sep 2012 → 20 Sep 2012
Kristian Hagsted Rasmussen (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Description
Surface properties of plasma etched SU-8, Kristian Hagsted Rasmussen, Ole Hansen, Flemming Jensen, Stephan S. Keller, and Anders M. Jorgensen

Related event

38th International Conference on Micro and Nano Engineering
16/09/2012 → 20/09/2012
Toulouse, France
Activity: Attending an event › Participating in or organising a conference

38th International Conference on Micro and Nano Engineering
Period: 16 Sep 2012 → 19 Sep 2012
Sanjukta Bose-Goswami (Participant)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing

Description
Poster Presentation
Documents:
MNESanjukta.pdf

Related event

Conducting polymers as active materials in microsystems
Period: 9 Sep 2012 → 12 Sep 2012
Niels Bent Larsen (Invited speaker)
Department of Micro- and Nanotechnology
Polymer Microsystems for Cell Processing

Related event

23rd Micromechanics And Microsystems Europe Workshop
09/09/2012 → 12/12/2012
Ilmenau, Germany
Activity: Talks and presentations › Conference presentations

26th Conference of the European Colloid and Interface Society
Period: 2 Sep 2012 → 7 Sep 2012
Olga Mednova (Participant)
Department of Micro- and Nanotechnology

Amphiphilic Polymers in Biological Sensing

**Description**

**Related event**
26th Conference of the European Colloid and Interface Society
02/09/2012 → 07/09/2012
Malmö, Sweden
Activity: Attending an event › Participating in or organising a conference

**Transport properties and atomic dynamics of nanoconductors from first principles calculations**
Period: 1 Sep 2012
Mads Brandbyge (Lecturer)
Department of Physics
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

**Description**
Invited talk at IUMRS-Int. Conf. on Elec. Materials (IUMRS-ICEM 2012), Yokohama, Japan.

**Related external organisation**
Unknown external organisation
Activity: Talks and presentations › Conference presentations

**Self Assembly in Soft Matter Systems**
Period: 8 Jul 2012 → 13 Jul 2012
Olga Mednova (Participant)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing

**Description**
O.Mednova, K.Almdal: Effect of poly(ethylethylene)-poly(2-vinylpyridine) diblock copolymers self-assembly on SU-8 toughening

**Related event**
Self Assembly in Soft Matter Systems
08/07/2012 → 13/07/2012
Mittelwihr, France
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

**Topology optimization of robust superhydrophobic surfaces**
Period: 1 Jul 2012 → 5 Jul 2012
Andrea Cavalli (Speaker)
Department of Micro- and Nanotechnology
Theoretical Microsystems Optimization

**Related event**
3rd International Conference on Engineering Optimization
01/07/2012 → 05/07/2012
Rio de Janeiro, Brazil
3rd Symposium on Graphene and Carbon Nanotubes  
Jaime Castillo (Participant)  
Department of Micro- and Nanotechnology  
Nano Bio Integrated Systems  

Description  
Poster presentation: Monitoring the functionalization of single-walled carbon nanotubes with chitosan and folic acid by two-dimensional diffusion-ordered NMR spectroscopy  

Related event  
3rd Symposium on Graphene and Carbon Nanotubes  
25/06/2012 → 26/06/2012  
Copenhagen, Denmark  
Activity: Attending an event › Participating in or organising a conference  

Nanotech 2012  
Period: 20 Jun 2012  
Peter Friis Østergaard (Participant)  
Department of Micro- and Nanotechnology  
Polymer Micro & Nano Engineering  

Description  
All polymer, injection molded nanoslits, fabricated through two-level UV-LIGA processes  

Related event  
Nanotech 2012: Conference & Expo  
18/06/2012 → 21/06/2012  
Santa Clara, United States  
Activity: Attending an event › Participating in or organising a conference  

Nanotech 2012  
Period: 18 Jun 2012 → 21 Jun 2012  
Simon Tylsgaard Larsen (Participant)  
Department of Micro- and Nanotechnology  
Polymer Micro & Nano Engineering  

Description  
Conductive Polymer Microelectrodes for on-chip measurement of transmitter release from living cells  

Related event  
Nanotech 2012: Conference & Expo  
18/06/2012 → 21/06/2012  
Santa Clara, United States  
Activity: Attending an event › Participating in or organising a conference  

Personalised Medicine  
Period: 18 Jun 2012  
Jaime Castillo (Participant)  
Department of Micro- and Nanotechnology  
Nano Bio Integrated Systems
Description
Poster presentation: Self-assembled Peptide and Protein Nanostructures in Diagnosis

Related event

Personalised Medicine: Better Healthcare for the Future - A Rational Approach Focusing on Bioinformatics, Medicinal Chemistry and Medicine
17/06/2012 → 22/06/2012
Larnaca, Cyprus
Activity: Attending an event › Participating in or organising a conference

III International Workshop on Analytical Miniaturization and NANOtechnologies
Period: 11 Jun 2012 → 12 Jun 2012
Jaime Castillo (Participant)
Department of Micro- and Nanotechnology
Nano Bio Integrated Systems

Description
Poster presentation: Spin casting of self-assembled peptide nanotubes for cheap and fast cleanroom fabrication

Related event

III International Workshop on Analytical Miniaturization and NANOtechnologies
11/06/2012 → 12/06/2012
Barcelona, Spain
Activity: Attending an event › Participating in or organising a conference

9th International Nanomechanical Sensing Workshop
Period: 7 Jun 2012
Xueling Quan (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

Description
Poster presentation: Investigation of cleaning and regeneration methods for reliable construction of DNA cantilever biosensors.
Documents:
NMC 2012-Final

Related event

9th International Nanomechanical Sensing Workshop
06/06/2012 → 08/06/2012
Mumbai, India
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Transport properties in graphene structures - in silico studies
Period: 1 Jun 2012
Mads Brandbyge (Speaker)
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics
Degree of recognition: International

Related event

3rd Symposium on Graphene and Carbon Nanotubes
25/06/2012 → 26/06/2012
49th Nordic Polymer Days 2012
Period: 29 May 2012 → 31 May 2012
Sanjukta Bose-Goswami (Participant)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing

Description
Poster Presentation

Related event

49th Nordic Polymer Days 2012
29/05/2012 → 31/05/2012
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Dansis Research Seminar 2012
Period: 23 May 2012
Kristian Ejlebjærg Jensen (Speaker)
Department of Micro- and Nanotechnology
Theoretical Microsystems Optimization

Description
The main objective of my project is to combine a state of the art numerical method for viscoelastic flow calculation with the topology optimisation method to improve on existing- as well as to discover novel non-Newtonian microfluidic devices.

The Danish Society for Industrial Fluid Dynamics (DANSIS - in Danish "Dansk Selskab for Industriel Strømningsmekanik") is a Danish company and networking organization based on industry research requirements and development within the area of fluid mechanics. DANSIS helps coordinate national efforts and strengthen the international relationships within the fluid flow field and catalyses the interdisciplinary collaboration between relevant sectors.

Documents:
Abstract

Related external organisation
Dansk Selskab for Industriel Strømningsmekanik
Denmark
Activity: Talks and presentations › Talks and presentations in private or public companies and organisations

4th IEEE International Memory Workshop
Period: 20 May 2012 → 23 May 2012
Daniel Kjær (Participant)
Department of Micro- and Nanotechnology
Silicon Microtechnology

Related event

4th IEEE International Memory Workshop
20/05/2012 → 23/05/2012
Milan, Italy
Activity: Attending an event › Participating in or organising a conference

Peptide nanostructures as scaffold for a SERS-based DNA biosensor
Jaime Castillo (Speaker)
Related event

22nd World Congress on Biosensors
15/05/2012 → 18/05/2012
Cancun, Mexico
Activity: Talks and presentations › Conference presentations

Self-assembled peptide nanostructures: A new alternative for the development of biosensors
Jaime Castillo (Speaker)

Department of Micro- and Nanotechnology
Nano Bio Integrated Systems
Links:
http://www.biosensors-congress.elsevier.com/

Related event

Conference on Lasers and Electro-Optics (CLEO 2012)
Period: 7 May 2012
Cameron Smith (Speaker)

Department of Micro- and Nanotechnology
Optofluidics

Description
Presenting speaker and session presider

Bragg grating filters in plasmonic V-groove waveguides
Documents:
CLEO12_CLCS_Vgrv_01.pdf

Related event

Conference on Lasers and Electro-Optics (CLEO 2012)
06/05/2012 → 11/05/2012
San Jose, CA, United States
Activity: Talks and presentations › Conference presentations

Theory and first principles calculations of current-induced atomic dynamics
Period: 1 May 2012
Mads Brandbyge (Lecturer)

Department of Physics
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Description
Invited talk at the "Int. Workshop on Computational Electronics (IWCE) 2012", Madison, Wisconsin, USA.
17th International Workshop on Numerical Methods for Non-Newtonian Flows
Period: 28 Mar 2012
Kristian Ejlebjærg Jensen (Speaker)
Department of Micro- and Nanotechnology
Theoretical Microsystems Optimization

Description
The main objective of my project is to combine a state of the art numerical method for viscoelastic flow calculation with the topology optimisation method to improve on existing- as well as to discover novel non-Newtonian microfluidic devices.

The International Workshops on Numerical Methods in Non-Newtonian Flows have been held roughly biennially, alternating between North America and Europe since 1979. This letter is an announcement that the next installment in this series of workshops will be held in The BLOIS Castle, France on March 25-28 2012, co-organized by Francisco CHINESTA of Ecole Centrale de Nantes (France), Roland KEUNINGS of Université de Louvain (Belgium), Raz KUPFERMAN of Hebrew University (Israel) and Marco DRESSLER of University of Massachusetts (USA). The objective of IWNMNF-2012 is to bring together researchers at the forefront of computational and experimental non-Newtonian fluid mechanics and rheology to discuss challenges, recent progress, future directions and emerging applications.

Finally, we emphasize that the workshop addresses not just numerical methods but also the natural phenomena and engineering processes whose prediction and understanding motivate those methods. Materials of interest have ranged from polymer solutions and melts to liquid crystals to suspensions of carbon nanotubes to micellar surfactant solutions to blood. Phenomena include turbulent drag reduction, flow instabilities and nonlinear dynamics, flows with complex geometries, multiphase flows, shear banding, extensional rheometry and many more. Despite the name of the workshop, presentations of experimental work are essential, as motivation and validation for the newest generations of methods.

Related event
17th International Workshop on Numerical Methods for Non-Newtonian Flows
25/03/2012 → 28/03/2012
Blois, France
Activity: Attending an event › Participating in or organising a conference

The Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy Inc.
Period: 11 Mar 2012 → 15 Mar 2013
Aikaterini Argyraki (Participant)
Department of Micro- and Nanotechnology
Polymer Micro & Nano Engineering

Related event
The Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy Inc.
11/03/2012 → 15/03/2012
Orlando, FL, United States
Activity: Attending an event › Participating in or organising a conference

Electronic transport, Joule-heating, and current-driven atomic dynamics in molecular contacts – theory and simulations
Period: 1 Mar 2012
Mads Brandbyge (Lecturer)
Department of Physics
Department of Micro- and Nanotechnology
Theoretical Nanoelectronics

Description
Invited talk at the Deutschen Physikalischen Gesellschaft (DPG), spring meeting, 2012.
Period: 26 Jan 2012 → 27 Jan 2012
Ida Lysgaard Thygesen (Speaker)
Department of Micro- and Nanotechnology

Description
Place: The Geological Survey of Denmark and Greenland (GEUS), København

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

14th International Union of Pure and Applied Chemistry Conference on Polymers and Organic Chemistry
Period: 6 Jan 2012 → 9 Jan 2012
Olga Mednova (Participant)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing

Description
14th IUPAC Conference on Polymers and Organic Chemistry
Links:
http://www.poc2012.com/

Related event
14th International Union of Pure and Applied Chemistry Conference on Polymers and Organic Chemistry
06/01/2012 → 09/01/2012
Doha, Qatar
Activity: Attending an event › Participating in or organising a conference

Thin Solid Films (Journal)
Period: 2011 → 2014
Duc-The Ngo (Reviewer)
Department of Energy Conversion and Storage
Imaging and Structural Analysis
Department of Micro- and Nanotechnology
Molecular Windows

Description
I have regularly worked as referee for the journal of Thin Solid Films since 2011

Related journal
Thin Solid Films
0040-6090
Central database
Activity: Research › Peer review of manuscripts

Low Cost and Fast Clean Room Fabrication Techniques using Peptide Nanotubes
Period: 11 Dec 2011 → 15 Dec 2011
Jaime Castillo (Speaker)
Department of Micro- and Nanotechnology
Nano Bio Integrated Systems

Related event

2nd Nano Today conference
11/12/2011 → 15/12/2011
Hawaii, United States
Activity: Talks and presentations › Conference presentations

Self-assembled peptide nanowires as multifunctional sensing platform for cellular studies
Period: 11 Dec 2011 → 15 Dec 2011
Jaime Castillo (Speaker)
Department of Micro- and Nanotechnology
Nano Bio Integrated Systems

Related event

2nd Nano Today conference
11/12/2011 → 15/12/2011
Hawaii, United States
Activity: Talks and presentations › Conference presentations

15th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Xueling Quan (Participant)
Department of Micro- and Nanotechnology
Nanoprobes
Description
Poster

Related event

15th International Conference on Miniaturized Systems for Chemistry and Life Sciences
02/10/2011 → 06/10/2011
Seattle, WA, United States
Activity: Attending an event › Participating in or organising a conference

Polymers for Advanced Technologies 2011
Period: 2 Oct 2011 → 5 Oct 2011
Olga Mednova (Participant)
Department of Micro- and Nanotechnology
Amphiphilic Polymers in Biological Sensing
Description
Polymers for Advanced Technologies
Links:

Related event

Polymers for Advanced Technologies 2011
02/10/2011 → 05/10/2011
Lodz, Poland
Activity: Attending an event › Participating in or organising a conference
Polymers for Advanced Technologies 2011
Period: 2 Oct 2011 → 5 Oct 2011
Olga Mednova (Participant)
Department of Micro- and Nanotechnology

Description
Nanostructure toughened SU-8 epoxy resin by poly(ethylethylene)-poly(2-vinylpyridine) diblock copolymer incorporation

Related event
Polymers for Advanced Technologies 2011
02/10/2011 → 05/10/2011
Lodz, Poland
Activity: Attending an event › Participating in or organising a conference

The 2011 Fluid•DTU Summer School
Period: 9 Aug 2011
Kristian Ejlebjærg Jensen (Speaker)
Department of Micro- and Nanotechnology
Theoretical Microsystems Optimization

Description
The main objective of my project is to combine a state of the art numerical method for viscoelastic flow calculation with the topology optimisation method to improve on existing- as well as to discover novel non-Newtonian microfluidic devices.

Krogerup Summer school is a Sunday-Saturday event with student contributions in the form of abstracts, posters and talks. Besides the student contributions, the event is attended by around ten internationally known lecturers each giving two talks.

