A lab-in-a-foil microfluidic reactor based on phaseguiding

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.
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
Contributors: Marie, R., Pedersen, J. N., Mir, K. U., Bilenberg, B., Kristensen, A.
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BFI (2016): BFI-level 2
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BFI (2015): BFI-level 2
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Web of Science (2015): Impact factor 7.76
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 7.64 SJR 2.646 SNIP 1.649
Web of Science (2014): Impact factor 7.394
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.89 SJR 2.558 SNIP 1.467
Web of Science (2013): Impact factor 6.739
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 6.08 SJR 2.769 SNIP 1.349
Web of Science (2012): Impact factor 6.233
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Web of Science (2012): Indexed yes
Scopus rating (2011): CiteScore 5.69 SJR 2.501 SNIP 1.454
Web of Science (2011): Impact factor 5.914
ISI indexed (2011): ISI indexed no
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Scopus rating (2010): SJR 1.84 SNIP 0.718
Web of Science (2009): Indexed yes
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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.

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Organisations: Department of Micro- and Nanotechnology, Optofluidics, Hebrew University of Jerusalem, University of Southern Denmark
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Web of Science (2016): Impact factor 17.476
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 10.29 SJR 5.956 SNIP 3.35
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BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 11.58 SJR 7.152 SNIP 4.498
Web of Science (2014): Impact factor 15
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BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 11.29 SJR 7.373 SNIP 3.903
Web of Science (2013): Impact factor 18.432
ISI indexed (2013): ISI indexed yes
Scopus rating (2012): CiteScore 11.34 SJR 7.995 SNIP 4.059
Web of Science (2012): Impact factor 17.689
ISI indexed (2012): ISI indexed yes
Scopus rating (2011): CiteScore 10.41 SJR 6.99 SNIP 3.623
Web of Science (2011): Impact factor 15.355
ISI indexed (2011): ISI indexed yes
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.
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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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 6.48 SJR 3.471 SNIP 1.852
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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 5.71 SJR 2.975 SNIP 1.51
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Multifunctional waveguide interferometer sensor: Simultaneous detection of refraction and absorption with size-exclusion function

A waveguide Young interferometer is presented with simultaneous detection of complex refractive index of a liquid sample. The real part of the refractive index change (refraction) is detected by tracing phase shifts of the interferogram generated by a sensing and reference waveguide. The imaginary part of the refractive index (absorption) is determined by the attenuation of the transmitted signal at certain wavelength. Furthermore, nano-filters are fabricated atop the sensing waveguide, which enables size-exclusion filtering of species to the evanescent field. It shows capability of distinguishing small and large particles from 100 nm to 500 nm in diameter, which is further confirmed by fluorescent excitation experiments. The present sensor could find broad application in optical characterization of complex turbid media with regard to their complex refractive index.
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.

Optoelectric scaffold for photo-responsive biological components.

According to one aspect, an optoelectric scaffold for accommodating photo-responsive biological components is provided. The scaffold comprises an optical waveguide configured for confining light propagating in a longitudinal direction thereof. The optical waveguide comprises at least one leaky section with enhanced emission of light in a direction transverse or lateral to the longitudinal direction. The scaffold further comprises an electrically conductive layer arranged on an outer surface of the optical waveguide, wherein the electrically conductive layer has an immobilisation or growth support surface for the immobilisation or cultivation of photo-responsive biological components thereon. The electrically conductive layer comprises transparent regions at least partially overlapping the leaky section. The transparent region is configured so as
to transmit light from the leaky section of the waveguide to the immobilisation and/or growth support surface. According to a further aspect, an optoelectric device comprises an optoelectric scaffold and a photo-responsive biological component arranged on the immobilisation/growth support surface. The growth support surface is arranged so as to transmit light received from the leaky section of the optical waveguide to the biological component placed thereon.

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State: Published
Organisations: Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, Department of Micro- and Nanotechnology, Bioanalytics, Department of Photonics Engineering, Programmable Phase Optics, Optofluidics
Contributors: Emnéus, J., Bunea, A., Keller, S. S., Kristensen, A., Heiskanen, A.
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**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.

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Planar waveguide device with nano-sized filter

A planar waveguide device (PWD) for interacting with a fluid (FLD) is disclosed, the planar waveguide device (PWD) comprising:
- a waveguide layer (WGL) for supporting optical confinement,
- a coupling arrangement (CPA) for in-coupling and out-coupling of light into and from the waveguide layer (WGL),
- a fluid zone (FZN) for accommodating the fluid (FLD),
- a filter layer (FTL) arranged between the fluid zone (FZN) and the waveguide layer (WGL) in an interaction region (IAR) of the waveguide layer (WGL), wherein the filter layer (FTL) comprises filter openings (FOP) arranged to allow the fluid (FLD) to interact with an evanescent field of light guided by the waveguide layer (WGL), wherein the filter openings (FOP) are adapted to prevent particles (PAR) larger than a predefined size from interacting with said evanescent field, wherein the filter openings (FOP) are arranged as line openings having their longitudinal direction in parallel with the direction of propagation (DOP) of light guided by the waveguide layer (WGL). Also, use of the planar waveguide device (PWD) for detecting blood hemolysis and a method of interacting light with a fluid is disclosed.

Resonant laser printing of bi-material metasurfaces: from plasmonic to photonic optical response

Metasurfaces are nanostructured surfaces with engineered optical properties - currently impacting many branches of optics, from miniaturization of optical components to realizing high-resolution structural colors. The optical properties of metasurfaces can be traced to the individual meta-atoms, which set the nature of the optical response, e.g., plasmonic for metallic meta-atoms or photonic for dielectric meta-atoms. Combining multiple types of responses opens up new horizons in design of optical materials, but has so far been avoided due to the fabrication difficulties associated with constructing a metasurface composed of several meta-atom materials. Here, we present a multi-material design approach by optically post-processing a metasurface constructed from self-assembled polystyrene spheres coated with silver. Using our concept of resonant laser printing, we locally alter the initial plasmonic response of the meta-atoms to a pure photonic response. Our work constitutes a conceptually different way of designing metasurfaces and can pave the way for realizing multi-material metasurfaces on large areas while being cost effective.
Sequencing of human genomes extracted from single cancer cells isolated in a valveless microfluidic device

Sequencing the genomes of individual cells enables the direct determination of genetic heterogeneity amongst cells within a population. We have developed an injection-moulded valveless microfluidic device in which single cells from colorectal cancer derived cell lines (LS174T, LS180 and RKO) and fresh colorectal tumors have been individually trapped, their genomes extracted and prepared for sequencing using multiple displacement amplification (MDA). Ninety nine percent of the DNA sequences obtained mapped to a reference human genome, indicating that there was effectively no contamination of these samples from non-human sources. In addition, most of the reads are correctly paired, with a low percentage of singletons (0.17 +/- 0.06%) and we obtain genome coverages approaching 90%. To achieve this high quality, our device design and process shows that amplification can be conducted in microliter volumes as long as the lysis is in sub-nanoliter volumes. Our data thus demonstrates that high quality whole genome sequencing of single cells can be achieved using a relatively simple, inexpensive and scalable device. Detection of genetic heterogeneity at the single cell level, as we have demonstrated for freshly obtained single cancer cells, could soon become available as a clinical tool to precisely match treatment with the properties of a patient's own tumor.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Oxford University Hospitals NHS Foundation Trust, Philips Lighting, Fasteris SA, NIL Technology ApS, Diagenode SA, XGenomes
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To elucidate cellular diversity and clonal evolution in tissues and tumors, one must resolve genomic heterogeneity in single cells. To this end, we have developed low-cost, mass-producible micro-/nanofluidic chips for DNA extraction from individual cells. These chips have modules that collect genomic DNA for sequencing or map genomic structure directly.
on-chip, with denaturation-renaturation (D-R) optical mapping [Marie R, et al. (2013) Proc Natl Acad Sci USA 110:4893-4898]. Processing of single cells from the LS174T colorectal cancer cell line showed that D-R mapping of single molecules can reveal structural variation (SV) in the genome of single cells. In one experiment, we processed 17 fragments covering 19.8 Mb of the cell's genome. One megabase-large fragment aligned well to chromosome 19 with half its length, while the other half showed variable alignment. Paired-end single-cell sequencing supported this finding, revealing a region of complexity and a 50-kb deletion. Sequencing struggled, however, to detect a 20-kb gap that D-R mapping showed clearly in a megabase fragment that otherwise mapped well to the reference at the pericentromeric region of chromosome 4. Pericentromeric regions are complex and show substantial sequence homology between different chromosomes, making mapping of sequence reads ambiguous. Thus, D-R mapping directly, from a single molecule, revealed characteristics of the single-cell genome that were challenging for short-read sequencing.
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
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Contributors: Kristensen, A., Sørensen, K. T., Hejlund-Nielsen, E.
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Source: espacenet
Source-ID: WO2017129196
Research output: Research › Patent – Annual report year: 2017
MICROFLUIDIC DEVICE POSSESSING STRUCTURES ENABLING DIFFERENTIAL ANALYSIS OF A SINGLE CELL'S
CONSTITUENTS

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.

Complete sequence-based pathway analysis by differential on-chip DNA and RNA extraction from a single cell

General information
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Organisations: Department of Micro- and Nanotechnology, Optofluidics
Contributors: Van Der Zaag, J. P., Marie, R., VAN STRIJP, W., Olesen, T., Vulders, M., Kristensen, A.
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Scopus rating (2016): CiteScore 4.63 SJR 1.692 SNIP 1.354
Web of Science (2016): Impact factor 4.259
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Digital resonant laser printing: manipulating optical meta-elements on demand

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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.

General Information
State: Published
Organisations: Department of Micro- and Nanotechnology, National Food Institute, Research Group for Nano-Bio Science, Center for Nanostructured Graphene, Optofluidics, Karlsruhe Institute of Technology
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.
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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Contributors: Sørensen, K. T., Kristensen, A.
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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 bioplasmnic chip for diverse cell-based sensing applications.
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
Contributors: Thirstrup, H., Rungling, T. B., Khalil Al-Hamdani, M. Z., Pathanchalinathan, R., Dziegiel, M. H., Kristensen, A., Marie, R., Berg-Sørensen, K.
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Publication date: 2017
Peer-reviewed: Yes

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.

General information
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Contributors: Eriksen, J., Bilenberg, B., Kristensen, A., Marie, R.
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Web of Science (2017): Indexed yes

BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.2 SJR 0.703 SNIP 1.048
Web of Science (2016): Impact factor 1.515
Web of Science (2016): Indexed yes

BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.11 SJR 0.686 SNIP 0.908
Web of Science (2015): Impact factor 1.336
Web of Science (2015): Indexed yes

BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.45 SJR 0.972 SNIP 1.261
Web of Science (2014): Impact factor 1.614
Web of Science (2014): Indexed yes

BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.28 SJR 0.9 SNIP 1.099
Web of Science (2013): Impact factor 1.584
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes

BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.45 SJR 1.017 SNIP 1.277
Web of Science (2012): Impact factor 1.602
ISI indexed (2012): ISI indexed yes
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BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.43 SJR 0.868 SNIP 1.108
Web of Science (2011): Impact factor 1.367
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Web of Science (2011): Indexed yes

BFI (2010): BFI-level 1
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Web of Science (2008): Indexed yes

Scopus rating (2007): SJR 0.922 SNIP 1.023
Web of Science (2007): Indexed yes

Scopus rating (2006): SJR 1.153 SNIP 1.297
Web of Science (2006): Indexed yes

Scopus rating (2005): SJR 0.883 SNIP 1.044
Web of Science (2005): Indexed yes

Scopus rating (2004): SJR 1.13 SNIP 1.393
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Scopus rating (2003): SJR 0.994 SNIP 1.301
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 $0.5 \mu m \cdot mW^{-1}$ away from the input beam and $\lambda$-DNA velocities reaching $0.2 \mu m \cdot s^{-1} \cdot mW^{-1}$. 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.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Department of Physics, Experimental Surface and Nanomaterials Physics, Stochastic Systems and Signals, Optofluidics, Technical University of Denmark
Contributors: Smith, C., Thilsted, A. H., Pedersen, J. N., Youngman, T. H., Dyrnum, J. C., Michaelsen, N. A., Marie, R., Kristensen, A.
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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.
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.

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.
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.
How to determine local stretching and tension in a flow-stretched DNA molecule

We determine the nonuniform stretching of and tension in a megabase 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.

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Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Optofluidics
Contributors: Pedersen, J. N., Marie, R., Kristensen, A., Flyvbjerg, H.
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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

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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 of Kiel, Olink AB, University of Leicester, Chalmers University of Technology, Pompeu Fabra University, Stockholm University, Max Planck Institute for Molecular Genetics, FlexGen BV, French Alternative Energies and Atomic Energy Commission, 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

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Scopus rating (2014): CiteScore 2.77 SJR 0.994 SNIP 1.237
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
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Organisations: Department of Micro- and Nanotechnology, Optofluidics, National Food Institute, Research Group for Nano-Bio Science, Center for Nanostructured Graphene, Karlsruhe Institute of Technology
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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.

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.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials, Singapore University of Technology and Design, University of Southern Denmark, Rice University
Contributors: Kristensen, A., Yang, J. K. W., Bozhevolnyi, S. I., Link, S., Nordlander, P., Halas, N. J., Mortensen, N. A.
Publication date: 2016
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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
Contributors: Zhu, X., Vannahme, C., Højlund-Nielsen, E., Mortensen, N. A., Kristensen, A.
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Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 21.85 SJR 18.916 SNIP 7.649
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Web of Science (2016): Indexed yes
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Web of Science (2015): Impact factor 35.267
Web of Science (2015): Indexed yes
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Scopus rating (2014): CiteScore 21.76 SJR 17.177 SNIP 8.047
Web of Science (2014): Impact factor 34.048
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ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 17.25 SJR 14.582 SNIP 8.354
Web of Science (2011): Impact factor 27.27
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 11.876 SNIP 7.037
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.

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.
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.
Pyrolytic carbon electrode for dopamine detection from cells

General information
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Organisations: Department of Micro- and Nanotechnology, Bioanalytics, Center for Nanostructured Graphene, Optofluidics, Polymer Microsystems for Cell Processing
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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.

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Organisations: Department of Micro- and Nanotechnology, Optofluidics, Stochastic Systems and Signals
Contributors: Vestergaard, C. L., Mikkelsen, M. B. L., Reisner, W., Kristensen, A., Flyvbjerg, H.
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Scopus rating (2016): CiteScore 11.8 SJR 6.414 SNIP 2.855
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.

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 invention further relates to a method.
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 4.5x10^{-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.
Automation of a single-DNA molecule stretching device

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
Bio-inspired aesthetic solar cells

General information
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Organisations: Department of Mechanical Engineering, Engineering Design and Product Development, Department of Micro- and Nanotechnology, Optofluidics
Contributors: Lenau, T. A., Kristensen, A., Brekke, T., Stokbro, L.
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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.

General information
State: Published
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.

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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.

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Contributors: Hermannsson, P. G., Kristensen, A., Vannahme, C., Smith, C.
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Electrospun dye-doped fiber networks: lasing emission from randomly distributed cavities

Dye-doped polymer fiber networks fabricated with electrospinning exhibit comb-like laser emission. We identify randomly distributed ring resonators being responsible for lasing emission by making use of spatially resolved spectroscopy. Numerical simulations confirm this result quantitatively.

Fiber-Based, Injection-Molded Optofluidic Systems: Improvements in Assembly and Applications

We present a method to fabricate polymer optofluidic systems by means of injection molding that allow the insertion of standard optical fibers. The chip fabrication and assembly methods produce large numbers of robust optofluidic systems that can be easily assembled and disposed of, yet allow precise optical alignment and improve delivery of optical power. Using a multi-level chip fabrication process, complex channel designs with extremely vertical sidewalls, and dimensions that range from few tens of nanometers to hundreds of microns can be obtained. The technology has been used to align optical fibers in a quick and precise manner, with a lateral alignment accuracy of 2.7 ± 1.8 μm. We report the production, assembly methods, and the characterization of the resulting injection-molded chips for Lab-on-Chip (LoC) applications. We demonstrate the versatility of this technology by carrying out two types of experiments that benefit from the improved optical system: optical stretching of red blood cells (RBCs) and Raman spectroscopy of a solution loaded into a hollow core fiber. The advantages offered by the presented technology are intended to encourage the use of LoC technology for commercialization and educational purposes.
Gap and channeled plasmons in tapered grooves: a review
Tapered metallic grooves have been shown to support plasmons - electromagnetically coupled oscillations of free electrons at metal-dielectric interfaces - across a variety of configurations and V-like profiles. Such plasmons may be divided into two categories: gap-surface plasmons (GSPs) that are confined laterally between the tapered groove sidewalls and propagate either along the groove axis or normal to the planar surface, and channeled plasmon polaritons (CPPs) that occupy the tapered groove profile and propagate exclusively along the groove axis. Both GSPs and CPPs exhibit an assortment of unique properties that are highly suited to a broad range of cutting-edge nanoplasmonic technologies, including ultracompact photonic circuits, quantum-optics components, enhanced lab-on-a-chip devices, efficient light-absorbing surfaces and advanced optical filters, while additionally affording a niche platform to explore the fundamental science of plasmon excitations and their interactions. In this Review, we provide a research status update of plasmons in tapered grooves, starting with a presentation of the theory and important features of GSPs and CPPs, and follow with an overview of the broad range of applications they enable or improve. We cover the techniques that can fabricate tapered groove structures, in particular highlighting wafer-scale production methods, and outline the various photon- and electron-based approaches that can be used to launch and study GSPs and CPPs. We conclude with a discussion of the challenges that remain for further developing plasmonic tapered-groove devices, and consider the future directions offered by this select yet potentially far-reaching topic area.

General information
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Organisations: Department of Micro- and Nanotechnology, Optofluidics, Center for Nanostructured Graphene, Department of Photonics Engineering, Structured Electromagnetic Materials, University of Southern Denmark
Contributors: Smith, C. L. C., Stenger, N., Kristensen, A., Mortensen, N. A., Bozhevolnyi, S. I.
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BFI (2018): BFI-level 2
High frame rate multi-resonance imaging refractometry with distributed feedback dye laser sensor

High frame rate and highly sensitive imaging of refractive index changes on a surface is very promising for studying the dynamics of dissolution, mixing and biological processes without the need for labeling. Here, a highly sensitive distributed feedback (DFB) dye laser sensor for high frame rate imaging refractometry without moving parts is presented. DFB dye lasers are low-cost and highly sensitive refractive index sensors. The unique multi-wavelength DFB laser structure presented here comprises several areas with different grating periods. Imaging in two dimensions of space is enabled by analyzing laser light from all areas in parallel with an imaging spectrometer. With this multi-resonance imaging
refractometry method, the spatial position in one direction is identified from the horizontal, i.e., spectral position of the multiple laser lines which is obtained from the spectrometer charged coupled device (CCD) array. The orthogonal spatial position is obtained from the vertical spatial position on the spectrometer CCD array as in established spatially resolved spectroscopy. Here, the imaging technique is demonstrated by monitoring the motion of small sucrose molecules upon dissolution of solid sucrose in water. The omission of moving parts improves the robustness of the imaging system and allows a very high frame rate of up to 12 Hz.

**General information**
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- **Organisations:** Department of Micro- and Nanotechnology, Optofluidics, Fluidic Array Systems and Technology
- **Contributors:** Vannahme, C., Dufva, M., Kristensen, A.
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**Ink-free color decoration**

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- **Contributors:** Kristensen, A., Højlund-Nielsen, E., Lavieta, C., Zhu, X., Mortensen, N. A.
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Microfluidics for single cell analysis
Isolation and manipulation of single cells have gained an increasing interest from researchers because of the heterogeneity of cells from the same cell culture. Single cell analysis can ensure a better understanding of differences between individual cells and potentially solve a variety of clinical problems. In this thesis lab on a chip systems for rare single cell analysis are investigated. The focus was to develop a commercial, disposable device for circulating tumour cell (CTC) analysis. Such a device must be able to separate rare cells from blood samples and subsequently capture the specific cells and simultaneously be fabricated and operated at low costs and be user-friendly. These challenges were addressed through development of two microfluidic devices, one for rare cell isolation based on pinched flow fractionation (PFF) and one for single cell capture based on hydrodynamic trapping. Both devices were fabricated by injection moulding with a nickel master.

CTC isolation was realised using PFF, which is a passive, size-based microfluidic technique. The focus was mainly on experimental work; however designs were based on flow calculations and analysed with numerical simulations to support experimental results. Devices were extensively characterised and tested with fluorescent nano- and microspheres, and with cancer cells and blood cell samples. It was demonstrated that the separation not only relies on size, but that differences in cell deformability are also exploited, which enabled a successful separation with an efficiency of over 90%.

Single cell capture was realised using hydrodynamic cell trapping, which is based on flow and cell interactions with microstructures. The criteria for hydrodynamic single cell capture were investigated and clarified through development of several devices with increasingly optimized designs. The final design provides the possibility of parallel single cell DNA extraction for subsequent off-chip investigations. Because the devices are sensitive to small changes of the structures, the injection moulding process was optimized to improve replication of the structures from the nickel master.

A novel method based on freeze-fracture was used to investigate and improve the bonding process used for sealing device microchannels. Structures were intentionally altered by bonding at high temperatures, and the resulting channel cross sections were visualized in a scanning electron microscope. It was demonstrated that chips with the altered structures had an increased capture efficiency.

Finally low cost mass-production of the devices was realised using injection moulding in thermoplastics from a nickel master. With this process the price per device rapidly decreases for higher numbers of fabricated devices. In addition devices were fabricated on a Luer-platform that ensures easy connection to external equipment. The devices were used by collaborators in a cancer research lab, which demonstrates their commercial potential.
Optical manipulation with two beam traps in microfluidic polymer systems

An optical trapping system with two opposing laser beams, also known as the optical stretcher, are naturally constructed inside a microfluidic lab-on-chip system. We present and compare two approaches to combine a simple microfluidic system with either waveguides directly written in the microfluidic chip or with optical fibers mounted in the chip.

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Organisations: Department of Physics, Department of Micro- and Nanotechnology, Optofluidics, Biophysics and Fluids, NIL Technology ApS
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Number of pages: 2
Publication date: 2015

Optical mapping of single-molecule human DNA in disposable, mass-produced all-polymer

We demonstrate all-polymer injection molded devices for optical mapping of denaturation–renaturation (DR) patterns on long, single DNA-molecules from the human genome. The devices have channels with ultra-low aspect ratio, only 110 nm deep while 20 μm wide, and are superior to the silica devices used previously in the field. With these polymer devices, we demonstrate on-chip recording of DR images of DNA-molecules stretched to more than 95% of their contour length. The stretching is done by opposing flows Marie et al (2013 Proc. Natl Acad. Sci. USA 110 4893–8). The performance is validated by mapping 20 out of 24 Mbp-long DNA fragments to the human reference genome. We optimized fabrication of the devices to a yield exceeding 95%. This permits a substantial economies-of-scale driven cost-reduction, leading to device costs as low as 3 USD per device, about a factor 70 lower than the cost of silica devices. This lowers the barrier to a wide use of DR mapping of native, megabase-size DNA molecules, which has a huge potential as a complementary method to next-generation sequencing.

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Web of Science (2016): Impact factor 1.794
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
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Web of Science (2015): Impact factor 1.768
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BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.84 SJR 0.802 SNIP 1.316
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BFI (2013): BFI-level 1
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Web of Science (2013): Indexed yes
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Web of Science (2012): Impact factor 1.79
ISI indexed (2012): ISI indexed yes
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Scopus rating (2011): CiteScore 2.43 SJR 1.036 SNIP 1.443
Web of Science (2011): Impact factor 2.105
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BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.013 SNIP 1.637
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BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.144 SNIP 1.5
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
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Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.422 SNIP 1.815
Web of Science (2007): Indexed yes
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Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.165 SNIP 2.073
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.057 SNIP 1.881
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.416 SNIP 1.579
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.103 SNIP 1.507
Polarization-dependent aluminum metasurface operating at 450 nm

We report on a polarization-dependent plasmonic aluminum-based high-density metasurface operating at blue wavelengths. The fabricated sub-wavelength structures, tailored in size and geometry, possess strong, localized, plasmonic resonances able to control linear polarization. Best performance is achieved by rotating an elongated rectangular structure of length 180 nm and width 110 nm inside a square lattice of period 250 nm. In the case of 45 degrees rotation of the structure with respect to the lattice, the normal-incidence reflectance drops around the resonance wavelength of 457 nm from about 60 percent to below 2 percent.

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Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
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Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
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Refractive index dispersion sensing using an array of photonic crystal resonant reflectors

Refractive index sensing plays a key role in various environmental and biological sensing applications. Here, a method is presented for measuring the absolute refractive index dispersion of liquids using an array of photonic crystal resonant reflectors of varying periods. It is shown that by covering the array with a sample liquid and measuring the resonance wavelength associated with transverse electric polarized quasi guided modes as a function of period, the refractive index dispersion of the liquid can be accurately obtained using an analytical expression. This method is compact, can perform
measurements at arbitrary number of wavelengths, and requires only a minute sample volume. The ability to sense a material's dispersion profile offers an added dimension of information that may be of benefit to optofluidic lab-on-a-chip applications. © 2015 AIP Publishing LLC.

**General information**

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Web of Science (2017): Impact factor 3.495
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): Impact factor 3.411
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.47 SJR 1.499 SNIP 1.226
Web of Science (2015): Impact factor 3.142
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.25 SJR 1.861 SNIP 1.492
Web of Science (2014): Impact factor 3.302
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.77 SJR 2.146 SNIP 1.633
Web of Science (2013): Impact factor 3.515
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.76 SJR 2.57 SNIP 1.739
Web of Science (2012): Impact factor 3.794
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.814 SNIP 1.917
Web of Science (2011): Impact factor 3.844
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.92 SNIP 1.775
Web of Science (2010): Impact factor 3.841
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BFI (2009): BFI-level 2
Refractometric monitoring of dissolution and fluid flow with distributed feedback dye laser sensor

Monitoring the dissolution of solid material in liquids and monitoring of fluid flow is of significant interest for applications in chemistry, food production, medicine, and especially in the fields of microfluidics and lab on a chip. Here, real-time refractometric monitoring of dissolution and fast fluid flow with DFB dye laser sensors with an optical imaging spectroscopy setup is presented. The dye laser sensors provide both low detection limits and high spatial resolution. It is demonstrated how the materials NaCl, sucrose, and bovine serum albumin show characteristic dissolution patterns. The unique feature of the presented method is a high frame rate of up to 20 Hz, which is proven to enable the monitoring of fast flow of a sucrose solution jet into pure water. (C) 2015 Optical Society of America
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Web of Science (2014): Impact factor 3.488
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196
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Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.85 SJR 2.562 SNIP 2.108
Web of Science (2012): Impact factor 3.546
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.58 SNIP 2.572
Web of Science (2011): Impact factor 3.587
ISI indexed (2011): ISI indexed yes
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BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.906 SNIP 2.428
Web of Science (2010): Impact factor 3.753
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
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Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 3.284 SNIP 2.11
Web of Science (2007): Indexed yes
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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
Separation of cancer cells from white blood cells by pinched flow fractionation

In this paper, the microfluidic size-separation technique pinched flow fractionation (PFF) is used to separate cancer cells from white blood cells (WBCs). The cells are separated at efficiencies above 90% for both cell types. Circulating tumor cells (CTCs) are found in the blood of cancer patients and can form new tumors. CTCs are rare cells in blood, but they are important for the understanding of metastasis. There is therefore a high interest in developing a method for the enrichment of CTCs from blood samples, which also enables further analysis of the separated cells. The separation is challenged by the size overlap between cancer cells and the 106 times more abundant WBCs. The size overlap prevents high efficiency separation, however we demonstrate that cell deformability can be exploited in PFF devices to gain higher efficiencies than expected from the size distribution of the cells.

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Organisations: Department of Micro- and Nanotechnology, Optofluidics, Oxford University Hospitals NHS Foundation Trust, Genotype2Phenotype LLC, NIL Technology ApS
Contributors: Jensen, M. P., Ashley, N., Koprowska, K., Mir, K. U., Zalkovskij, M., Bilenberg, B., Bodmer, W., Kristensen, A., Marie, R.
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Scopus rating (2015): CiteScore 5.74 SJR 2.239 SNIP 1.721
Web of Science (2015): Impact factor 5.586
Web of Science (2015): Indexed yes
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Web of Science (2014): Impact factor 6.115
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Smart plastic functionalization by nanoimprint and injection molding

In this paper, we present a route for making smart functionalized plastic parts by injection molding with sub-micrometer surface structures. The method is based on combining planar processes well known and established within silicon micro and sub-micro fabrication with proven high resolution and high fidelity with truly freeform injection molding inserts. The link between the planar processes and the freeform shaped injection molding inserts is enabled by the use of nanoimprint with flexible molds for the pattern definition combined with unidirectional sputter etching for transferring the pattern. With this approach, we demonstrate the transfer of down to 140 nm wide holes on large areas with good structure fidelity on an injection molding steel insert. The durability of the sub-micrometer structures on the inserts have been investigated by running two production series of 102,000 and 73,000 injection molded parts, respectively, on two different inserts and...
inspecting the inserts before and after the production series and the molded parts during the production series.

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**Tunable on chip optofluidic laser**

A chip scale tunable laser in the visible spectral band is realized by generating a periodic droplet array inside a microfluidic channel. Combined with a gain medium within the droplets, the periodic structure provides the optical feedback of the laser. By controlling the pressure applied to two separate inlets we can change the period of the droplet array. As a result, the lasing frequency is tuned over a broad spectral range. Using this configuration, we demonstrate wavelength tunability of about 70 nm and lasing threshold of about 15 μJ/mm².

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Contributors: Bakal, A., Vannahme, C., Kristensen, A., Levy, U.

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BFI (2016): BFI-level 2

Scopus rating (2016): CiteScore 2.67 SJR 1.673 SNIP 1.249

Web of Science (2016): Impact factor 3.411
Absolute analytical prediction of photonic crystal guided mode resonance wavelengths

A class of photonic crystal resonant reflectors known as guided mode resonant filters are optical structures that are widely used in the field of refractive index sensing, particularly in biosensing. For the purposes of understanding and design, their behavior has traditionally been modeled numerically with methods such as rigorous coupled wave analysis. Here it is demonstrated how the absolute resonance wavelengths of such structures can be predicted by analytically modeling them as slab waveguides in which the propagation constant is determined by a phase matching condition. The model is experimentally verified to be capable of predicting the absolute resonance wavelengths to an accuracy of within 0.75 nm, as well as resonance wavelength shifts due to changes in cladding index within an accuracy of 0.45 nm across the visible wavelength regime in the case where material dispersion is taken into account. Furthermore, it is demonstrated that the model is valid beyond the limit of low grating modulation, for periodically discontinuous waveguide layers, high refractive index contrasts, and highly dispersive media.