Documents:
Abstract: STRUCTURAL OPTIMIZATION OF NON-NEWTONIAN RECTIFIERS

Related event
The 2011 Fluid•DTU Summer School: The 2011 Fluid•DTU Summer School Complex Motion in Fluids
07/08/2011 → 13/08/2011
Krogerup, Denmark
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

2nd International Conference on Nanotechnology
Period: 27 Jul 2011 → 29 Jul 2011
Xueling Quan (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

Related event
2nd International Conference on Nanotechnology (ICNFA 2011): Fundamentals and Applications
27/07/2011 → 29/07/2011
Ottawa, Canada
Activity: Attending an event › Participating in or organising a conference

Microreactors for heterogenous catalysis: Oral presentation at Nordic Semiconductor Meeting 2011
Period: 19 Jun 2011
Thomas Pedersen (Speaker)
Department of Micro- and Nanotechnology
**Microreactors for heterogenous catalysis: Oral presentation at Nordic Semiconductor Meeting 2011**

Period: 19 Jun 2011

Ole Hansen (Speaker)

Department of Micro- and Nanotechnology

**Lab on a Chip/Microfluidics course at the 62th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy (PITTCON)**

Period: 16 Apr 2011

Jaime Castillo (Guest lecturer)

Biomedical Micro Systems Section

Nano-Bio Integrated Systems Group

Department of Micro- and Nanotechnology

**European Winter School on Physical Organic Chemistry**

Period: 30 Jan 2011 → 4 Feb 2011

Olga Mednova (Participant)

Department of Micro- and Nanotechnology

Amphiphilic Polymers in Biological Sensing


Period: 2010 → 2014
Duc-The Ngo (Reviewer)
Department of Energy Conversion and Storage
Imaging and Structural Analysis
Department of Micro- and Nanotechnology
Molecular Windows

Description
Peer review journal

I have worked for Materials Science and Engineering B, and other journals of Elsevier since 2010

Related journal

Local database
Activity: Research › Peer review of manuscripts

Polymer Degradation: 1st Cook Medical Bioabsorbable Material Symposium
Period: 11 Nov 2010
Kristoffer Almdal (Speaker)
Department of Micro- and Nanotechnology

Related external organisation
Cook Medical, Bjæverskov
Activity: Talks and presentations › Conference presentations

36th International Conference on Micro- and Nano-Engineering
Period: 19 Sep 2010 → 22 Sep 2010
Xueling Quan (Participant)
Department of Micro- and Nanotechnology
Nanoprobes

Description
Poster

Related event
36th International Conference on Micro- and Nano-Engineering
19/09/2010 → 22/09/2010
Genoa, Italy
Activity: Attending an event › Participating in or organising a conference

8th International Conference on the Scientific and Clinical applications of magnetic carriers
Period: 25 May 2010 → 29 May 2010
Bjarke Thomas Dalslet (Participant)
Department of Micro- and Nanotechnology
LabChip Section
Magnetic Systems Group

Description
Chip-based measurements of brownian relaxation of magnetic beads using a planar Hall effect magnetic fiels sensor

Note: Presented on the 8th International Conference on the Scientific and Clinical applications of magnetic carriers (SCAMC)
Place: Rostock, Germany
8th International Conference on the Scientific and Clinical applications of magnetic carriers
Period: 25 May 2010 → 29 May 2010
Rostock, Germany
Activity: Attending an event › Participating in or organising a conference

**Mikkel Fougt Hansen** (Participant)
Department of Micro- and Nanotechnology
LabChip Section
Magnetic Systems Group

**Description**
Chip-based measurements of brownian relaxation of magnetic beads using a planar Hall effect magnetic fields sensor

**Note:** Presented on the 8th International Conference on the Scientific and Clinical applications of magnetic carriers (SCAMC)
**Place:** Rostock, Germany

**Related external organisation**

**Unknown external organisation**
Activity: Talks and presentations › Conference presentations

**Talk about "Using high throughput probe selection strategies to obtain ideal allele specific hybridization probes" Presented at Advance in Microarray technology**
Period: 25 May 2010 → 26 May 2010
Martin Dufva (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Fluidic Array Systems and Technology Group

**Description**
Place: Dublin, Ireland

**Related external organisation**
Talk about 'Cell handling by standing ultrasound waves in microfluidic systems' presented at 42nd Annual Oak Ridge Conference
Period: 22 Apr 2010 → 23 Apr 2010
Henrik Bruus (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Microfluidics Group
Description
Place: San José, USA

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

5th International Conference on MicroManufacturing
Period: 5 Apr 2010 → 8 Apr 2010
Pirmin Rombach (Participant)
Department of Micro- and Nanotechnology
Center for Individual Nanoparticle Functionality
Center for Nanoteknologi
Description
Talk about "Micro Cutting and Forming of thin aluminium foils" presented at The 5th International conference on MicroManufacturing ICOMM/4M
Place: Madison, Wisconsin, USA

Related event
5th International Conference on MicroManufacturing
05/04/2010 → 08/04/2010
Madison, WI, United States
Activity: Attending an event › Participating in or organising a conference

5th International Conference on MicroManufacturing
Period: 5 Apr 2010 → 8 Apr 2010
Dennis Mortensen (Participant)
Department of Micro- and Nanotechnology
Center for Individual Nanoparticle Functionality
Center for Nanoteknologi
Description
Talk about "Micro Cutting and Forming of thin aluminium foils" presented at The 5th International conference on MicroManufacturing ICOMM/4M
Place: Madison, Wisconsin, USA

Related event
5th International Conference on MicroManufacturing
05/04/2010 → 08/04/2010
Madison, WI, United States
Activity: Attending an event › Participating in or organising a conference
5th International Conference on MicroManufacturing
Period: 5 Apr 2010 → 8 Apr 2010
Ole Hansen (Participant)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group
Center for Individual Nanoparticle Functionality
Center for Nanoteknologi
Description
Talk about "Micro Cutting and Forming of thin aluminium foils" presented at The 5th International conference on MicroManufacturing ICOMM/4M
Place: Madison, Wisconsin, USA
Related event
5th International Conference on MicroManufacturing
05/04/2010 → 08/04/2010
Madison, WI, United States
Activity: Attending an event › Participating in or organising a conference

Talk about "Micro Cutting and Forming of thin aluminium foils" presented at The 5th International conference on MicroManufacturing ICOMM/4M
Period: 5 Apr 2010 → 8 Apr 2010
Christian Danvad Damsgaard (Speaker)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group
Center for Individual Nanoparticle Functionality
Center for Nanoteknologi
Description
Place: Madison, Wisconsin, USA
Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Nano-needles in medical diagnostics, monitoring and treatment, a look ahead" presented at IDEAS 10 YEARS
Period: 11 Mar 2010
Winnie Edith Svendsen (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group
Description
Place: Copenhagen, Denmark
Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations
Lab on a Chip/Microfluidics course at the 61st Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy (PITTCON)
Period: 3 Mar 2010
Jaime Castillo (Lecturer)
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group
Department of Micro- and Nanotechnology

Related event
Pittcon Conference & Expo 2010
28/02/2010 → 05/03/2010
Orlando, United States
Activity: Talks and presentations › Conference presentations

Talk about 'From self-assembled block copolymers to nanoporous materials' on TUM-Physik
Period: 20 Oct 2009
Sokol Ndoni (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Self-organized Nanoporous Materials Group

Related external organisation
Munich, Germany
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

17th IEEE International Conference on Advanced Thermal Processing of Semiconductors RTP09
Period: 29 Sep 2009 → 2 Oct 2009
Dirch Hjorth Petersen (Participant)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

Description
Accurate micro Hall Effect measurements on scribe line pads.

Related event
17th International Conference on Advanced Thermal Processing of Semiconductors RTP09
29/09/2009 → 02/10/2009
Albany, United States
Activity: Attending an event › Participating in or organising a conference

17th IEEE International Conference on Advanced Thermal Processing of Semiconductors RTP09
Period: 29 Sep 2009 → 2 Oct 2009
Dirch Hjorth Petersen (Participant)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

Description
Four-Point Probe Measurements on Inhomogeneous Samples: A probe spacing Dependence Study.
Related event

17th International Conference on Advanced Thermal Processing of Semiconductors RTP09
29/09/2009 → 02/10/2009
Albany, United States
Activity: Attending an event › Participating in or organising a conference

17th International Conference on Advanced Thermal Processing of Semiconductors RTP09
Period: 29 Sep 2009 → 2 Oct 2009
Dirch Hjorth Petersen (Participant)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

Description
Monitoring of local and global temperature non-uniformities by means of Therma-Probe and Micro Four-Point Probe metrology

Related event

17th International Conference on Advanced Thermal Processing of Semiconductors RTP09
29/09/2009 → 02/10/2009
Albany, United States
Activity: Attending an event › Participating in or organising a conference

Accurate micro Hall Effect measurements on scribe line pads, Proceedings of the 17th IEEE ØInternational Conference on Advanced Thermal Processing of Semiconductors, RTP 2009
Period: 29 Sep 2009 → 2 Oct 2009
Frederik Westergaard Østerberg (Speaker)
Department of Micro- and Nanotechnology

Description
Place: New York

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Accurate micro Hall Effect measurements on scribe line pads, Proceedings of the 17th IEEE ØInternational Conference on Advanced Thermal Processing of Semiconductors, RTP 2009
Period: 29 Sep 2009 → 2 Oct 2009
Fei Wang (Speaker)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group

Description
Place: New York

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Accurate micro Hall Effect measurements on scribe line pads, Proceedings of the 17th IEEE ØInternational Conference on Advanced Thermal Processing of Semiconductors, RTP 2009
Period: 29 Sep 2009 → 2 Oct 2009
Ole Hansen (Speaker)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group

Description
Place: New York

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Period: 29 Sep 2009 → 2 Oct 2009
Fei Wang (Speaker)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group

Description
Place: New York

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Frederik Westergaard Østerberg (Speaker)
Department of Micro- and Nanotechnology

Description
Place: New York

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Ole Hansen (Speaker)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group

Description
Place: New York

Related external organisation
Unknown external organisation
Monitoring of local and global temperature non-uniformities by means of Therma-Probe and Micro Four-Point Probe metrology
Period: 29 Sep 2009 → 2 Oct 2009
Frederik Westergaard Østerberg (Speaker)
Department of Micro- and Nanotechnology

Description
Place: New York

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Monitoring of local and global temperature non-uniformities by means of Therma-Probe and Micro Four-Point Probe metrology
Period: 29 Sep 2009 → 2 Oct 2009
Ole Hansen (Speaker)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group

Description
Place: New York

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

1. Talk about 1,2-Polybutadine nanoporous liquid core polymer waveguides, presented at COMS09
Period: 30 Aug 2009 → 4 Sep 2009
Nimi Gopalakrishnan (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Place: Copenhagen, Denmark

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

1. Talk about 1,2-Polybutadine nanoporous liquid core polymer waveguides, presented at COMS09
Period: 30 Aug 2009 → 4 Sep 2009
Anders Kristensen (Speaker)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

Related event
Acetone vapor sensing using a vertical cavity surface emitting laser diode coated with polystyrene

We report theoretical and experimental on a new vapor sensor, using a single-mode vertical-cavity surface-emitting laser (VCSEL) coated with a polymer sensor coating, which can detect acetone vapor at a volume fraction of 2.5%. The sensor provides the advantage of standard packaging, small form-factor, mechanical stability and low cost when combined with a monolithically integrated photodiode detector.

Place: Copenhagen, Denmark

Degree of recognition: International
We report theoretical and experimental on a new vapor sensor, using a single-mode vertical-cavity surface-emitting laser (VCSEL) coated with a polymer sensor coating, which can detect acetone vapor at a volume fraction of 2.5%. The sensor provides the advantage of standard packaging, small form-factor, mechanical stability and low cost when combined with a monolithically integrated photodiode detector.

Place: Copenhagen, Denmark
Degree of recognition: International

Related event

Annual Conference on Commercialization of Micro and Nano Systems
Period: 30 Aug 2009 → 4 Sep 2009
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

COMS09
Period: 30 Aug 2009 → 4 Sep 2009
Kaushal Shashikant Sagar (Participant)
Department of Micro- and Nanotechnology

Description
Talk about 1,2-Polybutadine nanoporous liquid core polymer waveguides, presentated at COMS09

Place: Copenhagen, Denmark

Related event

Annual Conference on Commercialization of Micro and Nano Systems
Period: 30 Aug 2009 → 4 Sep 2009
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference
Mads Brøkner Christiansen (Participant)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Talk about 1,2-Polybutadine nanoporous liquid core polymer waveguides, presented at COMS09

Place: Copenhagen, Denmark

Related event

Annual Conference on Commercialization of Micro and Nano Systems
30/08/2009 → 04/09/2009
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

COMS09
Period: 30 Aug 2009 → 4 Sep 2009
Sokol Ndoni (Participant)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Self-organized Nanoporous Materials Group

Description
Talk about 1,2-Polybutadine nanoporous liquid core polymer waveguides, presented at COMS09

Place: Copenhagen, Denmark

Related event

Annual Conference on Commercialization of Micro and Nano Systems
30/08/2009 → 04/09/2009
Copenhagen, Denmark
Activity: Attending an event › Participating in or organising a conference

Medical Biofilm Techniques; 27820
David Sabourin (Participant)
Biomedical Micro Systems Section
Fluidic Array Systems and Technology Group
Center for Nanoteknologi
Department of Micro- and Nanotechnology

Description
It was performed a presentation regarding the analysis with microsensor measurement of photosynthesis and respiration in a biofilm. Biofilms with Salmonella (S. Typhimurium DT104 and S. Derby) isolated from pigs and Pseudomonas Pseudoalcaligenes isolated from metal working fluids were developed and experiments were done in order to better understand the biofilm systems.

Documents:
Group 3 presentation for 27820 - version 2.ppt

Related event

Medical Biofilm Techniques; 27820
22/08/2009 → 29/08/2009
Infection Microbiology Group
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.
Talk about "Manipulation of Biological Self-assembled nano tubes and nano spheres for bionanotechnology applications"
Presented at 1st Nano Today Conference
Period: 3 Aug 2009 → 5 Aug 2009
Jaime Castillo (Speaker)
Department of Micro- and Nanotechnology
NanoSystems Engineering Section
Nanoprobes Group

Description
Place: Singapore

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Individual addressable 3D nanoelectrodes for neural metabolic studies, NanoToday, Singapore 2009
Winnie Edith Svendsen (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Description
Place: Singapore

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Individual addressable 3D nanoelectrodes for neural metabolic studies, NanoToday, Singapore 2009
Patricia Vazquez Rodriguez (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group
Description
Place: Singapore

Individual addressable 3D nanoelectrodes for neural metabolic studies, NanoToday, Singapore 2009
Maria Dimaki (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Description
Place: Singapore

Individual addressable 3D nanoelectrodes for neural metabolic studies, NanoToday, Singapore 2009
Peter Jensen Paluszewski (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Singapore

Micro and nanomechanical sensors - miniaturized bridges, diving boards and lids, proceeding at Nanoseminar, Mads Clausen Institute
Period: 18 Jun 2009
Søren Dohn (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: University of Southern Denmark

Optical Biosensor for Point-of-care Cardiac Marker Detection
Period: 17 Jun 2009
Niels Bent Larsen (Speaker)
Department of Micro- and Nanotechnology
Optical Biosensor for Point-of-Care Cardiac Marker Detection: Oral Presentation of paper
Period: 17 Jun 2009
Niels Bent Larsen (Speaker)
Department of Micro- and Nanotechnology
Polymer Micro and Nano Engineering Section
Polymer Microsystems for Cell Processing Group

Talk about "Controlled Synthesis of peptide Nano Spheres in a microfluidic device" at NanoBio Europe 2009, Grenoble, France
Winnie Edith Svendsen (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Interaction between proteins and polymer surfaces during competitive adsorption
Maria Svendsmark Hansen (Speaker)
Department of Micro- and Nanotechnology
Polymer Micro and Nano Engineering Section
Polymer Microsystems for Electrophysiology Group

Description
Place: The 13th international association of colloid & Interface scientists conference on surface and colloid science 83rd ACS Colloid and surface science symposium in New York, USA
Talk about "Photo-voltage versus micro-probe sheet resistance measurements on ultra-shallow structures" at INSIGHT 2009
Period: 30 May 2009
Dirch Hjorth Petersen (Speaker)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

International Workshop on INSIGHT in Semiconductor Device Fabrication, Metrology, and Modeling
26/04/2009 → 29/04/2009
Napa Valley, United States
Activity: Talks and presentations › Conference presentations

Talk about "Photo-voltage versus micro-probe sheet resistance measurements on ultra-shallow structures" at INSIGHT 2009, San-Francisco, US
Period: 30 May 2009
Sune Thorsteinsson (Speaker)
Department of Micro- and Nanotechnology

Talk about "Review of electrical characterization of ultra-shallow junctions with micro four-point probes" at INSIGHT 2009, San Francisco, US
Period: 30 May 2009
Dirch Hjorth Petersen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanointegration Group

Talk about "Review of electrical characterization of ultra-shallow junctions with micro four-point probes" at INSIGHT 2009, San Francisco, US
Period: 30 May 2009
Ole Hansen (Speaker)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group

Related event
International Workshop on INSIGHT in Semiconductor Device Fabrication, Metrology, and Modeling
26/04/2009 → 29/04/2009
Napa Valley, United States
Activity: Talks and presentations › Conference presentations

Talk about "Review of electrical characterization of ultra-shallow junctions with micro four-point probes" at INSIGHT 2009, San Francisco, US
Period: 30 May 2009
Ole Hansen (Speaker)
Department of Micro- and Nanotechnology
MicroElectroMechanical Systems Section
Silicon Microtechnology Group

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations
Talk about "Review of electrical characterization of ultra-shallow junctions with micro four-point probes" at INSIGHT 2009, San Francisco, US
Period: 30 May 2009
Torben Mikael Hansen (Speaker)
Department of Micro- and Nanotechnology

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Review of electrical characterization of ultra-shallow junctions with micro four-point probes" at INSIGHT 2009, San Francisco, US
Period: 30 May 2009
Peter Bøggild (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanointegration Group

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Competitive Protein adsorption to plasma polymerised polymer surfaces
Maria Svendsmark Hansen (Speaker)
Department of Micro- and Nanotechnology
Polymer Micro and Nano Engineering Section
Polymer Microsystems for Electrophysiology Group

Description
Place: The 8th International Symposium on frontiers in biomedical polymers in Mishima, Japan

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Detection of multiple bacteria cells using cantilever based mass sensors
Period: 20 May 2009 → 22 May 2009
Søren Dohn (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: Presented at International workshop on Nano-mechanical centilever sensors, Jeju, Korea

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations
Detection of multiple bacteria cells using cantilever based mass sensors
Period: 20 May 2009 → 22 May 2009
Chia-Wen Chang (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Presented at International workshop on Nano-mechanical centilever sensors, Jeju, Korea

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Detection of multiple bacteria cells using cantilever based mass sensors
Period: 20 May 2009 → 22 May 2009
Anja Boisen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: Presented at International workshop on Nano-mechanical centilever sensors, Jeju, Korea

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

New approach for medical diagnostics:Customizable all-polymer microdevices* Presented at 2nd European conference for clinical nanomedicine
Period: 27 Apr 2009 → 29 Apr 2009
Noemi Rozlosnik (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Basel, Switzerland

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

8th International Symposium on Photonic and Electromagnetic Crystal Structures
Period: 5 Apr 2009 → 9 Apr 2009
Anders Kristensen (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Improved polymer band edge lasers by multifunctional photonic crystal" Presented at PECS VIII, The 8th International Photonic & Electromagnetic Crystal structures Meeting

Place: Sydney, Australien

Related event

8th International Symposium on Photonic and Electromagnetic Crystal Structures
05/04/2009 → 09/04/2009
Sydney, Australia
Activity: Attending an event › Participating in or organising a conference

All-polymer microdevices for medical diagnostics BIT's
Period: 5 Apr 2009 → 7 Apr 2009
Noemi Rozlosnik (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Presented at 2nd annual world congress of Industrial biotechnology in Seoul, South Korea

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Improved polymer band edge lasers by multifunctional photonic crystal" Presented at PECS VIII, The 8th International Photonic & Electromagnetic Crystal structures Meeting
Period: 5 Apr 2009 → 9 Apr 2009
Mads Brøkner Christiansen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Place: Sydney, Australien

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

An integrated microfluidic system to isolate leukocytes from whole blood
Period: 1 Apr 2009 → 3 Apr 2009
Pranjal Jaykumar Shah (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Description
Place: Presented at MMB2009, Quebec, Canada
Anders Kristensen (Participant)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

Description
Talk about "Polarization Anisotropy of DNA in Nanochannels" Presented at "APS March Meeting"

Related event
APS March Meeting 2009
16/03/2009 → 20/03/2009
Pittsburg, United States
Activity: Attending an event › Participating in or organising a conference

Walter Reisner (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Propagation modes of entropically trapped and extended DNA molecules" presented at 2009 APS March Meeting

Place: Pittsburg, Pennsylvania, USA

Related event
APS March Meeting 2009
16/03/2009 → 20/03/2009
Pittsburg, United States
Activity: Attending an event › Participating in or organising a conference

Henrik Flyvbjerg (Participant)
Theory Section
Stochastic Systems and Signals Group
Department of Micro- and Nanotechnology

Description
Talk about "Propagation modes of entropically trapped and extended DNA molecules" presented at 2009 APS March Meeting

Place: Pittsburg, Pennsylvania, USA

Related event
APS March Meeting 2009
16/03/2009 → 20/03/2009
Pittsburg, United States
Activity: Attending an event › Participating in or organising a conference

APS March Meeting 2009
Period: 16 Mar 2009 → 20 Mar 2009
Anders Kristensen (Participant)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

Description
Talk about "Propagation modes of entropically trapped and extended DNA molecules" presented at 2009 APS March Meeting

Place: Pittsburg, Pennsylvania, USA

Related event

APS March Meeting 2009
16/03/2009 → 20/03/2009
Pittsburg, United States
Activity: Attending an event › Participating in or organising a conference

Niels Bent Larsen (Participant)
Polymer Micro and Nano Engineering Section
Polymer Microsystems for Cell Processing Group
Department of Micro- and Nanotechnology

Description
Talk about "Single-Molecule Denaturation Mapping of Genomic DNA in Nanofluidic Channels" presented at APS March Meeting

Place: Pittsburg, Pennsylvania, USA

Related event

APS March Meeting 2009
16/03/2009 → 20/03/2009
Pittsburg, United States
Activity: Attending an event › Participating in or organising a conference
APS March Meeting 2009
Period: 16 Mar 2009 → 20 Mar 2009
Henrik Flyvbjerg (Participant)

Description
Talk about "Single-Molecule Denaturation Mapping of Genomic DNA in Nanofluidic Channels" presented at APS March Meeting

Place: Pittsburg, Pennsylvania, USA

Related event
APS March Meeting 2009
16/03/2009 → 20/03/2009
Pittsburg, United States
Activity: Attending an event › Participating in or organising a conference

APS March Meeting 2009
Period: 16 Mar 2009 → 20 Mar 2009
Walter Reisner (Participant)

Description
Talk about "Pressure-driven single-file transport of DNA molecules along linear arrays of nanopits ambedded in a slit-like nanochannel" Presented at 2009 APS March Meeting

Place: Pittsburg, Pennsylvania, USA

Related event
APS March Meeting 2009
16/03/2009 → 20/03/2009
Pittsburg, United States
Activity: Attending an event › Participating in or organising a conference

APS March Meeting 2009
Period: 16 Mar 2009 → 20 Mar 2009
Anders Kristensen (Participant)

Description
Talk about "Pressure-driven single-file transport of DNA molecules along linear arrays of nanopits ambedded in a slit-like nanochannel" Presented at 2009 APS March Meeting

Place: Pittsburg, Pennsylvania, USA

Related event
APS March Meeting 2009
16/03/2009 → 20/03/2009
Pittsburg, United States
Activity: Attending an event › Participating in or organising a conference
Talk about "Integrated Waveguides for Various Detection Schemes in Microfluidic Systems" Presented at LabAutomation '09
Period: 16 Mar 2009 → 20 Mar 2009
Olga Ordeig Sala (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Polarization Anisotropy of DNA in Nanochannels" Presented at "APS March Meeting
Period: 16 Mar 2009 → 20 Mar 2009
Karl Fredrik Persson (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Place: Pittsburg, Pennsylvania, USA

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Propagation modes of entropically trapped and extended DNA molecules" presented at 2009 APS March Meeting
Period: 16 Mar 2009 → 20 Mar 2009
Morten Bo Lindholm Mikkelsen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Place: Pittsburg, Pennsylvania, USA

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Single-Molecule Denaturation Mapping of Genomic DNA in Nanofluidic Channels" presented at APS March Meeting
Period: 16 Mar 2009 → 20 Mar 2009
Walter Reisner (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Pittsburg, Pennsylvania, USA

Related external organisation
Lab on a Chip/Microfluidics course at the 60th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy (PITTCON)
Period: 11 Mar 2009
Jaime Castillo (Lecturer)
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group
Department of Micro- and Nanotechnology

Related event
PITTCON 2009
11/03/2009 → …
United States
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

Quantifying antimicrobial peptide interactions with lipid membranes: Presented at the department of Chemistry, Purdue University
Period: 1 Mar 2009
Thomas Lars Andresen (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Colloids and Biological Interfaces Group

Description
Place: West Lafayette, USA

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Secretory phospholipase A2 hydrolysis of lipid membranes: Presented at Biozentrum, University of Basel
Period: 12 Feb 2009
Thomas Lars Andresen (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Colloids and Biological Interfaces Group

Description
Place: Basel, Switzerland

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Segregated polymer media. Order, disorder and possibilities in particle synthesis
Period: 11 Feb 2009
Kristoffer Almdal (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Amphiphilic polymers in biological sensing Group

Related external organisation

Lund University
Lund, Sweden
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

Talk about "Microchannel electrokinetics of charged analytes in buffered solutions near floating electrodes" Presented at Gdansk, Polen
Period: 9 Feb 2009 → 13 Feb 2009
Mathias Bækbo Andersen (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Microfluidics Group

Description
Place: Gdansk, Polen

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Microchannel electrokinetics of charged analytes in buffered solutions near floating electrodes" Presented at Gdansk, Polen
Period: 9 Feb 2009 → 13 Feb 2009
Misha Marie Gregersen (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Microfluidics Group

Description
Place: Gdansk, Polen

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Microchannel electrokinetics of charged analytes in buffered solutions near floating electrodes" Presented at Gdansk, Polen
Period: 9 Feb 2009 → 13 Feb 2009
Henrik Bruus (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Microfluidics Group

Description
Place: Gdansk, Polen

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations
talk about "On-Chip Leukocytes Isolation" Presented at The International Conference on Biomedical and Genomic Research (ICBGR)
Period: 30 Jan 2009
Pranjal Jaykumar Shah (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Description
Place: Ahmedabad, India

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Nanoporous materials from block copolymers
Period: 27 Jan 2009 → 29 Jan 2009
Sokol Ndoni (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Self-organized Nanoporous Materials Group

Related event
6th Nordic Workshop on Scattering from Soft Matter
27/01/2009 → 29/01/2009
Aarhus, Denmark
Activity: Talks and presentations › Conference presentations

Laboratories-on-chip: application of micro and nanotechnology for rapid and efficient molecular diagnostics
Period: 26 Jan 2009 → 28 Jan 2009
Monica Brivio (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Description
Place: Noordwijkerhoud, The Netherlands

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Lab-on-a-chip: application of Micro- and Nanotechnology for rapid and efficient molecular diagnostics" presented at Rapid Methods Europe 2009 Conference
Period: 26 Jan 2009 → 28 Jan 2009
Monica Brivio (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
BioLabChip Group

Description
Place: Noordwijkerhout, The Netherlands
Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

LabAutomation 2009
Period: 24 Jan 2009 → 29 Jan 2009
Pelle Ohlsson (Participant)

LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Integrated Waveguides for Various Detection Schemes in Microfluidic Systems"

Related event

LabAutomation 2009
24/01/2009 → 29/01/2009
Palm Springs, CA, United States
Activity: Attending an event › Participating in or organising a conference

LabAutomation 2009
Period: 24 Jan 2009 → 29 Jan 2009
Thomas Glasdam Jensen (Participant)

LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Integrated Waveguides for Various Detection Schemes in Microfluidic Systems"

Related event

LabAutomation 2009
24/01/2009 → 29/01/2009
Palm Springs, CA, United States
Activity: Attending an event › Participating in or organising a conference

LabAutomation 2009
Period: 24 Jan 2009 → 29 Jan 2009
Guisheng Zhuang (Participant)

LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Integrated Waveguides for Various Detection Schemes in Microfluidic Systems"

Related event

LabAutomation 2009
24/01/2009 → 29/01/2009
Palm Springs, CA, United States
Activity: Attending an event › Participating in or organising a conference
LabAutomation 2009
Period: 24 Jan 2009 → 29 Jan 2009
Klaus Bo Mogensen (Participant)

LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Integrated Waveguides for Various Detection Schemes in Microfluidic Systems"

Related event

LabAutomation 2009
24/01/2009 → 29/01/2009
Palm Springs, CA, United States
Activity: Attending an event › Participating in or organising a conference

LabAutomation 2009
Period: 24 Jan 2009 → 29 Jan 2009
Detlef Snakenborg (Participant)

LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Integrated Waveguides for Various Detection Schemes in Microfluidic Systems"

Related event

LabAutomation 2009
24/01/2009 → 29/01/2009
Palm Springs, CA, United States
Activity: Attending an event › Participating in or organising a conference

LabAutomation 2009
Period: 24 Jan 2009 → 29 Jan 2009
Jörg Peter Kutter (Participant)

LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Integrated Waveguides for Various Detection Schemes in Microfluidic Systems" Presented at LabAutomation '09