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Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 2.67 SJR 1.673 SNIP 1.249
Web of Science (2016): Impact factor 3.411
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.47 SJR 1.499 SNIP 1.226
Web of Science (2015): Impact factor 3.142
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.25 SJR 1.861 SNIP 1.492
Web of Science (2014): Impact factor 3.302
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BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.77 SJR 2.146 SNIP 1.633
Web of Science (2013): Impact factor 3.515
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Accurate wavelength prediction of photonic crystal resonant reflection and applications in refractive index measurement

In the past decade, photonic crystal resonant reflectors have been increasingly used as the basis for label-free biochemical assays in lab-on-a-chip applications. In both designing and interpreting experimental results, an accurate model describing the optical behavior of such structures is essential. Here, an analytical method for precisely predicting the absolute positions of resonantly reflected wavelengths is presented. The model is experimentally verified to be highly accurate using nanoreplicated, polymer-based photonic crystal grating reflectors with varying grating periods and superstrate materials. The importance of accounting for material dispersion in order to obtain accurate simulation results is highlighted, and a method for doing so using an iterative approach is demonstrated. Furthermore, an application for the model is demonstrated, in which the material dispersion of a liquid is extracted from measured resonance wavelengths.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
A microfluidic device with a diffusion barrier
The invention provides a microfluidic device for macromolecule amplification by sequential addition of liquid reagents. The device of the invention comprises a chip forming a plurality of reaction chambers each extending between an inlet and an outlet, each inlet being in fluid communication with a common junction via micro channels. To enable amplification of DNA, e.g. by MDA, the device comprises a diffusion barrier at each inlet configured to increase the pressure threshold for a reagent to cross the resistor. The invention further provides a method of mixing liquid reagents by use of the device where single DNA molecules are allowed to cross the diffusion barrier individually.

A microfluidic device with pillars
The invention provides a microfluidic device for mixing liquid reagents, the device comprises, a chip forming at least one reaction chamber between a bottom and a top and extending between an inlet and an outlet. To enable manufacturing from less rigid materials, the device comprises pillars extending from the bottom to the top. The invention further provides a method of mixing reagents by use of the device
Angle-independent structural colors of silicon

Structural colors are optical phenomena of physical origin, where microscale and nanoscale structures determine the reflected spectrum of light. Artificial structural colors have been realized within recent years. However, multilayer structures require substantial fabrication. Instead we considered one-layer surface textures of silicon. We explored four patterns of square structures in a square lattice with periods of 500, 400, 300, and 200 nm. The reflectivity and daylight-colors were measured and compared with simulations based on rigorously coupledwave analysis with excellent agreement. Based on the 200-nm periodic pattern, it was found that angle-independent specular colors up to 60 deg of incidence may be provided. The underlying mechanisms include (1) the suppression of diffraction and (2) a strong coupling of light to localized surface states. The strong coupling yields absorption anomalies in the visual spectrum, causing robust colors to be defined for a large angular interval. The result is a manifestation of a uniformly defined color, similar to pigment-based colors. These mechanisms hold potential for color engineering and can be used to explain and predict the structural-color appearance of silicon-based textures for a wide range of structural parameters.
An optical device capable of providing a structural color, and a corresponding method of manufacturing such a device.

The present invention relates to an optical device having a nano-structured surface capable of providing a structural color to a normal human viewer, the device made being manufactured in one single material. A plurality of nano-structured protrusions (5) is further arranged with a first periodicity (P1) in a first direction and a second periodicity (P2) in a second direction, the first and second periodicity being chosen so that the optical reflection is dominated by specular reflection. The nano-structured protrusions are optionally arranged with a relative spatial randomness (SR) with respect to the average surface positions. The position, size, and randomness of the protrusions are arranged so as to provide, at least up to a maximum angle of incidence (A_in) with respect to a normal to the surface, an angle-independent substantially homogeneous structural color perception for a normal human viewer, at least up to a maximum observation angle (A_obs) with respect to a normal to the surface.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Contributors: Kristensen, A., Højlund-Nielsen, E., Mortensen, N. A., Nørregaard, J.
Publication date: 2014

Publication information
IPC: G02B1/00; G02B5/00; G02B5/18
Patent number: WO2014194920
Date: 11/12/2014
Priority date: 04/06/2013
Priority number: EP20130170492
Original language: English
Electronic versions:
WO2014194920A1.pdf
Research output: Research - peer-review › Journal article – Annual report year: 2014

Efficient Excitation of Channel Plasmons in Tailored, UV-Lithography-Defined V-Grooves

We demonstrate the highly efficient (>50%) conversion of freely propagating light to channel plasmon-polaritons (CPPs) in gold V-groove waveguides using compact 1.6 μm long waveguide-termination coupling mirrors. Our straightforward fabrication process, involving UV-lithography and crystallographic silicon etching, forms the coupling mirrors innately and ensures exceptional-quality, wafer-scale device production. We tailor the V-shaped profiles by thermal silicon oxidation in order to shift initially wedge-located modes downward into the V-grooves, resulting in well-confined CPPs suitable for nanophotonic applications.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Nanoprobes, Department of Photonics Engineering, University of Southern Denmark
High Excitation Efficiency of Channel Plasmon Polaritons in Tailored, UV-Lithography-Defined V-Grooves

We demonstrate >50% conversion of light to V-groove channel plasmon-polaritons (CPPs) via compact waveguide-termination mirrors. Devices are fabricated using UV-lithography and crystallographic silicon etching. The V-shape is tailored by thermal oxidation to support confined CPPs.

Injection molded microfluidic device for enrichment of somatic cells in cow milk
In this paper the continuous microfluidic separation technique pinched flow fractionation is applied to the enrichment of somatic cells from cow milk. Somatic cells were separated from the smallest fat particles and proteins thus better imaging and analysis of the cells can be achieved. The enrichment was performed using an all-polymer pinched flow fractionation device fabricated by injection molding. The polymer chips were bonded to a 500 lm polymer foil using UV assisted thermal bonding. The quality of the final devices was reproducible and the injection molding process combined with the use of cheap materials ensures the possibility for device mass production.
Injection moulding antireflective nanostructures

We present a method for injection moulding antireflective nanostructures on large areas, for high volume production. Nanostructured black silicon masters were fabricated by mask-less reactive ion etching, and electroplated with nickel. The nickel shim was antistiction coated and used in an injection moulding process, to fabricate the antireflective surfaces. The cycle-time was 35 s. The injection moulded structures had a height of 125 nm, and the visible spectrum reflectance of injection moulded black polypropylene surfaces was reduced from 4.5±0.5% to 2.5±0.5%. The gradient of the refractive index of the nanostructured surfaces was estimated from atomic force micrographs and the theoretical reflectance was calculated using the transfer matrix method and effective medium theory. The measured reflectance shows good agreement with the theory of graded index antireflective nanostructures. © 2014 Elsevier B.V. All rights reserved.
Monolithic integration of DUV-induced waveguides into plastic microfluidic chip for optical manipulation

A monolithic polymer optofluidic chip for manipulation of microbeads in flow is demonstrated. On this chip, polymer waveguides induced by Deep UV lithography are integrated with microfluidic channels. The optical propagation losses of the waveguides are measured to be $0.66\pm0.13$ dB/mm at a wavelength of $\lambda = 808$ nm. An optimized bead tracking algorithm is implemented, allowing for determination of the optical forces acting on the particles. The algorithm features a spatio-temporal mapping of coordinates for uniting partial trajectories, without increased processing time. With an external laser power of 250 mW, a maximum scattering force of 0.84 pN is achieved for 5 $\mu$m diameter polystyrene beads in water.

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General information

State: Published
Organisations: Department of Physics, Department of Micro- and Nanotechnology, Optofluidics, Biophysics and Fluids
Contributors: Khoury Arvelo, M., Vannahme, C., Sørensen, K. T., Kristensen, A., Berg-Sørensen, K.
Number of pages: 5
Pages: 5-9
Publication date: 2014
Peer-reviewed: Yes

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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.87 SJR 0.604 SNIP 0.937
Web of Science (2017): Impact factor 2.02
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): Impact factor 1.806
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 1.35 SJR 0.507 SNIP 0.796
Web of Science (2015): Impact factor 1.277
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 1.44 SJR 0.586 SNIP 0.86
Web of Science (2014): Impact factor 1.197
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 1.45 SJR 0.595 SNIP 0.964
Web of Science (2013): Impact factor 1.338
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 1.44 SJR 0.737 SNIP 0.949
Web of Science (2012): Impact factor 1.224
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 1.8 SJR 0.813 SNIP 1.148
Web of Science (2011): Impact factor 1.557
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.934 SNIP 1.093
Web of Science (2010): Impact factor 1.575
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.834 SNIP 1.098
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.027 SNIP 1.06
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.045 SNIP 1.138
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.966 SNIP 1.093
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.952 SNIP 0.989
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1 SNIP 1.1
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.812 SNIP 0.956
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.712 SNIP 0.711
Scopus rating (2001): SJR 0.558 SNIP 0.645
Scopus rating (2000): SJR 0.502 SNIP 0.568
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.595 SNIP 0.555
Original language: English
Keywords: Optical manipulation, DUV-induced waveguides, Optofluidics, All-polymer, Hot embossing
DOI: 10.1016/j.mee.2014.02.022
Nanofluidics to Enhance Single Molecule DNA Imaging: Detecting Genomic Structural Variation in Humans

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Stochastic Systems and Signals, Department of Physics, Quantum Physics and Information Technology, University of Oxford, University College London
Pages: 395A
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Publication information
Journal: BIOPHYSICAL JOURNAL
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 3.15 SJR 1.949 SNIP 0.979
Web of Science (2017): Impact factor 3.495
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): Impact factor 3.656
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 3.3 SJR 2.13 SNIP 1.134
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 3.33 SJR 2.21 SNIP 1.15
Web of Science (2014): Impact factor 3.972
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.64 SJR 2.245 SNIP 1.156
Web of Science (2013): Impact factor 3.832
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.57 SJR 2.361 SNIP 1.143
Web of Science (2012): Impact factor 3.668
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 3.75 SJR 2.357 SNIP 1.202
Web of Science (2011): Impact factor 3.653
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
Nanoinprinted distributed feedback dye laser sensor for real-time imaging of small molecule diffusion

Label-free imaging is a promising tool for the study of biological processes such as cell adhesion and small molecule signaling processes. In order to image in two dimensions of space current solutions require motorized stages which results in low imaging frame rates. Here, a highly sensitive distributed feedback (DFB) dye laser sensor for real-time label-free imaging without any moving parts enabling a frame rate of 12 Hz is presented. The presence of molecules on the laser surface results in a wavelength shift which is used as sensor signal. The unique DFB laser structure comprises several areas of different grating periods which result in distinct laser emission wavelengths. Imaging in two dimensions of space is enabled by focusing an image of the laser surface with a cylindrical lens onto the entrance slit of an imaging spectrometer. Imaging is demonstrated by monitoring of diffusing small sucrose molecules in water.

General information
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Organisations: Department of Micro- and Nanotechnology, Optofluidics, Fluidic Array Systems and Technology
Contributors: Vannahme, C., Dufva, M., Kristensen, A.
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Publisher: IEEE
ISBN (Print): 9781479901623
Keywords: General Topics for Engineers, DFB laser, diffusion, dye laser, Label-free imaging, laser sensor, small molecule detection
DOI:s: 10.1109/ICSENS.2014.6985270
Nanoimprinted DWDM laser arrays on indium phosphide substrates

Dense wavelength division multiplexing lasers play a major role in today's long-haul broadband communication. Typical distributed feedback laser cavities consist of long half-pitch gratings in InGaAsP on InP substrates with grating periods of around 240 nm. The lasers include a quarter wavelength shift in the grating, and are single mode with high side-mode suppression. Typically, such lasers are patterned using e-beam lithography (EBL). We present a fabrication method based on patterning by thermal nanoimprint lithography, which is potentially less costly and faster than EBL. Thermal nanoimprint lithography of laser gratings raises two types of challenges: (1) The imprint process itself is delicate due to the mechanical fragility of indium phosphide substrates and the thermal mismatch between the substrate and the silicon stamp. (2) The subsequent processing puts requirements on the imprint resist thickness after patterning, and the alignment between the crystallographic direction of the substrate and the grating pattern. Working laser arrays were produced, with >40 mW optical power and side mode suppression ratios of more than 50 dB in all 12 channels.

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Organisations: Department of Micro- and Nanotechnology, Optofluidics, Nanoprobes, Silicon Microtechnology, NIL Technology ApS, NeoPhotonics Corporation
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Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.87 SJR 0.604 SNIP 0.937
Web of Science (2017): Impact factor 2.02
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): Impact factor 1.806
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 1.35 SJR 0.507 SNIP 0.796
Web of Science (2015): Impact factor 1.277
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 1.44 SJR 0.586 SNIP 0.86
Web of Science (2014): Impact factor 1.197
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 1.45 SJR 0.595 SNIP 0.964
Web of Science (2013): Impact factor 1.338
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 1.44 SJR 0.737 SNIP 0.949
Web of Science (2012): Impact factor 1.224
ISI indexed (2012): ISI indexed yes
Nanoscale surface topographies for structural colors

The thesis describes and demonstrates the possibilities for utilization of structural colors in mass fabricated plastic products as replacement for or in combination with pigments and inks. The motivation is the possible advantages related to re-cycling and re-use of plastic by limiting the number of materials in a given plastic part. Also, the reduction of process steps and materials leads to a reduction of the fabrication costs. In the thesis only surfaces, which may be fabricated using replication based methods, such as injection molding, are considered.

Nanostructures with sizes comparable to the wavelength of visible light are theoretically and experimentally investigated. These structures interact with light such that the appearance of a surface is modified. It is shown how sufficiently small tapered nanostructures lead to an anti-reflective effect were the reflection of light at the air-polymer interface is suppressed. This improves the ability to see through a clear plastic in the presence of specular reflection. The tapered nanostructures are also utilized to enhance the chroma of pigmented polymers. Larger tapered structures fabricated in a similar manor are shown to work as color filters. Through an experimental study is the color of the transmitted light linked directly to the random topography of the surface by use of diffraction theory. The color effects from periodic structures and how these might be employed to create bright colors are investigated. This is done both for opaque samples and transparent foils. In the latter case the specific sample geometry may be utilized to create a zero order reflectance, which is significantly higher than what may be achieved by a single interface.

When the design limitations are relaxed and a small amount of post processing of the nanostructured plastic is done, more possibilities arise. A surface utilizing the concept of localized surface plasmon resonances (LSPR) is produced, when an ultra-thin layer of aluminum is deposited on a suitable nanostructured plastic surface.
The choice of aluminum as active plasmonic material is based on cost and abundance aspects, but also advantages within robustness and optical properties compared to other metals commonly used for plasmonic applications. Hybridization theory is used to describe the behavior of the surface and a parameter space is identified where it by proper choice of vertical geometrical parameters is possible to create a plurality of bright colors by varying the lateral parameters only.

It is shown how diffraction effects and excitation of surface plasmon polaritons constitute the main limitations on the angular sensitivity of the surface.

General information
State: Published
Organisations: Department of Photonics Engineering, Department of Micro- and Nanotechnology, Optofluidics, Structured Electromagnetic Materials
Contributors: Clausen, J. S., Kristensen, A., Mortensen, N. A.
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Electronic versions:
Clausen_PhDThesis_final_low_quality..PDF

Nanostructured polymer- and metal surfaces: Antireflective and colour functionality
This Ph.D. thesis explores the optical properties of nanostructured dielectric and metallic surfaces. Focusing on scalable fabrication methods for antireflective nanostructures, this experimental study has resulted in the proof of concept of inexpensive, large area antireflective nanostructures, as well as structural enhancement of light absorption in thin metal films, deposited on nanostructured substrates.

Large areas of nanostructures were realized using the black silicon (BSi) method: a mask less reactive ion etching process, resulting in tapered nanostructures with tunable dimensions, on wafer scale. The BSi structures were replicated into the UV curable organicinorganic hybrid polymer Ormocomp, in order to further assess the optical properties of the structures. BSi structures with lateral dimensions of around 1 μm would selectively scatter specific bands of wavelengths, resulting in a structural colour filter for specularly transmitted light.

By reducing the height and lateral size, the structures enter a regime where scattering of visible light becomes insignificant. In this regime, the BSi structures were shown to be antireflective. An empirical relation between the characteristic length scale of the nanostructured surface, and the wavelength at which scattering becomes significant, was shown. The result is thus a design criterion for the use of random nanostructures for non-scattering antireflective surfaces.

Antireflective BSi nanostructures were fabricated using injection moulding in polypropylene. A Ni shim was electroplated from a BSi master, and inserted in an injection moulding tool. The reflectance of the injection moulded parts was reduced from 4.5 % to 2.5% in the visible spectrum. The reflectance was calculated from the gradient in the refractive index from AFM data, using effective medium theory, and the measured and theoretical reflectance showed good agreement.

Binary antireflective nanostructures were fabricated in Ormocomp by replication from a Si master which was patterned using fast e-beam lithography. The reflectance was decreased from 4% down to 1%.

Finally, the optical properties of thin metal films deposited on nanostructured surfaces was studied. When a metal film was deposited on BSi structures in Ormocomp, the reflectance of the metal film was lowered significantly, and the absorption was increased. In contrast to their reflective planar counterparts, these thin metal films appear completely black. Two effects causing the increased absorption were suggested: a gradient effect, causing the metal film to be antireflective, and that the structured surface allows for coupling to surface plasmons in the metal film.

General information
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Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Contributors: Christiansen, A. B., Kristensen, A., Mortensen, N. A.
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Publication date: 2014

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Original language: English
Electronic versions:
PhD_Thesis_Alexander_Bruun_Christiansen.pdf
Source: PublicationPreSubmission
Nanostructuring steel for injection molding tools
The production of nanostructured plastic items by injection molding with ridges down to 400 nm in width, which is the smallest line width replicated from nanostructured steel shims, is presented. Here we detail a micro-fabrication method where electron beam lithography, nano-imprint lithography and ion beam etching are combined to nanostructure the planar surface of a steel wafer. Injection molded plastic parts with enhanced surface properties, like anti-reflective, superhydrophobic and structural colors can be achieved by micro-and nanostructuring the surface of the steel molds. We investigate the minimum line width that can be realized by our fabrication method and the influence of etching angle on the structure profile during the ion beam etching process. Trenches down to 400 nm in width have been successfully fabricated into a 316 type electro-polished steel wafer. Afterward a plastic replica has been produced by injection molding with good structure transfer fidelity. Thus we have demonstrated that by utilizing well-established fabrication techniques, nanostructured steel shims that are used in injection molding, a technique that allows low cost mass fabrication of plastic items, are produced.
Optimized Distributed Feedback Dye Laser Sensor for Real-Time Monitoring of Small Molecule Diffusion

Nanoimprinted distributed feedback dye laser sensors featuring multilayer slab waveguides are presented. A simple yet precise analytical model is used to optimize the lasers in order to give highest sensitivity and it is found that the thickness of a high index TiO₂ top layer is the most important parameter for optimization. Using such laser sensors in an imaging spectroscopy setup, real-time label-free monitoring of sugar molecule diffusion in water is demonstrated. This method could potentially pave the way towards the analysis of small molecule diffusion in various media, e.g. protein signaling processes in tissue.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Fluidic Array Systems and Technology
Contributors: Vannahme, C., Smith, C., Dufva, M., Kristensen, A.
Number of pages: 2
Publication date: 2014

Host publication information
Title of host publication: Proceedings of ECIO-MOC 2014
Plasmonic Metasurfaces for Coloration of Plastic Consumer Products

We present reflective plasmonic colors based on the concept of localized surface plasmon resonances (LSPR) for plastic consumer products. In particular, we bridge the widely existing technological gap between clean-room fabricated plasmonic metasurfaces and the practical call for large-area structurally colored plastic surfaces robust to daily life handling. We utilize the hybridization between LSPR modes in aluminum nanodisks and nanoholes to design and fabricate bright angle-insensitive colors that may be tuned across the entire visible spectrum.
Plasmonic Structural Colors for Plastic Consumer Products

Today colorants, such as pigments or dyes, are used to color plastic-based consumer products, either as base for solid colored bulk polymer or in inks for surface decoration. After usage, the products must be mechanically sorted by color before recycling, limiting any large-scale efficient recycling effort. As an alternative to chemistry-based coloring, nano-scale structural coloring has been proposed to reduce the number of materials needed and to increase pattern resolution. Here colors are created by structural based light-matter interactions in the surface. Thereby, the sorting by color can be avoided in the recycling state. Plasmon color technology based on aluminum has recently been firmly established as a route towards structural coloring of polymeric materials. We report on the fabrication of colors by localized surface plasmon resonances (LSPR) using roll-to-roll printing and demonstrate a route for scalable production and commercial uptake of plasmonic colors.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Contributors: Højlund-Nielsen, E., Mortensen, N. A., Kristensen, A.
Number of pages: 1
Publication date: 2014

Host publication information
Title of host publication: Abstract Book - DTU Sustain Conference 2014
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 2014

Polymer laser bio-sensors

Organic dye based distributed feed-back lasers, featuring narrow linewidth and thus high quality spectral resolution, are used as highly sensitive refractive index sensors. The design, fabrication and application of the laser intra-cavity sensors are discussed.

General information
State: Published
Random-Cavity Lasing from Electrospun Polymer Fiber Networks

General information
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Organisations: Department of Micro- and Nanotechnology, Optofluidics, National Food Institute, Division of Industrial Food Research, Karlsruhe Institute of Technology
Contributors: Krämmer, S., Vannahme, C., Smith, C., Grossmann, T., Jenne, M., Schierle, S., Jørgensen, L., Chronakis, I. S., Kristensen, A., Kalt, H.
Number of pages: 5
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 21.1
Web of Science (2017): Impact factor 2.227
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 17.79
Web of Science (2016): Impact factor 1.333
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 18.5
Web of Science (2015): Impact factor 1.789
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 16.79
Web of Science (2014): Impact factor 1.703
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 15.78
Web of Science (2013): Impact factor 1.371
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 14.41
Web of Science (2012): Impact factor 1.316
Single-spot e-beam lithography for defining large arrays of nano-holes

Efficient nanoscale patterning of large areas is required for sub-wavelength optics. Here we use the single-spot exposure strategy, where electron beam lithography (EBL) with a focused Gaussian beam is used to define shapes directly. The serial technique is optimized on the JEOL JBX-9500FS 100 keV prototype EBL system for speed and pattern fidelity to a minimum writing time of around 30 min/cm² for 200 nm periods in 2D lattices. The machine time and feasibility of the method are assessed in terms of the trade-off between high current and large writing field. © 2014 Elsevier B.V. All rights reserved.
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 1.35 SJR 0.507 SNIP 0.796
Web of Science (2015): Impact factor 1.277
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 1.44 SJR 0.586 SNIP 0.86
Web of Science (2014): Impact factor 1.197
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 1.45 SJR 0.595 SNIP 0.964
Web of Science (2013): Impact factor 1.338
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 1.44 SJR 0.737 SNIP 0.949
Web of Science (2012): Impact factor 1.224
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 1.8 SJR 0.813 SNIP 1.148
Web of Science (2011): Impact factor 1.557
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.934 SNIP 1.093
Web of Science (2010): Impact factor 1.575
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.834 SNIP 1.098
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.027 SNIP 1.06
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.045 SNIP 1.138
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.966 SNIP 1.093
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.952 SNIP 0.989
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1 SNIP 1.1
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.812 SNIP 0.956
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.712 SNIP 0.711
Scopus rating (2001): SJR 0.558 SNIP 0.645
Scopus rating (2000): SJR 0.502 SNIP 0.568
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.595 SNIP 0.555

Original language: English
Keywords: Direct-writing, Electron beam lithography, Nanofabrication, Single-shot writing, Gaussian beams, Nanotechnology, e-Beam lithography, Focused Gaussian beam, High currents, Nanoscale patterning, Pattern fidelity, Single-shot, Sub-wavelength

DOIs:
Thermophoretic forces on DNA measured with a single-molecule spring balance

We stretch a single DNA molecule with thermophoretic forces and measure these forces with a spring balance: the DNA molecule itself. It is an entropic spring which we calibrate, using as a benchmark its Brownian motion in the nanochannel that contains and prestretches it. This direct measurement of the thermophoretic force in a static configuration finds forces up to 130 fN. This is eleven times stronger than the force experienced by the same molecule in the same thermal gradient in bulk, where the molecule shields itself. Our stronger forces stretch the middle of the molecule up to 80% of its contour length. We find the Soret coefficient per unit length of DNA at various ionic strengths. It agrees, with novel precision, with results obtained in bulk for DNA too short to shield itself and with the thermodynamic model of thermophoresis.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals, Optofluidics
Number of pages: 5
Pages: 268301
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Physical Review Letters
Volume: 113
Issue number: 26
ISSN (Print): 0031-9007
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.58 SJR 3.622 SNIP 2.464
Web of Science (2017): Impact factor 8.839
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): Impact factor 8.462
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.76 SJR 4.656 SNIP 2.538
Web of Science (2015): Impact factor 7.645
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.62 SJR 5.232 SNIP 2.71
Web of Science (2014): Impact factor 7.512
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 7.46 SJR 5.675 SNIP 2.781
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 7.19 SJR 6.292 SNIP 2.867
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 7.02 SJR 6.314 SNIP 2.905
ISI indexed (2011): ISI indexed yes
A nanofluidic device for mapping single DNA molecules to the human genome

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Stochastic Systems and Signals, Wellcome Trust Centre for Human Genetics
Number of pages: 1
Publication date: 2013

Host publication information
Title of host publication: Proceedings of the 39th International Conference on Micro and Nano Engineering
Keywords: Nanofluidics, Microfluidics, DNA, Mapping, Sequencing
Electronic versions:
AbstractRCWM_MNE2013.pdf
Source: dtu
Source-ID: u::10860
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 2014
Antireflective nanostructures replicated from black silicon

General information  
State: Published  
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Polymer Micro & Nano Engineering, Department of Photonics Engineering, Structured Electromagnetic Materials  
Contributors: Christiansen, A. B., Clausen, J. S., Mortensen, N. A., Kristensen, A.  
Number of pages: 1  
Publication date: 2013  
Peer-reviewed: Yes  
Event: Poster session presented at International Symposium on Nanoscale Pattern Formation at Surfaces, Copenhagen, Denmark.

Electronic versions:  
alexander_christiansen_department_days_poster.pdf  
Research output: Research - peer-review › Poster – Annual report year: 2014

Controlled angular redirection of light via nanoimprinted disordered gratings
Enhanced control of diffraction through transparent substrates is achieved via disordered gratings in a silica sol–gel film. Tailoring the degree of disorder allows tuning of the diffractive behavior from discrete orders into broad distributions over large angular range. Gratings of optical quality are formed by silica sol–gel nanoimprint lithography and an optical setup for the measurement of continuous diffraction patterns is presented. Sound agreement is found between measurements and simulation, validating both the approach for redirection of light and the fabrication process. The disordered gratings are presented in the context of improved interior daylighting and may furthermore be suited to a wide variety of applications where controlled angular redirection of light is desired.

General information  
State: Published  
Organisations: Optofluidics, Department of Micro- and Nanotechnology, Polymer Microsystems for Cell Processing, Saint-Gobain Recherche, Centre National de la Recherche Scientifique  
Contributors: Buss, T., Teisseire, J., Mazoyer, S., Smith, C., Mikkelsen, M. B. L., Kristensen, A., Søndergård, E.  
Pages: 709-716  
Publication date: 2013  
Peer-reviewed: Yes

Publication information  
Journal: Applied Optics  
Volume: 52  
Issue number: 4  
ISSN (Print): 1559-128X  
Ratings:  
BFI (2018): BFI-level 1  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 1  
Scopus rating (2017): CiteScore 1.84 SJR 0.715 SNIP 1.137  
Web of Science (2017): Impact factor 1.791  
Web of Science (2017): Indexed yes  
BFI (2016): BFI-level 1  
Scopus rating (2016): CiteScore 1.61 SJR 0.695 SNIP 1.124  
Web of Science (2016): Impact factor 1.65  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 1  
Scopus rating (2015): CiteScore 1.66 SJR 0.837 SNIP 1.218  
Web of Science (2015): Impact factor 1.598  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 1  
Scopus rating (2014): CiteScore 2.04 SJR 1.047 SNIP 1.487  
Web of Science (2014): Impact factor 1.784  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 1
DWDM laser arrays fabricated using thermal nanoimprint lithography on Indium Phosphide substrates

Dense Wavelength Division Multiplexing (DWDM) lasers play a major role in today’s long-haul broadband communication. Typical distributed feedback (DFB) laser cavities consist of long half-pitch gratings in InGaAsP on InP substrates with pitches around 240 nm. Lasers are made reliably single mode by including a lambda quarter shift at the center of the grating. The need for phase shifts and multiple wavelengths eliminates some lithography methods such as holography. Typically, these lasers are produced by e-beam lithography (EBL). We present a production method based on thermal nanoimprint lithography (T-NIL), which is potentially less costly and faster than EBL.

NIL Technology and NeoPhotonics designed a stamp with the structures shown in Figure 1. The stamp was fabricated using EBL and dry etching. The line width on the stamp was 40 nm to accommodate for line broadening in subsequent processing steps and the structures were placed on mesas on the stamp. T-NIL of these structures presents three major challenges: 1) The imprinted structures must be aligned to the crystallographic direction of the InP substrate within 0.1°; 2) InP is a fragile material that will break under high pressure; 3) InP and Si have different thermal expansion coefficients, so temperatures must be kept low in order to maintain the designed pitches in the final devices.

The imprinting was performed using NILT’s CNI tool. The imprint resist used was mr-I7020E spun to a thickness of 160 nm. Imprint pressure, temperature and time were 3 bar, 80°C, and 20 minutes, respectively. The release temperature was 55°C. The residual layer was removed by oxygen plasma. A representative AFM of the imprinted and etched grating structure is shown in Figure 2.

The low imprint pressure ensures that the fragile InP substrate is not damaged during the imprint process and the narrow temperature window for imprint and separation (80°C and 55°C) ensures minimal issues with thermal mismatch between the InP substrate and the Si stamp.

The imprinted InP wafers were processed in NeoPhotonics standard process line to create working lasers. The fabricated lasers were cleaved and measured. Laser arrays exhibited >40mW optical power in all 12 channels. Figure 3 shows the overlaid spectra of a 12-channel array laser chip with uniform (~3nm) wavelength spacing and good sidemode suppression.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Silicon Microtechnology, Optofluidics, NIL Technology ApS, NeoPhotonics Corporation
Contributors: Smistrup, K., Narregaard, J., Mironov, A., Bro, T., Bilenberg, B., Nielsen, T., Hansen, O., Kristensen, A., Rishton, S., Khan, F., Emanuel, M., Ma, Y., Zhang, Y.
Publication date: 2013
Peer-reviewed: Yes
Electronic versions:
EIPBN_abstract_NILT_Neophotonics_v3.pdf

Bibliographical note
Poster # 167
Source: dtu
Source-ID: u::9224
Research output: Research - peer-review » Poster – Annual report year: 2013

Electrically modulated transparent liquid crystal-optical grating projection

A transparent, fully integrated electrically modulated projection technique is presented based on light guiding through a thin liquid crystal layer covering sub-wavelength gratings. The reported device operates at 10 V with response times of 4.5 ms. Analysis of the liquid crystal alignment shows that director-reorientation occurs over timescales on the order of 90 μs.
close to the grating surface. The technology is suitable for next generation heads-up-displays and reconfigurable multilayer photonic integrated circuits. © 2013 Optical Society of America.