Related event

LabAutomation 2009
24/01/2009 → 29/01/2009
Palm Springs, CA, United States
Activity: Attending an event › Participating in or organising a conference

Talk about "Radiative heat transport in quantum circuits" presented at Unifying Themes in Condensed Matter
Period: 11 Jan 2009 → 17 Jan 2009
Antti-Pekka Jauho (Speaker)
Department of Micro- and Nanotechnology
Talk about "Micro and Nanomechanical sensors; new materials and read-out methods" presented at ICMEMS 2009
Period: 3 Jan 2009 → 5 Jan 2009
Anja Boisen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Talk about "Integration of Carbon Nanotubes in Electrokinetic Separation Devices" presented at MicroTAS 2008
Period: 1 Jan 2009 → …
Klaus Bo Mogensen (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Institute of Physics (External organisation)
Period: 2008 → …
Duc-The Ngo (Participant)
Department of Energy Conversion and Storage
Imaging and Structural Analysis
Department of Micro- and Nanotechnology
Molecular Windows

Description
Member
I have been a member of Institute of Physics (IOP, UK) since 2008

Body type: Society
Degree of recognition: International
Beograd
Activity: Membership › Membership of research networks or expert groups

The 3rd International Workshop on Nanomechanical Sensors
Period: 2008
Gabriela Blagoi (Participant)
NanoSystemsEngineering Section
Nanoprobes Group
Department of Micro- and Nanotechnology

Description
Talk about "Advances in the fabrication of cantilever-based sensors with the polymer SU-8" Presented at 3rd International workshop on Nanomechanical sensors

Place: Mainz, Germany
Degree of recognition: International

Related event
The 3rd International Workshop on Nanomechanical Sensors
01/01/2008 → ...
Mainz, Germany
Activity: Attending an event › Participating in or organising a conference

The 3rd International Workshop on Nanomechanical Sensors
Period: 2008 → ...
Anja Boisen (Participant)
NanoSystemsEngineering Section
Nanoprobes Group
Department of Micro- and Nanotechnology

Description
Talk about "Advances in the fabrication of cantilever-based sensors with the polymer SU-8" Presented at 3rd International workshop on Nanomechanical sensors

Place: Mainz, Germany
Degree of recognition: International

Related event
The 3rd International Workshop on Nanomechanical Sensors
01/01/2008 → ...
Mainz, Germany
Activity: Attending an event › Participating in or organising a conference

Talk about "Atomistic Modeling of Electronic and Thermal Transport Properties of Si-nanowires" Presented at Advanced Heterostructures and Nanostructures Workshop
Period: 7 Dec 2008 → 12 Dec 2008
Antti-Pekka Jauho (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Hawaii, USA

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations
Talk about "Atomistic Modeling of Electronic and Thermal Transport Properties af Si-nanowires" Presented at International Workshop on Nonequilibrium Nanostructures
Period: 1 Dec 2008 → 6 Dec 2008
Antti-Pekka Jauho (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Dresden, Germany

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

5th International Interdisciplinary Meeting on Bioanalysis
Period: 24 Nov 2008 → 25 Nov 2008
Detlef Snakenborg (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Combining Microfluidics and Small Angle X-ray Scattering for Structural Analysis of Proteins: Small Chip - Large Detector - Perfect Marriage" Presented at CECE 2008 - 5th International Interdisciplinary Meeting on Bioanalysis.

Place: Brno, Czech
Degree of recognition: International

Related event

5th International Interdisciplinary Meeting on Bioanalysis
24/11/2008 → 25/11/2008
Brno, Czech Republic
Activity: Attending an event › Participating in or organising a conference

5th International Interdisciplinary Meeting on Bioanalysis
Period: 24 Nov 2008 → 25 Nov 2008
Søren Skou Nielsen (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Combining Microfluidics and Small Angle X-ray Scattering for Structural Analysis of Proteins: Small Chip - Large Detector - Perfect Marriage" Presented at CECE 2008 - 5th International Interdisciplinary Meeting on Bioanalysis.

Place: Brno, Czech
Degree of recognition: International

Related event

5th International Interdisciplinary Meeting on Bioanalysis
24/11/2008 → 25/11/2008
Brno, Czech Republic
Activity: Attending an event › Participating in or organising a conference
5th International Interdisciplinary Meeting on Bioanalysis
Period: 24 Nov 2008 → 25 Nov 2008
Katrine Nørgaard Toft (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Combining Microfluidics and Small Angle X-ray Scattering for Structural Analysis of Proteins: Small Chip - Large Detector - Perfect Marriage" Presented at CECE 2008 - 5th International Interdisciplinary Meeting on Bioanalysis.

Place: Brno, Czech
Degree of recognition: International

Related event
5th International Interdisciplinary Meeting on Bioanalysis
24/11/2008 → 25/11/2008
Brno, Czech Republic
Activity: Attending an event › Participating in or organising a conference

61st Annual Meeting of the APS Division of Fluid Dynamics
Period: 23 Nov 2008 → 25 Nov 2008
Kaare Hartvig Jensen (Participant)
Theory Section
Theoretical Microfluidics Group
Department of Micro- and Nanotechnology

Description
Talk about "Osmotically driven flows in microchannels separated by a semipermeable membrane" presented at "APS Division of Fluid Mechanics"

Related event
61st Annual Meeting of the APS Division of Fluid Dynamics
23/11/2008 → 25/11/2008
San Antonio, United States
Activity: Attending an event › Participating in or organising a conference

61st Annual Meeting of the APS Division of Fluid Dynamics
Period: 23 Nov 2008 → 25 Nov 2008
Dan Bohr (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Osmotically driven flows in microchannels separated by a semipermeable membrane" presented at "APS Division of Fluid Mechanics"

Related event
61st Annual Meeting of the APS Division of Fluid Dynamics
23/11/2008 → 25/11/2008
San Antonio, United States
Activity: Attending an event › Participating in or organising a conference

61st Annual Meeting of the APS Division of Fluid Dynamics
Period: 23 Nov 2008 → 25 Nov 2008
Fridolin Okkels (Participant)
Theory Section
Theoretical Microfluidics Group
Department of Micro- and Nanotechnology

**Description**
Talk about "Topology optimization of induced-charge electroosmotic flows" presented at "APS Division of Fluid Mechanics"

**Related event**

**61st Annual Meeting of the APS Division of Fluid Dynamics**
Period: 23 Nov 2008 → 25 Nov 2008
San Antonio, United States
Activity: Attending an event › Participating in or organising a conference

Henrik Bruus (Participant)
Theory Section
Theoretical Microfluidics Group
Department of Micro- and Nanotechnology

**Description**
Talk about "Topology optimization of induced-charge electroosmotic flows" presented at "APS Division of Fluid Mechanics"

**Related event**

**61st Annual Meeting of the APS Division of Fluid Dynamics**
Period: 23 Nov 2008 → 25 Nov 2008
San Antonio, United States
Activity: Attending an event › Participating in or organising a conference

Martin Heller (Participant)
Theory Section
Theoretical Microfluidics Group
Department of Micro- and Nanotechnology

**Description**
Talk about "Viscous extensional film withdrawal, APS Division of Fluid Mechanics" presented at "San Antonio (TX)".

**Related event**

**61st Annual Meeting of the APS Division of Fluid Dynamics**
Period: 23 Nov 2008 → 25 Nov 2008
San Antonio, United States
Activity: Attending an event › Participating in or organising a conference

Henrik Bruus (Participant)
Theory Section
Theoretical Microfluidics Group
Department of Micro- and Nanotechnology

**Description**
Talk about "Viscous extensional film withdrawal, APS Division of Fluid Mechanics" presented at "San Antonio (TX)".
Related event

61st Annual Meeting of the APS Division of Fluid Dynamics
23/11/2008 → 25/11/2008
San Antonio, United States
Activity: Attending an event › Participating in or organising a conference

Talk about "Osmotically driven flows in microchannels separated by a semipermeable membrane" presented at "APS Division of Fluid Mechanics"
Period: 23 Nov 2008 → 25 Nov 2008
Henrik Bruus (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Microfluidics Group

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Topology optimization of induced-charge electroosmotic flows" presented at "APS Division of Fluid Mechanics"
Period: 23 Nov 2008 → 25 Nov 2008
Misha Marie Gregersen (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Microfluidics Group

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

2008 AIChE Annual Meeting
Martin Heller (Participant)
Theory Section
Theoretical Microfluidics Group
Department of Micro- and Nanotechnology

Description
Talk about "Investigation of Hemodynamics in saccular aneurysms" Presented at Amercan Institute of Chemical Engineers (AIChE) Annual Meeting
Place: Philadelphia, Pennsylvania, USA

Related event

2008 AIChE Annual Meeting
16/11/2008 → 21/11/2008
Philadelphia, PA, United States
Activity: Attending an event › Participating in or organising a conference

Comsol Conference 2008
Period: 4 Nov 2008 → 6 Nov 2008
Dirch Hjorth Petersen (Participant)
Description
Talk about "Simulation of Toology Optimized Microgrippers"
Place: Hannover, Germany

Related event

Comsol Conference 2008
04/11/2008 → 06/11/2008
Hannover, Germany
Activity: Attending an event › Participating in or organising a conference

Comsol Conference 2008
Period: 4 Nov 2008 → 6 Nov 2008
Peter Bøggild (Participant)

NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

Description
Talk about "Simulation of Toology Optimized Microgrippers"

Related event

Comsol Conference 2008
04/11/2008 → 06/11/2008
Hannover, Germany
Activity: Attending an event › Participating in or organising a conference

Comsol Conference 2008
Period: 4 Nov 2008 → 6 Nov 2008
Jacob Lange Moresco (Participant)

Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group
Department of Micro- and Nanotechnology

Description
Talk about "Comsol Multiphysisc Simulation of Microfluidic Systems for Biomedical Applications" presented at Comsol User Conference

Place: Hannover, Germany

Related event

Comsol Conference 2008
04/11/2008 → 06/11/2008
Hannover, Germany
Activity: Attending an event › Participating in or organising a conference

Comsol Conference 2008
Period: 4 Nov 2008 → 6 Nov 2008
Patricia Vazquez Rodriguez (Participant)
**Biomedical Micro Systems Section**

**Nano-Bio Integrated Systems Group**

**Department of Micro- and Nanotechnology**

**Description**

Talk about "Comsol Multiphysisc Simulation of Microfluidic Systems for Biomedical Applications" presented at Comsol User Conference

**Place:** Hannover, Germany  
**Degree of recognition:** International

**Related event**

**Comsol Conference 2008**  
04/11/2008 → 06/11/2008  
Hannover, Germany  
Activity: Attending an event › Participating in or organising a conference

**Comsol Conference 2008**  
Period: 4 Nov 2008 → 6 Nov 2008  
Pranjul Jaykumar Shah (Participant)  
Biomedical Micro Systems Section  
Nano-Bio Integrated Systems Group  
Department of Micro- and Nanotechnology

**Description**

Talk about "Comsol Multiphysisc Simulation of Microfluidic Systems for Biomedical Applications" presented at Comsol User Conference

**Place:** Hannover, Germany  
**Degree of recognition:** International

**Related event**

**Comsol Conference 2008**  
04/11/2008 → 06/11/2008  
Hannover, Germany  
Activity: Attending an event › Participating in or organising a conference

**Comsol Conference 2008**  
Period: 4 Nov 2008 → 6 Nov 2008  
Fridolin Okkels (Participant)  
Theory Section  
Theoretical Microfluidics Group  
Department of Micro- and Nanotechnology

**Description**

Talk about "Comsol Multiphysisc Simulation of Microfluidic Systems for Biomedical Applications" presented at Comsol User Conference

**Place:** Hannover, Germany  
**Degree of recognition:** International

**Related event**

**Comsol Conference 2008**  
04/11/2008 → 06/11/2008  
Hannover, Germany  
Activity: Attending an event › Participating in or organising a conference
**Comsol Conference 2008**  
Period: 4 Nov 2008 → 6 Nov 2008  
Winnie Edith Svendsen (Participant)  
Biomedical Micro Systems Section  
Nano-Bio Integrated Systems Group  
Department of Micro- and Nanotechnology  

**Description**  
Talk about "Comsol Multiphysisc Simulation of Microfluidic Systems for Biomedical Applications" presented at Comsol User Conference  
Place: Hannover, Germany  
Degree of recognition: International  

**Related event**  
Comsol Conference 2008  
04/11/2008 → 06/11/2008  
Hannover, Germany  
Activity: Attending an event › Participating in or organising a conference  

**Talk about "Simulation of Tooology Optimized Microgrippers**  
Period: 4 Nov 2008 → 6 Nov 2008  
Özlem Sardan Sukas (Speaker)  
Department of Micro- and Nanotechnology  

**Description**  
Place: Hannover, Germany  

**Related external organisation**  
Unknown external organisation  
Activity: Talks and presentations › Conference presentations  

**Talk about "New Materials and read-out methods for Cantilever-based sensing" Presented at Instute of Physics, Academia Sinica**  
Period: 29 Oct 2008  
Anja Boisen (Speaker)  
Department of Micro- and Nanotechnology  
NanoSystemsEngineering Section  
Nanoprobes Group  

**Description**  
Place: Taiwan  

**Related external organisation**  
Unknown external organisation  
Activity: Talks and presentations › Conference presentations  

**Talk about "Nanomechanical Sensors" Presented at National Cheng Kung University**  
Period: 28 Oct 2008  
Anja Boisen (Speaker)  
Department of Micro- and Nanotechnology  
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: Taiwan

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Quantitative Strategies to Handle Stamp Banding in NIL" Presented at "The 7th International Conference on Nanoimprint and Nanoprint Technology"
Rasmus Haugstrup Pedersen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Place: Kyoto, Japan

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Roll-to-Roll Thermal Nanoimprinted Microfluidic Separation Devices" Presented at "The 7th International Conference on Nanoimprint and Nanoprint Technology"
Asger Laurberg Vig (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Place: Kyoto, Japan

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

The 7th International Conference on Nanoimprint and Nanoprint Technology
Asger Laurberg Vig (Participant)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Talk about "Quantitative Strategies to Handle Stamp Banding in NIL" Presented at "The 7th International Conference on Nanoimprint and Nanoprint Technology"
Place: Kyoto, Japan
Degree of recognition: International

Related event
The 7th International Conference on Nanoimprint and Nanoprint Technology: NNT’08 October 13-15 2008  
13/10/2008 → 15/10/2008  
Kyoto, Japan  
Activity: Attending an event › Participating in or organising a conference

**The 7th International Conference on Nanoimprint and Nanoprint Technology**  
Anders Kristensen (Participant)  
Department of Micro- and Nanotechnology  
NanoSystemsEngineering Section  
NSE-Optofluidics Group

**Description**  
Talk about "Quantitative Strategies to Handle Stamp Banding in NIL" Presented at "The 7th International Conference on Nanoimprint and Nanoprint Technology"

Place: Kyoto, Japan  
Degree of recognition: International

**Related event**  

The 7th International Conference on Nanoimprint and Nanoprint Technology: NNT’08 October 13-15 2008  
13/10/2008 → 15/10/2008  
Kyoto, Japan  
Activity: Attending an event › Participating in or organising a conference

**The 7th International Conference on Nanoimprint and Nanoprint Technology**  
Anders Kristensen (Participant)  
Department of Micro- and Nanotechnology  
NanoSystemsEngineering Section  
NSE-Optofluidics Group

**Description**  
Talk about "Roll-to-Role Thermal Nanoimprinted Microfluidic Separation Devices" Presented at "The 7th International Conference on Nanoimprint and Nanoprint Technology"

Place: Kyoto, Japan

**Related event**  

The 7th International Conference on Nanoimprint and Nanoprint Technology: NNT’08 October 13-15 2008  
13/10/2008 → 15/10/2008  
Kyoto, Japan  
Activity: Attending an event › Participating in or organising a conference

**The 7th International Conference on Nanoimprint and Nanoprint Technology**  
Lasse Højlund Thamdrup (Participant)  
Department of Micro- and Nanotechnology  
NanoSystemsEngineering Section  
NSE-Optofluidics Group

**Description**  
Talk about "Quantitative Strategies to Handle Stamp Banding in NIL" Presented at "The 7th International Conference on Nanoimprint and Nanoprint Technology"

Place: Kyoto, Japan
Related event

The 7th International Conference on Nanoimprint and Nanoprint Technology: NNT'08 October 13-15 2008
13/10/2008 → 15/10/2008
Kyoto, Japan
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Peter Bøggild (Participant)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

Description
Talk about "Integration of Carbon Nanotubes in Electrokinetic Separation Devices" presented at MicroTAS 2008
Place: San Diego, USA

Related event

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Jörg Peter Kutter (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Integration of Carbon Nanotubes in Electrokinetic Separation Devices" presented at MicroTAS 2008
Place: San Diego, USA

Related event

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Detlef Snakenborg (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Automated High-Throughput Structural Protein Analysis Using Small Angle X-ray Scattering Combined with a Microfluidic Approach" presented at MicroTAS 2008
Place: San Diego, USA
Degree of recognition: International
Related event

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Katrine Nørgaard Toft (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Automated High-Throughput Structural Protein Analysis Using Small Angle X-ray Scattering Combined with a Microfluidic Approach" presented at MicroTAS 2008

Place: San Diego, USA
Degree of recognition: International

Related event

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Jörg Peter Kutter (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Automated High-Throughput Structural Protein Analysis Using Small Angle X-ray Scattering Combined with a Microfluidic Approach" presented at MicroTAS 2008

Place: San Diego, USA
Degree of recognition: International

Related event

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Katrine Nørgaard Toft (Participant)
Department of Micro- and Nanotechnology

Description

Place: Berlin, Germany
Degree of recognition: International

Related event
12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Jörg Peter Kutter (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Integration of Carbon Nanotubes in Electrokinetic Separation Devices" presented at "MicroTAS".
Degree of recognition: International

Related event

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Peter Bøggild (Participant)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

Description
Talk about "Integration of Carbon Nanotubes in Electrokinetic Separation Devices" presented at "MicroTAS".
Degree of recognition: International

Related event

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Anders Kristensen (Participant)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Talk about "Polarization Anisotropy of DNA in Nanochannels" Presented at "The 12th International Conference on Miniaturized Systems for Chemistry and Life Sciences, MicroTAS"

Related event

12th International Conference on Miniaturized Systems for Chemistry and Life Sciences
12/10/2008 → 16/10/2008
San Diego, United States
Activity: Attending an event › Participating in or organising a conference
4th STIPOMAT Conference
Period: 21 Sep 2008 → 24 Sep 2008
Thomas Steen Hansen (Participant)
Polymer Micro and Nano Engineering Section
Polymer Microsystems for Cell Processing Group
Department of Micro- and Nanotechnology

Description
Talk about "Functionalized conducting Polymers for Cell Processing" presented at 4th STIPOMAT Conference

Place: Lacanau. France

Related event
4th STIPOMAT Conference
21/09/2008 → 29/09/2008
Lacanau, France
Activity: Attending an event › Participating in or organising a conference

4th STIPOMAT Conference
Period: 21 Sep 2008 → 24 Sep 2008
Niels Bent Larsen (Participant)
Polymer Micro and Nano Engineering Section
Polymer Microsystems for Cell Processing Group
Department of Micro- and Nanotechnology

Description
Talk about "Functionalized conducting Polymers for Cell Processing" presented at 4th STIPOMAT Conference

Place: Lacanau. France

Related event
4th STIPOMAT Conference
21/09/2008 → 29/09/2008
Lacanau, France
Activity: Attending an event › Participating in or organising a conference

Talk about "Functionalized conducting Polymers for Cell Processing" presented at 4th STIPOMAT Conference
Period: 21 Sep 2008 → 24 Sep 2008
Johan Ulrik Lind (Speaker)
Department of Micro- and Nanotechnology
Polymer Micro and Nano Engineering Section
Polymer Microsystems for Cell Processing Group

Description
Place: Lacanau. France

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

34th International Conference on Micro and Nano Engineering
Period: 15 Sep 2008 → 18 Sep 2008
Anders Kristensen (Participant)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

**Description**
Talk about "Excitation of Flourecent Nanoparticles by Plasmons confined and Propagating in V-Grooves" Presented at the 34th International Conference on Micro and Nano Engineering MNE

**Related event**
*34th International Conference on Micro and Nano Engineering*
14/09/2008 → 18/09/2008
Athens, Greece
Activity: Attending an event › Participating in or organising a conference

Polymer Micro and Nano Engineering Section
Polymer Microsystems for Cell Processing Group
Department of Micro- and Nanotechnology

**Description**
Talk about "In-mold Patterning: Micro- and Nanopatterning of Proteins during Injection Molding" Presented at 34th International Conference on Micro and Nano Engineering

Place: Athens, Greece

**Related event**
*34th International Conference on Micro and Nano Engineering*
14/09/2008 → 18/09/2008
Athens, Greece
Activity: Attending an event › Participating in or organising a conference

NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

**Description**
Talk about "Roll-to-Role Thermal Nanoimprinted Microfluidic Separation Devices based on Pinched Flow Fractionation" Presented at "The 34th International Conference on Micro and Nano Engineering"

Place: Athens, Greece

**Related event**
*34th International Conference on Micro and Nano Engineering*
14/09/2008 → 18/09/2008
Athens, Greece
Activity: Attending an event › Participating in or organising a conference

**III-V Nanowires for Molecular Junctions: Fabrication and DFT Simulations**
Period: 15 Sep 2008 → 18 Sep 2008
Christian Kallesøe (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanointegration Group

**Description**
Place: Athens, Greece

**Related external organisation**
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Roll-to-Roll Thermal Nanoimprinted Microfluidic Separation Devices based on Pinched Flow Fractionation"
Presented at "The 34th International Conference on Micro and Nano Engineering"
Period: 15 Sep 2008 → 18 Sep 2008
Asger Laurberg Vig (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

**Description**
Place: Athens, Greece

**Related external organisation**
Unknown external organisation
Activity: Talks and presentations › Conference presentations

unknown
Period: 15 Sep 2008 → 18 Sep 2008
Kristian Mølhave (Participant)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

**Description**
III-V-Nanowires for Molecular Junctions: Fabrication and DFT Simulations
Place: Athens, Greece

**Related event**
unknown
15/09/2008 → 18/09/2008
Athens, Greece
Activity: Attending an event › Participating in or organising a conference

unknown
Period: 15 Sep 2008 → 18 Sep 2008
Lars Samuelson (Participant)
Department of Micro- and Nanotechnology

**Description**
III-V-Nanowires for Molecular Junctions: Fabrication and DFT Simulations
Place: Athens, Greece
**Related event**

**unknown**
15/09/2008 → 18/09/2008  
Athens, Greece  
Activity: Attending an event › Participating in or organising a conference

**unknown**
Period: 15 Sep 2008 → 18 Sep 2008  
Mads Brandbyge (Participant)

Theory Section  
Theoretical Nanoelectronics Group  
Department of Micro- and Nanotechnology

**Description**
Ill-V-Nanowires for Molecular Junctions: Fabrication and DFT Simulations

Place: Athens, Greece

**Related event**

**unknown**
15/09/2008 → 18/09/2008  
Athens, Greece  
Activity: Attending an event › Participating in or organising a conference

**unknown**
Period: 15 Sep 2008 → 18 Sep 2008  
Peter Bøggild (Participant)

NanoSystemsEngineering Section  
Nanointegration Group  
Department of Micro- and Nanotechnology

**Description**
Ill-V-Nanowires for Molecular Junctions: Fabrication and DFT Simulations

Place: Athens, Greece

**Related event**

**unknown**
15/09/2008 → 18/09/2008  
Athens, Greece  
Activity: Attending an event › Participating in or organising a conference

**34th International Conference on Micro and Nano Engineering**
Period: 14 Sep 2008 → 18 Sep 2008  
Casper Hyttel Clausen (Participant)

Biomedical Micro Systems Section  
Nano-Bio Integrated Systems Group  
Department of Micro- and Nanotechnology

**Description**
Talk about "Manipulation and Integration of Biological Nanofibers with Electronic Micro Structures for the Development of Biosensing Devices" presented at "34th International Conference on Micro and Nano Engineering"

Place: Athens, Greece  
Degree of recognition: International
**Related event**

**34th International Conference on Micro and Nano Engineering**  
Period: 14 Sep 2008 → 18 Sep 2008  
Athens, Greece  
Activity: Attending an event › Participating in or organising a conference

- **Karsten Brandt Andersen** (Participant)  
  Biomedical Micro Systems Section  
  Nano-Bio Integrated Systems Group  
  Department of Micro- and Nanotechnology

**Description**  
Talk about "Manipulation and Integration of Biological Nanofibers with Electronic Micro Structures for the Development of Biosensing Devices" presented at "34th International Conference on Micro and Nano Engineering"  
Place: Athens, Greece  
Degree of recognition: International

**Related event**

**34th International Conference on Micro and Nano Engineering**  
Period: 14 Sep 2008 → 18 Sep 2008  
Athens, Greece  
Activity: Attending an event › Participating in or organising a conference

- **Maria Dimaki** (Participant)  
  Biomedical Micro Systems Section  
  Nano-Bio Integrated Systems Group  
  Department of Micro- and Nanotechnology

**Description**  
Talk about "Manipulation and Integration of Biological Nanofibers with Electronic Micro Structures for the Development of Biosensing Devices" presented at "34th International Conference on Micro and Nano Engineering"  
Place: Athens, Greece  
Degree of recognition: International

**Related event**

**34th International Conference on Micro and Nano Engineering**  
Period: 14 Sep 2008 → 18 Sep 2008  
Athens, Greece  
Activity: Attending an event › Participating in or organising a conference

- **Winnie Edith Svendsen** (Participant)  
  Biomedical Micro Systems Section  
  Nano-Bio Integrated Systems Group  
  Department of Micro- and Nanotechnology

**Description**  
Talk about "Manipulation and Integration of Biological Nanofibers with Electronic Micro Structures for the Development of Biosensing Devices" presented at "34th International Conference on Micro and Nano Engineering"  
Place: Athens, Greece  
Degree of recognition: International
Place: Athens, Greece  
Degree of recognition: International

Related event

**34th International Conference on Micro and Nano Engineering**  
14/09/2008 → 18/09/2008  
Athens, Greece  
Activity: Attending an event › Participating in or organising a conference

### Eurosensors 2008  
Period: 7 Sep 2008 → 10 Sep 2008  
Bjarke Thomas Dalslet (Participant)

LabChip Section  
Magnetic Systems Group  
Department of Micro- and Nanotechnology

**Description**

Talk about "Temperature effects in Exchange-Biased Planar Hall Sensors for Bioapplications" Presented at "Eurosensors 2008"  
Degree of recognition: International

### Related event

**Eurosensors 2008**  
07/09/2008 → 10/09/2008  
Dresden, Germany  
Activity: Attending an event › Participating in or organising a conference

### Eurosensors 2008  
Period: 7 Sep 2008 → 10 Sep 2008  
Mikkel Fougt Hansen (Participant)

LabChip Section  
Magnetic Systems Group  
Department of Micro- and Nanotechnology

**Description**

Talk about "Temperature effects in Exchange-Biased Planar Hall Sensors for Bioapplications" Presented at "Eurosensors 2008"  
Degree of recognition: International

### Related event

**Eurosensors 2008**  
07/09/2008 → 10/09/2008  
Dresden, Germany  
Activity: Attending an event › Participating in or organising a conference

### Talk about "Innovation Strategy and IP Management at DTU Nanotech" Presented at COMS2008, Conference on Commercialization of Micro and Nano Systems

Period: 31 Aug 2008 → 4 Sep 2008  
Mogens Rysholt Poulsen (Speaker)

Department of Micro- and Nanotechnology

**Description**

Place: Puerto Vallarta, Mexico

### Related external organisation
Talk about "Innovation Strategy and IP Management at DTU Nanotech" Presented at COMS2008, Conference on Commercialization of Micro and Nano Systems
Period: 31 Aug 2008 → 4 Sep 2008

Jörg Hübner (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Puerto Vallarta, Mexico

Related external organisation

Talk about "Innovation Strategy and IP Management at DTU Nanotech" Presented at COMS2008, Conference on Commercialization of Micro and Nano Systems
Period: 31 Aug 2008 → 4 Sep 2008

Mikael Ørum (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Puerto Vallarta, Mexico

Related external organisation

Talk about "Innovation Strategy and IP Management at DTU Nanotech" Presented at COMS2008, Conference on Commercialization of Micro and Nano Systems
Period: 31 Aug 2008 → 4 Sep 2008

Rolf Henrik Berg (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Colloids and Biological Interfaces Group

Description
Place: Puerto Vallarta, Mexico

Related external organisation

Talk about "Micro and Nanotech Innovation and Education in Scandinavia" Presented at COMS2008, Conference on Commercialization of Micro and Nano Systems
Period: 31 Aug 2008 → 4 Sep 2008

Mogens Rysholt Poulsen (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Puerto Vallarta, Mexico

Related external organisation

Unknown external organisation
Nordic Demining Research Forum Summer Conference
Michael Stenbæk Schmidt (Participant)

NanoSystemsEngineering Section
Nanoprobes Group
Department of Micro- and Nanotechnology

Description
Talk about "XSence -Mechanical Sensing for Explosive Detection" Presented at "Nordic Demining Research Forum Summer Conference"

Place: Skövde, Sweden

Related event
Nordic Demining Research Forum Summer Conference
27/08/2008 → 29/08/2008
Skövde, Sweden
Activity: Attending an event › Participating in or organising a conference

Nordic Demining Research Forum Summer Conference
Filippo Bosco (Participant)

Department of Micro- and Nanotechnology

Description
Talk about "XSence -Mechanical Sensing for Explosive Detection" Presented at "Nordic Demining Research Forum Summer Conference"

Place: Skövde, Sweden

Related event
Nordic Demining Research Forum Summer Conference
27/08/2008 → 29/08/2008
Skövde, Sweden
Activity: Attending an event › Participating in or organising a conference

Nordic Demining Research Forum Summer Conference
Gabriela Blagoi (Participant)

NanoSystemsEngineering Section
Nanoprobes Group
Department of Micro- and Nanotechnology

Description
Talk about "XSence -Mechanical Sensing for Explosive Detection" Presented at "Nordic Demining Research Forum Summer Conference"

Place: Skövde, Sweden

Related event
Nordic Demining Research Forum Summer Conference
27/08/2008 → 29/08/2008
Skövde, Sweden
Activity: Attending an event › Participating in or organising a conference
Talk about "XSence - Mechanical Sensing for Explosive Detection" Presented at "Nordic Demining Research Forum Summer Conference"
Jesper Kenneth Olsen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: Skövde, Sweden

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society
Sune Bro Duun (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Photoplethysmography with a Ring Shaped Photodiode in an Electronic Patch" presented at "EMBC 2008, 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society".