**General information**
State: Published
Organisations: Optofluidics, Department of Micro- and Nanotechnology
Contributors: Buss, T., Smith, C., Kristensen, A.
Pages: 1820-1829
Publication date: 2013
Peer-reviewed: Yes

**Publication information**
Journal: Optics Express
Volume: 21
Issue number: 2
ISSN (Print): 1094-4087
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Web of Science (2014): Impact factor 3.488
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196
Web of Science (2013): Impact factor 3.525
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.85 SJR 2.562 SNIP 2.108
Web of Science (2012): Impact factor 3.546
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.58 SNIP 2.572
Web of Science (2011): Impact factor 3.587
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): Impact factor 3.753
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 3.039 SNIP 2.679
Enhancing the chroma of pigmented polymers using antireflective surface structures

In this paper we investigate how the color of a pigmented polymer is affected by reduction of the reflectance at the air-polymer interface. Both theoretical and experimental investigations show modified diffuse-direct reflectance spectra when the reflectance of the surface is lowered. Specifically it is found that the color change is manifested as an increase in chroma, leading to a clearer color experience. The experimental implementation is done using random tapered surface structures replicated in polymer from silicon masters using hot embossing.

General information
State: Published
Organisations: Department of Photonics Engineering, Structured Electromagnetic Materials, Department of Micro- and Nanotechnology, Optofluidics
Contributors: Clausen, J. S., Christiansen, A. B., Kristensen, A., Mortensen, N. A.
Pages: 7832-7837
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Applied Optics
Volume: 52
Issue number: 32
ISSN (Print): 1559-128X
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.84 SJR 0.715 SNIP 1.137
Web of Science (2017): Impact factor 1.791
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Fabrication of passive Lab-in-a-Foil devices for phaseguiding and stoichiometric reactions

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
Contributors: Eriksen, J., Marie, R., Kristensen, A.
Number of pages: 2
Publication date: 2013

Host publication information
Title of host publication: Proceedings of the 12th International Conference on Nanoimprint & Nanoprint Technology
Electronic versions:
Johan_NNT2013_Abstract_final.pdf
Source: dtu
Source-ID: u::10911
Research output: Research - peer-review → Conference abstract in proceedings – Annual report year: 2014

Fast-writing E-beam for defining large arrays of nano-holes
Efficient nanoscale patterning of large areas is required for sub-wavelength optics. For example, 200 nm periodic structures are often too small to be made with standard UV- and DUV-equipment. Still, the final product must be made at an economic cost. Here we use a fast-writing strategy described in [1], where electron beam lithography (EBL) with a focused Gaussian beam is used to define shapes directly. The serial technique is optimized for speed and pattern fidelity to a maximum writing speed of around 30 min/cm² for 200 nm periods in 2D lattices. The overall costs in terms of machine time and feasibility are assessed for different topographies and dimensions.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials, DTU Danchip
Contributors: Højlund-Nielsen, E., Clausen, J. S., Christiansen, A. B., Greibe, T., Mortensen, N. A., Kristensen, A.
Number of pages: 1
Publication date: 2013

Host publication information
Title of host publication: Proceedings of the 39th International Conference on Micro and Nano Engineering
Keywords: Electron Beam Lithography, Nanofabrication, Sub-wavelength, Optics
Electronic versions:
prod11395223727740.WORD_20130529_Abstract_MNE2013_Version_20130607.pdf
Source: dtu
Source-ID: u::10876
Research output: Research - peer-review → Book chapter – Annual report year: 2014

Fast-writing E-beam for large arrays of nano-holes

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials, DTU Danchip
Contributors: Højlund-Nielsen, E., Clausen, J. S., Christiansen, A. B., Greibe, T., Mortensen, N. A., Kristensen, A.
Number of pages: 1
Fully Stretched Single DNA Molecules in a Nanofluidic Chip Show Large-Scale Structural Variation

When stretching and imaging DNA molecules in nanofluidic devices, it is important to know the relation between the physical length as measured in the lab and the distance along the contour of the DNA. Here a single DNA molecule longer than 1 Mbp is loaded into a nanofluidic device consisting of two crossing nanoslits (85nm x 50 microns) connected to microchannels. An applied pressure creates a stagnation point at the crossing of the nanoslits. The drag force from the fluid stretches the DNA. We determine the degree of stretching of the molecule (i) without the use of markers, (ii) without knowing the contour length of the DNA, and (iii) without having the full DNA molecule inside the field-of-view. The analysis is based on the transverse motion of the DNA due its Brownian motion, i.e. the DNA's response to the thermal fluctuations of the liquid surrounding it. The parameter values obtained by fitting agree well with values we obtain from simplified modeling of the DNA as a cylinder in a parallel flow. Secondly, DNA molecules stained with the intercalating dye YOYO-1 are de- and renatured locally following a modified version of the protocol used in Ref. 1. The result is a melting pattern which reflects the local AT/GC-content. Single molecules are loaded into the chip and imaged. Due to the almost complete stretching of the DNA, structural variations in the size range from kbp to Mbp can be detected and quantified from the melting pattern alone.
Imprinted and injection-molded nano-structured optical surfaces

Inspired by nature, nano-textured surfaces have attracted much attention as a method to realize optical surface functionality. The moth-eye antireflective structure and the structural colors of Morpho butterflies are well-known examples used for inspiration for such biomimetic research. In this paper, nanostructured polymer surfaces suitable for up-scalable polymer replication methods, such as imprinting/embossing and injection-molding, are discussed. The limiting case of injection-moulding compatible designs is investigated. Anti-reflective polymer surfaces are realized by replication of Black Silicon (BSi) random nanostructure surfaces. The optical transmission at normal incidence is measured for wavelengths from 400 nm to 900 nm. For samples with optimized nanostructures, the reflectance is reduced by 50 % compared to samples with planar surfaces. The specular and diffusive reflection of light from polymer surfaces and their implication for
creating structural colors is discussed. In the case of injection-moulding compatible designs, the maximum reflection of nano-scale textured surfaces cannot exceed the Fresnel reflection of a corresponding flat polymer surface, which is approx. 4 % for normal incidence. Diffraction gratings provide strong color reflection defined by the diffraction orders. However, the appearance varies strongly with viewing angles. Three different methods to address the strong angular-dependence of diffraction grating based structural color are discussed.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Contributors: Christiansen, A. B., Højlund-Nielsen, E., Clausen, J. S., Caringal, G. P., Mortensen, N. A., Kristensen, A.
Number of pages: 12
Pages: 881803
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Peer-reviewed: Yes

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Journal: Proceedings of SPIE, the International Society for Optical Engineering
Volume: 8818
ISSN (Print): 0277-786X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 0.43 SJR 0.243 SNIP 0.289
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SJR 0.226 SNIP 0.258
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.3 SJR 0.212 SNIP 0.239
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.3 SJR 0.217 SNIP 0.249
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 0.26 SJR 0.234 SNIP 0.273
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.27 SJR 0.219 SNIP 0.275
ISI indexed (2012): ISI indexed no
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 0.31 SJR 0.217 SNIP 0.286
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.233 SNIP 0.277
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.236 SNIP 0.312
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.245 SNIP 0.3
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.247 SNIP 0.376
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.323 SNIP 0.676
Scopus rating (2005): SJR 0.162 SNIP 0.372
Web of Science (2004): Indexed yes
Web of Science (2002): Indexed yes
We present a method for injection moulding antireflective nanostructures on large areas, for high volume production. Nanostructured black silicon masters were fabricated by mask-less reactive ion etching, and electroplated with nickel. The nickel shim was antistiction coated and used in an injection moulding process, to fabricate the antireflective surfaces. The cycle-time was 35 s. The injection moulded structures had a height of 125 nm, and the visible spectrum reflectance of injection moulded black polypropylene surfaces was reduced from 4.5±0.5% to 2.5±0.5%. The gradient of the refractive index of the nanostructured surfaces was estimated from atomic force micrographs and the theoretical reflectance was calculated using the transfer matrix method and effective medium theory. The measured reflectance shows good agreement with the theory of graded index antireflective nanostructures. © 2014 Elsevier B.V. All rights reserved.
Injection moulding antireflective nanostructures

We present a method for injection moulding antireflective nanostructures on large areas, for high volume production. Nanostructured black silicon masters were fabricated by mask-less reactive ion etching, and electroplated with nickel. The nickel shim was antistiction coated and used in an injection moulding process, to fabricate the antireflective surfaces. The cycle-time was 35 s. The injection moulded structures had a height of 125 nm, and the visible spectrum reflectance of injection moulded black polypropylene surfaces was reduced from 4.5±0.5% to 2.5±0.5%. The gradient of the refractive index of the nanostructured surfaces was estimated from atomic force micrographs and the theoretical reflectance was calculated using the transfer matrix method and effective medium theory. The measured reflectance shows good agreement with the theory of graded index antireflective nanostructures. © 2014 Elsevier B.V. All rights reserved.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Optofluidics, Department of Photonics Engineering, Structured Electromagnetic Materials
Contributors: Christiansen, A. B., Clausen, J. S., Mortensen, N. A., Kristensen, A.
Number of pages: 4
Publication date: 2013
Peer-reviewed: Yes
Keywords: Antireflection, Black silicon, Injection moulding, Large area, Large volume production, Nanofabrication, Nanostructures, Nanotechnology, Nickel, Polypropylenes, Reflection, Silicon, Transfer matrix method, Anti-reflection, Antireflective nanostructure, Atomic force micrographs, Effective medium theories, Gradient of the refractive index, Large volumes, Injection molding
Electronic versions:
ABC_MNE_abstract_Injection_molding_antireflective_black_silicon_nanostructures.pdf
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2013

Integrated view of genome structure and sequence of a single DNA molecule in a nanofluidic device

We show how a bird’s-eye view of genomic structure can be obtained at ~1-kb resolution from long (~2 Mb) DNA molecules extracted from whole chromosomes in a nanofluidic laboratory-on-a-chip. We use an improved single-molecule denaturation mapping approach to detect repetitive elements and known as well as unique structural variation. Following its mapping, a molecule of interest was rescued from the chip; amplified and localized to a chromosome by FISH; and interrogated down to 1-bp resolution with a commercial sequencer, thereby reconciling haplotype-phased chromosome substructure with sequence.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Stochastic Systems and Signals, Silicon Microtechnology, University of Oxford
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Publication information
Journal: Proceedings of the National Academy of Sciences of the United States of America
Volume: 110
Issue number: 13
ISSN (Print): 0027-8424
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 8.59 SJR 6.092 SNIP 2.626
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 8.56 SJR 6.576 SNIP 2.642
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 8.84 SJR 6.814 SNIP 2.691
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 8.86 SJR 6.898 SNIP 2.734
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 9.5 SJR 7.073 SNIP 2.738
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 9.49 SJR 6.868 SNIP 2.697
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 9.31 SJR 6.864 SNIP 2.646
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 6.898 SNIP 2.545
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 7.025 SNIP 2.556
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 7.034 SNIP 2.449
Web of Science (2008): Indexed yes
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 6.849 SNIP 2.45
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 6.94 SNIP 2.555
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 7.197 SNIP 2.629
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 7.129 SNIP 2.515
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 6.913 SNIP 2.503
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 7.189 SNIP 2.47
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 8.751 SNIP 2.458
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 8.52 SNIP 2.418
Original language: English
Keywords: Physical Sciences, Biological Sciences, Applied Physical Sciences, Genetics
DOIs: 10.1073/pnas.1214570110
Source: dtu
Source-ID: u:7270
Research output: Research - peer-review › Journal article – Annual report year: 2013
Multilayer distributed feedback dye lasers: Enhanced emission wavelength and sensing

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
Contributors: Vannahme, C., Smith, C., Leung, M., Richter, F., Christiansen, M. B., Kristensen, A.
Number of pages: 1
Publication date: 2013
Peer-reviewed: Yes
Event: Abstract from Conference on Lasers and Electro-Optics Europe 2013 (CLEO Europe), Munich, Germany.

**Bibliographical note**
Source: dtu
Source-ID: u::8902
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2013

**Multilayer Slab Waveguide Distributed Feedback Dye Laser Sensors**
Organic dye-based distributed feedback (DFB) lasers are widely tunable laser light sources in the visible wavelength range and exhibit low-cost, simple fabrication, low threshold and single-mode emission [1]. Precise emission wavelength modeling is essential for understanding and optimization of DFB lasers. Here, we present a simple yet precise model for calculating the emission wavelength of multilayer DFB lasers. We find that experimental and calculated wavelength values are in compelling agreement for hybrid nanoimprinted Ormocomp-TiO2 (doped with Pyrromethene 597) first order DFB lasers [2]. Applying the model, we explain the occurrence of different laser light polarization, i.e., transvers electric (TE) or transvers magnetic (TM) emission. We further explore hybrid Ormocomp-TiO2 second order DFB lasers as highly sensitive refractive index sensors featuring narrow linewidth and thus high quality spectral resolution. Design guidelines for high performance sensing are given and the influences of layer thicknesses and grating period on wavelength and wavelength shifts are discussed in this context [3]. This is used for optimizing the laser sensors towards highest sensitivity and thus lowest detection limits. We show that the additional TiO2 layer can increase the sensitivity by a factor of 5 making the laser sensors competitive with state-of-the-art photonic crystal sensors. In addition, single-mode biological second order distributed feedback dye lasers are presented [4]. The active core of these lasers consists of vitamin B2 doped gelatin which is spin-coated onto a nanoimprinted grating structure in low-index polymer. These single-mode biological lasers represent a next step towards all-biological lasers where the resonator is formed from structured biological material. Such devices could be biocompatible and eventually biodegradable laser light sources and laser sensors.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
Contributors: Vannahme, C., Smith, C., Leung, M., Richter, F., Christiansen, M. B., Hermannsson, P. G., Kristensen, A.
Number of pages: 1
Publication date: 2013
Peer-reviewed: Yes
Event: Abstract from Conference on Lasers and Electro-Optics Europe 2013 (CLEO Europe), Munich, Germany.

**Nanoimprinted distributed feedback lasers comprising TiO2 thin films: Design guidelines for high performance sensing**
Design guidelines for optimizing the sensing performance of nanoimprinted second order distributed feedback dye lasers are presented. The guidelines are verified by experiments and simulations. The lasers, fabricated by UV-nanoimprint lithography into Pyrromethene doped Ormocomp thin films on glass, have their sensor sensitivity enhanced by a factor of up to five via the evaporation of a titanium dioxide (TiO2) waveguiding layer. The influence of the TiO2 layer thickness on the device sensitivity is analyzed with a simple model that accurately predicts experimentally measured wavelength shifts induced by varied superstrate refractive indices. The superstrate refractive index is additionally shown to determine which of the possible waveguiding modes dominates for lasing, indicating a method to flexibly select the polarization of the laser. The detection limit of the sensor system is further discussed, finding an optimum at 7.5·10^-6 RIU. Wavelength changes caused by dye bleaching must be taken into account for long-term measurements.

**General information**
State: Published
Publication information
Journal: Laser & Photonics Reviews
Volume: 7
Issue number: 6
ISSN (Print): 1863-8880
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 9.02 SJR 4.228 SNIP 2.988
Web of Science (2017): Impact factor 8.529
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 8.71 SJR 4.013 SNIP 3.351
Web of Science (2016): Impact factor 8.434
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 8.54 SJR 4.205 SNIP 3.479
Web of Science (2015): Impact factor 7.486
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 8.62 SJR 4.958 SNIP 4.446
Web of Science (2014): Impact factor 8.008
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 9.26 SJR 5.132 SNIP 4.796
Web of Science (2013): Impact factor 9.313
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 7.59 SJR 5.144 SNIP 3.617
Web of Science (2012): Impact factor 7.976
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 7.98 SJR 5.844 SNIP 4.857
Web of Science (2011): Impact factor 7.388
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 5.851 SNIP 4.009
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 4.896 SNIP 4.884
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 2.573 SNIP 3.117
Original language: English
Keywords: Distributed feedback laser, Dye laser, Refractive index sensor, Laser sensor, Detection limit
DOIs:
Nanometrology using localized surface plasmon resonance spectroscopy
A novel optical characterization technique called localized surface plasmon resonance (LSPR) spectroscopy is presented. LSPR spectroscopy exploits light excited surface plasmons, which are collective coherent electron oscillations at a metal/dielectric interface. The LSPR can be observed in a transmission spectrum and it is very sensitive to the constituent materials as well as both lateral and vertical dimensions of the structures. This makes LSPR spectroscopy interesting for a number of applications including nanometrology. Like scatterometry, LSPR spectroscopy requires test structures and computer simulations to establish the correlation between spectra and physical dimensions. Instead of measuring on individual structures like CD-SEM and AFM, LSPR spectroscopy measures on an array of test structures with an arbitrary array size. This makes LSPR spectroscopy particularly interesting for dense device layers where the vacant space for test structures is limited. In this work, LSPR spectroscopy is used to evaluate a fabrication process including imprinting, etching and metallisation of gamammadion test structures distributed on a 4" wafer.

General information
State: Published
Organisations: Department of Photonics Engineering, Department of Micro- and Nanotechnology, Optofluidics, Structured Electromagnetic Materials, Danish Technological Institute
Contributors: Jeppesen, C., Lindstedt, D. N., Laurberg, A. V., Kristensen, A., Mortensen, N. A.
Number of pages: 1
Pages: 1
Publication date: 2013

Host publication information
Title of host publication: Proceedings of CLEO Europe 2013
Publisher: IEEE
ISBN (Print): 978-1-4799-0593-5
Keywords: etching, metallisation, optical testing, spectroscopy, surface plasmon resonance, Aerospace, Bioengineering, Communication, Networking and Broadcast Technologies, Components, Circuits, Devices and Systems, Engineered Materials, Dielectrics and Plasmas, Engineering Profession, Fields, Waves and Electromagnetics, General Topics for Engineers, Nuclear Engineering, Photonics and Electrooptics, Power, Energy and Industry Applications, collective coherent electron oscillations, Correlation, dense device layers, Educational institutions, fabrication process, gammagammmation test structures, imprinting, light excited surface plasmons, localized surface plasmon resonance spectroscopy, LSPR spectroscopy, metal-dielectric interface, nanometrology, Nanotechnology, optical characterization technique, Plasmons, scatterometry, Size measurement, Spectroscopy, transmission spectrum, Uncertainty
DOIs:
10.1109/CLEOE-IQEC.2013.6801236
Source: FindIt
Source-ID: 266826236
Research output: Research - peer-review › Article in proceedings – Annual report year: 2013

Passive Lab-in-a-Foil Devices for Phaseguiding and Multiple Displacement Amplification of DNA

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Fasteris SA
Contributors: Eriksen, J., Marie, R., Schira, J., Vincent, N., Kristensen, A.
Number of pages: 2
Publication date: 2013

Host publication information
Title of host publication: Proceedings of NanoBioTech - Montreux 2013
Electronic versions:
Nanobiotech_Montreux_final_fasteris.pdf
Source: dtu
Source-ID: u::10910
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 2014

Photonic crystal-adaptive optical devices
This Ph.D. thesis presents methods for enhancing the optical functionality of transparent glass panes by introduction of invisible nanoscale surface structures, such as gratings and planar photonic crysstals. In this way the primary functionality
of the glass - transparancy - may be enhanced with new properties, turning window glasses or glass surfaces of hand-held electronics into multifunctional devices. Common to all examples discussed, gratings and photonic crystals are used to engineer the optical dispersion and selectively modify the direction of guided light and transfer free-space light into guided modes and vice-versa. This is done in a way such that the interaction of guided light inside the glass and transmitted light through the glass is minimized. The relevant physical background for these processes is discussed and four practical devices which demonstrate the principle have been designed, fabricated and analyzed. First a solar harvesting method, based on nanoscale gratings which are imprinted in a thin-film which is deposited on the window pane is discussed. Free-space light which is incident onto a window is coupled to guided modes in the thin-film or the substrate and guided towards the edge, while transparency of the glass is preserved. Solar cells could be attached to the edges to generate electricity. More complex structures than single-period gratings are investigated in gratings used for daylighting, i.e. optimizing the way how natural sunlight is transmitted through windows into the room. It is shown that gratings with disorder introduced to the period effectively modify the diffraction characteristics from distinct sharp and wavelength dependent orders into a broad distributions over large angular range and with sufficient mixing such that color effects are minimized, thus allowing a homogeneous, glare-free, white-light daylighting into the room. Even more functionality can be achieved when the optical effects are tunable or reconfigurable. This is investigated with photonic crystal dye lasers. These lasers combine a photonic crystal resonator with a dye-doped liquid crystal gain medium for the realization of cheap and compact optically pumped, electrically tunable lasers. Finally, a transparent projection display is presented which uses sub-wavelength gratings for redirection of light guided inside a waveguide and facilitates electro-optic switching by means of liquid crystals. The study presents a working proof-of-principle for a transparent projection display and furthermore allows for a detailed study of the interaction between guided light and the voltage-dependent molecular alignment of liquid crystal molecules. The influence of TE/TM polarization is investigated and switching times and driving voltages are competitive with existing non-projection liquid crystal displays. The principle has been investigated for use in projection displays but may also be applied to other applications such as cell manipulation in lab-on-a-chip systems and reconfigurable optical switches in multilayer photonic circuits and optical interconnects.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
Contributors: Buss, T., Kristensen, A., Smith, C.
Number of pages: 143
Publication date: 2013

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Electronic versions:
Thesis._1_.PDF
Research output: Research › Ph.D. thesis – Annual report year: 2013

Polymer optofluidic chip with DUV-induced waveguides for optical manipulation

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Department of Physics, Biophysics and Fluids
Contributors: Khoury Arvelo, M., Vannahme, C., Sørensen, K., Kristensen, A., Berg-Sørensen, K.
Number of pages: 1
Publication date: 2013
Peer-reviewed: Yes
Event:
Keywords: Optofluidics, Monolithic Integration, Polymer, DUV-induced waveguides
Source: dtu
Source-ID: u::8906
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2013

Single-mode biological distributed feedback laser
Single-mode second order distributed feedback (DFB) lasers of riboflavin (vitamin B2) doped gelatine films on nanostructured low refractive index material are demonstrated. Manufacturing is based on a simple UV nanoimprint and spin-coating. Emission wavelengths of 543 nm and 562 nm for two different grating periods are reported.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Karlsruhe Institute of Technology
Contributors: Vannahme, C., Maier-Flaig, F., Lemmer, U., Kristensen, A.
Pages: 2675-2678
Single-mode biological distributed feedback lasers based on vitamin B2 doped gelatin

Biological second-order distributed feedback (DFB) lasers are presented. Riboflavin (vitamin B2) doped gelatin as active material is spin-coated onto nanoimprinted polymer with low refractive index. DFB grating periods of 368 nm and 384 nm yield laser emission at 543 nm and 562 nm, respectively.

Tailoring channeled plasmon polaritons in metallic V-grooves

Channeled plasmon polaritons (CPPs) are electromagnetic excitations that are bound to and propagate along metallic V-groove waveguides [1]. CPPs offer subwavelength lateral confinement, an ability to turn sharp bends with near-zero loss and are considered to be one of the most suitable forms of propagating plasmons to optimize the trade-off between lateral confinement and loss [2]. Accordingly, the traits of CPPs in metallic V-grooves suggest their widespread implementation, with applications ranging from ultracompact photonic circuitry [3] to lab-on-a-chip sensing. Current CPP research focuses on the optimisation of their properties (e.g. propagation length, confinement) and improving both the quality and cost of fabrication techniques [4]. © 2013 IEEE.
Teaching and Learning Nanoimprint Lithography at DTU

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Polymer Microsystems for Cell Processing, Nanointegration
Contributors: Vannahme, C., Pedersen, R. H., Mikkelsen, M. B. L., Buss, T., Bøggild, P., Hermannsson, P. G., Richter, F., Kristensen, A.
Number of pages: 2
Publication date: 2013
Peer-reviewed: Yes
Source: dtu
Source-ID: u::8908

Visualizing structural variations of single DNA molecules in a nanofluidic device

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Stochastic Systems and Signals, Wellcome Trust Centre for Human Genetics
Number of pages: 1
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Peer-reviewed: Yes
Event: Abstract from DNA in nanotechnology, Gothenburg, Sweden.
Electronic versions:
prod11395143995943.AbstractRCWM_goteborg2013.pdf
Source: dtu
Source-ID: u::10861

Addressing the mechanical deformation of flexible stamps for nanoimprint lithography on double-curved surfaces

General information
State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Department of Micro- and Nanotechnology, Optofluidics
Contributors: Sonne, M. R., Hattel, J. H., Kristensen, A.
Publication date: 2012
Peer-reviewed: No
Event: Abstract from NNT 2012, Napa, CA, United States.
Electronic versions:
Abstract_NNT_2012.pdf
Source: dtu
Source-ID: u::5294

Addressing the mechanical deformation of flexible stamps for nanoimprint lithography on double-curved surfaces

General information
State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Department of Micro- and Nanotechnology, Optofluidics
Contributors: Sonne, M. R., Hattel, J. H., Kristensen, A.
Publication date: 2012
Peer-reviewed: No
Event: Poster session presented at NNT 2012, Napa, CA, United States.
Electronic versions:
All polymer, injection molded nanoslits, fabricated through two-level UV-LIGA processes

Micro- and nanofluidic systems fabricated in silicon and glass substrates are expensive and have long production cycles. To minimize the time used by researchers to fabricate their systems, rather than using them, medium to high volume throughput of specific chips, containing fluidic channels in the micro- and nanoregime is required. To obtain this, injection molding is included in the research process for making several chips (100-1000) with the same layout. The time it takes for the individual chip to be fabricated in this way is much shorter than with conventional cleanroom methods, and the price is equally lower. Optimization of the final chip is explored, by looking at which aspects ratios are possible to obtain in polymer chips. Finally, signal to noise ratio of the chips used for fluorescent experiments is investigated, by an expected reduction of the excitation of fluorescent states in the polymer with the use of chips in different colors.

Bragg grating filters in plasmonic V-groove waveguides

Color effects from scattering on random surface structures in dielectrics.
We show that cheap large area color filters, based on surface scattering, can be fabricated in dielectric materials by replication of random structures in silicon. The specular transmittance of three different types of structures, corresponding to three different colors, have been characterized. The angle resolved scattering has been measured and compared to predictions based on the measured surface topography and by the use of non-paraxial scalar diffraction theory. From this it is shown that the color of the transmitted light can be predicted from the topography of the randomly textured surfaces.
Diffusion driven optofluidic dye lasers encapsulated into polymer chips

Lab-on-a-chip systems made of polymers are promising for the integration of active optical elements, enabling e.g. on-chip excitation of fluorescent markers or spectroscopy. In this work we present diffusion operation of tunable optofluidic dye lasers in a polymer foil. We demonstrate that these first order distributed feedback lasers can be operated for more than 90 min at a pulse repetition rate of 2 Hz without fluidic pumping. Ultra-high output pulse energies of more than 10 μJ and laser thresholds of 2 μJ are achieved for resonator lengths of 3 mm. By introducing comparatively large on-chip dye solution reservoirs, the required exchange of dye molecules is accomplished solely by diffusion. Polymer chips the size of a microscope cover slip (18 × 18 mm2) were fabricated in batches on a wafer using a commercially available polymer (TOPAS® Cyclic Olefin Copolymer). Thermal imprinting of micro- and nanoscale structures into 100 μm foils simultaneously defines photonic resonators, liquid-core waveguides, and fluidic reservoirs. Subsequently, the fluidic structures are sealed with another 220 μm foil by thermal bonding. Tunability of laser output wavelengths over a spectral range of 24 nm on a single chip is accomplished by varying the laser grating period in steps of 2 nm. Low-cost manufacturing suitable for mass production, wide laser tunability, ultra-high output pulse energies, and long operation times without external fluidic pumping make these on-chip lasers suitable for a wide range of lab-on-a-chip applications, e.g. on-chip spectroscopy, biosensing, excitation of fluorescent markers, or surface enhanced Raman spectroscopy (SERS).