Related event
30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society
20/08/2008 → 24/08/2008
Vancouver, Canada
Activity: Attending an event › Participating in or organising a conference

30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society
Erik Vilain Thomsen (Participant)
Department of Micro- and Nanotechnology

Description

Related event
30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society
20/08/2008 → 24/08/2008
Vancouver, Canada
Activity: Attending an event › Participating in or organising a conference

Talk about "Photoplethysmography with a Ring Shaped Photodiode in an Electronic Patch" presented at "EMBC 2008, 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society".
Rasmus Grønbek Haahr (Speaker)
Department of Micro- and Nanotechnology

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations
Ionic Liquids: From Knowledge to Application
Fengxiao Guo (Participant)
Self-organizing materials for nanotechnology Section
Self-organized Nanoporous Materials Group
Department of Micro- and Nanotechnology

Description
Hydrophilic Nanoporous Polystyrenes and 1,2 - Polybutadiene via Surface-initiated Atom Transfer Radical Polymerization

Place: American Chemical Society 236th National Meeting, Philadelphia, Pennsylvania, USA
Degree of recognition: International

Related event
Ionic Liquids: From Knowledge to Application: 236th ACS National Meeting
17/08/2008 – 21/08/2008
Philadelphia, (PA), United States
Activity: Attending an event › Participating in or organising a conference

Ionic Liquids: From Knowledge to Application
Sokol Ndoni (Participant)
Self-organizing materials for nanotechnology Section
Self-organized Nanoporous Materials Group
Department of Micro- and Nanotechnology

Description
Hydrophilic Nanoporous Polystyrenes and 1,2 - Polybutadiene via Surface-initiated Atom Transfer Radical Polymerization

Place: American Chemical Society 236th National Meeting, Philadelphia, Pennsylvania, USA
Degree of recognition: International

Related event
Ionic Liquids: From Knowledge to Application: 236th ACS National Meeting
17/08/2008 – 21/08/2008
Philadelphia, (PA), United States
Activity: Attending an event › Participating in or organising a conference

ASME 2008 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference
Volkmar Eichhorn (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Topology Optimized Microgrippers for Nanomanipulation of Carbon Nanotubes" Presented at IDETC/CIE

Place: Brooklyn, New York, USA

Related event
ASME 2008 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference
03/08/2008 – 06/08/2008
Brooklyn, NY, United States
Activity: Attending an event › Participating in or organising a conference
ASME 2008 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference
Dirch Hjorth Petersen (Participant)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

Description
Topology Optimized Microgrippers for Nanomanipulation of Carbon Nanotubes Presented at IDETC/CIE

Place: Brooklyn, New York, USA

Related event

ASME 2008 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference
Peter Bøggild (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Topology Optimized Microgrippers for Nanomanipulation of Carbon Nanotubes" Presented at IDETC/CIE

Place: Brooklyn, New York, USA

Related event

ASME 2008 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference
Ozlem Sardan Sukas (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Brooklyn, New York, USA

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Danish Physical Society Annual Meeting 2008
Jaime Castillo (Participant)
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group
Department of Micro- and Nanotechnology

Description
talk about "Qualitative Mapping of Structural Different Polypeptide Nanotubes" presented at Danish Physical Society Annual Meeting

Place: Copenhagen, Denmark
Degree of recognition: National

Related event

Danish Physical Society Annual Meeting 2008
17/06/2008 → 18/06/2008
Nyborg Strand, Denmark
Activity: Attending an event › Participating in or organising a conference

Danish Physical Society Annual Meeting 2008
Winnie Edith Svendsen (Participant)

Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group
Department of Micro- and Nanotechnology

Description
talk about "Qualitative Mapping of Structural Different Polypeptide Nanotubes" presented at Danish Physical Society Annual Meeting

Place: Copenhagen, Denmark
Degree of recognition: National

Related event

Danish Physical Society Annual Meeting 2008
17/06/2008 → 18/06/2008
Nyborg Strand, Denmark
Activity: Attending an event › Participating in or organising a conference

Nordic Polymer Days 2008
Period: 11 Jun 2008 → 13 Jun 2008
Sokol Ndoni (Participant)

Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Self-organized Nanoporous Materials Group

Description
talk about "Hydrophilic Nanoporous Polystyrenes and 1,2 - Polybutadienes" presented at Nordic Polymer Days NPD 2008, June 11-13

Place: Stockholm, Sweden

Related event

Nordic Polymer Days 2008
11/06/2008 → 13/06/2008
Stockholm, Sweden
Activity: Attending an event › Participating in or organising a conference
Talk about "Atomistic Calculations of Electron and Phonon Transport in Silicon Nanowires" Presented at CECAM Workshop
Period: 9 Jun 2008 → 12 Jun 2008
Troels Markussen (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Nanoelectronics Group

Related event
CECAM Workshop: Atomistic Calculations of Electron and Phonon Transport in Silicon Nanowires
09/06/2008 → 12/06/2008
Lyon, France
Activity: Talks and presentations › Conference presentations

Talk about "Working with Gender in the Network of Excellence Nano2life" Presented at Women Shaping Science
Period: 5 Jun 2008 → 7 Jun 2008
Jenny Emnéus (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Bioanalytics Group

Description
Place: Vilnius, Lithuania

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

5th International Workshop on Wearable and Implantable Body Sensor Networks
Period: 1 Jun 2008 → 3 Jun 2008
Sune Bro Duun (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "A Wearable Electronic Patch for Wireless Continuous Monitoring of Chronically Diseased Patients" presented at "5th International Workshop on Wearable and Implantable Body Sensor Networks being held in Hong Kong"
Degree of recognition: International

Related event
5th International Workshop on Wearable and Implantable Body Sensor Networks
01/06/2008 → 03/06/2008
Hong Kong, China
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

5th International Workshop on Wearable and Implantable Body Sensor Networks
Period: 1 Jun 2008 → 3 Jun 2008
Erik Vilain Thomsen (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "A Wearable Electronic Patch for Wireless Continuous Monitoring of Chronically Diseased Patients" presented at "5th International Workshop on Wearable and Implantable Body Sensor Networks being held in Hong Kong"

Related event
5th International Workshop on Wearable and Implantable Body Sensor Networks
Period: 1 Jun 2008 → 3 Jun 2008
Hong Kong, China
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Description
Talk about "A Wearable Electronic Patch for Wireless Continuous Monitoring of Chronically Diseased Patients" presented at "5th International Workshop on Wearable and Implantable Body Sensor Networks being held in Hong Kong"

Related event
5th International Workshop on Wearable and Implantable Body Sensor Networks
Period: 1 Jun 2008 → 3 Jun 2008
Hong Kong, China
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Description
Talk about "A Wearable Electronic Patch for Wireless Continuous Monitoring of Chronically Diseased Patients" presented at "5th International Workshop on Wearable and Implantable Body Sensor Networks being held in Hong Kong"

Related event
5th International Workshop on Wearable and Implantable Body Sensor Networks
Period: 1 Jun 2008 → 3 Jun 2008
Hong Kong, China
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Talk about "A Wearable Electronic Patch for Wireless Continuous Monitoring of Chronically Diseased Patients" presented at "5th International Workshop on Wearable and Implantable Body Sensor Networks being held in Hong Kong"

Period: 1 Jun 2008 → 3 Jun 2008
Rasmus Grønbek Haahr (Speaker)
Department of Micro- and Nanotechnology

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Fabrication of Cantilevers by Nanoimprint Lithography" Presented at "International Workshop on Cantilever sensors"
Period: 19 May 2008 → 21 May 2008
Anders Greve (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: Mainz, Germany
Talk about "Fabrication of Cantilevers by Nanoimprint Lithography" Presented at "International Workshop on Cantilever sensors"
Period: 19 May 2008 → 21 May 2008
Stephan Sylvest Keller (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: Mainz, Germany

Talk about "Fabrication of Cantilevers by Nanoimprint Lithography" Presented at "International Workshop on Cantilever sensors"
Period: 19 May 2008 → 21 May 2008
Anders Kristensen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Place: Mainz, Germany

Talk about "Fabrication of Cantilevers by Nanoimprint Lithography" Presented at "International Workshop on Cantilever sensors"
Period: 19 May 2008 → 21 May 2008
Anja Boisen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: Mainz, Germany

Talk about "laser self-mixing interferometry in VCSELs - an ultra-compact and massproceaseable deflection detection system for Nanomechanical Polymer cantilever sensors" Presented at "International workshop on cantilever Sensors"
Period: 19 May 2008 → 21 May 2008
Anders Greve (Speaker)
Talk about "laser self-mixing interferometry in VCSELs - an ultra-compact and massproceable deflection detection system for Nanomechanical Polymer cantilever sensors" presented at "International workshop on cantilever Sensors".
Period: 19 May 2008 → 21 May 2008
Anja Boisen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Talk about "Self-assembly peptide Nanofibers as Electrochemical Biosensing Elements" presented at "The tenth World Confress on Biosensors.
Jaime Castillo (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

The Tenth World Congress on Biosensors
Winnie Edith Svendsen (Participant)
Department of Micro- and Nanotechnology

The Tenth World Congress on Biosensors
Winnie Edith Svendsen (Participant)
Department of Micro- and Nanotechnology

Related event
The Tenth World Congress on Biosensors  
14/05/2008 → 16/05/2008  
Shanghai, China  
Activity: Attending an event › Participating in or organising a conference

2nd annual Lab-on-a-Chip World Congress  
Period: 7 May 2008 → 8 May 2008  
Detlef Snakenborg (Participant)  
LabChip Section  
ChemLabChip Group  
Department of Micro- and Nanotechnology  
Description  
Talk about "Re-usable PDMS interconnect Blocks allowing Multiple Rapid Planar Interconnections. Presented at "Lab-on-a-Chip World Congress"  
Place: Barcelona, Spain  
Degree of recognition: International

Related event  
2nd annual Lab-on-a-Chip World Congress  
07/05/2008 → 08/05/2008  
Barcelona, Spain  
Activity: Attending an event › Participating in or organising a conference

2nd annual Lab-on-a-Chip World Congress  
Period: 7 May 2008 → 8 May 2008  
Jörg Peter Kutter (Participant)  
LabChip Section  
ChemLabChip Group  
Department of Micro- and Nanotechnology  
Description  
Talk about "Re-usable PDMS interconnect Blocks allowing Multiple Rapid Planar Interconnections. Presented at "Lab-on-a-Chip World Congress"  
Place: Barcelona, Spain  
Degree of recognition: International

Related event  
2nd annual Lab-on-a-Chip World Congress  
07/05/2008 → 08/05/2008  
Barcelona, Spain  
Activity: Attending an event › Participating in or organising a conference

2nd annual Lab-on-a-Chip World Congress  
Period: 7 May 2008 → 8 May 2008  
Martin Dufva (Participant)  
Biomedical Micro Systems Section  
Fluidic Array Systems and Technology Group  
Department of Micro- and Nanotechnology  
Description  
Talk about "Re-usable PDMS interconnect Blocks allowing Multiple Rapid Planar Interconnections. Presented at "Lab-on-a-Chip World Congress"  
Place: Barcelona, Spain
Degree of recognition: International

Related event

2nd annual Lab-on-a-Chip World Congress
07/05/2008 → 08/05/2008
Barcelona, Spain
Activity: Attending an event › Participating in or organising a conference

4th annual Advances in Microarray Technology (AMT) conference
Period: 7 May 2008 → 8 May 2008
Martin Dufva (Participant)
Biomedical Micro Systems Section
Fluidic Array Systems and Technology Group
Department of Micro- and Nanotechnology

Description
Talk about "An Inexpensive and Simple Method for Covalent Immobilization of DNA to unmodified Glass surfaces for the use in Thermal Cycling reactions. Presented at "Advances in Microarray Technology"

Place: Barcelona, Spain
Degree of recognition: International

Related event

4th annual Advances in Microarray Technology (AMT) conference
Period: 7 May 2008 → 8 May 2008
Anders Wolff (Participant)
LabChip Section
BioLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "An Inexpensive and Simple Method for Covalent Immobilization of DNA to unmodified Glass surfaces for the use in Thermal Cycling reactions. Presented at "Advances in Microarray Technology"

Place: Barcelona, Spain
Degree of recognition: International

Related event

4th annual Advances in Microarray Technology (AMT) conference
Period: 7 May 2008 → 8 May 2008
Lena Poulsen (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Salinity Gradients for Improved Array based allele Specific Hybridization presented at "Advances in Microarray Technology"
Related event

4th annual Advances in Microarray Technology (AMT) conference
07/05/2008 → 08/05/2008
Barcelona, Spain
Activity: Attending an event › Participating in or organising a conference

Martin Dufva (Participant)
Biomedical Micro Systems Section
Fluidic Array Systems and Technology Group
Department of Micro- and Nanotechnology

Description
Talk about "Salinity Gradients for Improved Array based allele Specific Hybridization presented at "Advances in Microarray Technology"

Place: Barcelona, Spain
Degree of recognition: International

Related event

4th annual Advances in Microarray Technology (AMT) conference
07/05/2008 → 08/05/2008
Barcelona, Spain
Activity: Attending an event › Participating in or organising a conference

Martin Jensen Søe (Participant)
Biomedical Micro Systems Section
Fluidic Array Systems and Technology Group
Department of Micro- and Nanotechnology

Description
Talk about "Signal Intensity and Specificity of Microarray Hybridization: Effects of Varying the length of Spacer and Capture Probe. Presented at "Advances in Microarray technology"

Place: Barcelona, Spain
Degree of recognition: International

Related event

4th annual Advances in Microarray Technology (AMT) conference
07/05/2008 → 08/05/2008
Barcelona, Spain
Activity: Attending an event › Participating in or organising a conference

Detlef Snakenborg (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Signal Intensity and Specificity of Microarray Hybridization: Effects of Varying the length of Spacer and Capture Probe. Presented at "Advances in Microarray technology"

Place: Barcelona, Spain
Degree of recognition: International

Related event

4th annual Advances in Microarray Technology (AMT) conference
07/05/2008 → 08/05/2008
Barcelona, Spain
Activity: Attending an event › Participating in or organising a conference

4th annual Advances in Microarray Technology (AMT) conference
Period: 7 May 2008 → 8 May 2008
Martin Dufva (Participant)
Biomedical Micro Systems Section
Fluidic Array Systems and Technology Group
Department of Micro- and Nanotechnology

Description
Talk about "Signal Intensity and Specificity of Microarray Hybridization: Effects of Varying the length of Spacer and Capture Probe. Presented at "Advances in Microarray technology"

Place: Barcelona, Spain
Degree of recognition: International

Related event

Rasmus Haugstrup Pedersen (Participant)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

Description
Talk about "Fabrication of Nanophotonic Circuit Components by Thermal Nano Imprint Lithography" Presented at "CLEO/QELS 2008"

Place: San José, USA
Degree of recognition: International

Related event

04/05/2008 → 09/05/2008
San Jose, CA, United States
Activity: Attending an event › Participating in or organising a conference
Anders Kristensen (Participant)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

**Description**
Talk about "Fabrication of Nanophotonic Circuit Components by Thermal Nano Imprint Lithography" Presented at "CLEO/QELS 2008"

Place: San José, USA
Degree of recognition: International

**Related event**
04/05/2008 → 09/05/2008
San Jose, CA, United States
Activity: Attending an event › Participating in or organising a conference

Morten Gersborg-Hansen (Participant)
Department of Micro- and Nanotechnology

**Description**
Talk about "Polymer Photonic Crystal Band Edge Lasers for Evanescent Wave Sensing" Presented at "CLEO/QELS 2008"

Place: San José, USA
Degree of recognition: International

**Related event**
04/05/2008 → 09/05/2008
San Jose, CA, United States
Activity: Attending an event › Participating in or organising a conference

Anders Kristensen (Participant)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

**Description**
Talk about "Polymer Photonic Crystal Band Edge Lasers for Evanescent Wave Sensing" Presented at "CLEO/QELS 2008"

Place: San José, USA
Degree of recognition: International

**Related event**
04/05/2008 → 09/05/2008
San Jose, CA, United States
Activity: Attending an event › Participating in or organising a conference
Talk about "Polymer Photonic Crystal Band Edge Lasers for Evanescent Wave Sensing" Presented at CLEO/QELS 2008
Mads Brøkner Christiansen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Description
Place: San José, USA

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "3D Pick-and-Place of carbon Nanotubes Using Shape-optimized Grippers" Presented at Smart Systems Integration
Period: 9 Apr 2008 → 10 Apr 2008
Peter Bøggild (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanointegration Group

Description
Place: Barcelona, Spain

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

2008 MRS Spring Meeting & Exhibit
Kenneth Carlson (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "3D Pick-and-Place of carbon Nanotubes Using Shape-optimized Grippers" Presented at MRS Spring Meeting
Place: San Fransisco, USA
Degree of recognition: International

Related event

2008 MRS Spring Meeting & Exhibit
24/03/2008 → 28/03/2008
San Francisco, United States
Activity: Attending an event › Participating in or organising a conference

2008 MRS Spring Meeting & Exhibit
Volkmar Eichhorn (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "3D Pick-and-Place of carbon Nanotubes Using Shape-optimized Grippers" Presented at MRS Spring Meeting
Place: San Fransisco, USA
Degree of recognition: International

Related event

2008 MRS Spring Meeting & Exhibit
San Francisco, United States
Activity: Attending an event › Participating in or organising a conference

2008 MRS Spring Meeting & Exhibit
San Francisco, United States
Activity: Attending an event › Participating in or organising a conference

Dirch Hjorth Petersen (Participant)
NanoSystemsEngineering Section
Nanointegration Group
Department of Micro- and Nanotechnology

Description
Talk about "3D Pick-and-Place of carbon Nanotubes Using Shape-optimized Grippers" Presented at MRS Spring Meeting

Place: San Francisco, USA
Degree of recognition: International

Related event

2008 MRS Spring Meeting & Exhibit
San Francisco, United States
Activity: Attending an event › Participating in or organising a conference

Talk about "3D Pick-and-Place of carbon Nanotubes Using Shape-optimized Grippers" Presented at MRS Spring Meeting
Peter Bøggild (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanointegration Group

Description
Place: San Francisco, USA

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "3D Pick-and-Place of carbon Nanotubes Using Shape-optimized Grippers" Presented at MRS Spring Meeting
Özlem Sardan Sukas (Speaker)
Department of Micro- and Nanotechnology

Description
Place: San Francisco, USA
Degree of recognition: International

Related event

2008 MRS Spring Meeting & Exhibit
San Francisco, United States
Activity: Talks and presentations › Conference presentations
IMAPS 4th International Conference and Exhibition on Device Packaging
Anders Hyldgård (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Packaged multi sensor system for fisheries research: New test methods of package" presented at "4th International Conference and Exhibition on Device Packaging"
Degree of recognition: International

Related event
IMAPS 4th International Conference and Exhibition on Device Packaging
15/03/2008 → 20/03/2008
Scottsdale, Arizona, United States
Activity: Attending an event › Participating in or organising a conference

Erik Vilain Thomsen (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Packaged multi sensor system for fisheries research: New test methods of package" presented at "4th International Conference and Exhibition on Device Packaging"
Degree of recognition: International

Related event
IMAPS 4th International Conference and Exhibition on Device Packaging
15/03/2008 → 20/03/2008
Scottsdale, Arizona, United States
Activity: Attending an event › Participating in or organising a conference

Karen Birkelund (Speaker)
Department of Micro- and Nanotechnology

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

2008 APS March Meeting
Pawel Utko (Participant)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

Description
Talk about "A Novel Approach to DNA Force Spectroscopy"
Place: New Orleans, USA
Degree of recognition: International
Related event

2008 APS March Meeting
10/03/2008 → 14/03/2008
New Orleans, United States
Activity: Attending an event › Participating in or organising a conference

2008 APS March Meeting
Walter Reisner (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "A Novel Approach to DNA Force Spectroscopy"

Place: New Orleans, USA
Degree of recognition: International

Related event

2008 APS March Meeting
10/03/2008 → 14/03/2008
New Orleans, United States
Activity: Attending an event › Participating in or organising a conference

2008 APS March Meeting
Anders Kristensen (Participant)
NanoSystemsEngineering Section
NSE-Optofluidics Group
Department of Micro- and Nanotechnology

Description
Talk about "A Novel Approach to DNA Force Spectroscopy"

Place: New Orleans, USA
Degree of recognition: International

Related event

2008 APS March Meeting
10/03/2008 → 14/03/2008
New Orleans, United States
Activity: Attending an event › Participating in or organising a conference

2008 APS March Meeting
Pawel Utko (Participant)
Polymer Micro and Nano Engineering Section
Polymer Microsystems for Cell Processing Group
Department of Micro- and Nanotechnology

Description
Talk about "Confinement Spectroscopy: A novel approach to DNA force spectroscopy" presented at "APS March Meeting".
Degree of recognition: International

Related event
2008 APS March Meeting  
New Orleans, United States  
Activity: Attending an event › Participating in or organising a conference

Walter Reisner (Participant)  
Department of Micro- and Nanotechnology  

Description  
Talk about "Confinement Spectroscopy: A novel approach to DNA force spectroscopy" presented at "APS March Meeting".  
Degree of recognition: International  

Related event

2008 APS March Meeting  
New Orleans, United States  
Activity: Attending an event › Participating in or organising a conference

Anders Kristensen (Participant)  
NanoSystemsEngineering Section  
NSE-Optofluidics Group  
Department of Micro- and Nanotechnology  

Description  
Talk about "Confinement Spectroscopy: A novel approach to DNA force spectroscopy" presented at "APS March Meeting".  
Degree of recognition: International  

Related event

Talk about "A Novel Approach to DNA Force Spectroscopy"  
Karl Fredrik Persson (Speaker)  
Department of Micro- and Nanotechnology  
NanoSystemsEngineering Section  
NSE-Optofluidics Group  

Description  
Place: New Orleans, USA  

Related external organisation

Unknown external organisation  
Activity: Talks and presentations › Conference presentations

Talk about "Confinement Spectroscopy: A novel approach to DNA force spectroscopy" presented at "APS March Meeting".
Karl Fredrik Persson (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

22nd International Symposium on MicroScale Bioseparations
Søren Skou Nielsen (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description

Place: Berlin, Germany
Degree of recognition: International

Related event

22nd International Symposium on MicroScale Bioseparations
09/03/2008 → 13/03/2008
Berlin, Germany
Activity: Attending an event › Participating in or organising a conference

22nd International Symposium on MicroScale Bioseparations
Jörg Peter Kutter (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description

Place: Berlin, Germany
Degree of recognition: International

Related event

22nd International Symposium on MicroScale Bioseparations
09/03/2008 → 13/03/2008
Berlin, Germany
Activity: Attending an event › Participating in or organising a conference

Lab on a Chip/Microfluidics course at the 59th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy (PITTCON)
Period: 5 Mar 2008
Jaime Castillo (Lecturer)
Related event:
Pittcon Conference and Expo 2008
Period: 01/03/2008 → 07/03/2008
New Orleans, United States
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

Description
Talk about "Synthesis and Characterization of Lanthanide-Based Nanophosphots" Presented at Pittcon Conference and Expo
Place: New Orleans, USA
Degree of recognition: International

Related event:
Pittcon Conference and Expo 2008
Period: 21 Jan 2008 → 23 Jan 2008
Bilthoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Rapid Methods Europe 2008
Period: 21/01/2008 → 23/01/2008
Bilthoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Description
Talk about "Rapid molecular detection of food- and waterborne diseases" Presented at Rapid Methods, Europe
Place: Bilthoven, Netherlands
Degree of recognition: International

Related event:
Rapid Methods Europe 2008: for Food and Feed Safety and Quality
Period: 21 Jan 2008 → 23 Jan 2008
Bilthoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Rapid Methods Europe 2008
Period: 21/01/2008 → 23/01/2008
Bilthoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Related event:
Rapid Methods Europe 2008
Period: 21 Jan 2008 → 23 Jan 2008
Alicia Charlotte Johansson (Participant)
Department of Micro- and Nanotechnology
Description
Talk about "Rapid molecular detection of food and waterborne diseases" Presented at Rapid Methods, Europe

Place: Bilthoven, Netherlands
Degree of recognition: International

Related event
Rapid Methods Europe 2008: for Food and Feed Safety and Quality
21/01/2008 → 23/01/2008
Bilthoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Rapid Methods Europe 2008
Period: 21 Jan 2008 → 23 Jan 2008
Gabriela Blagoi (Participant)
NanoSystemsEngineering Section
Nanoprobes Group
Department of Micro- and Nanotechnology

Description
Talk about "Rapid molecular detection of food and waterborne diseases" Presented at Rapid Methods, Europe

Place: Bilthoven, Netherlands
Degree of recognition: International

Related event
Rapid Methods Europe 2008: for Food and Feed Safety and Quality
21/01/2008 → 23/01/2008
Bilthoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Rapid Methods Europe 2008
Period: 21 Jan 2008 → 23 Jan 2008
Mogens Havsteen Jakobsen (Participant)
Polymer Micro and Nano Engineering Section
Surface Engineering Group
Department of Micro- and Nanotechnology

Description
Talk about "Rapid molecular detection of food and waterborne diseases" Presented at Rapid Methods, Europe

Place: Bilthoven, Netherlands
Degree of recognition: International

Related event
Rapid Methods Europe 2008: for Food and Feed Safety and Quality
21/01/2008 → 23/01/2008
Bilthoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Rapid Methods Europe 2008
Period: 21 Jan 2008 → 23 Jan 2008
Anja Boisen (Participant)
NanoSystemsEngineering Section
Nanoprobes Group
Department of Micro- and Nanotechnology

Description
Talk about "Rapid molecular detection of food and waterborne diseases" Presented at Radip Methods, Europe

Place: Bilthoven, Netherlands
Degree of recognition: International

Related event
Rapid Methods Europe 2008: for Food and Feed Safety and Quality
21/01/2008 → 23/01/2008
Bilthoven, Netherlands
Activity: Attending an event › Participating in or organising a conference

Stephan Sylvest Keller (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Description
Place: Bilthoven, Netherlands

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Photonics West 2008
Period: 19 Jan 2008 → 24 Jan 2008
Pedro Nunes (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Lab-on-a-chip System with Integrated Optics for Biochemical Applications" presented at Photonic West

Place: San José, USA
Degree of recognition: International

Related event
Photonics West 2008
19/01/2008 → 24/01/2008
San Jose, CA, United States
Activity: Attending an event › Participating in or organising a conference

Photonics West 2008
Period: 19 Jan 2008 → 24 Jan 2008
Jörg Peter Kutter (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Lab-on-a-chip System with Integrated Optics for Biochemical Applications" presented at Photonic West

Place: San José, USA
Degree of recognition: International

Related event

**Photonics West 2008**
19/01/2008 → 24/01/2008
San Jose, CA, United States
Activity: Attending an event › Participating in or organising a conference

2008 3rd IEEE International Conference on Nano/Micro Engineered and Molecular Systems
Period: 6 Jan 2008 → 9 Jan 2008
Jan Harry Hales (Participant)
NanoSystemsEngineering Section
Dynamic NEMS Group
Department of Micro- and Nanotechnology

**Description**
Au Nanoparticle Detection using Silicon Micro/Nano mechanical devices with Integrated Strain Gauge Readout

Place: IEEE NEMS 2008. Sanya, China
Degree of recognition: International

Related event

2008 3rd IEEE International Conference on Nano/Micro Engineered and Molecular Systems
06/01/2008 → 09/01/2008
Sanya, China
Activity: Attending an event › Participating in or organising a conference

**IEEE-NEMS 2008**
Period: 6 Jan 2008 → 9 Jan 2008
Meng Tang (Participant)
NanoSystemsEngineering Section
Dynamic NEMS Group
Department of Micro- and Nanotechnology

**Description**
Au Nanoparticle Detection using Silicon Micro/Nano mechanical devices with Integrated Strain Gauge Readout

Place: IEEE NEMS 2008. Sanya, China
Degree of recognition: International

Related event

2008 3rd IEEE International Conference on Nano/Micro Engineered and Molecular Systems
06/01/2008 → 09/01/2008
Sanya, China
Activity: Attending an event › Participating in or organising a conference

**Talk about "Development in materials and read-out methods for cantilever-based sensing"**
Presented at "IEEE International Conference and Nano/Micro Engineered and Molecular Sustems"
Period: 6 Jan 2008 → 9 Jan 2008
Anja Boisen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group
Description
Place: Sanya, Hainan, China

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

2008 3rd IEEE International Conference on Nano/Micro Engineered and Molecular Systems
Period: 1 Jan 2008 → …
Anja Boisen (Participant)
NanoSystemsEngineering Section
Nanoprobes Group
Department of Micro- and Nanotechnology

Description
Au Nanoparticle Detection using Silicon Micro/Nano mechanical devices with Integrated Strain Gauge Readout
Place: IEEE NEMS 2008. Sanya, China
Degree of recognition: International