General information
Direct laser writing for nanoporous liquid core laser sensors

We report the fabrication of nanoporous liquid core lasers via direct laser writing based on two-photon absorption in combination with thiolene-chemistry. As gain medium Rhodamine 6G was embedded in the nanoporous polybutadiene matrix. The lasing devices with thresholds of 19 µJ/mm² were measured to have bulk refractive index sensitivities of 169 nm/RIU at a laser wavelength of 600 nm, demonstrating strongly increased overlap of the modes with the analyte in comparison to solid state evanescent wave sensors.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Karlsruhe Institute of Technology, Technical University of Denmark
Contributors: Grossmann, T., Christiansen, M. B., Peterson, J., Kalt, H., Mappes, T., Kristensen, A.
Pages: 17467-17473
Publication date: 2012
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Publication information

Journal: Optics Express
Volume: 20
Issue number: 16
ISSN (Print): 1094-4087
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Bibliographical note
This paper was published in Optics Express and is made available as an electronic reprint with the permission of OSA. The paper can be found at the following URL on the OSA website: http://www.opticsinfobase.org/oe/abstract.cfm?uri=oe-20-16-17467. Systematic or multiple reproduction or distribution to multiple locations via electronic or other means is prohibited and is subject to penalties under law.
Research output: Research - peer-review › Journal article – Annual report year: 2012
DNA Catenation Maintains Structure of Human Metaphase Chromosomes

Mitotic chromosome structure is pivotal to cell division but difficult to observe in fine detail using conventional methods. DNA catenation has been implicated in both sister chromatid cohesion and chromosome condensation, but has never been observed directly. We have used a lab-on-a-chip microfluidic device and fluorescence microscopy, coupled with a simple image analysis pipeline, to digest chromosomal proteins and examine the structure of the remaining DNA, which maintains the canonical 'X' shape. By directly staining DNA, we observe that DNA catenation between sister chromatids (separated by fluid flow) is composed of distinct fibres of DNA concentrated at the centromeres. Disrupting the catenation of the chromosomes with Topoisomerase IIa significantly alters overall chromosome shape, suggesting that DNA catenation must be simultaneously maintained for correct chromosome condensation, and destroyed to complete sister chromatid disjunction. In addition to demonstrating the value of microfluidics as a tool for examining chromosome structure, these results lend support to certain models of DNA catenation organization and regulation: in particular, we conclude from our observation of centromere-concentrated catenation that spindle forces could play a driving role in decatenation and that Topoisomerase IIa is differentially regulated at the centromeres, perhaps in conjunction with cohesin.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Silicon Microtechnology, University of Oxford
Contributors: L. V. Bauer, D., Marie, R., Rasmussen, K. H., Kristensen, A., U. Mir, K.
Pages: 11428-11434
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: Nucleic Acids Research
Volume: 40
Issue number: 22
ISSN (Print): 0305-1048
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 10.84 SJR 9.025 SNIP 3.028
Web of Science (2017): Impact factor 11.561
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): Impact factor 10.162
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 9.48 SJR 7.358 SNIP 2.631
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 8.74 SJR 6.64 SNIP 2.552
Web of Science (2014): Impact factor 9.112
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 8.46 SJR 6.801 SNIP 2.284
Web of Science (2013): Impact factor 8.808
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Web of Science (2012): Impact factor 8.278
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Emission wavelength of multilayer distributed feedback dye lasers

Precise emission wavelength modeling is essential for understanding and optimization of distributed feedback (DFB) lasers. An analytical approach for determining the emission wavelength based on setting the propagation constant of the Bragg condition and solving for the resulting slab waveguide mode is reported. The method is advantageous to established methods as it predicts the wavelength precisely with reduced complexity. Four-layered hybrid polymer-TiO2 first order DFB dye lasers with different TiO2 layer thicknesses are studied. Varying the TiO2 thickness from 0 nm to 30 nm changes the emission wavelength by 7 nm with compelling agreement of modeling results to experimental measurements.
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<th>BFI Level</th>
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<td>SJR 2.92 SNIP 1.775</td>
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<td>SJR 3.755 SNIP 2.353</td>
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<td>2004</td>
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<td>3.841</td>
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<td>2003</td>
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<td>Indexed yes</td>
<td>SJR 3.897 SNIP 2.275</td>
<td>3.841</td>
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Fabrication of Low Aspect Ratio, Injection Molded Structures for Use In dsDNA Elongation

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Polymer Micro & Nano Engineering, Optofluidics
Contributors: Østergaard, P. F., Matteucci, M., Marie, R., Kristensen, A., Taboryski, R. J.
Number of pages: 1
Publication date: 2012
Peer-reviewed: Yes
Source: dtu
Source-ID: n:oai:DTIC-ART:swets/371599993::20476
Research output: Research - peer-review » Journal article – Annual report year: 2012

Integrated lasers for polymer Lab-on-a-Chip systems

We develop optical Lab-on-a-Chips on different platforms for marker-based and label-free biophotonic sensor applications. Our chips are based on polymers and fabricated by mass production technologies to integrate microfluidic channels, optical waveguides and miniaturized lasers.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Karlsruhe Institute of Technology, Technical University of Denmark
Publication date: 2012

Microfluidic device and method for processing of macromolecules

A microfluidic device and method for enzymatic processing of ultra-long macromolecules is disclosed. The device comprises a reaction chamber with a first manifold, a second manifold, and a plurality of reaction channels, each reaction channel extending from the first manifold to the second manifold. The device further comprises first inlet and outlet channels for filling the reaction channels via the manifolds with one or more macromolecule containers suspended in a first carrier fluid, wherein the first inlet and outlet channels are configured such that a flow established from the first set of inlets to the first set of outlets is guided through the reaction channels, and second inlet and outlet channels for feeding an enzymatic reagent to the reaction chamber essentially without displacing the macromolecule containers trapped in the reaction channels, wherein the second set of inlets and outlets are configured such that a flow established from the second inlet to the second outlet is guided through at least one of the manifolds and bypasses the reaction channels.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Silicon Microtechnology
Contributors: Kristensen, A., Marie, R., Rasmussen, K. H., Kalim Ullah, M.
Publication date: 2012
Minimizing scattering from antireflective surfaces replicated from low-aspect-ratio black silicon

The scattering properties of randomly structured antireflective black silicon polymer replica have been investigated. Using a two-step casting process, the structures can be replicated in Ormocomp on areas of up to 3 in. in diameter. Fourier analysis of scanning electron microscopy images of the structures shows that the scattering properties of the surfaces are related to the spatial periods of the nanostructures. Structures with a dominating spatial period of 160 nm, a height of 200 nm, and aspect ratio of 1.3 show insignificant scattering of light with wavelength above 500 nm and lower the reflectance by a factor of two.
Nanofluidic devices towards single DNA molecule sequence mapping

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics
Contributors: Marie, R., Kristensen, A.
Pages: 673
On-chip integrated lasers for biophotonic applications

Meeting the need of biomedical users, we develop disposable Lab-on-a-Chip systems based on commercially available polymers. We are combining passive microfluidics with active optical elements on-chip by integrating multiple solid-state and liquid-core lasers. While covering a wide range of laser emission wavelengths, the chips have the size of microscope cover slips and use optical and fluidic interconnects only. Here, we present our latest realizations of integrated optofluidic lasers using whispering gallery mode or distributed feedback laser cavities.
Plasmonic V-groove waveguides with Bragg grating filters via nanoimprint lithography

We demonstrate spectral filtering with state-of-the-art Bragg gratings in plasmonic V-groove waveguides fabricated by wafer scale processing based on nanoimprint lithography. Transmission spectra of the devices having 16 grating periods exhibit spectral rejection of the channel plasmon polaritons with 8.2 dB extinction ratio and -3 dB bandwidth of Δλ = 39.9 nm near telecommunications wavelengths. Near-field scanning optical microscopy measurements verify spectral reflection from the grating structures, and the oscillations of propagating modes along grating-less V-grooves correspond well with effective refractive index values calculated by finite element simulations in COMSOL. The results represent advancement towards the implementation of plasmonic V-grooves with greater functional complexity and mass-production compatibility.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Hebrew University of Jerusalem
Contributors: Smith, C. L. C., Desiatov, B., Goykmann, I., Cuesta, I. F., Levy, U., Kristensen, A.
Pages: 5696-5706
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: Optics Express
Volume: 20
Issue number: 5
ISSN (Print): 1094-4087
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Web of Science (2014): Impact factor 3.488
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196
Web of Science (2013): Impact factor 3.525
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Sub-wavelength surface gratings for light redirection in transparent substrates

We demonstrate sub-wavelength grating couplers patterned on glass surfaces which are designed to convert incident free-space radiation into guided modes along the glass material. The devices are fabricated by nanoimprint lithography and the measured optical performance is compared to a simple model based on diffraction and ray-optics, and complemented by numerical simulations. We show that our approach is suitable for redirecting and guiding light over a broad range of incident angles and wavelengths in transparent substrates. The technique has potential applications for solar harvesting in window panes and display applications with minimal influence on vision quality. (C) 2012 American Institute of Physics. [http://dx.doi.org/10.1063/1.4738777]
Wafer scale imprint uniformity evaluated by LSPR spectroscopy: a high volume characterization method for nanometer scale structures: Paper

We exploit the localized surface-plasmon resonance (LSPR) of terahertz gold gammadion structures for wafer scale critical dimension metrology of nanostructures. The proposed characterization method, LSPR spectroscopy, is based on optical transmission measurements and is benchmarked against numerical simulations of imprinted structures characterized by atomic force microscopy. There is a fair agreement between the two methods and the simulations enable the translation of optical spectra to critical dimensions of the physical structures, a concept known from scatterometry. The results demonstrate the potential of LSPR spectroscopy as an alternative characterization method to scanning electron microscopy, atomic force microscopy and scatterometry.

General information

State: Published
Organisations: Department of Photonics Engineering, Structured Electromagnetic Materials, Department of Micro- and Nanotechnology, Optofluidics, Danish Technological Institute
Contributors: Jeppesen, C., Lindstedt, D. N., Vig, A. L., Kristensen, A., Mortensen, N. A.
Number of pages: 5
Pages: 385306
Publication date: 2012
Peer-reviewed: Yes

Publication information

Journal: Nanotechnology
Volume: 23
Issue number: 38
ISSN (Print): 0957-4484
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.01 SJR 1.079 SNIP 0.788
Web of Science (2017): Impact factor 3.404
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Sol-gel materials for optofluidics - process and applications

This Ph.D. thesis is concerned with the use of sol-gel materials in optofluidic applications and the physics of DNA molecules in nanoconfinement. The bottom-up formation of solid material, which is provided by the sol-gel process, enables control of the chemical composition and porosity of the material. At early stages of gelation, thin gel coatings can be structured by nanoimprint lithography, and purely inorganic silica materials can be obtained by subsequent thermal annealing. The sol-gel process thus constitutes a unique method for nanofabrication of silica materials of special properties.

In this work, sol-gel silica is introduced as a new material class for the fabrication of lab-on-a-chip devices for DNA analysis. An imprint process with a rigid, non-permeable stamp was developed, which enabled fabrication of micro- and nanofluidic silica channels in a single process step without use of any high-vacuum techniques. Sealing of the channels was performed by fusion bonding of a glass cover slip to the imprinted surface, and the applicability of the device was demonstrated by sizing experiments on DNA molecules confined in the imprinted nanochannels.

In addition, in a fused silica device, the dynamics of linear and circular DNA molecules was studied under pressure driven flow in a slit channel with arrays of transverse nanogrooves. In the nanogroove geometry, transport occurs through two states of propagation: a slow, stepwise groove-to-groove translation called the ‘sidewinder’ and a fast, continuous tumbling across the grooves called the ‘tumbleweed’. Dynamical transitions between the two states cause DNA molecules to exhibit both size- and topology-dependent velocities that may be utilized for separation.

By templating the porosity of sol-gel silica with sub-wavelength latex particles, tuning of the effective refractive index of the material was enabled. Using nanoimprint lithography, a diffraction grating with refractive index of 1.33 was fabricated. This low-index grating demonstrated reconfigurability of an optically functional surface topography by electrophoretic actuation of charged latex nanoparticles. Preliminary results showed 22 dB modulation of the intensity of the first diffraction order.

Sol-gel material was also used as a permeable solid matrix for immobilization of analyte-sensitive dye molecules, thus constituting a sensor material for use in reagent-based optical sensing systems. Using the principle of hemiwicking, a method that enables deposition of the liquid sensor material in a homogeneous layer on a well-defined region of a surface was developed. The method simplifies the fabrication of optical sensors integrated in disposable lab ware.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Mikkelsen, M. B. L., Kristensen, A.
Number of pages: 125
Publication date: 31 Oct 2011

Publication information
Original language: English
Electronic versions:

Sol-gel materials for optofluidics – process and applications

Bibliographical note
PhD-thesis related to the PhD-project: "Nanoimprint litografi for optofluidik"
Author: Morten Bo Lindholm Mikkelsen
Department: DTU Nanotech
Supervisor: Anders Kristensen
Source: dtu
Source-ID: u::3659
Research output: Research › Ph.D. thesis – Annual report year: 2012
A device for extraction, manipulation and stretching of DNA from single human chromosomes

We describe the structure and operation of a micro/nanofluidic device in which individual metaphase chromosomes can be isolated and processed without being displaced during exchange of reagents. The change in chromosome morphology as a result of introducing protease into the device was observed by time-lapse imaging; pressure-driven flow was then used to shunt the chromosomal DNA package into a nanoslit. A long linear DNA strand (>1.3 Mbp) was seen to stretch out from the DNA package and along the length of the nanoslit. Delivery of DNA in its native metaphase chromosome package as well as the microfluidic environment prevented DNA from shearing and will be important for preparing ultra-long lengths of DNA for nanofluidic analysis.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Nano-Bio Integrated Systems Group, Biomedical Micro Systems Section, University of Oxford
Contributors: Rasmussen, K. H., Marie, R., Moresco, J. L., Svendsen, W. E., Kristensen, A., Mir, K. U.
Pages: 1431-1433
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Lab on a Chip
Volume: 11
Issue number: 8
ISSN (Print): 1473-0197
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
All-silica nanofluidic devices for DNA-analysis fabricated by imprint of sol-gel silica with silicon stamp.

We present a simple and cheap method for fabrication of silica nanofluidic devices for single-molecule studies. By imprinting sol-gel materials with a multi-level stamp comprising micro- and nano-features, channels of different depth are produced in a single process step. Calcination of the imprinted hybrid sol-gel material produces purely inorganic silica, which has very low autofluorescence and can be fusion bonded to a glass lid. Compared to top-down processing of fused silica or silicon substrates, imprint of sol-gel silica enables fabrication of high-quality nanofluidic devices without expensive high-vacuum lithography and etching techniques. The applicability of the fabricated device for single-molecule studies is demonstrated by measuring the extension of DNA molecules of different lengths confined in the nanochannels.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Mikkelsen, M. B. L., Letailleur, A. A., Søndergård, E., Barthel, E., Teisseire, J., Marie, R., Kristensen, A.
Pages: 262-267
Publication date: 2011
Peer-reviewed: Yes

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Journal: Lab on a Chip
Volume: 12
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ISSN (Print): 1473-0197
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 6.05 SJR 2.158 SNIP 1.586
Web of Science (2017): Impact factor 5.995
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 5.98 SJR 2.162 SNIP 1.569
Web of Science (2016): Impact factor 6.045
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 5.74 SJR 2.239 SNIP 1.721
Web of Science (2015): Impact factor 5.586
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 5.6 SJR 2.555 SNIP 1.797
Web of Science (2014): Impact factor 6.115
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.9 SJR 2.397 SNIP 1.693
Web of Science (2013): Impact factor 5.748
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.35 SJR 2.405 SNIP 1.731
Web of Science (2012): Impact factor 5.697
ISI indexed (2012): ISI indexed yes
A nanoporous optical sensor element

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Biomodics ApS
Contributors: Christiansen, M. B., Ndoni, S., Vigild, M. E., Kristensen, A., Thomsen, P.
Publication date: 2011

Publication information
Patent number: WO 2011098090
Date: 18/08/2011
Original language: English
Source: orbit
Source-ID: 317023
Research output: Research - peer-review › Journal article – Annual report year: 2011

Controlled deposition of sol–gel sensor material using hemiwicking
Optical sensors are fabricated by depositing liquid sol–gel sensor material on a polycarbonate surface, which has been decorated with arrays of periodic micropillars. Using the principle of hemiwicking, the liquid material is spread, guided by the surface structures, to homogeneously fill the volume between the surface structures and form a liquid film with a thickness determined by the height of the micropillars. After evaporation of solvents, a uniform layer of sensor material resides on the surface. This fabrication method enables easy and reproducible deposits of isolated spots of different sensor materials of precise thickness to be made on plastic surfaces, and it provides an improved method for fabricating
cheap optical sensors integrated in disposable lab containers.
We present a method for homogeneous deposition of sol-gel sensor materials, which enable fabrication of sensor spots for optical pH and oxygen measurements inside plastic containers. A periodic pattern of posts is imprinted into a polycarbonate substrate and, using the principle of hemi-wicking, a deposited droplet spreads, guided by the posts, to automatically fill the imprinted structure, not being sensitive to alignment as long as it is deposited inside the patterned area. Hemi-wicking is an effective method to immobilize a low viscosity liquid material in well-defined spots on a surface, when conventional methods such as screen- or stamp-printing do not work. On length scales of the order of the microstructure period, surface tension will govern the shape of the liquid-air interface, and the liquid will climb up the pillars to keep a fixed contact angle with the sidewalls. The surface to volume ratio is therefore constant all over the surface of the liquid spread by hemi-wicking, when considering length scales larger than the microstructure period. Material redistribution caused by solvent evaporation, i.e., the "coffee ring effect", can therefore be avoided because the evaporation rate does not vary on length scales larger than the periodic pattern.

**Deposition of sol-gel sensor spots by nanoimprint lithography and hemi-wicking**

We present a method for homogeneous deposition of sol-gel sensor materials, which enable fabrication of sensor spots for optical pH and oxygen measurements inside plastic containers. A periodic pattern of posts is imprinted into a polycarbonate substrate and, using the principle of hemi-wicking, a deposited droplet spreads, guided by the posts, to automatically fill the imprinted structure, not being sensitive to alignment as long as it is deposited inside the patterned area. Hemi-wicking is an effective method to immobilize a low viscosity liquid material in well-defined spots on a surface, when conventional methods such as screen- or stamp-printing do not work. On length scales of the order of the microstructure period, surface tension will govern the shape of the liquid-air interface, and the liquid will climb up the pillars to keep a fixed contact angle with the sidewalls. The surface to volume ratio is therefore constant all over the surface of the liquid spread by hemi-wicking, when considering length scales larger than the microstructure period. Material redistribution caused by solvent evaporation, i.e., the "coffee ring effect", can therefore be avoided because the evaporation rate does not vary on length scales larger than the periodic pattern.
DNA analysis by single molecule stretching in nanofluidic biochips

Stretching single DNA molecules by confinement in nanofluidic channels has attracted a great interest during the last few years as a DNA analysis tool. We have designed and fabricated a sealed micro/nanofluidic device for DNA stretching applications, based on the use of the high throughput NanoImprint Lithography (NIL) technology combined with a conventional anodic bonding of the silicon base and Pyrex cover. Using this chip, we have performed single molecule imaging on a bench-top fluorescent microscope system. Lambda phage DNA was used as a model sample to characterize the chip. Single molecules of λ-DNA stained with the fluorescent dye YOYO-1 were stretched in the nanochannel array and the experimental results were analysed to determine the extension factor of the DNA in the chip and the geometrical average of the nanochannel inner diameter. The determination of the extension ratio of the chip provides a method to determining DNA size. The results of this work prove that the developed fabrication process is a good alternative for the fabrication of single molecule DNA biochips and it allows developing a variety of innovative bio/chemical sensors based on single-molecule DNA sequencing devices.
Dynamic in situ chromosome immobilisation and DNA extraction using localized poly(N-isopropylacrylamide) phase transition

A method of in situ chromosome immobilisation and DNA extraction in a microfluidic polymer chip was presented. Light-induced local heating was used to induce poly(N-isopropylacrylamide) phase transition in order to create a hydrogel and embed a single chromosome such that it was immobilised. This was achieved with the use of a near-infrared laser focused on an absorption layer integrated in the polymer chip in close proximity to the microchannel. It was possible to proceed to DNA extraction while holding on the chromosome at an arbitrary location by introducing protease K into the microchannel.

© 2011 American Institute of Physics.
We present the enhanced transduction of a photonic crystal dye laser for gas sensing via deposition of an additional swelling polymer film. Device operation involves swelling of the polymer film during exposure to specific gases, leading to a change in total effective refractive index. Experimental results show an enhancement of 16.09 dB in sensing ethanol vapor after deposition of a polystyrene film. We verify different responses of the polystyrene film when exposed to either ethanol vapor or increased humidity, indicating selectivity. The concept is generic and, in principle, straightforward in its application to other intracavity-based detection schemes to enable gas sensing. © 2011 Optical Society of America.
Extended verification of scaling behavior in split-ring resonators

We present an expanded LC-model for nanoscale split-ring resonators (SRR), including the influence of dielectric host materials. The LC-model is experimentally verified by changing the geometry of the SRR unit cell as well as by optofluidic tuning, where the SRR samples are covered with index oil. The extended model can be used as a general guideline for metal SRR structures with arbitrary dielectric host materials.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Structured Electromagnetic Materials, Department of Photonics Engineering
Contributors: Jeppesen, C., Xiao, S., Mortensen, A., Kristensen, A.
Pages: 799-801
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Optics Communications
Volume: 284
Issue number: 3
ISSN (Print): 0030-4018
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.86 SJR 0.614 SNIP 0.95
Web of Science (2017): Impact factor 1.887
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.65 SJR 0.603 SNIP 0.87
Web of Science (2016): Impact factor 1.588
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 1.62 SJR 0.673 SNIP 0.928
Web of Science (2015): Impact factor 1.48
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 1.62 SJR 0.7 SNIP 1.03
Web of Science (2014): Impact factor 1.449
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 1.78 SJR 0.74 SNIP 1.154
Web of Science (2013): Impact factor 1.542
ISI indexed (2013): ISI indexed yes
Fabrication of nanostructures on double-curved PMMA surfaces by thermal imprint with PDMS stamp

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Christiansen, A. B., Cech, J., Kristensen, A., Taboryski, R. J.
Publication date: 2011
Peer-reviewed: Yes
Event: Poster session presented at The 55th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication, Las Vegas, Nevada, USA.
Gratings in plasmonic V-groove waveguides
We introduce visible light optical gratings to surface plasmon V-groove waveguides. Gradient e-beam dosage onto silicon stamp enables structuring V-grooves of varying depth. Nanoimprint lithography maintains a Λ=265 nm corrugation for gold surface devices.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Smith, C., Cuesta, I. F., Kristensen, A.
Publication date: 2011

Host publication information
Title of host publication: 2011 Conference on Lasers and Electro-Optics
Publisher: IEEE Computer Society Press
ISBN (Print): 9781557529107
Keywords: Optical waveguides, Biomedical optical imaging, Plasmons, Gratings, DNA, Gold, Optical device fabrication
URLs:
http://www.cleoconference.org/

Injection molded nanofluidic chips: Fabrication method and functional tests using single-molecule DNA experiments
We demonstrate that fabrication of nanofluidic systems can be greatly simplified by injection molding of polymers. We functionally test our devices by single-molecule DNA experiments in nanochannels.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Utko, P., Persson, K. F., Kristensen, A., Larsen, N. B.
Pages: 303-308
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Peer-reviewed: Yes

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Volume: 11
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ISSN (Print): 1473-0197
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 6.05 SJR 2.158 SNIP 1.586
Web of Science (2017): Impact factor 5.995
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 5.98 SJR 2.162 SNIP 1.569
Web of Science (2016): Impact factor 6.045
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 5.74 SJR 2.239 SNIP 1.721
Web of Science (2015): Impact factor 5.586
Web of Science (2015): Indexed yes
Injection molding tools with micro/nano-meter pattern

The present invention relates to methods for embedded a micrometer and/or nanometer pattern into an injection molding tool. In a first main aspect, a micro/nanometer structured imprinting device is applied in, or on, an active surface so as to transfer the micro/nanometer patterned structure to the tool while the imprinting device is, at least partly, within a cavity of the injection molding tool. In a second main aspect, a base plate with a micro/nanometer structured pattern positioned on an upper part is positioned on the active surface of the tool, the lower part of the base plate facing the tool, the active surface receiving the base plate being non-planar on a macroscopic scale. Both aspects enable a simple and effective way of transferring the pattern, and the pattern may be transferred on the active working site of tool immediately prior to
molding without the need for extensive preparations or remounting of the tool before performing the molding process.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Optofluidics, Polymer Micro & Nano Engineering
Contributors: Kristensen, A., Kamp Nielsen, T., Søgaard, E., Nørregaard, J., Olsen, B. B., Smistrup, K.
Publication date: 2011

**Publication information**
Country: Denmark
IPC: B29C45/37
Patent number: WO2011038741
Date: 07/04/2011
Original language: English

**Bibliographical note**
DTU reference number: 92463-09
Research output: Research › Patent – Annual report year: 2012

**Injection molding tools with micro/nano-peter pattern**

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nielsen, T. K., Olsen, B. B., Nørregaard, J., Kristensen, A., Smistrup, K., Søgaard, E.
Publication date: 2011

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Original language: English
Electronic versions:
WO_2011038741_A1[1].pdf
Source: orbit
Source-ID: 317044
Research output: Research › Patent – Annual report year: 2011

**Integrated lasers for biophotonic Lab-on-a-Chip systems in polymer**

Lab-on-a-Chip (LoC) systems enable biomedical or chemical testing for point-of-care analysis at the patient's bedside or in the field. Our work is focused on developing optical LoCs based on polymers by integrating microfluidic channels, optical waveguides, and miniaturized lasers on different platforms. The chips introduced in our work are using optical and fluidic interconnects only. While some of our photonic structures require features with lateral dimensions in the range of 100 nm, the microfluidic channels are more than one order of magnitude above this regime. In order to allow for mass production, the processes for multiscale replication of the chips are optimized for a minimal number of parallel production steps.

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology, Karlsruhe Institute of Technology
Publication date: 2011

**Host publication information**
Title of host publication: Microoptics Conference
Volume: 17th
ISBN (Print): 9781457713446
Keywords: Stimulated emission, Optical pumping, Optical imaging, Polymers, Optical device fabrication
Source: orbit
Source-ID: 316083
Research output: Research - peer-review › Article in proceedings – Annual report year: 2011

**Large area color effects in polymer replica of black silicon**
Lasing in dye-doped high-Q conical polymeric microcavities

We report on lasing in conical microcavities, which are made out of the low-loss polymer poly (methyl methacrylate) (PMMA) doped with the dye rhodamine 6G, and directly fabricated on silicon. Including a thermal reflow step during fabrication enables a significantly reduced surface roughness, resulting in low scattering losses of the whispering gallery modes (WGMs). The high cavity quality factors (above 2.106 in passive cavities) in combination with the large oscillator strength gain material enable lasing threshold energies as low as 3 nJ, achieved by free-space excitation in the quasistationary pumping regime. Lasing wavelengths are detected in the visible wavelength region around 600 nm. Finite element simulations indicate that lasing occurs in fundamental TE/TM cavity modes, as these modes have - in comparison to higher order cavity modes - the smallest mode volume and the largest overlap with the gain material. In addition, we investigate the effect of dye concentration on lasing wavelength and threshold by comparing samples with four different concentrations of rhodamine 6G. Observations are explained by modifying the standard dye laser model.
Liquid Core Waveguides by UV Modification of Nanoporous Polymer

Liquid core waveguides are fabricated from a self-assembled nanoporous polymer, with a porosity of 40%. The high porosity results in an effective refractive index of 1.26 for visible light, i.e. below the refractive index of aqueous solutions. However, since the polymer is hydrophobic, fluids do not initially penetrate into the pores. We show that the inner surface of the pores can be rendered selectively hydrophilic by exposing them to ultraviolet light through a photo mask. As liquids infiltrate the exposed regions and replace air, the refractive index is raised to 1.42, and thus these areas can function as liquid core waveguides. Fig. 1 illustrates this principle.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, The Danish Polymer Centre, Department of Chemical and Biochemical Engineering, Self-organized Nanoporous Materials Group, Self-organizing materials for nanotechnology Section
Contributors: Christiansen, M. B., Gopalakrishnan, N., Sagar, K. S., Berthold, A., Ndoni, S., Kristensen, A.
Number of pages: 198
Publication date: 2011

Metal-dielectric superlenses for ultraviolet and visible light

This thesis describes a variety of experiments towards the goal of improved superlensing. This new type of lenses are based on materials with a negative refractive index, which opens up the possibility of resolving details that are significantly smaller than the wavelength of light. The results show that a resolution of 80nm can be achieved at a wavelength of 365nm, which is well below the diffraction limit, and thus proves that the superlensing effect is occurring. The use of a superlens to translate an optical hotspot was tested. For this purpose, a silver superlens was used to image the enhanced field local field intensity from a nanoantenna array, and the results indicate a successful transfer, which opens up a number of possibilities within the fields of biological, chemical and medical diagnostics. The use of multilayer lenses to improve imaging was also tested, for which a very low roughness lens consisting of alternating silver and silicon dioxide layers was fabricated. Unfortunately no clear conclusion could be reached, due to problems with the underlying chrome test structure. Finally, experiments were performed on the use of metal-dielectric composites as a superlensing material, due to their tunable optical properties. The results show, that when using such composites, it is indeed possible to selectively alter the real part of the permittivity, as predicted by effective medium theory, but the loss is much higher than expected.

General information
State: Published
Organisations: Department of Photonics Engineering, Nanophotonics Theory and Signal Processing, Plasmonics and Metamaterials, Department of Micro- and Nanotechnology
Contributors: Nielsen, R. B., Hvam, J. M., Boltasseva, A., Kristensen, A.
Number of pages: 158
Publication date: 2011

Method for depositing sensor material on a substrate

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Nanoporous Liquid Core Waveguides with Filtering Effect

General information
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Contributors: Christiansen, M. B., Gopalakrishnan, N., Sagar, K. S., Berthold, A., Ndoni, S., Kristensen, A.
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Publication date: 2011

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Source: orbit
Source-ID: 314502
Research output: Research - peer-review › Article in proceedings – Annual report year: 2011

Photolithographic fabrication of solid–liquid core waveguides by thiol-ene chemistry
In this work we demonstrate an efficient and cleanroom compatible method for the fabrication of solid–liquid core waveguides based on nanoporous polymers. We have used thiol-ene photo-grafting to tune and pattern the hydrophilicity of an originally hydrophobic nanoporous 1, 2-polybutadiene. The generated refractive index contrast between the patterned water-filled volume and the surrounding empty hydrophobic porous polymer allows for light confinement within the water-filled volume—the solid–liquid core. The presented fabrication process is simple and fast. It allows a high degree of flexibility on the type and grade of surface chemistry imparted to the large nanoporous area depending upon the application. The fabrication does not need demanding chemical reaction conditions. Thus, it can be readily used on a standard silicon lithography bench. The propagation loss values reported in this work are comparable with literature values for state-of-the-art liquid-core waveguide devices. The demonstrated waveguide function added to the nanoporous polymer with a very high internal surface area makes the system interesting for many applications in different areas, such as diagnostics and bio-chemical sensing.

General information
State: Published
Organisations: The Danish Polymer Centre, Department of Chemical and Biochemical Engineering, Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Sagar, K. S., Gopalakrishnan, N., Christiansen, M. B., Kristensen, A., Ndoni, S.
Pages: 095001
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Journal of Micromechanics and Microengineering
Volume: 21
Issue number: 9
ISSN (Print): 0960-1317
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.02 SJR 0.554 SNIP 0.968
Web of Science (2017): Impact factor 1.888
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Pressure-Driven DNA in Nanogroove Arrays: Complex Dynamics Leads to Length- and Topology-Dependent Separation

The motion of linear and circular DNA molecules is studied under pressure driven buffer flow in a 50 nm slit channel with arrays of transverse 150 nm deep nanogrooves. Transport occurs through two states of propagation unique to this nanogroove geometry, a slow, stepwise groove-to-groove translation called the "sidewinder" and a fast, continuous tumbling across the grooves called the "tumbleweed". Dynamical transitions between the two states are observed at fixed buffer velocity. Molecules exhibit size- and topology-dependent velocities.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Stochastic Systems and Signals Group, Theory Section
Contributors: Mikkelsen, M. B. L., Reisner, W., Flyvbjerg, H., Kristensen, A.
Pages: 1598–1602
Publication date: 2011
Peer-reviewed: Yes

Publication Information
Journal: Nano Letters
Volume: 11
Issue number: 4
ISSN (Print): 1530-6984
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 13.07
Web of Science (2017): Impact factor 12.08
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 13.4
Web of Science (2016): Impact factor 12.712
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): Impact factor 13.592
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 14.23
Web of Science (2013): Impact factor 12.94
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 13.78
Web of Science (2012): Impact factor 13.025
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
We present a high-volume fabrication technique for making polymer lab-on-a-chip devices. Microfluidic separation devices, relying on pinched flow fraction, are roll-to-roll fabricated in a cellulose acetate (CA) film at a volume of 360 devices h⁻¹ for a cost of approximately 0.5 euro/device. The manufacturing process consists of two steps: (i) roll-to-roll thermal nanoimprint for patterning the microchannels into a CA film and (ii) roll-to-roll lamination for bonding another CA film onto the imprinted film to seal the microchannels. Reverse gravure coating is used to apply an adhesive polymer onto the CA lid film before roll-to-roll lamination in order to increase the bonding strength. The fabricated devices are compared with planar imprinted devices with regard to the cross-sectional profile of the imprinted channels and their separation functionality. The separation functionality is characterized using fluorescent polystyrene microspheres with diameters ranging from 0.5 to 5 µm.

Roll-to-roll fabricated lab-on-a-chip devices

We present a high-volume fabrication technique for making polymer lab-on-a-chip devices. Microfluidic separation devices, relying on pinched flow fraction, are roll-to-roll fabricated in a cellulose acetate (CA) film at a volume of 360 devices h⁻¹ for a cost of approximately 0.5 euro/device. The manufacturing process consists of two steps: (i) roll-to-roll thermal nanoimprint for patterning the microchannels into a CA film and (ii) roll-to-roll lamination for bonding another CA film onto the imprinted film to seal the microchannels. Reverse gravure coating is used to apply an adhesive polymer onto the CA lid film before roll-to-roll lamination in order to increase the bonding strength. The fabricated devices are compared with planar imprinted devices with regard to the cross-sectional profile of the imprinted channels and their separation functionality. The separation functionality is characterized using fluorescent polystyrene microspheres with diameters ranging from 0.5 to 5 µm.

General information
State: Published
Organisations: DTU Danchip, NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, VTT - Technical Research Centre of Finland, Fiat
Contributors: Vig, A. L., Mäkelä, T., Majander, P., Lambertini, V., Ahopelto, J., Kristensen, A.
Pages: 035006
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Journal of Micromechanics and Microengineering
Volume: 21
Issue number: 3
ISSN (Print): 0960-1317
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
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<td>2009</td>
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<td>2002</td>
<td>1</td>
<td>SJR 1.103 SNIP 1.507</td>
<td>Indexed yes</td>
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Selective gas sensing for photonic crystal lasers
We facilitate photonic crystal lasers to sense gases via an additional swelling polymer film. We describe the transduction transfer function and experimentally demonstrate an enhanced ethanol vapor sensitivity over 15 dB with low humidity crosstalk.