Related event
2008 3rd IEEE International Conference on Nano/Micro Engineered and Molecular Systems
06/01/2008 → 09/01/2008
Sanya, China
Activity: Attending an event › Participating in or organising a conference

Au Nanoparticle Detection using Silicon Micro/Nano mechanical devices with Integrated Strain Gauge Readout
Period: 1 Jan 2008 → …
Zachary James Davis (Speaker)
NanoSystemsEngineering Section
Dynamic NEMS Group

Description
Place: IEEE NEMS 2008. Sanya, China

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Elucidation of degradation mechanisms in rubbers - oxidation and hydrolysis of model rubbers
Period: 1 Jan 2008 → …
Kristoffer Almdal (Speaker)
NanoSystemsEngineering Section
Self-organizing materials for nanotechnology Section
Amphiphilic polymers in biological sensing Group

Description
Place: Danish Society for Polymer Technology meeting. Copenhagen, Denmark

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations
Fluorescent gel Particles in the Nanometer Range for Detection of Metabolites in living cells
Period: 1 Jan 2008 → …
Kristoffer Almdal (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Amphiphilic polymers in biological sensing Group

Description
Place: Danish Colloid and Interface Symposium 2008. Aarhus, Denmark

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Microemulsion as a synthetic tool. Any theory required? Adjusting the thermodynamics and timescales in soft physics by varying polymer chain length
Period: 1 Jan 2008 → …
Kristoffer Almdal (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Amphiphilic polymers in biological sensing Group

Description
Place: Theory Section Lunch. Lyngby, Copenhagen

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Segregated media. Order, disorder, critical phenomena and synthetic utilization for Nanoparticle synthesis
Period: 1 Jan 2008 → …
Kristoffer Almdal (Speaker)
Department of Micro- and Nanotechnology
Self-organizing materials for nanotechnology Section
Amphiphilic polymers in biological sensing Group

Description
Place: Departmental Colliquia DTU. Lyngby, Copenhagen

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Anisotropic Heat Conduction in Pristine Silicon Nanowires" Presented at ICN+T-2008
Period: 1 Jan 2008 → …
Troels Markussen (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Nanoelectronics Group
Talk about "Automated High-Throughput Structural Protein Analysis Using Small Angle X-ray Scattering Combined with a Microfluidic Approach" presented at MicroTAS 2008
Period: 1 Jan 2008 → …
Søren Skou Nielsen (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Period: 1 Jan 2008 → …
Detlef Snakenborg (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Talk about "Combining Microfluidics and Small Angle X-ray Scattering for Structural Analysis of Proteins: Small Chip - Large Detector - Perfect Marriage" Presented at CECE 2008 - 5th International Interdisciplinary Meeting on Bioanalysis.
Period: 1 Jan 2008 → …
Jörg Peter Kutter (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Talk about "Combining Microfluidics and Small Angle X-ray Scattering for Structural Analysis of Proteins: Small Chip - Large Detector - Perfect Marriage" Presented at CECE 2008 - 5th International Interdisciplinary Meeting on Bioanalysis.
Period: 1 Jan 2008 → …
Jörg Peter Kutter (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Talk about "Combining Microfluidics and Small Angle X-ray Scattering for Structural Analysis of Proteins: Small Chip - Large Detector - Perfect Marriage" Presented at CECE 2008 - 5th International Interdisciplinary Meeting on Bioanalysis.
Period: 1 Jan 2008 → …
Jörg Peter Kutter (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Talk about "Combining Microfluidics and Small Angle X-ray Scattering for Structural Analysis of Proteins: Small Chip - Large Detector - Perfect Marriage" Presented at CECE 2008 - 5th International Interdisciplinary Meeting on Bioanalysis.
Period: 1 Jan 2008 → …
Jörg Peter Kutter (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group
Talk about "Comsol Multiphysisc Simulation of Microfluidic Systems for Biomedical Applications" presented at Comsol User Conference
Period: 1 Jan 2008 → …
Maria Dimaki (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Description
Place: Hannover, Germany

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Design and Fabrication Issues of Microfluidic Devices for Protein Analysis" Presented at Microfluidics for X-ray Nanoanalytics
Period: 1 Jan 2008 → …
Detlef Snakenborg (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Description
Place: Graz, Austria

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "DFT-NEGF Approach to Electron Transport in Nanoconductors; Vibrational Signals and Joule Heating" Presented at IoP Conference "Molecular Dynamics for Non-Adiabatic Processes"
Period: 1 Jan 2008 → …
Mads Brandbyge (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Nanoelectronics Group

Description
Place: London, UK

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Inelastic Scattering, Heating and Heat Transport in Nanoconductors" Presented at M4NANO Symposium at MINATEC Crossroads
Period: 1 Jan 2008 → …
Mads Brandbyge (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Nanoelectronics Group
Talk about "Integration of Carbon Nanotubes in Electrophoretic Separation Devices" presented at "MicroTAS".
Period: 1 Jan 2008 → …
Klaus Bo Mogensen (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Talk about "Lab-on-a-chip System with Integrated Optics for Biochemical Applications" presented at Photonic West
Period: 1 Jan 2008 → …
Klaus Bo Mogensen (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Talk about "Manipulation and Integration of Biological Nanofibers with Electronic Micro Structures for the Development of Biosensing Devices" presented at "34th International Conference on Micro and Nano Engineering"
Period: 1 Jan 2008 → …
Jaime Castillo (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Talk about "Qualitative Mapping of Structural Different Polypeptide Nanotubes" presented at Danish Physical Society Annual Meeting
Period: 1 Jan 2008 → …
Casper Hyttel Clausen (Speaker)
Department of Micro- and Nanotechnology
Talk about "Re-usable PDMS interconnect Blocks allowing Multiple Rapid Planar Interconnections. Presented at "Lab-on-a-Chip World Congress"

Period: 1 Jan 2008 → …

David Sabourin (Speaker)

Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Talk about "Salinity Gradients for Improved Array based allele Specific Hybridization presented at "Advances in Microarray Technology"

Period: 1 Jan 2008 → …

Jesper Petersen (Speaker)

Department of Micro- and Nanotechnology

Talk about "Self-assembly peptide Nanofibers as Electrochemical Biosensing Elements" presented at "The tenth World Confress on Biosensors."

Period: 1 Jan 2008 → …

Jaime Castillo (Speaker)

Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group
Talk about "Self-assembly peptide Nanofibers as Electrochemical Biosensing Elements" presented at "The tenth World Conference on Biosensors."
Period: 1 Jan 2008 → …
Winnie Edith Svendsen (Speaker)
Department of Micro- and Nanotechnology
Biomedical Micro Systems Section
Nano-Bio Integrated Systems Group

Description
Place: Shanghai, China

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Sensors Based on Miniature Bridges, Diving Boards and Lids" presented at "21st Century Medicine conference: Breakthroughs and Challenges".
Period: 1 Jan 2008 → …
Anja Boisen (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Signal Intensity and Specificity of Microarray Hybridization: Effects of Varying the length of Spacer and Capture Probe. Presented at "Advances in Microarray technology"
Period: 1 Jan 2008 → …
Lena Poulsen (Speaker)
Department of Micro- and Nanotechnology

Description
Place: Barcelona, Spain

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Temperature effects in Exchange-Biased Planar Hall Sensors for Bioapplications" Presented at "Eurosensors 2008"
Period: 1 Jan 2008 → …
Christian Danvad Damsgaard (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
Magnetic Systems Group

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations
Talk about "Theoretical Studies of Electron Transport in Nano-Systems" presented at ISSS-5 International Symposium
Period: 1 Jan 2008 → …
Mads Brandbyge (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Nanoelectronics Group

Description
Place: Tokyo, Japan

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

unknown
Period: 1 Jan 2008 → …
Jörg Peter Kutter (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Design and Fabrication Issues of Microfluidic Devices for Protein Analysis" Presented at Microfluidics for X-ray Nanoanalytics
Place: Graz, Austria

Related event
unknown
01/01/2008 → …
Graz, Austria
Activity: Attending an event › Participating in or organising a conference

unknown
Period: 1 Jan 2008 → …
Katrine Nørgaard Toft (Participant)
Department of Micro- and Nanotechnology

Description
Talk about "Design and Fabrication Issues of Microfluidic Devices for Protein Analysis" Presented at Microfluidics for X-ray Nanoanalytics
Place: Graz, Austria

Related event
unknown
01/01/2008 → …
Graz, Austria
Activity: Attending an event › Participating in or organising a conference

unknown
Period: 1 Jan 2008 → …
Søren Skou Nielsen (Participant)
LabChip Section
ChemLabChip Group
Department of Micro- and Nanotechnology

Description
Talk about "Design and Fabrication Issues of Microfluidic Devices for Protein Analysis" Presented at Microfluidics for X-ray Nanoanalytics

Place: Graz, Austria

Related event
unknown
01/01/2008 → …
Graz, Austria
Activity: Attending an event › Participating in or organising a conference

Lab-on-a-chip Devices for Point-of-care Diagnostics
Monica Brivio (Speaker)
Department of Micro- and Nanotechnology
LabChip Section
ChemLabChip Group

Description
Place: Copenhagen, Denmark

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Acoustic handling of liquid and particles in microfluidicsystems" Presented at The Lorentz Center Workshop on Physics of Micro- and Nanofluids
Henrik Bruus (Speaker)
Department of Micro- and Nanotechnology
Theory Section
Theoretical Microfluidics Group

Description
Place: Leiden University, Netherland

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Talk about "Advances in the fabrication og cantilever-based sensors with the polymer SU-8" Presented at 3rd International workshop on Nanomechanical sensors
Period: 8 Aug 1906 → 21 May 2008
Stephan Sylvest Keller (Speaker)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
Nanoprobes Group
Description
Place: Mainz, Germany

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Prizes:

DropSens International Award
Suhith Hemanth (Recipient)
Department of Micro- and Nanotechnology
Description
Finalist- 2016
Details
Awarded date: 13 Jun 2016
Degree of recognition: International
event: ESEAC, The BAth, UK
Prize: Prizes, scholarships, distinctions

Entrepreneurship in Technical Science
Suhith Hemanth (Recipient)
Department of Micro- and Nanotechnology
Description
Won 1st place
Details
Awarded date: 29 Jun 2015
Degree of recognition: Local
Prize: Prizes, scholarships, distinctions

Nanoscale zero-valent iron impregnation of covalent organic polymer grafted activated carbon for water treatment: 11th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials (ICEENN 2016)
Paul D. Mines (Recipient)
Department of Environmental Engineering, Water Technologies, Department of Micro- and Nanotechnology, Surface Engineering
Description
Best Poster Prize
Details
Awarded date: 18 Aug 2016
Granting Organisations: Royal Society of Chemistry
Prize: Prizes, scholarships, distinctions

Poul V. Andersen Foundation grant
Arnab Halder (Recipient) & Suhith Hemanth (Recipient)
Department of Chemistry, NanoChemistry, Organic Chemistry, Department of Micro- and Nanotechnology
Description
The project “3D Nanocarbon chips for microsupercapacitors and ultrasensitive detection” by PhD students Arnab Halder from DTU Chemistry and Suhith Hemanth from DTU Nanotech has been selected as the winning project by the Poul V. Andersen Foundation and will receive a grant of 250,000 DKK. Only one project per year is awarded by the Poul V. Andersen Foundation.
Details
Awarded date: 29 Feb 2016
Granting Organisations: Technical University of Denmark
The 2017 EIPBN Best Overall Poster Paper Award
Mikkel Rønne Lotz (Recipient)
Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering

Description
For the poster titled: "Thermal Nanoimprinting of Mid-IR Antireflective Moth-eye Nanostructures on Chalcogenide Glass Windows"

Details
Awarded date: 31 May 2017
Degree of recognition: International
event: The 61st International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication
Prize: Prizes, scholarships, distinctions

Venture Cup
Suhith Hemanth (Recipient)
Department of Micro- and Nanotechnology

Description
Finalist in GreenTech

Details
Awarded date: 26 Jan 2017
Degree of recognition: National
Prize: Prizes, scholarships, distinctions

Young Scientist Award
Andrea Crovetto (Recipient)
Department of Micro- and Nanotechnology, Silicon Microtechnology

Details
Awarded date: 4 May 2016
Granting Organisations: European Materials Research Society
Prize: Prizes, scholarships, distinctions

Press clippings:

Vi skal stadig blive klogere på vindmøller (We still need to learn more about wind turbines)
Niels-Erik Clausen & Tom Nervil
17/10/2017

Description

Subject
Noise from wind turbines
Støj fra vindmøller
Department of Micro- and Nanotechnology, Office for Research and Relations, Department of Wind Energy, Integration & Planning

Media contribution (1)

Vi skal stadig blive klogere på vindmøller
17/10/2017
Bornholms Tidende (Regional), Denmark, Print
Niels-Erik Clausen and Tom Nervil
1 page
Niels-Erik Clausen & Tom Nervil
Department of Wind Energy, Integration & Planning, Office for Research and Relations, Department of Micro- and Nanotechnology
Kunstigt blod kan blive en realitet
Leticia Hosta-Rigau
03/02/2017

Subject
På DTU Nanotech vil man ved hjælp af hæmoglobinmolekyler fra dyr fremstille kunstigt blod, der kan transportere ilt rundt i kroppen. Der er især behov for alternativer til donorblod i lavindkomstlande, vurderer overlæge.
Department of Micro- and Nanotechnology, Colloids and Biological Interfaces

Media contribution (1)

Kunstigt blod kan blive en realitet
03/02/2017
videnskab.dk, Print
Leticia Hosta-Rigau
Department of Micro- and Nanotechnology, Colloids and Biological Interfaces

Nanotubes help engineer attractive electrons
Kristen Kaasbjerg
21/07/2016 → 22/07/2016
Department of Micro- and Nanotechnology, Theoretical Nanotechnology, Center for Nanostructured Graphene

Media coverage (2)

Nanotubes help engineer attractive electrons
22/07/2016
nanotechweb.org (International), Web
Belle Dumé
http://nanotechweb.org/cws/article/tech/65677
Electrons normally repel each other. This basic property may change, however, in certain solids such as superconductors, in which electrons coupled to lattice vibrations (or phonons) attract each other, forming bound pairs that then travel freely together through the material. Now, researchers in Israel, Germany, the US and Denmark have observed another type of "excitonic" electron attraction that does not involve phonons but actual repulsion between electrons. This mechanism, first predicted 50 years ago, but never yet seen in a laboratory experiment, could help make stronger and more exotic superconductors and be used to study the fundamental physical properties of these structures.
Kristen Kaasbjerg

Condensed-matter physics: Attractive electrons from nanoengineering
21/07/2016
Nature (International), Print
Takis Kontos
https://www.nature.com/articles/535362a
Electrons repel each other because they are negatively charged. An experiment now confirms a fifty-year-old theory that electrons can also attract one another as a result of repulsion from other electrons.
Kristen Kaasbjerg
Center for Nanostructured Graphene, Department of Micro- and Nanotechnology, Theoretical Nanotechnology

Relations
Research outputs:
Electron attraction mediated by Coulomb repulsion

Press / Media