Solar energy harvesting system

UV Defined Nanoporous Liquid Core Waveguides
Nanoporous liquid core waveguides, where both core and cladding are made from the same material, are presented. The nanoporous polymer used is intrinsically hydrophobic, but selective UV exposure enables it to infiltrate with an aqueous solution, thus raising the refractive index from 1.26 to 1.42. The waveguides are promising for integrated optofluidic sensor systems, where a long optical interaction length can be achieved with a small fluid sample. The propagation loss of a 200×200 μm waveguide is measured to 0.62 dB/mm.
Pinched Flow Fractionation – Teknologi og Applikation


MEMS-Teknologi i Nanoimprint Litografi

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Pedersen, R. H., Kristensen, A., Hansen, O.
Publication date: Mar 2010

Publication information
Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark (DTU)
Original language: English
Source: orbit
Source-ID: 271226
Research output: Research › Ph.D. thesis – Annual report year: 2010
Nanofluidics for ssDNA analysis

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Polymer Microsystems for Cell Processing Group, Polymer Micro and Nano Engineering Section
Contributors: Thamdrup, L. H., Larsen, N. B., Kristensen, A.
Publication date: Mar 2010

Publication information
Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark (DTU)
Original language: English
Source: orbit
Source-ID: 271236
Research output: Research › Ph. D. thesis – Annual report year: 2010

All-polymer organic semiconductor laser chips: Parallel fabrication and encapsulation
Organic semiconductor lasers are of particular interest as tunable visible laser light sources. For bringing those to market encapsulation is needed to ensure practicable lifetimes. Additionally, fabrication technologies suitable for mass production must be used. We introduce all-polymer chips comprising encapsulated distributed feedback organic semiconductor lasers. Several chips are fabricated in parallel by thermal nanoimprint of the feedback grating on 4? wafer scale out of poly(methyl methacrylate) (PMMA) and cyclic olefin copolymer (COC). The lasers consisting of the organic semiconductor tris(8-hydroxyquinoline) aluminum (Alq3) doped with the laser dye 4-dicyanomethylene-2-methyl-6-(p-dimethylaminostyril)-4H-pyrane (DCM) are hermetically sealed by thermally bonding a polymer lid. The organic thin film is placed in a basin within the substrate and is not in direct contact to the lid. Thus, the spectral properties of the lasers are unmodified in comparison to unencapsulated lasers. Grating periods of 378 nm to 428 nm in steps of 10 nm result in lasing at wavelengths of 622 nm to 685 nm. The operational lifetime of the lasers expressed in number of pulses is improved 11-fold (PMMA) and 3-fold (COC) in comparison to unencapsulated PMMA devices. © 2010 Optical Society of America.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Karlsruhe Institute of Technology
Pages: 24881-24887
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Optics Express
Volume: 18
Issue number: 24
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Capacitance tuning of nanoscale split-ring resonators
In this paper, we investigate the capacitance tuning of nanoscale split-ring resonators. Based on a simple LC circuit model (LC-model), we derive an expression where the inductance is proportional to the area while the capacitance reflects the aspect ratio of the slit. The resonance frequency may be tuned by the slit aspect ratio leaving the area, the lattice constant \( \Lambda \), and nearest-neighbor couplings in periodic split-ring resonator structures invariant. Experimental data as well as numerical simulation data, verify the predictions of the simple LC-model.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Pages: 77111K
Publication date: 2010

Host publication information
Title of host publication: Metamaterials V
Publisher: SPIE - International Society for Optical Engineering
ISBN (Print): 978-0-8194-8184-9
Keywords: Metamaterials, split-ring resonators
DOIs:
10.1117/12.854191
Source: orbit
Source-ID: 277946
Research output: Research - peer-review › Article in proceedings – Annual report year: 2010

Di-block co-polymer derived nanoporous polymer liquid core waveguides
Nanoporous liquid core waveguides are fabricated by selectively UV modifying a nanoporous polymer. The starting point is a diblock polymer where 1,2-polybutadiene (PB) molecules are bound to PDMS. When the PB is cross linked it self-assembles into PB with a network of 14 nm diameter PDMS filled pores. When the PDMS is etched, the hydrophobic PB is left with a porosity of 44%. The polymer is subsequently UV exposed through a shadow mask. This renders the exposed part hydrophilic, making it possible for water to infiltrate these areas. Water infiltration raises the refractive index, thus forming a liquid core waveguide. Here we present both the fabrication scheme and characterization results for the waveguides.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, The Danish Polymer Centre, Department of Chemical and Biochemical Engineering, Self-organized Nanoporous Materials Group, Self-organizing materials for nanotechnology Section
Contributors: Christiansen, M. B., Gopalakrishnan, N., Sagar, K. S., Ndoni, S., Kristensen, A.
Publication date: 2010

Host publication information
Title of host publication: Proceedings of SPIE
Volume: 7764
Publisher: SPIE - International Society for Optical Engineering
Keywords: Liquid core waveguides, UV surface modification, Self assembly, Nanoporous polymers
DOIs:
10.1117/12.860805
Source: orbit
Source-ID: 277745
Research output: Research - peer-review › Article in proceedings – Annual report year: 2010

Electromagnetically induced transparency in metamaterials at near-infrared frequency
We employ a planar metamaterial structure composed of a split-ring-resonator (SRR) and paired nano-rods to experimentally realize a spectral response at near-infrared frequencies resembling that of electromagnetically induced transparency. A narrow transparency window associated with low loss is produced, and the magnetic field enhancement at the center of the SRR is dramatically changed, due to the interference between the resonances with significantly different linewidths. The variation of the spectral response in terms of relative position of the bright and dark elements is evaluated with numerical simulations.
Enhanced transduction of polymer photonic crystal band-edge lasers via additional layer deposition

We present the concept of enhanced transduction for polymer photonic crystal lasers by deposition of an additional polymer layer with selective gas response. We report a significant increase in sensitivity to changes in gas concentration.

Enhanced transduction of polymer photonic crystal band-edge lasers via additional layer deposition

We present the concept of enhanced transduction for polymer photonic crystal lasers by deposition of an additional polymer layer with selective gas response. We report a significant increase in sensitivity to changes in gas concentration.
Fluorescence enhancement of single DNA molecules confined in Si/SiO2 nanochannels
We demonstrate that the detected emission intensity from YOYO-labeled DNA molecules confined in 180 nm deep Si/SiO2 nano-funnels changes significantly and not monotonically with the width of the funnel. This effect may be of importance for quantitative fluorescence microscopy and for experiments with a tight photon budget.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section, University of Gothenburg
Contributors: Westerlund, F., Persson, K. F., Kristensen, A., Tegenfeldt, J.
Pages: 2049-2051
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Lab on a Chip
Volume: 10
Issue number: 16
ISSN (Print): 1473-0197
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 6.05 SJR 2.158 SNIP 1.586
Web of Science (2017): Impact factor 5.995
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 5.98 SJR 2.162 SNIP 1.569
Web of Science (2016): Impact factor 6.045
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 5.74 SJR 2.239 SNIP 1.721
Web of Science (2015): Impact factor 5.586
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 5.6 SJR 2.555 SNIP 1.797
Web of Science (2014): Impact factor 6.115
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.9 SJR 2.397 SNIP 1.693
Web of Science (2013): Impact factor 5.748
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.35 SJR 2.405 SNIP 1.731
Web of Science (2012): Impact factor 5.697
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.76 SJR 2.54 SNIP 1.788
Web of Science (2011): Impact factor 5.67
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.718 SNIP 1.876
Geometrical tuning of nanoscale split-ring resonators
We investigate the capacitance tuning of nanoscale split-ring resonators. An LC-model predicts a simple dependence of resonance frequency on slit aspect ratio. Experimental and numerical data follow the predictions of the LC-model.

Improved emission properties of polymer photonic crystal lasers by introducing a phase-shift
Introducing a phase-shift in nanoimprinted polymer dye lasers is shown to increase the probability of single mode lasing from 19% to 99%. Low-index lasers with only one longitudinal mode are thus superior to band-edge lasers.
The influence of index contrast variations for obtaining single-mode operation and low threshold in dye doped polymer two dimensional photonic crystal (PhC) lasers is investigated. We consider lasers made from Pyromethene 597 doped Ormocore imprinted with a rectangular lattice PhC having a cavity in the middle of the crystal structure. We demonstrate that the index contrast, $n_{\text{eff, high}}/n_{\text{eff, low}}$, is an essential parameter for achieving low threshold, and we identify a trade-off between low threshold and single-mode operation.
Light-Induced Local Heating for Thermophoretic Manipulation of DNA in Polymer Micro- and Nanochannels

We present a method for making polymer chips with a narrow-band near-infrared absorber layer that enables light-induced local heating of liquids inside fluidic micro- and nanochannels fabricated by thermal imprint in polymethyl methacrylate. We have characterized the resulting liquid temperature profiles in microchannels using the temperature dependent fluorescence of the complex [Ru(bpy)3]2+. We demonstrate thermophoretic manipulation of individual YOYO-1 stained T4 DNA molecules inside micro- and nanochannels.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Polymer Microsystems for Cell Processing Group, Polymer Micro and Nano Engineering Section
Contributors: Thamdrup, L. H., Larsen, N. B., Kristensen, A.
Pages: 826-832
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Nano Letters
Volume: 10
Issue number: 3
ISSN (Print): 1530-6984
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 13.07
Web of Science (2017): Impact factor 12.08
Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 13.4
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Web of Science (2016): Indexed yes
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Scopus rating (2014): CiteScore 14.04
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Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 14.23
Web of Science (2013): Impact factor 12.94
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 13.78
Web of Science (2012): Impact factor 13.025
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 13.83
Web of Science (2011): Impact factor 13.198
Liquid crystal tunable photonic crystal dye laser
We present a dye-doped liquid crystal laser using a photonic crystal cavity. An applied electric field to the liquid crystal provides wavelength tunability. The photonic crystal enhances resonant interaction with the gain medium.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystems Engineering Section, Department of Micro- and Nanotechnology
Contributors: Buss, T., Christiansen, M. B., Smith, C., Kristensen, A.
Pages: 1-2
Publication date: 2010

Host publication information
Title of host publication: 2010 Conference on Lasers and Electro-Optics (CLEO) and Quantum Electronics and Laser Science Conference (QELS)
Publisher: IEEE
ISBN (Print): 978-1-55752-890-2
Electronic versions: Buss.pdf

Bibliographical note
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Source: orbit
Source-ID: 265503
Research output: Research - peer-review › Article in proceedings – Annual report year: 2010

Low-threshold conical microcavity dye lasers
We report on lasing in rhodamine 6G-doped, conical polymeric microcavities with high quality factors fabricated on a silicon substrate. Threshold pump energies as low as 3 nJ are achieved by free-space excitation in the quasistationary pumping regime with lasing wavelengths around 600 nm. Finite element simulations confirm that lasing occurs in whispering gallery modes which corresponds well to the measured multimode laser-emission. The effect of dye concentration on lasing threshold and lasing wavelength is investigated and can be explained using a standard dye laser model.

General information
Metal-dielectric composites with tunable optical properties

General information
State: Published
Organisations: Department of Photonics Engineering, NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Nanophotonics Theory and Signal Processing, Plasmonics and Metamaterials
Contributors: Nielsen, R. B., Kristensen, A., Hvam, J. M., Boltasseva, A.
Pages: 10
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Proceedings of SPIE, the International Society for Optical Engineering
Volume: 7711
ISSN (Print): 0277-786X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 0.43 SJR 0.243 SNIP 0.289
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SJR 0.226 SNIP 0.258
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.3 SJR 0.212 SNIP 0.239
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.3 SJR 0.217 SNIP 0.249
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 0.26 SJR 0.234 SNIP 0.273
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Metamaterial localized resonance sensors: prospects and limitations

The prospects and limitations of metamaterial localized resonance sensors are investigated theoretically and experimentally. Gold split-ring resonators are employed as the model system where the light induced LC-resonance yields a figure-of-merit, sensitivity divided by linewidth, up to 54 depending on the split-ring resonator design and engineering of the light-plasmon coupling. This highest measured value is comparable to quasi-static predictions, suggesting incremental improvements beyond this point. Further optimization attempts show the effect of inhomogeneous broadening giving some indication that the limits have been reached for this particular design and material choice.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Structured Electromagnetic Materials, Department of Photonics Engineering
Contributors: Jeppesen, C., Xiao, S., Mortensen, A., Kristensen, A.
Pages: 25075-25080
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Optics Express
Volume: 18
Issue number: 24
ISSN (Print): 1094-4087
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
Modeling of DNA in Nanochannels using linear elasticity theory

General information
State: Published
Organisations: Stochastic Systems and Signals Group, Theory Section, Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Pedersen, J. N., Mikkelsen, M. B. L., Reisner, W., Kristensen, A., Flyvbjerg, H.
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Source: orbit
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Research output: Research - peer-review > Poster – Annual report year: 2010

Nanoimprinted polymer chips for light induced local heating of liquids in micro- and nanochannels

A nanoimprinted polymer chip with a thin near-infrared absorber layer that enables light-induced local heating (LILH) of liquids inside micro- and nanochannels is presented. An infrared laser spot and corresponding hot-spot could be scanned across the device. Large temperature gradients yield thermophoretic forces, which are used to manipulate and stretch individual DNA molecules confined in nanochannels. The absorber layer consists of a commercially available phthalocyanine dye (Fujifilm), with a narrow absorption peak at approximately 775 nm, dissolved in SU-8 photoresist (Microchem Corp.). The 500 nm thick absorber layer is spin-coated on a transparent substrate and UV exposed. Micro- and nanofluidic channels are defined by nanoimprint lithography in a 1.5 μm thick layer of low molecular weight polymethyl methacrylate (PMMA, Microchem Corp.), which is spin coated on top of the absorber layer. We have used a previously developed two-level hybrid stamp for replicating two V-shaped microchannels (width=50 μm and height = 900 nm) bridged by an array of 200 nanochannels (width and height of 250 nm). The fluidic channels are finally sealed with a lid using PMMA to PMMA thermal bonding. Light from a 785 nm laser diode was focused from the backside of the chip to a spot diameter down to 5 μm in the absorber layer, yielding a localized heating (Gaussian profile) and large temperature gradients in the liquid in the nanochannels. A laser power of 38 mW yielded a temperature of 40°C in the center of a 10 μm 1/e diameter. Fluorescence microscopy was performed from the frontside.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Stochastic Systems and Signals Group, Theory Section, Stochastic Systems and Signals, Polymer Microsystems for Cell Processing, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Thamdrup, L. H., Pedersen, J. N., Flyvbjerg, H., Larsen, N. B., Kristensen, A.
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Journal: Proceedings of the SPIE - The International Society for Optical Engineering
Volume: 7764
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  BFI (2018): BFI-level 1
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Scopus rating (2017): CiteScore 0.43 SJR 0.243 SNIP 0.289
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SJR 0.226 SNIP 0.258
Nanoimprinted polymer photonic crystal dye lasers

Optically pumped polymer photonic crystal band-edge dye lasers are presented. The photonic crystal is a rectangular lattice providing laser feedback as well as an optical resonance for the pump light. The lasers are defined in a thin film of photodefinable Ormocore hybrid polymer, doped with the laser dye Pyrromethene 597. A compact frequency doubled Nd:YAG laser (352 nm, 5 ns pulses) is used to pump the lasers from above the chip. The laser devices are 450 nm thick slab waveguides with a rectangular lattice of 100 nm deep air holes imprinted into the surface. The 2-dimensional rectangular lattice is described by two orthogonal unit vectors of length $a$ and $b$, defining the P and X directions. The frequency of the laser can be tuned via the lattice constant $a$ (187 nm - 215 nm) while pump light is resonantly coupled into the laser from an angle ($\theta$) depending on the lattice constant $b$ (355 nm). The lasers are fabricated in parallel on a 10 cm diameter wafer by combined nanoimprint and photolithography (CNP). CNP relies on a UV transparent quartz nanoimprint stamp with an integrated metal shadow mask. In the CNP process the photonic crystal is formed by mechanical deformation (imprinting) while the larger features are defined by UV exposure through the combined mask/mold.

General information

State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Structured Electromagnetic Materials, Department of Photonics Engineering
Contributors: Christiansen, M. B., Smith, C., Buss, T., Xiao, S., Mortensen, A., Kristensen, A.
Publication date: 2010
Peer-reviewed: Yes
Nanoporous polymer liquid core waveguides
We demonstrate liquid core waveguides defined by UV to enable selective water infiltration in nanoporous polymers, creating an effective refractive index shift $\Delta n=0.13$. The mode confinement and propagation loss in these waveguides are presented.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Self-organized Nanoporous Materials Group, Self-organizing materials for nanotechnology Section, The Danish Polymer...
Nearly zero transmission through periodically modulated ultrathin metal films
Transmission of light through an optically ultrathin metal film with a thickness comparable to its skin depth is significant. We demonstrate experimentally nearly-zero transmission of light through a film periodically modulated by a one-dimensional array of subwavelength slits. The suppressed optical transmission is due to the excitation of surface plasmon polaritons and the zero-transmission phenomenon is strongly dependent on the polarization of the incident wave.
Optofluidic applications using 1,2-PolyButadine nanoporous diblock copolymer.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, The Danish Polymer Centre, Department of Chemical and Biochemical Engineering, Self-organized Nanoporous Materials
Optofluidic dye laser in a foil

First order distributed feedback optofluidic dye lasers embedded in a 350 μm thick TOPAS (R) foil are demonstrated. They are designed in order to give high output pulse energies. Microfluidic channels and first order distributed feedback gratings are fabricated in parallel by thermal nanoimprint into a 100 μm foil. The channels are closed by thermal bonding with a 250 μm thick foil and filled with 5.10(-3) mol/l Pyrromethene 597 in benzyl alcohol. The fluid forms a liquid core single mode slab waveguide of 1.6 μm height on a nanostructured grating area of 0.5 x 0.5 mm². This results in a large gain volume. Two grating periods of 185 nm and 190 nm yield single mode laser light emission at 566 nm and 581 nm respectively. High emitted pulse energies of more than 1 μJ are reported. Stable operation for more than 25 min at 10 Hz pulse repetition rate is achieved.
Optofluidic microscope with 3D spatial resolution

This paper reports on-chip based optical detection with three-dimensional spatial resolution by integration of an optofluidic microscope (OFM) in a microfluidic pinched flow fractionation (PFF) separation device. This setup also enables on-chip particle image velocimetry (PIV). The position in the plane perpendicular to the flow direction and the velocity along the flow direction of separated fluorescent labeled polystyrene microspheres with diameters of 1μm, 2.1μm, 3μm and 4μm is determined by the OFM. These results are bench marked against those obtained with a PFF device using conventional fluorescence microscope readout. The size separated microspheres are detected by OFM with an accuracy of ±0.92μm. The position in the height of the channel and the velocity of the separated microspheres are detected with an accuracy of ±1.4μm and ±0.08 mm/s respectively. Throughout the measurements of the height and velocity distribution, the microspheres
are observed to move towards the center of the channel in regard to its height.

**General information**
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Vig, A. L., Marie, R., Jensen, E., Kristensen, A.
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Peer-reviewed: Yes

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BFI (2017): BFI-level 2
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Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Web of Science (2014): Impact factor 3.488
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196
Web of Science (2013): Impact factor 3.525
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.85 SJR 2.562 SNIP 2.108
Web of Science (2012): Impact factor 3.546
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.58 SNIP 2.572
Web of Science (2011): Impact factor 3.587
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): Impact factor 3.753
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
Single mode dye-doped polymer photonic crystal lasers

Dye-doped polymer photonic crystal (PhC) lasers fabricated by combined nanoimprint and photolithography are studied for their reproducibility and stability characteristics. We introduce a phase shift in the PhC lattice that substantially improves the yield of single wavelength emission. Single mode emission and reproducibility of laser characteristics are important if the lasers are to be mass produced in, e.g., optofluidic sensor chips. The fabrication yield is above 85% with highly reproducible wavelengths (within 0.5%), and the temperature dependence on the wavelength is found to be -0.045 or -0.066 nmK\(^{-1}\), depending on the material.

General information
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Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Department of Photonics Engineering
Contributors: Christiansen, M. B., Buss, T., Smith, C., Petersen, S. R., Jørgensen, M. M., Kristensen, A.
Publication date: 2010
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Web of Science (2018): Indexed yes
Single-molecule denaturation mapping of DNA in nanofluidic channels
Here we explore the potential power of denaturation mapping as a single-molecule technique. By partially denaturing YOYO (R)-1-labeled DNA in nanofluidic channels with a combination of formamide and local heating, we obtain a sequence-dependent "barcode" corresponding to a series of local dips and peaks in the intensity trace along the extended molecule. We demonstrate that this structure arises from the physics of local denaturation: statistical mechanical calculations of sequence-dependent melting probability can predict the barcode to be observed experimentally for a given sequence. Consequently, the technique is sensitive to sequence variation without requiring enzymatic labeling or a restriction step. This technique may serve as the basis for a new mapping technology ideally suited for investigating the long-range structure of entire genomes extracted from single cells.
The effect of Ti and ITO adhesion layers on gold split-ring resonators

Ultrathin adhesion layers serve a well-documented fabrication purpose while its influence on the optical properties of gold nanostructures is often neglected. Gold split-ring resonators are fabricated with two commonly used adhesion layers: titanium and indium tin oxide. When compared to all-gold reference samples, a spectral shift of the ground mode resonance is observed. For the titanium sample the spectral shift is accompanied by a resonance broadening, which is less profound for indium tin oxide. The mutual correlation between the shift and the broadening is shown to be qualitatively consistent with perturbative considerations.

**General information**

State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Structured Electromagnetic Materials, Department of Photonics Engineering
Contributors: Jeppesen, C., Mortensen, A., Kristensen, A.
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Peer-reviewed: Yes

**Publication information**

Volume: 97
Thermoplastic microcantilevers fabricated by nanoimprint lithography

Nanoimprint lithography has been exploited to fabricate micrometre-sized cantilevers in thermoplastic. This technique allows for very well defined microcantilevers and gives the possibility of embedding structures into the cantilever surface. The microcantilevers are fabricated in TOPAS and are up to 500 μm long, 100 μm wide, and 4.5 μm thick. Some of the cantilevers have built-in ripple surface structures with heights of 800 nm and pitches of 4 μm. The yield for the cantilever fabrication is 95% and the initial out-of-plane bending is below 10 μm. The stiffness of the cantilevers is measured by deflecting the cantilever with a well-characterized AFM probe. An average stiffness of 61.3 mN m⁻¹ is found. Preliminary tests with water vapour indicate that the microcantilevers can be used directly for vapour sensing applications and illustrate the influence of surface structuring of the cantilevers.
Three-dimensional positioning with optofluidic microscope

This paper reports on-chip based optical detection with three-dimensional spatial resolution by integration of an optofluidic microscope (OFM) in a microfluidic pinched flow fractionation (PFF) separation device. This setup also enables on-chip particle image velocimetry (PIV). The position in the plane perpendicular to the flow direction and the velocity along the flow direction of separated fluorescent labeled polystyrene microspheres with diameters of 1 μm, 2.1 μm, 3 μm and 4 μm is measured using the OFM readout. These results are benchmarked against those obtained with a PFF device using a conventional fluorescence microscope as readout. The size separated microspheres are detected by OFM with an accuracy of ≤ 0.92 μm. The position in the height of the channel and the velocity of the separated microspheres are detected with an accuracy of 1.4 μm and 0.08 mm/s respectively. Throughout the measurement of the height and velocity distribution, the microspheres are observed to move towards the center of the channel in regard to its height.

General information
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Contributors: Vig, A. L., Marie, R., Jensen, E., Kristensen, A.
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BFI (2017): BFI-level 1
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SJR 0.226 SNIP 0.258
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.3 SJR 0.212 SNIP 0.239
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.3 SJR 0.217 SNIP 0.249
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 0.26 SJR 0.234 SNIP 0.273
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.27 SJR 0.219 SNIP 0.275
ISI indexed (2012): ISI indexed no
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 0.31 SJR 0.217 SNIP 0.286
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.233 SNIP 0.277
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.236 SNIP 0.312
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.245 SNIP 0.3
Web of Science (2008): Indexed yes
Toward superlensing with metal-dielectric composites and multilayers

We report on the fabrication of two types of adjustable, near-field superlens designs: metal–dielectric composites and metal–dielectric multilayer films. We fabricated a variety of films with different materials, thicknesses and compositions. These samples were characterized physically and optically to determine their film composition, quality, and optical responses. Our results on metal–dielectric composites indicate that although the real part of the effective permittivity generally follows effective medium theory predictions, the imaginary part does not and substantially higher losses are observed. Going forward, it appears that multilayer metal–dielectric designs are more suitable for sub-diffraction imaging applications because they could provide both tunability and low loss.
UV patterned nanoporous solid-liquid core waveguides
Nanoporous Solid-Liquid core waveguides were prepared by UV induced surface modification of hydrophobic nanoporous polymers. With this method, the index contrast (delta n = 0.20) is a result of selective water infiltration. The waveguide core is defined by UV light, rendering the exposed part of a nanoporous polymer block hydrophilic. A propagation loss of 0.62 dB/mm and a bend loss of 0.81 dB/90 degrees for bend radius as low as 1.75 mm was obtained in these multimode waveguides.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, The Danish Polymer Centre, Department of Chemical and Biochemical Engineering, Self-organized Nanoporous Materials Group, Self-organizing materials for nanotechnology Section
Wafer scale coating of polymer cantilever fabricated by nanoimprint lithography

Microcantilevers can be fabricated in TOPAS by nanoimprint lithography, with the dimensions of 500 μm length, 4.5 μm thickness, and 100 μm width. By using a plasma polymerization technique it is possible to selectively functionalize individually cantilevers with a polymer coating, on wafer scale by using a shadow masking technique.
An experimental investigation of Fang's Ag superlens suitable for integration

We report on experimental realization of the Fang Ag superlens structure [1] suitable for further processing and integration in bio-chips by replacing PMMA with a highly chemical resistant cyclo-olefin copolymer, mr-I T85 (Micro Resist Technology, Berlin, Germany). The superlens was able to resolve 80 nm half-pitch gratings when operating at a free space wavelength of 365 nm. Fang et al. used PMMA since it enables the presence of surface plasmons at the PMMA/Ag interface at 365 nm and because it planarizes the quartz/chrome mask. If the superlens is to be integrated into a device where further processing is needed involving various organic polar solvents, PMMA cannot be used. We propose to use mr-I T85, which is highly chemically resistant to acids and polar solvents. Our superlens stack consists of a quartz/chrome grating mask, a 40 nm layer of mr-I T85, 35 nm Ag, and finally 70 nm of the negative photoresist mr-UVL 6000 (Micro Resist). A 50 nm layer of aluminium on top of the quartz/chrome mask reflected all light that did not penetrate through the mask openings thereby reducing waveguiding in the top resist layer. The exposures took place in a UV-aligner at 365 nm corresponding to the excitation wavelength of the surface plasmons at the mr-I T85/Ag interface. Supporting COMSOL simulations illustrate the field intensity distribution inside the resist as well as the presence of surface plasmons at the mr-I T85/Ag boundary. AFM scans of the exposed structure revealed 80 nm gratings.
Capacitance tuning of nanoscale split-ring resonators

We investigate the capacitance tuning of nanoscale split-ring resonators. Based on a simple inductor-capacitor circuit model, we derive an expression, where the inductance is proportional to the area while the capacitance reflects the aspect ratio of the slit. The resonance frequency may thus be tuned by the slit aspect ratio leaving the area, the lattice constant, and nearest-neighbor coupling in periodic structures invariant. Experimental data follow the predictions of the simple LC-model.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Structured Electromagnetic Materials, Department of Photonics Engineering
Contributors: Jeppesen, C., Mortensen, A., Kristensen, A.
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  Web of Science (2018): Indexed yes
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  Scopus rating (2017): CiteScore 3.25 SJR 1.382 SNIP 1.167
  Web of Science (2017): Impact factor 3.495
  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): Impact factor 3.411
  Web of Science (2016): Indexed yes
  BFI (2015): BFI-level 2
  Scopus rating (2015): CiteScore 2.47 SJR 1.499 SNIP 1.226
  Web of Science (2015): Impact factor 3.142
  Web of Science (2015): Indexed yes
  BFI (2014): BFI-level 2
  Scopus rating (2014): CiteScore 3.25 SJR 1.861 SNIP 1.492
  Web of Science (2014): Impact factor 3.302
  Web of Science (2014): Indexed yes
  BFI (2013): BFI-level 2
  Scopus rating (2013): CiteScore 3.77 SJR 2.146 SNIP 1.633
  Web of Science (2013): Impact factor 3.515
  ISI indexed (2013): ISI indexed yes
Competition between the Thermal Gradient and the Bimorph Effect in Locally Heated MEMS Actuators

We have investigated the influence of thermal gradient effects in inhomogeneously heated MEMS/NEMS. The actuation perturbations caused by thermal gradients have been studied through static optothermal actuation experiments of a bi-
material polymer based cantilever and supported by finite element modeling. As a result, bidirectional bending has been experimentally observed and interpreted as the competition between bimorph and thermal gradient effects. The competition has illustrated the importance of including the thermal gradient effect in the behavior analysis of bimorph driven MEMS/NEMS devices.

**General information**
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Nanointegration Group
Contributors: Jeppesen, C., Mølhave, K., Kristensen, A.
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Publication date: 2009
Peer-reviewed: Yes

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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.02 SJR 0.554 SNIP 0.968
Web of Science (2017): Impact factor 1.888
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): Impact factor 1.794
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.96 SJR 0.687 SNIP 1.265
Web of Science (2015): Impact factor 1.768
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.84 SJR 0.802 SNIP 1.316
Web of Science (2014): Impact factor 1.731
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.74 SJR 0.737 SNIP 1.233
Web of Science (2013): Impact factor 1.725
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.92 SJR 0.936 SNIP 1.491
Web of Science (2012): Impact factor 1.79
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.43 SJR 1.036 SNIP 1.443
Web of Science (2011): Impact factor 2.105
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.013 SNIP 1.637
Web of Science (2010): Impact factor 2.281
Web of Science (2010): Indexed yes
Confinement Spectroscopy: Probing Single DNA Molecules with Tapered Nanochannels

We demonstrate a confinement spectroscopy technique capable of probing small conformational changes of unanchored single DNA molecules in a manner analogous to force spectroscopy, in the regime corresponding to femtonewton forces. In contrast to force spectroscopy, various structural forms of DNA can easily be probed, as indicated by experiments on linear and circular DNA. The extension of circular DNA is found to scale according to the de Gennes exponent, unlike for linear DNA.

General information
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Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Polymer Microsystems for Cell Processing Group, Polymer Micro and Nano Engineering Section
Contributors: Persson, K. F., Utko, P., Reisner, W., Larsen, N. B., Kristensen, A.
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ISSN (Print): 1530-6984
Ratings:
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 13.07
Web of Science (2017): Impact factor 12.08
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Directed self-organization of single DNA molecules in a nanoslit via embedded nanopit arrays

We show that arrays of nanopit structures etched in a nanoslit can control the positioning and conformation of single DNA molecules in nanofluidic devices. By adjusting the spacing, organization and placement of the nanopits it is possible to immobilize DNA at predetermined regions of a device without additional chemical modification and achieve a high degree of control over local DNA conformation. DNA can be extended between two nanopits and in closely spaced arrays will self-assemble into "connect-the-dots" conformations consisting of locally pinned segments joined by fluctuating linkers. These results have broad implications for nanotechnology fields that require methods for the nanoscale positioning and manipulation of DNA.
Droplet based cavities and lasers
The self-organized and molecularly smooth surface on liquid microdroplets makes them attractive as optical cavities with very high quality factors. This chapter describes the basic theory of optical modes in spherical droplets. The mechanical properties including vibrational excitation are also described, and their implications for microdroplet resonator technology are discussed. Optofluidic implementations of microdroplet resonators are reviewed with emphasis on the basic optomechanical properties.

Enhancement of polymer dye lasers by multifunctional photonic crystal lattice
The light output of dye doped hybrid polymer band-edge lasers is increased more than 100 times by using a rectangular lattice photonic crystal, which provides both feedback and couples more pump light into the laser.
Excitation of fluorescent nanoparticles by channel plasmon polaritons propagating in V-grooves

Recently, it has been proven that light can be squeezed into metallic channels with subwavelength lateral dimensions. Here, we present the study of the propagation of channel plasmon polaritons confined in gold V-grooves, filled with fluorescent particles. In this way, channel plasmon polaritons propagating in nonempty V-grooves can be characterized, as the propagation track can be directly visualized in the microscope. We have found that beads with subwavelength diameters act as frequency converters for the propagating channel modes, resulting in larger propagation lengths. For micrometric-diameter beads, we show the possibility of individual excitation, what may have applications to develop very sensitive biosensors.
Fabricating plasmonic components for nano-and meta-photonics: [invited]
Fabricating plasmonic components for nano-and meta-photonics

Different fabrication approaches for realization of metal-dielectric structures supporting propagating and localized surface plasmons are described including fabrication of nanophotonic waveguides and plasmonic nanoantennae.

Fabricating plasmonic components for nanophotonics: [invited]

We report on experimental realization of different metal-dielectric structures that are used as surface plasmon polariton waveguides and as plasmonic metamaterials. Fabrication approaches based on different lithographic and deposition techniques are discussed.

Bibliographical note

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Fabricating plasmonic components for nanophotonics and lab-on-a-chip applications: [invited]

General information
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Organisations: Department of Photonics Engineering, Plasmonics and Metamaterials, Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Boltasseva, A., Nielsen, R. B., Jeppesen, C., Kristensen, A.
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Local Conformation of Confined DNA Studied Using Emission Polarization Anisotropy

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Contributors: Persson, K. F., Westerlund, F., Tegenfeldt, J. O., Kristensen, A.
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Web of Science (2017): Impact factor 9.598
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 8.11 SJR 3.45 SNIP 1.505
Web of Science (2016): Impact factor 8.643
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 8.11 SJR 3.212 SNIP 1.596
Web of Science (2015): Impact factor 8.315
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 7.74 SJR 3.165 SNIP 1.652
Web of Science (2014): Impact factor 8.368
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 8.13 SJR 3.628 SNIP 1.685
Web of Science (2013): Impact factor 7.514
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 8.17 SJR 4.52 SNIP 1.902
Web of Science (2012): Impact factor 7.823
ISI indexed (2012): ISI indexed yes
Making plasmonic structures for nano- and metaphotonics: fabrication methods and challenges: [invited]

General information
State: Published
Organisations: Department of Photonics Engineering, Plasmonics and Metamaterials, Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Boltasseva, A., West, P., Nielsen, R. B., Jeppesen, C., Kristensen, A.
Publication date: 2009

Host publication information
Title of host publication: SPIE Optics and Photonics: Plasmonics
Place of publication: San Diego, California, USA
Source: orbit
Source-ID: 251176
Research output: Research - peer-review › Article in proceedings – Annual report year: 2009

Optofluidic dye lasers

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Structured Electromagnetic Materials, Department of Photonics Engineering
Contributors: Kristensen, A., Mortensen, A.
Pages: 241-258
Publication date: 2009

Host publication information
Title of host publication: Optofluidics: Fundamentals, Devices, and Applications
Place of publication: USA
Publisher: McGraw-Hill
Edition: 1
ISBN (Print): 9780071601566
Source: orbit
Source-ID: 254195
Polymer photonic crystal dye lasers as label free evanescent cell sensors

Dye doped polymer photonic crystal band edge lasers are applied for evanescent wave sensing of cells. The lasers are rectangular shaped slab waveguides of dye doped polymer on a glass substrate, where a photonic crystal is formed by 100 nm deep air-holes in the surface of the 375 nm high waveguides. The lasers are fabricated by combined nanoimprint and photolithography in Ormocore hybrid polymer doped with the laser dye Pyrromethene 597. The lasers emit in the chip plane at a wavelength around 595 nm when pumped with 5 ns pulses from a compact frequency doubled Nd:YAG laser. We investigate the sensitivity of photonic crystal band-edge lasers to partial coverage with HeLa cells. The lasers are chemically activated with a flexible UV activated anthraquinone based linker molecule, which enables selective binding of cells and molecules. When measuring in Phosphate Buffered Saline (PBS), which has a refractive index close to that of the cells, the emission wavelength depends linearly on the cell density on the sensor surface. Our results demonstrate that nanostructured hybrid polymer lasers, which are cheap to fabricate and very simple to operate, can be selectively chemically activated with UV sensitive photolinkers for further bioanalytical applications. This opens the possibility to functionalize arrays of optofluidic laser sensors with different bio-recognition molecules for multiplexed sensing. The linear relationship between cell coverage and wavelength indicates that the slight refractive index perturbation from the partial coverage of the sensor influences the entire optical mode, rather than breaking down the photonic crystal feedback.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology Group, Biomedical Micro Systems Section, Surface Engineering Group, Polymer Micro and Nano Engineering Section, Structured Electromagnetic Materials, Department of Photonics Engineering
Publication date: 2009
Peer-reviewed: Yes

Publication information
Journal: Proceedings of SPIE, the International Society for Optical Engineering
Volume: 7402
ISSN (Print): 0277-786X
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 0.43 SJR 0.243 SNIP 0.289
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SJR 0.226 SNIP 0.258
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.3 SJR 0.212 SNIP 0.239
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.3 SJR 0.217 SNIP 0.249
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 0.26 SJR 0.234 SNIP 0.273
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.27 SJR 0.219 SNIP 0.275
ISI indexed (2012): ISI indexed no
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 0.31 SJR 0.217 SNIP 0.286
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.233 SNIP 0.277
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.236 SNIP 0.312
Polymer photonic crystal dye lasers as optofluidic cell sensors

Hybrid polymer photonic crystal band-edge lasers are chemically activated to covalently bind bio-molecules or for HeLa cell attachment using an anthraquinone (AQ) UV activated photolinker. The lasers change emission wavelength linearly with inhomogeneous cell coverage.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology Group, Biomedical Micro Systems Section, Surface Engineering Group, Polymer Micro and Nano Engineering Section, Structured Electromagnetic Materials, Department of Photonics Engineering
Pages: 1-2
Publication date: 2009

Host publication information
Publisher: IEEE
ISBN (Print): 978-1-55752-869-8
Electronic versions: Christiansen.pdf

Bibliographical note
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Source: orbit
Source-ID: 265548
Research output: Research - peer-review › Article in proceedings – Annual report year: 2009

Polymer photonic crystal dye lasers as optofluidic cell sensors

Dye doped hybrid polymer lasers are implemented as label free evanescent field biosensors for detection of cells. It is demonstrated that although the coverage is irregular and the cells extend over several lattice constants, the emission wavelength depends linearly on the fraction of the surface covered by the HeLa cells used as model system. Design parameters relating to photonic crystal sensing of large objects are identified and discussed. The lasers are chemically modified to bind cells and molecules with flexible UV activated linker molecules.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology Group, Biomedical Micro Systems Section, Surface Engineering Group, Polymer Micro and Nano Engineering Section, Structured Electromagnetic Materials, Department of Photonics Engineering
Pages: 2722-2730
Publication date: 2009
Peer-reviewed: Yes
Publication information
Journal: Optics Express
Volume: 17
Issue number: 4
ISSN (Print): 1094-4087
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Web of Science (2014): Impact factor 3.488
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196
Web of Science (2013): Impact factor 3.525
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.85 SJR 2.562 SNIP 2.108
Web of Science (2012): Impact factor 3.546
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.58 SNIP 2.572
Web of Science (2011): Impact factor 3.587
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): Impact factor 3.753
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
Thin film Ag superlens towards lab-on-a-chip integration

A thin metal film near-field superlens, as originally suggested by Pendry and realized by Fang et al. and Melville et al., is investigated with emphasis on materials suitable for integration on a lab-on-a-chip platform. A chemically resistant cyclo-olefin copolymer (COC), mr-l-T85 from microresist technology, is applied as dielectric matrix/spacer for an Ag thin film superlens. The superlens successfully resolves 80 nm half-pitch gratings when illuminated with UV radiation at a free space wavelength of 365 nm. The superlens design, fabrication and characterization is discussed.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Plasmonics and Metamaterials, Department of Photonics Engineering, Structured Electromagnetic Materials
Contributors: Jeppesen, C., Nielsen, R. B., Boltasseva, A., Xiao, S., Mortensen, A., Kristensen, A.
Pages: 22543-22552
Publication date: 2009
Peer-reviewed: Yes

Publication information
Journal: Optics Express
Volume: 17
Issue number: 25
ISSN (Print): 1094-4087
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
UV written Liquid Core Waveguides in 1,2-Polybutadine nanoporous polymers

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, The Danish Polymer Centre, Department of Chemical and Biochemical Engineering, Self-organized Nanoporous Materials Group, Self-organizing materials for nanotechnology Section
Contributors: Gopalakrishnan, N., Sagar, K. S., Christiansen, M. B., Vigild, M. E., Ndoni, S., Kristensen, A.
Publication date: 2009
Peer-reviewed: Yes
Event: Poster session presented at MNE-09, 2009 September 28 - October 1, Ghent, Belgium.
Source: orbit
Source-ID: 253708
Research output: Research - peer-review > Journal article – Annual report year: 2009

Windowless microfluidic platform based on capillary burst valves for high intensity x-ray measurements

We propose and describe a microfluidic system for high intensity x-ray measurements. The required open access to a microfluidic channel is provided by an out-of-plane capillary burst valve (CBV). The functionality of the out-of-plane CBV is characterized with respect to the diameter of the windowless access hole, ranging from 10 to 130 Åm. Maximum driving pressures from 22 to 280 mbar corresponding to refresh rates of the exposed sample from 300 Hz to 5 kHz is demonstrated. The microfluidic system is tested at beamline ID09b at the ESRF synchrotron radiation facility in Grenoble, and x-ray scattering measurements are shown to be feasible and to require only very limited amounts of sample, <1 ml/h of measurements without recapturing of sample. With small adjustments of the present chip design, scattering angles up to 30 can be achieved without shadowing effects and integration on-chip mixing and spectroscopy appears straightforward. (C) 2009 American Institute of Physics.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Nanoprobes, Technical University of Denmark, University of Copenhagen
Pages: 115114
Publication date: 2009
Peer-reviewed: Yes

Publication information
Journal: Review of Scientific Instruments
Volume: 80
Issue number: 11
ISSN (Print): 0034-6748
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.32 SJR 0.585 SNIP 0.858
Web of Science (2017): Impact factor 1.428
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
A compact system for large-area thermal nanoimprint lithography using smart stamps

We present a simple apparatus for thermal nanoimprint lithography. In this work, the stamp is designed to significantly reduce the requirements for pressure application on the external imprint system. By MEMS-based processing, an air cavity inside the stamp is created, and the required pressure for successful imprint is reduced. Additionally, the stamp is capable of performing controlled demolding after imprint. Due to the complexity of the stamp, a compact and cost-effective imprint apparatus can be constructed. The design and fabrication of the advanced stamp as well as the simple imprint equipment is presented. Test imprints of micrometer- and nanometer-scale structures are performed and characterized with respect to uniformity across a large area (36 mm radius). State-of-the-art uniformity for μm-scale features is demonstrated.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Silicon Microtechnology Group, MicroElectroMechanical Systems Section, Center for Individual Nanoparticle Functionality, Center for Nanoteknologi
Contributors: Pedersen, R. H., Hansen, O., Kristensen, A.
Pages: 055018
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Journal of Micromechanics and Microengineering
Volume: 18
Issue number: 5
ISSN (Print): 0960-1317
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.02 SJR 0.554 SNIP 0.968
Web of Science (2017): Impact factor 1.888
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): Impact factor 1.794
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.96 SJR 0.687 SNIP 1.265
Web of Science (2015): Impact factor 1.768
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.84 SJR 0.802 SNIP 1.316
Web of Science (2014): Impact factor 1.731
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.74 SJR 0.737 SNIP 1.233
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.92 SJR 0.936 SNIP 1.491
Web of Science (2012): Impact factor 1.79
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.43 SJR 1.036 SNIP 1.443
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.013 SNIP 1.637
Web of Science (2010): Impact factor 2.105
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.144 SNIP 1.5
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.243 SNIP 1.616
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.422 SNIP 1.815
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.264 SNIP 2.098
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.165 SNIP 2.073
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.057 SNIP 1.881
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.416 SNIP 1.579
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.103 SNIP 1.507
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.763 SNIP 1.651
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.741 SNIP 1.011
A Novel Approach to DNA Force Spectroscopy

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemEngineering Section, Department of Micro- and Nanotechnology
Contributors: Persson, K. F., Utko, P., Reisner, W., Kristensen, A.
PUBLICATION DATE: 2008

Host publication information
Title of host publication: Proceeding of APS March Meeting
Publisher: American Physical Society
Source: orbit
Source-ID: 232108
Research output: Research - peer-review › Article in proceedings – Annual report year: 2008

Channel plasmon polariton propagation in nanoimprinted V-groove waveguides
We present the results of optical characterization of metal V-groove waveguides using scanning near-field microscopy, showing broadband transmission with subwavelength confinement and propagation lengths exceeding 100 μm. An updated fabrication method using a combination of UV and nanoimprint lithography is presented. The developed approach is mass-production compatible, adaptable to different designs, and offers wafer-scale parallel fabrication of plasmonic components based on profiled metal surfaces.

General information
State: Published
Organisations: Plasmonics and Metamaterials, Department of Photonics Engineering, Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemEngineering Section
Pages: 2800-2802
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Optics Letters
Volume: 33
Issue number: 23
ISSN (Print): 0146-9592
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.89 SJR 1.79 SNIP 1.597
Web of Science (2017): Impact factor 3.589
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.54 SJR 1.769 SNIP 1.549
Web of Science (2016): Impact factor 3.416
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.53 SJR 2.013 SNIP 1.53
Web of Science (2015): Indexed yes
General information
State: Published
Organisations: Plasmonics and Metamaterials, Department of Photonics Engineering, NSE-Optofluidics Group, 
NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Nielsen, R. B., Fernandez-Cuesta, I., Boltasseva, A., Volkov, V., Bozhevolnyi, S., Klukowska, A., 
Kristensen, A.
Pages: 2800-2802
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Optics Letters
Volume: 33
ISSN (Print): 0146-9592
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.89 SJR 1.79 SNIP 1.597
Web of Science (2017): Impact factor 3.589
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.54 SJR 1.769 SNIP 1.549
Web of Science (2016): Impact factor 3.416
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.53 SJR 2.013 SNIP 1.53
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.86 SJR 2.429 SNIP 1.997
Web of Science (2014): Impact factor 3.292
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.95 SJR 2.441 SNIP 2.058
Web of Science (2013): Impact factor 3.179
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.52 SJR 2.577 SNIP 1.92
Web of Science (2012): Impact factor 3.385
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 3.69 SJR 2.519 SNIP 2.453
Web of Science (2011): Impact factor 3.399
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.637 SNIP 2.263
Web of Science (2010): Impact factor 3.318
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 3.077 SNIP 2.658
Continuous roll-to-roll method to produce Fluidies channels on plastic web

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Mäkelä, T., Haatainen, T., Majander, P., Ahopelto, J., Larsen, A. V., Kristensen, A.
Publication date: 2008

Host publication information
Place of publication: Athens, Greece

Bibliographical note
Presented with a poster of the same title
Source: orbit
Source-ID: 239459
Research output: Research - peer-review » Journal article – Annual report year: 2008

Determination of Stress Build-up during Nanoimprint process in Triangular Polymer Structures

General information
State: Published
Organisations: Silicon Microtechnology Group, MicroElectroMechanical Systems Section, Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section, Center for Nanoteknologi, Center for Individual Nanoparticle Functionality
Contributors: Fernandez-Cuesta, I., Borrise, X., Retolaza, A., Merino, S., Mendels, D., Hansen, O., Kristensen, A., Perez-Murano, F.
Pages: 838-841
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Microelectronic Engineering
Electroviscous effects in capillary filling of nanochannels

We theoretically examine the widespread hypothesis of an electroviscous origin of the increase in apparent viscosity observed in recent experiments on capillary filling of nanochannels. Including Debye-layer corrections to the hydraulic resistance, we find that the apparent viscosity reaches a maximum in the mesoscopic regime where the channel height (or more generally the hydraulic radius) is comparable to the screening length. However, for realistic estimates of central parameters, we find that the electroviscous contribution to the apparent viscosity is at most a 1% effect.
Excitation of Fluorescent Nanoparticles by Plasmons Confined and propagating in V-grooves

General information
State: Published
Organisations: Plasmonics and Metamaterials, Department of Photonics Engineering, NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Publication date: 2008

Host publication information
Place of publication: Athens, Greece
Source: orbit
Source-ID: 228132
Research output: Research - peer-review › Article in proceedings – Annual report year: 2008

Fabrication of Cantilevers by NIL

General information
State: Published
Organisations: Nanoprobes Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Nanophotonic Devices, Department of Photonics Engineering, NSE-Optofluidics Group, Nanophotonics Theory and Signal Processing
Contributors: Greve, A., Keller, S. U., Larsson, D., Kristensen, A., Yvind, K., Hvam, J. M., Boisen, A.
Publication date: 2008

Host publication information
Title of host publication: In proceeding of "International Workshop on Nanomechanical Cantilever Sensors"
Publisher: Max Planck Institute for Polymer Research
Source: orbit
Source-ID: 233656
Research output: Research - peer-review › Article in proceedings – Annual report year: 2008

Fabrication of channel and wedge plasmon polariton devices by combined UV and nanoimprint lithography

General information
State: Published
Organisations: Plasmonics and Metamaterials, Department of Photonics Engineering, NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Nielsen, R., Boltasseva, A., Kristensen, A., Bozhevolnyi, S., Volkov, V., Fernandez-Cuesta, I., Klukowska, A.
Pages: QWA6
Publication date: 2008

Host publication information
Title of host publication: CLEO/QELS 2008
Place of publication: San Jose, CA, USA
Publisher: IEEE
ISBN (Print): 15-57-52859-4
Source: orbit
Source-ID: 220873
Research output: Research - peer-review › Article in proceedings – Annual report year: 2008

Fabrication of Nanophotonic Circuit Components by Thermal Nano Imprint Lithography

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Scheerlinck, S., Pedersen, R. H., Dumon, P., Bogaerts, W., Plachetka, U., van Thourhout, D., Baets, R., Kristensen, A.
Publication date: 2008

Host publication information
Title of host publication: Proceeding of CLEO/QELS 2008
Fabrication of photonic components by nanoimprint technology within ePIXnet

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Plachetka, U., Kristensen, A., Scheerlinck, S., Huskens, J., Koo, N., Kurz, H.
Pages: 886-889
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Microelectronic Engineering
Volume: 85
Issue number: 5-6
ISSN (Print): 0167-9317
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.87 SJR 0.604 SNIP 0.937
Web of Science (2017): Impact factor 2.02
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): Impact factor 1.806
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 1.35 SJR 0.507 SNIP 0.796
Web of Science (2015): Impact factor 1.277
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 1.44 SJR 0.586 SNIP 0.86
Web of Science (2014): Impact factor 1.197
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 1.45 SJR 0.595 SNIP 0.964
Web of Science (2013): Impact factor 1.338
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 1.44 SJR 0.737 SNIP 0.949
Web of Science (2012): Impact factor 1.224
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 1.8 SJR 0.813 SNIP 1.148
Web of Science (2011): Impact factor 1.557
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Fabrication of Plasmonic Waveguides by Nanoimprint and UV Lithography

General information
State: Published
Organisations: Plasmonics and Metamaterials, Department of Photonics Engineering, NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Nielsen, R. B., Boltasseva, A., Kristensen, A., Bozhevolnyi, S. I., Volkov, V.
Publication date: 2008

Host publication information
Title of host publication: Proceeding of SPIE Optic & Photonics
Volume: 6883
Place of publication: San Diego, California
Publisher: SPIE - International Society for Optical Engineering
DOIs: 10.1117/12.762999
Source: orbit
Source-ID: 231669
Research output: Research - peer-review › Article in proceedings – Annual report year: 2008

Fast thermal nanoimprint lithography by a stamp with integrated heater
We propose fast nanoimprinting lithography (NIL) process based on the use of stamps with integrated heater. The latter consists of heavily ion implantation n-type doped silicon layer buried below the microstructured surface of the stamp. The stamp is heated by Joule effect, by 50 μs 25 Hz repetition rate current pulses flowing in the conductive layer. Using this approach we have reproducibly imprinted areas of 2 cm2 within 16 s with residual layers in the range of few tens of nm. This result paves the way for processes in the sub-1 s timescale over large area surfaces.
International Conference on Micro- and Nano-Engineering (MNE) held in Copenhagen, Denmark September 23-26, 2007 -

Preface

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Nanoprobes Group, Department of Physics
Contributors: Kristensen, A., Boisen, A., Tenje, M., Montelius, L.
Pages: 733-733
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Microelectronic Engineering
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.87 SJR 0.604 SNIP 0.937
Web of Science (2017): Impact factor 2.02
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): Impact factor 1.806
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 1.35 SJR 0.507 SNIP 0.796
Web of Science (2015): Impact factor 1.277
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 1.44 SJR 0.586 SNIP 0.86
Web of Science (2014): Impact factor 1.197
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 1.45 SJR 0.595 SNIP 0.964
Web of Science (2013): Impact factor 1.338
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 1.44 SJR 0.737 SNIP 0.949
Web of Science (2012): Impact factor 1.224
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 1.8 SJR 0.813 SNIP 1.148
Web of Science (2011): Impact factor 1.557
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.934 SNIP 1.093
Web of Science (2010): Impact factor 1.575
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.834 SNIP 1.098
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.027 SNIP 1.06
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.045 SNIP 1.138
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.966 SNIP 1.093
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.952 SNIP 0.989
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1 SNIP 1.1
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.812 SNIP 0.956
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.712 SNIP 0.711
Scopus rating (2001): SJR 0.558 SNIP 0.645
Scopus rating (2000): SJR 0.502 SNIP 0.568
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.595 SNIP 0.555
Original language: English
DOIs:
10.1016/j.mee.2008.03.014
Source: orbit
Source-ID: 223958
Research output: Research - peer-review › Journal article – Annual report year: 2008
Photonic integration in k-space: Enhancing the performance of photonic crystal dye lasers

We demonstrate how two optical functionalities can be implemented in a single photonic crystal structure by carefully engineering dispersion in several different bands at several different wavelengths. We use the concept for optically pumped dye doped hybrid polymer band edge lasers and show how a rectangular photonic crystal lattice imprinted into the surface can provide both feedback for in-plane band edge lasing and couple pump light into the device plane, thus increasing the emitted intensity and lowering the lasing threshold by more than an order of magnitude.
Pinched flow fractionation devices for detection of single nucleotide polymorphisms

We demonstrate a new and flexible micro fluidic based method for genotyping single nucleotide polymorphisms (SNPs). The method relies on size separation of selectively hybridized polystyrene microspheres in a micro fluidic pinched flow fractionation (PFF) device. The micro fluidic PFF devices with 13 μm deep channels were fabricated by thermal nanoimprint lithography (NIL) in a thin film of cyclic-olefin copolymer (mr-I T85) on a silicon wafer substrate, and the channels were sealed by thermal polymer bonding. Streptavidin coated polystyrene microspheres with a mean diameter of 3.09 μm and 5.6 μm were functionalized with biotin-labeled oligonucleotides for the detection of a mutant (Mt) or wild-type (Wt) DNA sequence in the HBB gene, respectively. Hybridization to functionalized beads was performed with fluorescent targets comprising synthetic DNA oligonucleotides or amplified RNA, synthesized using human DNA samples from individuals with point mutations in the HBB gene. Following a stringent wash, the beads were separated in a PFF device and the fluorescent signal from the beads was analyzed. Patients being wildtypes, heterozygotes or mutated respectively for the investigated mutation could reliably be diagnosed in the PFF device. This indicates that the PFF technique can be used for accurate and fast genotyping of SNPs.

General information

State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Fluidic Array Systems and Technology Group, Biomedical Micro Systems Section
Contributors: Larsen, A. V., Poulsen, L., Birgens, H., Dufva, H. M., Kristensen, A.
Pages: 818-821
Publication date: 2008
Peer-reviewed: Yes

Publication information

Journal: Lab on a Chip
Volume: 8
Issue number: 5
ISSN (Print): 1473-0197
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 6.05 SJR 2.158 SNIP 1.586
Web of Science (2017): Impact factor 5.995
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 5.98 SJR 2.162 SNIP 1.569
Web of Science (2016): Impact factor 6.045
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 5.74 SJR 2.239 SNIP 1.721
Web of Science (2015): Impact factor 5.586
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 5.6 SJR 2.555 SNIP 1.797
Web of Science (2014): Impact factor 6.115
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.9 SJR 2.397 SNIP 1.693
Web of Science (2013): Impact factor 5.748
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.35 SJR 2.405 SNIP 1.731
Web of Science (2012): Impact factor 5.697
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Polarization Anisotropy of DNA in Nanochannels

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Persson, F., Westerlund, F., Tegenfeldt, J., Kristensen, A.
Publication date: 2008

Host publication information
Place of publication: San Diego, California
Publisher: Chemical and Biological Microsystems Society
ISBN (Print): 09-79-80641-0
Source: orbit
Source-ID: 228125
Research output: Research - peer-review : Article in proceedings – Annual report year: 2008

Polymer Photonic Crystal Band Edge Lasers for Evanescent Wave Sensing

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Christiansen, M. B., Arango, F., Gersborg-Hansen, M., Kristensen, A.
Quantitative Strategies to Handle Stamp Bending in NIL

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Pedersen, R. H., Thamdrup, L. H., Larsen, A. V., Kristensen, A., Mendels, D.
Publication date: 2008

Host publication information
Title of host publication: Proceeding of The 7th International Conference on Nanoimprint and Nanoprint Technology: NNT'08 October 13-15 2008
Place of publication: Kyoto, Japan
Source: orbit
Source-ID: 228117
Research output: Research - peer-review Article in proceedings – Annual report year: 2008

Quantitative Strategies to Handle Stamp Bending in NIL

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Pedersen, R. H., Thamdrup, L. H., Larsen, A. V., Kristensen, A., Mendels, D.
Publication date: 2008

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Title of host publication: Proceeding of the 34th International Conference on Micro and Nano Engineering: MNE 2008 15-18 September 2008
Place of publication: Athens, Greece
Source: orbit
Source-ID: 228180
Research output: Research - peer-review Article in proceedings – Annual report year: 2008

Quantitative Strategies to Handle Stamp Bending in NIL

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Pedersen, R. H., Thamdrup, L. H., Vig, A. L., Kristensen, A., Mendels, D.
Publication date: 2008
Peer-reviewed: Yes
Event: Poster session presented at The 34th International Conference on Micro and Nanoimprint and Nanoprint Technology, Athens, Greece.
Source: orbit
Source-ID: 231679
Research output: Research - peer-review Poster – Annual report year: 2008

Roll-to-Roll Thermal Nanoimprinted Microfluidic Separation Devices

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Larsen, A. V., Mäkelä, T., Majander, P., Ahopelto, J., Kristensen, A.
Roll-to-Roll Thermal nanoimprinted Microfluidic separation devices based on Pinched flow Fractionation

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Larsen, A. V., Mäkelä, T., Majander, P., Ahopelto, J., Kristensen, A.
Publication date: 2008

Separation enhancement in pinched flow fractionation
A method for enhancing the separation in the microfluidic size separation technique called pinched flow fractionation (PFF) is demonstrated experimentally and analyzed by numerical calculations. The enhancement is caused by a geometrical modification of the original PFF design. Seven different polystyrene bead sizes ranging from 0.25 to 2.5 \( \mu m \) in radius were separated in a PFF and in an enhanced PFF device. The separation in the two types of devices were compared and an amplification in the separation of up to 70% was achieved. Numerical calculations, which include an edge effect, are used to analyze the device.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Vig, A. L., Kristensen, A.
Pages: 203507
Publication date: 2008
Peer-reviewed: Yes

Publication information
Volume: 93
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ISSN (Print): 0003-6951
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.25 SJR 1.382 SNIP 1.167
Web of Science (2017): Impact factor 3.495
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): Impact factor 3.411
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.47 SJR 1.499 SNIP 1.226
Web of Science (2015): Impact factor 3.142
Short-Cycle Thermal Nanoimprint using Smart Stamps

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Silicon Microtechnology, Silicon Microtechnology Group, MicroElectroMechanical Systems Section
Contributors: Pedersen, R. H., Rasmussen, K. H., Lorenzen, L., Lüscher, C., Hansen, O., Kristensen, A.
Publication date: 2008

Host publication information
Title of host publication: Proceeding of The 7th International Conference on Nanoimprint and Nanoprint Technology : NNT'08 October 13-15 2008
Source: orbit
Source-ID: 228119
Research output: Research - peer-review › Article in proceedings – Annual report year: 2008

Short-Cycle Thermal Nanoimprint using Smart Stamps

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Silicon Microtechnology, Silicon Microtechnology Group, MicroElectroMechanical Systems Section
Contributors: Pedersen, R. H., Rasmussen, K. H., Lorenzen, L., Lüscher, C. J., Hansen, O., Kristensen, A.
Publication date: 2008

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Place of publication: Athens, Greece
Source: orbit
Source-ID: 228179
Research output: Research - peer-review › Article in proceedings – Annual report year: 2008

Short-Cycle Thermal Nanoimprint using Smart Stamps

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Silicon Microtechnology, Silicon Microtechnology Group, MicroElectroMechanical Systems Section
Contributors: Pedersen, R. H., Rasmussen, K. H., Lorenzen, I., Lüscher, C., Hansen, O., Kristensen, A.
Publication date: 2008
Peer-reviewed: Yes
Event: Poster session presented at The 7th International Conference on Nanoimprint and Nanoprint Technology, Kyoto, Japan.
Source: orbit
Source-ID: 231674
Research output: Research - peer-review › Poster – Annual report year: 2008

Stretching DNA in polymer nanochannels fabricated by thermal imprint in PMMA
We present results regarding the fast and inexpensive fabrication of polymer biochips for investigating the statics and dynamics of DNA confined in nanochannels. The biochips have been fabricated by means of nanoimprint lithography (NIL) in low molecular weight polymethyl methacrylate (PMMA) using a 4 inch diameter two-level hybrid stamp. The fluidic structures were sealed using thermal polymer fusion bonding. The stamp has nanometer-and micrometer-sized protrusions defined in a thermally grown SiO2 layer and the sol - gel process derived duromeric hybrid polymer Ormocomp, respectively. The stamp is compatible with molecular vapor deposition (MVD), used for applying a durable
chlorosilane based antistiction coating, and allows for imprint up to a temperature of 270 degrees C. The extension of YOYO-1 stained T4 GT7 bacteriophage DNA inside the PMMA nanochannels has been experimentally investigated using epi-fluorescence microscopy. The measured average extension length amounts to 20% of the full contour length with a standard deviation of 4%. These results are in good agreement with results obtained by stretching DNA in conventional fused silica nanochannels.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Thamdrup, L. H., Klukowska, A., Kristensen, A.
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Nanotechnology
Volume: 19
Issue number: 12
ISSN (Print): 0957-4484
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.01 SJR 1.079 SNIP 0.788
Web of Science (2017): Impact factor 3.404
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): Impact factor 3.44
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.07 SJR 1.257 SNIP 1.035
Web of Science (2015): Impact factor 3.573
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.09 SJR 1.497 SNIP 1.269
Web of Science (2014): Impact factor 3.821
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 2.74 SJR 1.602 SNIP 1.231
Web of Science (2013): Impact factor 3.672
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.34 SJR 1.861 SNIP 1.307
Web of Science (2012): Impact factor 3.842
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 3.86 SJR 1.899 SNIP 1.451
Web of Science (2011): Impact factor 3.979
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): Impact factor 3.652
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Benchmarking of 50 nm features in thermal nanoimprint
The objective of this benchmarking is to establish a comparison of several tools and processes used in thermal NIL with Si stamps at the nanoscale among the authors’ laboratories. The Si stamps have large arrays of 50 nm dense lines and were imprinted in all these laboratories in a similar to 100 nm thick mr-18010E film. Other materials, such as mr-17010E, were also tested. Good patterns were obtained and some limitations were identified. Reducing the pressure to 15 bars enables the printing of 50 nm structures without pulling them off. At higher pressures, some bending effects resulting in pattern deformation were observed. It was proven that a pressure of 1.5 bars is sufficient to imprint perfect 50 nm lines. The influence of the antiadhesive layer and mold design has been characterized by the demonstration of pulled off lines in some cases. Moreover, it has been shown that the scatterometry method is particularly useful for the characterization of 50 nm lines and that the residual layer thickness corresponds to the theoretical estimate as long as the lines are well defined. One process was demonstrated which combines high reproducibility with high throughput, achieving a cycle time of 2 min.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Pages: 2373-2378
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Journal of Vacuum Science & Technology B
Volume: 25
Issue number: 6
ISSN (Print): 1071-1023
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.25 SJR 0.467 SNIP 0.631
Web of Science (2017): Impact factor 1.314
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.08 SJR 0.595 SNIP 0.691
Web of Science (2016): Impact factor 1.573
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.66 SJR 0.533 SNIP 0.641
Web of Science (2015): Impact factor 1.398
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.61 SJR 0.509 SNIP 0.601
Web of Science (2014): Impact factor 1.464
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 0.83 SJR 0.55 SNIP 0.631
Web of Science (2013): Impact factor 1.358
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.85 SJR 0.691 SNIP 0.717
Web of Science (2012): Impact factor 1.267
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.22 SJR 0.868 SNIP 0.857
Web of Science (2011): Impact factor 1.341
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.9 SNIP 0.852
Web of Science (2010): Impact factor 1.271
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.929 SNIP 0.955
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.998 SNIP 0.941
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.267 SNIP 1.02
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.285 SNIP 1.211
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.248 SNIP 1.026
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.322 SNIP 1.186
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.495 SNIP 1.235
Scopus rating (2002): SJR 1.306 SNIP 1.277
Scopus rating (2001): SJR 1.608 SNIP 1.218
Scopus rating (2000): SJR 1.899 SNIP 0.998
Web of Science (2000): Indexed yes
The authors have investigated the bleaching dynamics that occur in optofluidic dye lasers where the liquid laser dye in a microfluidic channel is locally bleached due to optical pumping. They find that for microfluidic devices, the dye bleaching may be compensated through diffusion of dye molecules alone. By relying on diffusion rather than convection to generate the necessary dye replenishment, their observation potentially allows for a significant simplification of optofluidic dye laser device layouts, omitting the need for cumbersome and costly external fluidic handling or on-chip microfluidic pumping devices. ©2007 American Institute of Physics.
Capillary driven tunable optofluidic DFB dye lasers

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Gersborg-Hansen, M., Kristensen, A.
Publication date: 2007

Bibliographical note
Copyright (2007) American Institute of Physics. This article may be downloaded for personal use only. Any other use requires prior permission of the author and the American Institute of Physics.
Source: orbit
Source-ID: 205801
Research output: Research - peer-review | Journal article — Annual report year: 2007
Combined electron beam and UV lithography in SU-8
We present combined electron beam and UV lithography (CEUL) in SU-8 as a fast and flexible lithographic technique for prototyping of functional polymer devices and pattern transfer applications. CEUL is a lithographic technique suitable for defining both micrometer and nanometer scale features in a single polymer film on the wafer scale. The height of the micrometer and nanometer scale features is matched within 30 nm. As a pattern transfer application, we demonstrate stamp fabrication and thermal nanoimprint of a 2-dimensional array of 100 nm wide lines with a pitch of 380 nm in connection with micrometer scale features.
Combined nano-imprint and photolithography (CNP) of integrated polymer optics

We demonstrate wafer-scale fabrication of integrated polymer optics, comprising nm to mm features, by combined nanoimprint and photolithography (CNP). Active and passive polymer optical components are integrated: Distributed feedback (DFB) polymer dye lasers and polymer waveguides. The laser devices are defined in SU-8 resist, doped with Rhodamine 6G laser dye, shaped as planar slab waveguides on a Si/SiO2 substrate, and with a 1st-order DFB surface corrugation forming the laser resonator. In the CNP process, a combined UV mask and nanoimprint stamp is embossed into the resist, which is softened by heating, and UV exposed. Hereby the mm to /mi sized features are formed by the UV exposure through the metal mask, while nm-scale features are formed by mechanical deformation (nanoimprinting). The UV exposed (and imprinted) SU-8 is crosslinked by a post-exposure bake, before the stamp and substrate are separated, and the un-exposed resist is dissolved. Polymer waveguides are added to the system by an additional UV lithography step in a film of un-doped SU-8, which is spincoated on top of the lasers and substrate. When optically pumped at 532 nm, lasing is obtained in the wavelength range 559 nm - 600 nm, determined by the grating period. Our results, where 20 laser devices are defined across a 10 cm diameter wafer substrate, demonstrate the feasibility of CNP for wafer-scale fabrication of advanced nano-structured active and passive polymer optical components.
Combined nanoimprint and photolithography of integrated polymer optics

We demonstrate wafer-scale fabrication by combined nanoimprint and photolithography (CNP) of integrated polymer optics, combining active and passive polymer components with nm to mm features. Distributed feed-back (DFB) polymer dye lasers are integrated with polymer waveguides. The laser devices are defined in SU-8 resist, doped with Rhodamine 6G laser dye, shaped as planar slab waveguides on a Fused Silica buffer substrate, and with a 1st-order DFB surface corrugation forming the laser resonator. When optically pumped at 532 nm, lasing is obtained in the wavelength range 560 nm -600 nm, determined by the grating period. Our results, where 20 laser devices are defined across a 10 cm diameter wafer substrate, demonstrate the feasibility of CNP for wafer-scale fabrication of advanced nano-structured active and passive polymer optical components.
Determination of stress build-up during NIL process in triangular polymer structures

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Microreactors, Lab-on-a-Chip
Contributors: Fernández-Cuesta, I., Borrisé, X., Retolaza, A., Merino, S., Mendels, D. A., Hansen, O., Kristensen, A., Pére, F.
Pages: 177-178
Publication date: 2007

Host publication information
Title of host publication: MNE 33rd International Conference on Micro- and Nano-Engineering
Source: orbit
Source-ID: 205983

Diffusion dynamics in microfluidic dye lasers

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Optofluidics Theory and Simulation
Contributors: Gersborg-Hansen, M., Balslev, S., Mortensen, N. A., Kristensen, A.
Publication date: 2007

Host publication information
Title of host publication: Proceedings of the conference on Microfluidics, BioMEMS, and Medical Microsystems V
Volume: 6465
Place of publication: San Jose, CA USA
Publisher: SPIE
Source: orbit
Source-ID: 195926

Diffusive and convective dye replenishment in optofluidic light sources

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Optofluidics Theory and Simulation

Diffusion dynamics in microfluidic dye lasers
We have investigated the bleaching dynamics that occur in opto-fluidic dye lasers, where the liquid laser dye in a channel is locally bleached due to optical pumping. Our studies suggest that for micro-fluidic devices, the dye bleaching may be compensated through diffusion of dye molecules alone. By relying on diffusion rather than convection to generate the necessary dye replenishment, our observation potentially allows for a significant simplification of opto-fluidic dye laser device layouts, omitting the need for cumbersome and costly external fluidic handling or on-chip micro-fluidic pumping devices.
Double thermal oxidation scheme for the fabrication of SiO2 nanochannels

We present a planar fabrication scheme for fluidic systems with silicon dioxide nanochannels and assess the waferscale quality and homogeneity of the fabricated devices. The nanochannels have heights \( h \) ranging from 14 to 300 nm and widths \( w \) of 2.5, 5, and 10 \( \mu \)m. Compared to other state-of-the-art fabrication techniques, our double thermal oxidation scheme (DTOS) displays improvements with respect to 4 inch waferscale height variation \( \sigma(h) \) 2500. We test the devices by measuring capillary filling speed in different channel heights, ranging from 14 to 310 nm. These tests reproduce as well as extend the results reported by Tas et al (2004 Appl. Phys. Lett. 85 3274). A systematic deviation from bulk behaviour has been observed for channel heights below 100 nm.
Experimental investigation of bubble formation during capillary filling of SiO2 nanoslits

Experimental results are presented regarding the influence of bubble formation on the capillary filling speed of water in SiO2 nanoslits with heights ranging from 33 to 158 nm. The formation of an isolated pinned bubble in a nanoslit with a height of 111 nm causes an immediate decrease in the filling speed. In nanoslits with heights below 100 nm, pinned bubbles are continuously formed at the advancing liquid meniscus. This observed increase in bubble density, which increases the fluidic resistance, quantitatively coincides with an observed reduction of the filling speed during filling of nanoslits with heights below 100 nm.

General information

State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Lab-on-a-Chip, Theoretical Microfluidics Group, Theory Section, Rise National Laboratory for Sustainable Energy
Contributors: Thamdrup, L. H., Persson, K. F., Bruus, H., Kristensen, A., Flyvbjerg, H.
Fabrication of plasmonic waveguides by nanoimprint lithography

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Nanophotonics, Department of Photonics Engineering
Contributors: Nielsen, R. B., Kristensen, A., Boltasseva, A., Cuesta, I. F.
Publication date: 2007
Peer-reviewed: Yes
Event: Abstract from Third International Conference on Surface Plasmon Photonics, SPP3, Dijon, France.
Source: orbit
Source-ID: 206786
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2007

Fabrication of plasmonic waveguides for device applications
We report on experimental realization of different metal-insulator geometries that are used as plasmonic waveguides guiding electromagnetic radiation along metal-dielectric interfaces via excitation of surface plasmon polaritons (SPPs). Three configurations are considered: metal strips, symmetric nanowires and nanowire pairs embedded in a dielectric, and metal V-shaped grooves. Planar plasmonic waveguides based on nm-thin and pm-wide gold strips embedded in a polymer that support propagation of long-range SPPs are shown to constitute an alternative for integrated optical circuits. Using uniform and thickness-modulated gold strips different waveguide components including reflecting gratings can be realized. For applications where polarization is random or changing, metal nanowire waveguides are shown to be suitable candidates for efficient guiding of arbitrary polarized light. Plasmonic waveguides based on metal V-grooves that offer subwavelength confinement are also considered. We focus on recent advances in manufacturing of nanostructured metal strips and metal V-grooves using combined UV, electron-beam and nanoimprint lithography.

General information
State: Published
Organisations: Plasmonics and Metamaterials, Department of Photonics Engineering, NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Fast thermal nanoimprint lithography by a stamp with integrated heater

General information
State: Published
Organisations: Plasmonics and Metamaterials, Department of Photonics Engineering, NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Silicon Microtechnology Group, MicroElectroMechanical Systems Section
Contributors: Tormen, M., Malureanu, R., Kristensen, A., Hansen, O.
Pages: 117-118
Publication date: 2007

Host publication information
Title of host publication: MNE 33rd International Conference on Micro- and Nano-Engineering
Source: orbit
Source-ID: 205981
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 2007

Imprinted plasmonic waveguides

General information
State: Published
Organisations: Department of Photonics Engineering, Nanophotonics, Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Boltasseva, A., Nielsen, R., Jørgensen, K., Pedersen, R., Kristensen, A., Cuesta, I. F.
Publication date: 2007
Peer-reviewed: Yes
Event: Abstract from International Conference on Coherent and Nonlinear Optics, Minsk, Belarus, .
Source: orbit
Source-ID: 202119
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2007

Imprinted silicon-based nanophotonics
We demonstrate and optically characterize silicon-on-insulator based nanophotonic devices fabricated by nanoimprint lithography. In our demonstration, we have realized ordinary and topology-optimized photonic crystal waveguide structures. The topology-optimized structures require lateral pattern definition on a sub 30-nm scale in combination with a deep vertical silicon etch of the order of ~300 nm. The nanoimprint method offers a cost-efficient parallel fabrication process with state-of-the-art replication fidelity, comparable to direct electron beam writing.

General information
State: Published
Organisations: Nanophotonics, Department of Photonics Engineering, Lab-on-a-Chip, Department of Micro- and Nanotechnology, Nanophotonic Devices, Plasmonics and Metamaterials, Solid Mechanics, Department of Mechanical Engineering, Center for Nanoteknologi
Contributors: Borel, P. I., Olsen, B. B., Frandsen, L. H., Nielsen, T., Fage-Pedersen, J., Lavrinenko, A., Jensen, J. S., Sigmund, O., Kristensen, A.
Pages: 1261-1266
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Optics Express
Volume: 15
Issue number: 3
ISSN (Print): 1094-4087
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Web of Science (2014): Impact factor 3.488
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196
Web of Science (2013): Impact factor 3.525
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.85 SJR 2.562 SNIP 2.108
Web of Science (2012): Impact factor 3.546
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.58 SNIP 2.572
Web of Science (2011): Impact factor 3.587
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): Impact factor 3.753
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
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.442 SNIP 0.843
Original language: English
Integrated Active and Passive Polymer Optical Components with nm to mm Features

We present wafer-scale fabrication of integrated active and passive polymer optics with nm to mm features. First order DFB lasers, defined in dye doped SU-8 resist are integrated with SU-8 waveguides.

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Christiansen, M. B., Schøler, M., Kristensen, A.
Pages: 1-2
Publication date: 2007

Host publication information
Publisher: IEEE
ISBN (Print): 978-1-55752-834-6
Electronic versions:
Christiansen.pdf
DOIs:
10.1109/CLEO.2007.4452709

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Source: orbit
Source-ID: 199134
Research output: Research - peer-review › Article in proceedings – Annual report year: 2007

Integration of active and passive polymer optics

We demonstrate a wafer scale fabrication process for integration of active and passive polymer optics: Polymer DFB lasers and waveguides. Polymer dye DFB lasers are fabricated by combined nanoimprint and photolithography (CNP). The CNP fabrication relies on an UV transparent stamp with nm sized protrusions and an integrated metal shadow mask. In the CNP process, a combined UV mask and nanoimprint stamp is embossed into the resist, which is softened by heating, and UV exposed. Hereby the mm to m m sized features are defined by the UV exposure through the metal mask, while nm-scale features are formed by mechanical deformation (nanoimprinting). The lasers are integrated with undoped SU-8 polymer waveguides. The waferscale fabrication process has a yield above 90% and the emission wavelengths are reproduced within 2 nm. Confinement of the light on the chip is demonstrated, and the influence on the laser wavelength from temperature and refractive index changes in the surroundings is investigated, pointing towards the use of the described fabrication method for on-chip polymer sensor systems.

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Christiansen, M. B., Schøler, M., Kristensen, A.
Pages: 3931-3939
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Optics Express
Volume: 15
Issue number: 7
ISSN (Print): 1094-4087
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.76 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Web of Science (2014): Impact factor 3.488
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196
Web of Science (2013): Impact factor 3.525
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.85 SJR 2.562 SNIP 2.108
Web of Science (2012): Impact factor 3.546
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.58 SNIP 2.572
Web of Science (2011): Impact factor 3.587
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): Impact factor 3.753
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
Metal strips and wires as plasmonic waveguides for integrated-optics components
Propagation of long-range surface plasmon polaritons in different waveguide components based on nm-thin and µm-wide metal strips and symmetrical sub-wavelength metal nanowires embedded in a uniform dielectric is experimentally studied at telecom wavelengths.

Microfabricated chips and novel methods for characterisation of nanostructures integrated in microsystems
We show that the ionic environment plays a critical role in determining the configurational properties of DNA confined in silica nanochannels. The extension of DNA in the nanochannels increases as the ionic strength is reduced, almost tripling over two decades in ionic strength for channels around 100×100 nm in dimension. Surprisingly, we find that the variation of the persistence length alone with ionic strength is not enough to explain our results. The effect is due mainly to increasing self-avoidance created by the reduced screening of electrostatic interactions at low ionic strength. To quantify the increase in self-avoidance, we introduce a new parameter into the de Gennes theory: an effective DNA width that gives the increase in the excluded volume due to electrostatic repulsion.
Nanoimprinted reflecting gratings for long-range surface plasmon polaritons

We present a novel design, fabrication, and characterization of reflecting gratings for long-range surface plasmon polaritons (LR-SPPs) at telecom wavelengths. LR-SPP waveguides consisting of a thin (12 nm) gold film embedded in a thick (45 μm) layer of dielectric polymer cladding are structured by nanoimprint lithography to form a reflecting Bragg grating. By performing spectrally resolved transmission measurements pronounced Bragg grating behaviour is observed, with the transmission dip increasing (up to 12 dB) with the increasing grating length.

General information
State: Published
Organisations: NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Plasmonics and Metamaterials, Department of Photonics Engineering
Contributors: Pedersen, R. H., Boltasseva, A., Johansen, D. M., Nielsen, T., Jørgensen, K. B., Leosson, K., Østergaard, J. E., Kristensen, A.
Pages: 895-898
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Microelectronic Engineering
Volume: 84
Issue number: 5-8
ISSN (Print): 0167-9317
Ratings:
  BFI (2018): BFI-level 2
  Web of Science (2018): Indexed yes
  BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.87 SJR 0.604 SNIP 0.937
  Web of Science (2017): Impact factor 2.02
  Web of Science (2017): Indexed yes
Keywords: Reflecting grating, Nanoimprint lithography, Long-range surface plasmon polaritons

DOIs: 10.1016/j.mee.2007.01.110

URLs: http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V0W-4MYMFNB-7&_user=10&_coverDate=08%2F31%2F2007&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=fa0552fe6211b97f87e0a340a5e1c82f

Source: orbit  
Source-ID: 205803  
Research output: Research - peer-review › Journal article – Annual report year: 2007

**Nanoimprint Lithography**

**General information**
State: Published  
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology  
Contributors: Schift, H., Kristensen, A.  
Publication date: 2007

**Host publication information**
Title of host publication: Springer Handbook of Nanotechnology  
Volume: Chapter 8  
Place of publication: Berlin, Heidelberg  
Publisher: Springer  
Editor: Bhushan, B.  
Edition: 2nd  
ISBN (Print): 3-540-29855-x, 978-3-540-29855-7  
Source: orbit  
Source-ID: 195869  
Research output: Research - peer-review › Book chapter – Annual report year: 2007

**Optofluidic tuning of photonic crystal band edge lasers**
We demonstrate optofluidic tuning of polymer photonic crystal band edge lasers with an imposed rectangular symmetry. The emission wavelength depends on both lattice constant and cladding refractive index. The emission wavelength is shown to change 1 nm with a cladding refractive index change of 10^-2. The rectangular symmetry modification alters the emission characteristics of the devices and the relative emission intensities along the symmetry axes depend on cladding refractive index, suggesting a sensor concept based on detection of intensity rather than wavelength.

**General information**
State: Published  
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section, Lab-on-a-Chip  
Contributors: Bernal, F., Christiansen, M. B., Gersborg-Hansen, M., Kristensen, A.  
Pages: 223503  
Publication date: 2007  
Peer-reviewed: Yes

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Volume: 91  
Issue number: 22  
ISSN (Print): 0003-6951  
Ratings:  
BFI (2018): BFI-level 2  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 2  
Scopus rating (2017): CiteScore 3.25 SJR 1.382 SNIP 1.167  
Web of Science (2017): Impact factor 3.495  
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): Impact factor 3.411
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.47 SJR 1.499 SNIP 1.226
Web of Science (2015): Impact factor 3.142
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.25 SJR 1.861 SNIP 1.492
Web of Science (2014): Impact factor 3.302
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.77 SJR 2.146 SNIP 1.633
Web of Science (2013): Impact factor 3.515
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.76 SJR 2.57 SNIP 1.739
Web of Science (2012): Impact factor 3.794
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.814 SNIP 1.917
Web of Science (2011): Impact factor 3.844
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.92 SNIP 1.775
Web of Science (2010): Impact factor 3.841
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.826 SNIP 1.834
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.894 SNIP 1.82
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 3.012 SNIP 1.916
Web of Science (2007): Indexed yes
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 3.755 SNIP 2.353
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 3.992 SNIP 2.367
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 3.897 SNIP 2.275
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 4.018 SNIP 2.414
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 4.281 SNIP 2.22
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 4.178 SNIP 2.017
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 4.173 SNIP 2.066

Original language: English
Strips, wires and grooves as plasmonic waveguides for device applications

General information
State: Published
Organisations: Department of Photonics Engineering, Nanophotonics, Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Boltasseva, A., Leosson, K., Rosenzveig, T., Jung, J., Søndergaard, T., Bozhevolnyi, S. I., Nielsen, R., Jørgensen, K., Pedersen, R., Kristensen, A., Cuesta, I. F.
Publication date: 2007
Peer-reviewed: Yes
Event: Abstract from SPIE Optics and Photonics: Photonics Metamaterials, San Diego, CA, USA.
Source: orbit
Source-ID: 202117
Research output: Research - peer-review  Conference abstract for conference – Annual report year: 2007

The physics of DNA in nanochannels

General information
State: Published
Organisations: Polymers for Biological and Medical Technology, Polymer Department, Risø National Laboratory for Sustainable Energy, Cell Biology, Biosystems Division, Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Reisner, W., Larsen, N. B., Flyvbjerg, H. K., Tegenfeldt, J., Kristensen, A.
Number of pages: 329
Publication date: 2007

Host publication information
Title of host publication: Book of abstracts
Place of publication: Copenhagen
Publisher: MNE 2007
URLs:
Source: orbit
Source-ID: 216020
Research output: Research  Conference abstract in proceedings – Annual report year: 2007

The physics of DNA in nanochannels

General information
State: Published
Organisations: Polymers for Biological and Medical Technology, Polymer Department, Risø National Laboratory for Sustainable Energy, Cell Biology, Biosystems Division, NSE-Optofluidics Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology
Contributors: Reisner, W., Larsen, N. B., Tegenfeldt, J., Flyvbjerg, H., Kristensen, A.
Publication date: 2007
Peer-reviewed: No
Event: Abstract from 3rd Annual meeting Danish Physical Society, Nyborg, Denmark.
URLs:
Source: orbit
Source-ID: 216253
Research output: Research  Conference abstract for conference – Annual report year: 2007

Tunability of optofluidic distributed feedback dye lasers
We investigate the tunability of optofluidic distributed feedback (DFB) dye lasers. The lasers rely on light-confinement in a nano-structured polymer film where an array of nanofluidic channels constitutes a third order Bragg grating DFB laser resonator with a central phase-shift. The lasers are operated by filling the DFB laser resonator with a dye solution by capillary action and optical pumping with a frequency doubled Nd: YAG laser. The low reflection order of the DFB laser resonator yields low out-of-plane scattering losses as well as a large free spectral range (FSR), and low threshold fluences down to similar to 7 μJ/mm2 are observed. The large FSR facilitates wavelength tuning over the full gain spectrum of the chosen laser dye and we demonstrate 45 nm tunability using a single laser dye by changing the grating period and dye solution refractive index. The lasers are straightforward to integrate on lab-on-a-chip microsystems, e. g. for novel sensor concepts, where coherent light in the visible range is desired.
Tunable Optofluidic Third Order DFB Dye Laser

We present a low-threshold polymer-based nanofluidic dye laser. By employing a third order DFB laser resonator, we demonstrate a threshold fluence of ~7 μJ/mm² and a tunability of 45 nm using a single laser dye.

V-groove plasmonic waveguides fabricated by nanoimprint lithography

Bibliographical note

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V-groove plasmonic waveguides fabricated by nanoimprint lithography

Propagation of channel plasmon-polariton modes in the bottom of a metal V groove has been recently demonstrated. It provides a unique way of manipulating light at nanometer length scale. In this work, we present a method based on nanoimprint lithography that allows parallel fabrication of integrated optical devices composed of metal V grooves. This method represents an improvement with respect to previous works, where the V grooves were fabricated by direct milling of the metal, in terms of robustness and throughput.

© 2007 American Vacuum Society
V-groove waveguides fabricated by nanoimprint lithography

General information
State: Published
Organisations: Department of Photonics Engineering, Nanophotonics, Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Fernandez-Cuesta, I., Nielsen, R., Boltasseva, A., Borrisé, X., Peréz-murano, F., Kristensen, A.
Publication date: 2007
Peer-reviewed: Yes
Source: orbit
Source-ID: 205878
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2007

Polymer dye lasers

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Balslev, S., Kristensen, A.
Number of pages: 144
Publication date: Apr 2006
Capillary filling speed in silicon dioxide nano-channels

General information
State: Published
Organisations: Microfluidics Theory and Simulation, Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Jarlgaard, S., Mikkelsen, M., Skafte-Pedersen, P., Bruus, H., Kristensen, A.
Pages: 521-523
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the 2006 NSTI Nanotech 2006
Volume: 2
Place of publication: Boston, USA
Source: orbit
Source-ID: 188176
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Combined electron beam lithography and UV lithography in SU-8

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Gersborg-Hansen, M., Thamdrup, L. H., Mironov, A., Kristensen, A.
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the 32nd International Conference on Micro and Nano Engineering
Source: orbit
Source-ID: 192706
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Comparison of High Resolution Negative Electron Beam Resists
Four high resolution negative electron beam resists are compared: TEBN-1 from Tokuyama Corp. Japan, ma-N 2401XP and mr-L 6000AXP from microresist technology GmbH Germany, and SU-8 2000 series from MicroChem Corp., USA. Narrow linewidth high density patterns are defined by 100 kV electron beam lithography, and the pattern is transferred into silicon by a highly anisotropic SF6/O-2/CHF3 based reactive ion etch process with a selectivity between silicon and the investigated resists of approximately 2.20 nm half-pitch lines and 10 nm lines with a pitch down to 60 nm are written and transferred into silicon. © 2006 American Vacuum Society.

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Cell Particle Handling, DTU Danchip, Nanoprobes Group, NanoSystemsEngineering Section, Nanointegration Group, NSE-Optofluidics Group
Pages: 1776-1779
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Journal of Vacuum Science & Technology B
Volume: 24
Issue number: 4
ISSN (Print): 1071-1023
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes

BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.25 SJR 0.467 SNIP 0.631
Web of Science (2017): Impact factor 1.314
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.08 SJR 0.595 SNIP 0.691
Web of Science (2016): Impact factor 1.573
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.66 SJR 0.533 SNIP 0.641
Web of Science (2015): Impact factor 1.398
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.61 SJR 0.509 SNIP 0.601
Web of Science (2014): Impact factor 1.464
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 0.83 SJR 0.55 SNIP 0.631
Web of Science (2013): Impact factor 1.358
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.85 SJR 0.691 SNIP 0.717
Web of Science (2012): Impact factor 1.267
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.22 SJR 0.868 SNIP 0.857
Web of Science (2011): Impact factor 1.341
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.9 SNIP 0.852
Web of Science (2010): Impact factor 1.271
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.929 SNIP 0.955
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.998 SNIP 0.941
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.267 SNIP 1.02
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.285 SNIP 1.211
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.248 SNIP 1.026
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.322 SNIP 1.186
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.495 SNIP 1.235
Scopus rating (2002): SJR 1.306 SNIP 1.277
Scopus rating (2001): SJR 1.608 SNIP 1.218
Scopus rating (2000): SJR 1.899 SNIP 0.998
Fabrication of Long-Range Surface Plasmon Polariton Devices by Nanoimprint Lithography

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Pedersen, R. H., Boltasseva, A., Johansen, D. M., Nielsen, T., Jørgensen, K., Leosson, K., Østergaard, J., Kristensen, A.
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the 32nd International Conference on Micro and Nano Engineering
Source: orbit
Source-ID: 190635
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Grey scale electron beam lithography in functionalized SU-8 for active optical devices

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Microreactors
Contributors: Balslev, S., Rasmussen, T., Shi, P., Kristensen, A.
Pages: 69-76
Publication date: 2006

Host publication information
Title of host publication: Proceedings of SPIE
Volume: 6110
Source: orbit
Source-ID: 188177
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

High pattern density nanoimprint lithography stamps fabricated by means of negative electron beam lithography resist, TEBN-1, and dry etching in silicon

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Cell Particle Handling, Nanointegration
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the 4th International Conference on Nanoimprint and Nanoprint, NNT'05
Source: orbit
Source-ID: 193693
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

High resolution 100 kV electron beam lithography in SU-8

High resolution 100 kV electron beam lithography in thin layers of the negative resist SU-8 is demonstrated. Sub-30 nm lines with a pitch down to 300 nm are written in 100 nm thick SU-8. Two reactive ion etch processes are developed in order to transfer the SU-8 structures into a silicon substrate, a Soft O-2-Plasma process to remove SU-8 residues on the silicon surface after development and a highly anisotropic SF6/O-2/CHF3 based process to transfer the pattern into a silicon substrate, with selectivity between silicon and SU-8 of approximately 2. 30 nm lines patterned in SU-8 are successfully transferred into a silicon substrate, which is used as a stamp in a nanoimprint lithography process to fabricate a nanochannel device for DNA stretching experiments.
Investigation of fluid dynamics during capillary filling in low aspect ratio SiO2 nanochannels

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip, Microfluidics Theory and Simulation
Contributors: Persson, F., Thamdrup, L. H., Mikkelsen, M., Bruus, H., Kristensen, A.
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the 32nd International Conference on Micro and Nano Engineering
Source: orbit
Source-ID: 190636
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Lab-on-a-chip Lasers

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Kristensen, A., Balslev, S., Gersborg-Hansen, M., Christiansen, M. B., Schøler, M., Nilsson, D.
Publication date: 2006
Peer-reviewed: Yes
Source: orbit
Source-ID: 190858
Research output: Research - peer-review › Paper – Annual report year: 2006

Lab-on-a-chip Lasers

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Cell Particle Handling
Contributors: Kristensen, A., Balslev, S., Gersborg-Hansen, M., Christiansen, M. B., Schøler, M., Nilsson, D.
Publication date: 2006
Peer-reviewed: Yes
Event: Poster session presented at 3rd NanoSpain Workshop, Pamplona, Spain.
Source: orbit
Source-ID: 193691
Research output: Research - peer-review › Poster – Annual report year: 2006
Lab-on-a-chip with integrated optical transducers

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, InSERS, MicroTAS, POEM
Pages: 213-217
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Lab on a Chip
Volume: 6
Issue number: 2
ISSN (Print): 1473-0197
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 6.05 SJR 2.158 SNIP 1.586
Web of Science (2017): Impact factor 5.995
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 5.98 SJR 2.162 SNIP 1.569
Web of Science (2016): Impact factor 6.045
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 5.74 SJR 2.239 SNIP 1.721
Web of Science (2015): Impact factor 5.586
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 5.6 SJR 2.555 SNIP 1.797
Web of Science (2014): Impact factor 6.115
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.9 SJR 2.397 SNIP 1.693
Web of Science (2013): Impact factor 5.748
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.35 SJR 2.405 SNIP 1.731
Web of Science (2012): Impact factor 5.697
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.76 SJR 2.54 SNIP 1.788
Web of Science (2011): Impact factor 5.67
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.718 SNIP 1.876
Web of Science (2010): Impact factor 6.26
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Levitated droplet dye laser

We present the first observation, to our knowledge, of lasing from a levitated, dye droplet. The levitated droplets are created by computer controlled pico-liter dispensing into one of the nodes of a standing ultrasonic wave (100 kHz), where the droplet is trapped. The free hanging droplet forms a high quality optical resonator. Our 750 nL lasing droplets consist of Rhodamine 6G dissolved in ethylene glycol, at a concentration of 0.02 M. The droplets are optically pumped at 532 nm light from a pulsed, frequency doubled Nd:YAG laser, and the dye laser emission is analyzed by a fixed grating spectrometer. With this setup we have achieved reproducible lasing spectra in the visible wavelength range from 610 nm to 650 nm. The levitated droplet technique has previously successfully been applied for a variety of bio-analytical applications at single cell level. In combination with the lasing droplets, the capability of this high precision setup has potential applications within highly sensitive intra-cavity absorbance detection.

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General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Optofluidics Theory and Similation
Pages: 4374-4379
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Optics Express
Volume: 14
Issue number: 10
ISSN (Print): 1094-4087
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
Levitated Droplet Dye Laser

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Optofluidics Theory and Simulation, Technical University of Denmark
Number of pages: 68
Publication date: 2006

Host publication information
Title of host publication: Proceedings of SPIE
Volume: 6092
Source: orbit
Source-ID: 188166
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Long-Range Surface Plasmon Polariton Devices Fabricated by Nanoimprint Lithography

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Pedersen, R. H., Boltasseva, A., Jørgensen, K., Johansen, D. M., Nielsen, T., Leosson, K., Østergaard, J., Kristensen, A.
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the conference on Ultimate Lithography and Nanofabrication for Electronic and Life Science
Source: orbit
Source-ID: 190642
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Micro-fabricated single mode polymer dye laser

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Balslev, S., Mironov, A., Nilsson, D., Kristensen, A.
Pages: 2170-2177
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Optics Express
Volume: 14
Issue number: 6
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567
Web of Science (2017): Impact factor 3.356
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): Impact factor 3.307
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124
Web of Science (2014): Impact factor 3.488
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196
Web of Science (2013): Impact factor 3.525
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.85 SJR 2.562 SNIP 2.108
Web of Science (2012): Impact factor 3.546
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 4.04 SJR 2.58 SNIP 2.572
Web of Science (2011): Impact factor 3.587
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): Impact factor 3.753
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
Web of Science (2000): Indexed yes
Microfluidic Dye Lasers
A technology for miniaturized, polymer based lasers, suitable for integration with planar waveguides and microfluidic networks is presented. The microfluidic dye laser device consists of a microfluidic channel with an embedded optical resonator. The devices are fabricated in a thin polymer film sandwiched between two glass substrates. The devices are defined in the 1-10 mum thick polymer film by photolithography, nanoimprinting or by electron beam lithography, and the lid is bonded using adhesive polymer bonding.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section, Lab-on-a-Chip, Microreactors, Optofluidics Theory and Simulation
Pages: 56-57
Publication date: 2006

Host publication information
Title of host publication: Digest of the 2006 IEEE/LEOS Summer Topical Meetings
Publisher: IEEE
DOIs: 10.1109/LEOSST.2006.1693979
Source: orbit
Source-ID: 193690
Research output: Research - peer-review > Article in proceedings – Annual report year: 2006

Micro-Fluidic Dye Ring Laser - Experimental Tuning of the Wavelength and Numerical Simulation of the Cavity Modes
We demonstrate wavelength tuning of a micro-fluidic dye ring laser. Wavelength tunability is obtained by controlling the liquid dye concentration. The device performance is modelled by FEM simulations supporting a ray-tracing view.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip, Optofluidics Theory and Simulation, Optofluidics
Contributors: Gersborg-Hansen, M., Balslev, S., Mortensen, N. A., Kristensen, A.
Pages: 1-2
Publication date: 2006

Host publication information
Title of host publication: 2006 Quantum Electronics Lasers and Electro-Optics
Publisher: IEEE
ISBN (Print): 978-1-55752-813-1
Electronic versions: Kristensen.pdf
DOIs: 10.1109/CLEO.2006.4627734

Bibliographical note
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Source: orbit
Source-ID: 193692
Research output: Research - peer-review > Article in proceedings – Annual report year: 2006

Nanocomposites Based on Luminescent Colloidal Nanocrystal and Thermoplastic Polymer For Fabrication of Optical Elements
Nanoimprinted Long-range Surface Plasmon Polariton Waveguide Components

We report on the fabrication by nanoimprint lithography (NIL) and performance of metal stripe waveguides embedded in a polymer, capable of supporting long-range surface plasmon polariton (LRSPP) propagation.

Nanoimprint Fabrication of Long-Range Surface Plasmon Polariton Devices

Nanoimprint lithography fabrication of photonic crystal devices
Nanoimprint Lithography of Topology Optimized Photonic Crystal Devices

We demonstrate a nanoimprint process for fabrication of photonic crystal devices. The nanoimprint process, defining stamp patterns in a thin e-beam resist, yields improved pattern replication compared to direct e-beam writing of the devices.

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Nanophotonics, Department of Photonics Engineering
Contributors: Olsen, B. B., Frandsen, L. H., Nielsen, T., Vogler, M., Borel, P. I., Kristensen, A.
Pages: 1-2
Publication date: 2006

Host publication information
Publisher: IEEE
ISBN (Print): 978-1-55752-813-1
Electronic versions: Bilenberg.pdf
DOIs: 10.1109/CLEO.2006.4628228

Bibliographical note
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Source: orbit
Source-ID: 190861
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Optical characterisation of photonic wire and photonic crystal waveguides fabricated using nanoimprint lithography

We have characterised photonic-crystal and photonic-wire waveguides fabricated by thermal nanoimprint lithography. The structures, with feature sizes down below 20 nm, are benchmarked against similar structures defined by direct electron beam lithography.

General information
State: Published
Organisations: Nanophotonics, Department of Photonics Engineering, Lab-on-a-Chip, Department of Micro- and Nanotechnology, Solid Mechanics, Department of Mechanical Engineering, Center for Nanoteknologi
Contributors: Borel, P. I., Frandsen, L. H., Lavrinenko, A., Olsen, B. B., Nielsen, T., Kristensen, A., Jensen, J. S., Sigmund, O.
Optofluidic third order distributed feedback dye laser
This letter describes the design and operation of a polymer-based third order distributed feedback (DFB) microfluidic dye laser. The device relies on light confinement in a nanostructured polymer film where an array of nanofluidic channels is filled by capillary action with a liquid dye solution which has a refractive index lower than that of the polymer. In combination with a third order DFB grating, formed by the array of nanofluidic channels, this yields a low threshold for lasing. The laser is straightforward to integrate on lab-on-a-chip microsystems where coherent, tunable light in the visible range is desired. (c) 2006 American Institute of Physics.
Optofluidic third order distributed feedback dye laser

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Gersborg-Hansen, M., Kristensen, A.
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Virtual Journal of Nanoscale Science & Technology
Volume: 14
Issue number: 12
ISSN (Print): 1553-9644
Original language: English
Source: orbit
Source-ID: 192651
Research output: Research - peer-review › Journal article – Annual report year: 2006

Polmer-based nano-fluidic dye laser

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Gersborg-Hansen, M., Kristensen, A.
Publication date: 2006

Host publication information
Title of host publication: The 32nd International Conference on Micro and Nano Engineering
Source: orbit
Source-ID: 190634
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Pushing the limits of deterministic Lateral displacement

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors: Larsen, A. V., Beech, J., Ozkapici, V., Olsen, B. B., Kristensen, A.
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the 10th International Conference on Miniaturized Systems for Chemistry and Life Sciences
Source: orbit
Source-ID: 190633
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Real-time tunability of chip-based light source enabled by microfluidic mixing

We demonstrate real-time tunability of a chip-based liquid light source enabled by microfluidic mixing. The mixer and light source are fabricated in SU-8 which is suitable for integration in SU-8-based laboratory-on-a-chip microsystems. The tunability of the light source is achieved by changing the concentration of rhodamine 6G dye inside two integrated vertical resonators, since both the refractive index and the gain profile are influenced by the dye concentration. The effect on the refractive index and the gain profile of rhodamine 6G in ethanol is investigated and the continuous tuning of the laser output wavelength is demonstrated using an ethanolic rhodamine 6G solution of 2×10−2 mol/l mixed with pure ethanol. This yields rhodamine 6G concentrations from 5×10−3 to 1.5×10−2 mol/l inside the laser resonators and a wavelength
change of 10 nm with a response time of 110 s. ©2006 American Institute of Physics

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Silicon Microtechnology Group, MicroElectroMechanical Systems Section, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Olsen, B. B., Rasmussen, T., Balslev, S., Kristensen, A.
Pages: 023102
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Journal of Applied Physics
Volume: 99
Issue number: 2
ISSN (Print): 0021-8979
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.03 SJR 0.739 SNIP 0.953
Web of Science (2017): Impact factor 2.176
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): Impact factor 2.068
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.57 SJR 0.821 SNIP 0.996
Web of Science (2015): Impact factor 2.101
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.04 SJR 1.039 SNIP 1.197
Web of Science (2014): Impact factor 2.183
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.24 SJR 1.155 SNIP 1.286
Web of Science (2013): Impact factor 2.185
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.13 SJR 1.312 SNIP 1.291
Web of Science (2012): Impact factor 2.21
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.24 SJR 1.374 SNIP 1.3
Web of Science (2011): Impact factor 2.168
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.484 SNIP 1.204
Web of Science (2010): Impact factor 2.079
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.51 SNIP 1.237
Single mode and tunable microfluidic dye lasers

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Kristensen, A., Balslev, S., Gersborg-Hansen, M., Olsen, B. B., Nilsson, D.
Number of pages: 632,901
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the conference on Optofluidics at the SPIE Symposium on Optics & Photonics 2005, 13 - 17 August 2006
Volume: 6329
Place of publication: San Diego, CA, USA
Source: orbit
Source-ID: 193668
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Single-step NIL of micro and nanochannels combined with optical waveguides for characterization of DNA molecules

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Ultra-compact Low Pressure Nanoimprint System With Automated Demolding

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, MicroNano Tribology and Modeling, Center for Individual Nanoparticle Functionality
Contributors: Pedersen, R. H., Hansen, O., Kristensen, A.
Publication date: 2006
Peer-reviewed: No
Source: orbit
Source-ID: 193078
Research output: Research › Conference abstract for conference – Annual report year: 2006

Wafer-scale fabrication of polymer distributed feedback lasers
The authors demonstrate wafer-scale, parallel process fabrication of distributed feedback (DFB) polymer dye lasers by two different nanoimprint techniques: By thermal nanoimprint lithography (TNIL) in polymethyl methacrylate and by combined nanoimprint and photolithography (CNP) in SU-8. In both techniques, a thin film of polymer, doped with rhodamine-6G laser dye, is spin coated onto a Borofloat glass buffer substrate and shaped into a planar waveguide slab with first order DFB surface corrugations forming the laser resonator. When optically pumped at 532 nm, lasing is obtained in the wavelength range between 576 and 607 nm, determined by the grating period. The results, where 13 laser devices are defined across a 10 cm diameter wafer substrate, demonstrate the feasibility of NIL and CNP for parallel wafer-scale fabrication of advanced nanostructured active optical polymer components, with a yield above 95%.

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Plasmonics and Metamaterials, Nanointegration
Contributors: Christiansen, M. B., Schøler, M., Balslev, S., Nielsen, R. B., Petersen, D. H., Kristensen, A.
Pages: 3252-3257
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Journal of Vacuum Science & Technology B
Volume: 24
Issue number: 6
ISSN (Print): 1071-1023
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.25 SJR 0.467 SNIP 0.631
Web of Science (2017): Impact factor 1.314
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.08 SJR 0.595 SNIP 0.691
Web of Science (2016): Impact factor 1.573
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.66 SJR 0.533 SNIP 0.641
Web of Science (2015): Impact factor 1.398
Wafer-scale Fabrication of Single Mode Polymer DFB Lasers

General information
State:Published
Organisations:Lab-on-a-Chip, Department of Micro- and Nanotechnology
Contributors:Christiansen, M. B., Schøler, M., Balslev, S., Kristensen, A.
Publication date:2006
Polymer based miniaturized dye lasers for lab-on-a-chip-systems

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Nilsson, J. D. G., Kristensen, A., Menon, A. K.
Number of pages: 208
Publication date: May 2005

Publication information
Original language: English
Source: orbit
Source-ID: 186329
Research output: Research › Ph.D. thesis – Annual report year: 2005

20 nm Nanoimprint Lithography Stamps RIE-Etched in Silicon Using Carbon Nanotubes as Etch Masks

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip, Nanointegration
Contributors: Schmidt, M. S., Nielsen, T., Schurmann, T., Madsen, D. N., Kristensen, A., Bøggild, P.
Publication date: 2005
Peer-reviewed: No
Source: orbit
Source-ID: 186189
Research output: Research › Poster – Annual report year: 2005

A coupled cavity microfluidic dye ring laser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Gersborg-Hansen, M., Balslev, S., Mortensen, N. A., Kristensen, A.
Pages: 185-189
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Microelectronic Engineering
Volume: 78-79
ISSN (Print): 0167-9317
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.87 SJR 0.604 SNIP 0.937
Web of Science (2017): Impact factor 2.02
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): Impact factor 1.806
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
A microfluidic dye laser fabricated by nanoimprint lithography in a highly transparent and chemically resistant cyclo-olefin copolymer (COC)
A nanoimprinted polymer lab-on-a-chip with integrated optics

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Hansen, M. S., Nilsson, D., Johansen, D. M., Balslev, S., Kristensen, A.
Pages: 76-82
Publication date: 2005

Host publication information
Title of host publication: Proceedings of SPIE : Advancements in Polymer Optics Design, Fabrication and Materials at the SPIE Symposium on Optics & Photonics 2005
Volume: 5872
Editor: Goodman, T. D.
(Proc. SPIE; No. 5872).
DOIs: 10.1117/12.615997
Source: orbit
Source-ID: 182662
Research output: Research - peer-review › Article in proceedings – Annual report year: 2005

A polymer lab-on-a-chip with integrated optics fabricated by nanoimprint lithography

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Hansen, M., Balslev, S., Kristensen, A.
Publication date: 2005
Peer-reviewed: Yes
Event: Poster session presented at EUROSENSORS XIX, 11 14 September, Barcelona, Spain, .
Source: orbit
Source-ID: 193695
Research output: Research - peer-review › Poster – Annual report year: 2005
Flexible Stamp for Nanoimprint Lithography

The design, fabrication and performance of a flexible silicon stamp for homogenous large area nanoimprint lithography (NIL) are presented. The flexible stamp is fabricated by bulk semiconductor micro machining of a 4-inch silicon wafer and consists of thick anchor like imprint areas connected by membranes. The bending stiffness difference between the imprint areas and the membranes ensures that the deformation of the stamp during the imprint process mainly takes place in the membranes, leaving the imprint structures unaffected. By this design the strong demand to the parallelism between stamp and substrate in the imprint situation is decoupled from the pressing tool and the wafer quality. The stamp consist of 1562 imprint areas (1 mm × 1 mm) containing the patterns to be replicated. The imprinted patterns are characterized with respect to the imprint depth and the polymer residual layer thickness. It is found that within a 50 mm diameter the polymer residual layer thickness is 18.8 nm with a standard deviation of 6.6 nm.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Center for Individual Nanoparticle Functionality
Contributors: Nielsen, T., Pedersen, R. H., Hansen, O., Haatainen, T., Tollki, A., Ahopelto, J., Kristensen, A.
Pages: 508-511
Publication date: 2005

Host publication information
Title of host publication: Technical Digest of the 18th IEEE Conference on Micro Electro Mechanical Systems, MEMS 2005
Publisher: IEEE
ISBN (Print): 0-7803-8732-5
Electronic versions:
Nielsen.pdf
DOIs: 10.1109/MEMSYS.2005.1453978

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Source: orbit
Source-ID: 182667
Research output: Research - peer-review › Article in proceedings – Annual report year: 2005

Flexible stamp for thermal nanoimprint lithography

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, MicroNano Tribology and Modeling, Center for Individual Nanoparticle Functionality
Contributors: Nielsen, T., Pedersen, R. H., Hansen, O., Ahopelto, J., Kristensen, A.
Publication date: 2005
Peer-reviewed: Yes
Source: orbit
Source-ID: 193696
Research output: Research - peer-review › Poster – Annual report year: 2005

Fully integrated optical systems for lab-on-a-chip applications

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip, POEM, MicroTAS
Pages: 211-217
Publication date: 2005

Host publication information
Title of host publication: Proceedings of SPIE
Volume: 5730
(Proc. SPIE; No. 5730).
Functionalised SU-8 patterned with X-ray lithography

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Balslev, S., Kristensen, A., Romanato, F., Di Fabrizio, E.
Publication date: 2005

Host publication information
Title of host publication: Proceedings of the 49th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication, EIPBN49
Source: orbit
Source-ID: 182663
Research output: Research - peer-review › Article in proceedings – Annual report year: 2005

High Pattern Density Nanoimprint Lithography Stamps Fabricated by Means of Negative Electron Beam Lithography Resist and dry Etching in Silicon

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Nanointegration
Publication date: 2005
Peer-reviewed: No
Event: Poster session presented at Danish Optical Society Annual Meeting.
Source: orbit
Source-ID: 186188
Research output: Research › Poster – Annual report year: 2005

High pattern density nanoimprint lithography stamps fabricated by means of negative electron beam lithography resist, TEBN-1, and dry etching in silicon

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Cell Particle Handling, DTU Danchip, Nanointegration, Nanophotonics, Department of Photonics Engineering
Publication date: 2005
Peer-reviewed: Yes
Event: Poster session presented at The 4th Internternational Conference on Nanoimprint and Nanoprint, NNT'05, 19 - 21 October, Nare, Japan.
Source: orbit
Source-ID: 192957
Research output: Research › Poster – Annual report year: 2005

Laser devices via greyscale EBL on functionalized SU-8

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Microreactors, Lab-on-a-Chip
Contributors: Balslev, S., Rasmussen, T., Shi, P., Kristensen, A.
Publication date: 2005

Host publication information
Title of host publication: Proceedings of the Internternational Conference on Micro and Nano Engineering, MNE 2005
Place of publication: Vienna, Austria
Source: orbit
Source-ID: 182660
Low pressure thermal nanoimprint with automatic demolding

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Microreactors, Center for Individual Nanoparticle Functionality
Contributors: Pedersen, R. H., Kristensen, A., Nielsen, T., Hansen, O.
Publication date: 2005
Peer-reviewed: Yes
Event: Poster session presented at The 4th International Conference on Nanoimprint and Nanoprint, ,Nara, Japan, 19 - 21 October 2005, .
Source: orbit
Source-ID: 186312
Research output: Research - peer-review › Poster – Annual report year: 2005

Micro-fabricated solid state dye lasers based on a photo-definable polymer
We present a solid polymer dye laser based on a single-mode planar waveguide. The all-polymer device is self-contained in the photodefinable polymer SU-8 and may therefore easily be placed on any substrate and be integrated with polymer-based systems. We use as the active medium for the laser the commercially available laser dye Rhodamine 6G, which is incorporated into the SU-8 polymer matrix. The single-mode slab waveguide is formed by three-step spin-coating deposition: a buffer layer of undoped SU-8, a core layer of SU-8 doped with Rhodamine, and a cladding layer of undoped SU-8. (c) 2005 Optical Society of America

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Mathematics
Contributors: Nilsson, D., Balslev, S., Gregersen, M. M., Kristensen, A.
Pages: 4965-4971
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Applied Optics
Volume: 44
Issue number: 23
ISSN (Print): 1559-128X
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.84 SJR 0.715 SNIP 1.137
Web of Science (2017): Impact factor 1.791
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.61 SJR 0.695 SNIP 1.124
Web of Science (2016): Impact factor 1.65
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.66 SJR 0.837 SNIP 1.218
Web of Science (2015): Impact factor 1.598
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.04 SJR 1.047 SNIP 1.487
Web of Science (2014): Impact factor 1.784
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.98 SJR 0.985 SNIP 1.584
Microfluidic Single Mode Laser Using High Order Bragg Grating and Antiguiding Segments

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Balslev, S., Kristensen, A.
Pages: 344-351
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Opt. Express  
Volume: 13  
Issue number: 1  
Ratings:  
BFI (2018): BFI-level 2  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 2  
Scopus rating (2017): CiteScore 3.74 SJR 1.519 SNIP 1.567  
Web of Science (2017): Impact factor 3.356  
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): Impact factor 3.307  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 2  
Scopus rating (2015): CiteScore 3.78 SJR 1.91 SNIP 1.674  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 2  
Scopus rating (2014): CiteScore 4.18 SJR 2.313 SNIP 2.124  
Web of Science (2014): Impact factor 3.488  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 2  
Scopus rating (2013): CiteScore 4.38 SJR 2.337 SNIP 2.196  
Web of Science (2013): Impact factor 3.525  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 2  
Scopus rating (2012): CiteScore 3.85 SJR 2.562 SNIP 2.108  
Web of Science (2012): Impact factor 3.546  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 2  
Scopus rating (2011): CiteScore 4.04 SJR 2.58 SNIP 2.572  
Web of Science (2011): Impact factor 3.587  
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): Impact factor 3.753  
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
Nanochannels for DNA stretching fabricated on wafer scale by nanoimprint lithography with a stamp fabricated by 100 kV electron beam lithography in SU-8

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Nanointegration
Contributors: Olsen, B. B., Jacobsen, S., Schmidt, M. S., Skjolding, L., Bøggild, P., Tegenfeldt, J., Kristensen, A.
Publication date: 2005

Host publication information
Title of host publication: Proceeding of the International Conference on Micro and Nano Engineering, MNE 2005
Source: orbit
Source-ID: 182659
Research output: Research - peer-review › Article in proceedings – Annual report year: 2005

Nanoscale silicon structures by using carbon nanotubes as reactive ion etch masks

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip, Nanointegration
Contributors: Schmidt, M. S., Nielsen, T., Madsen, D. N., Kristensen, A., Bøggild, P.
Pages: 750-753
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Nanotechnology
Volume: 16
Issue number: 6
ISSN (Print): 0957-4484
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.01 SJR 1.079 SNIP 0.788
Web of Science (2017): Impact factor 3.404
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): Impact factor 3.44
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.07 SJR 1.257 SNIP 1.035
Web of Science (2015): Impact factor 3.573
Nano-scale silicon structures by using Carbon nanotubes as reactive ion mask
Polymers microcavity dye laser based on a single mode SU-8 planar waveguide

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Nilsson, D., Balslev, S., Kristensen, A.
Pages: 208-216
Publication date: 2005

Host publication information
Title of host publication: Proceedings of SPIE. Solid State Lasers XIV : Technology and Devices
Volume: 5707
Editors: Hoffman, H. J., Shori, R. K.
DOIs: 10.1117/12.590438
Source: orbit
Source-ID: 182669
Research output: Research - peer-review; Article in proceedings – Annual report year: 2005

We demonstrate grey scale electron beam lithography on functionalized SU-8 resist for fabrication of single mode solid state dye laser devices. The resist is doped with Rhodamine 6G perchlorate and the lasers are based on a first order Bragg grating distributed feedback resonator. The lasers are optically pumped at 532 nm, and exhibit low lasing threshold from 530 nJ/mm2 and single mode output at selectable wavelengths from 580 to 630 nm, determined by the grating pitch. The lasers are well suited for integration into polymer based lab-on-chip circuits for interference based sensing.

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Microreactors, DTU Danchip
Contributors: Balslev, S., Rasmussen, T., Shi, P., Kristensen, A.
Pages: 2456-2460
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Journal of Micromechanics and Microengineering
Volume: 15
Issue number: 12
ISSN (Print): 0960-1317
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.02 SJR 0.554 SNIP 0.968
Web of Science (2017): Impact factor 1.888
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): Impact factor 1.794
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.96 SJR 0.687 SNIP 1.265
Web of Science (2015): Impact factor 1.768
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.84 SJR 0.802 SNIP 1.316
Web of Science (2014): Impact factor 1.731
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.74 SJR 0.737 SNIP 1.233
Web of Science (2013): Impact factor 1.725
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.92 SJR 0.936 SNIP 1.491
Web of Science (2012): Impact factor 1.79
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.43 SJR 1.036 SNIP 1.443
Web of Science (2011): Impact factor 2.105
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.013 SNIP 1.637
Web of Science (2010): Impact factor 2.281
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.144 SNIP 1.5
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.243 SNIP 1.616
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.422 SNIP 1.815
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.264 SNIP 2.098
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.165 SNIP 2.073
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.057 SNIP 1.881
Web of Science (2004): Indexed yes
Single-mode solid-state polymer dye lasers fabricated with standard I-line UV lithography

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Lab-on-a-Chip
Contributors: Balslev, S., Mironov, A., Nilsson, D., Tegenfeldt, J., Kristensen, A.
Publication date: 2005

Host publication information
Title of host publication: Proceedings of the CLEO/QELS conference
Source: orbit
Source-ID: 182666
Research output: Research - peer-review › Article in proceedings – Annual report year: 2005

Technology for Fabrication of Nanostructures by Standard Cleanroom Processing and Nanoimprint Lithography

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Pages: 5606-5608
Publication date: 2005
Peer-reviewed: Yes

Publication information
Volume: 44
ISSN (Print): 0021-4922
Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): CiteScore 1.13 SJR 0.497 SNIP 0.668
Web of Science (2017): Impact factor 1.452
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 0.67 SJR 0.497 SNIP 0.768
Web of Science (2016): Impact factor 1.384
Web of Science (2016): Indexed yes
Scopus rating (2015): CiteScore 0.58 SJR 0.426 SNIP 0.682
Web of Science (2015): Impact factor 1.122
Scopus rating (2014): CiteScore 0.73 SJR 0.209 SNIP 0.189
Web of Science (2014): Impact factor 1.127
Scopus rating (2013): CiteScore 0.65 SJR 0.111 SNIP 0
Web of Science (2013): Impact factor 1.057
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
Scopus rating (2012): CiteScore 0.7 SJR 0.151 SNIP 0.171
Web of Science (2012): Impact factor 1.067
ISI indexed (2012): ISI indexed no
Scopus rating (2011): CiteScore 0.94 SJR 0.61 SNIP 1.476
Web of Science (2011): Impact factor 1.058
ISI indexed (2011): ISI indexed no
Scopus rating (2010): SJR 0.574 SNIP 1.066
Web of Science (2010): Impact factor 1.024
Scopus rating (2009): SJR 0.585 SNIP 1.039
Scopus rating (2008): SJR 0.764 SNIP 0.689
Scopus rating (2007): SJR 0.858 SNIP 0.877
Scopus rating (2006): SJR 0.829 SNIP 0.969
Scopus rating (2005): SJR 0.764 SNIP 0.889
Scopus rating (2004): SJR 0.842 SNIP 0.998
Scopus rating (2003): SJR 0.92 SNIP 0.994
Scopus rating (2002): SJR 0.961 SNIP 1.134
Scopus rating (2001): SJR 1.061 SNIP 1.013
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.105 SNIP 0.916
Scopus rating (1999): SJR 1.166 SNIP 1.044
Original language: English
Source: orbit
Source-ID: 182519
Research output: Research - peer-review › Journal article – Annual report year: 2005

Topas based lab-on-a-chip microsystems fabricated by thermal nanoimprint lithography

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology
Publication date: 2005
Peer-reviewed: Yes
Source: orbit
Source-ID: 193697
Research output: Research - peer-review › Poster – Annual report year: 2005

Topas Based Lab-on-a-chip Microsystems Fabricated by Thermal Nanoimprint Lithography

We, present a one-step technology for fabrication of Topas-based lab-on-a-chip (LOC) microsystems by the use of thermal nanoimprint lithography (NIL). The technology is demonstrated by the fabrication of two working devices: a particle separator and a LOC with integrated optics for absorbance measurements. These applications demonstrate the fabrication of millimeter to micrometer-sized structures in one lithographic step. The use of NIL makes the technology easily scalable into the nanometer regime by the use of a suitable lithographic technique in the fabrication of the stamp. Processing issues such as environmental stress cracking of the Topas and the requirements to anti-sticking layers on the stamp when imprinting into Topas are discussed.

General information
State: Published
Organisations: Lab-on-a-Chip, Department of Micro- and Nanotechnology, Department of Chemical and Biochemical Engineering, The Danish Polymer Centre
Pages: 2944-2949
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Journal of Vacuum Science and Technology Vol
Volume: 23
Issue number: 6
ISSN (Print): 1071-1023
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.25 SJR 0.467 SNIP 0.631
Web of Science (2017): Impact factor 1.314
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.08 SJR 0.595 SNIP 0.691
Web of Science (2016): Impact factor 1.573
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.66 SJR 0.533 SNIP 0.641
Web of Science (2015): Impact factor 1.398
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.61 SJR 0.509 SNIP 0.601
Web of Science (2014): Impact factor 1.464
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 0.83 SJR 0.55 SNIP 0.631
Web of Science (2013): Impact factor 1.358
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.85 SJR 0.691 SNIP 0.717
Web of Science (2012): Impact factor 1.267
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.22 SJR 0.868 SNIP 0.857
Web of Science (2011): Impact factor 1.341
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.9 SNIP 0.852
Web of Science (2010): Impact factor 1.271
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.929 SNIP 0.955
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.998 SNIP 0.941
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.267 SNIP 1.02
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.285 SNIP 1.211
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.248 SNIP 1.026
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.322 SNIP 1.186
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.495 SNIP 1.235
A Coupled Cavity Micro Fluidic Dye Ring Laser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Gersborg-Hansen, M., Balslev, S., Mortensen, N. A., Kristensen, A.
Publication date: 2004

Host publication information
Title of host publication: Proceedings of Micro- and Nano-Engineering (MNE) 2004 Conference
Source: orbit
Source-ID: 61658
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

A microfluidic dye laser fabricated by nanoimprint lithography in a highly transparent and chemically resistant polymer (COC)

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nilsson, D., Balslev, S., Kristensen, A.
Publication date: 2004

Host publication information
Title of host publication: Proceedings of Micro- and Nano-Engineering (MNE) 2004 Conference
Source: orbit
Source-ID: 61657
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

A nanoimprinted microfluidic dye laser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nilsson, D., Balslev, S., Nielsen, T., Kristensen, A.
Publication date: 2004

Host publication information
Title of host publication: Proceedings of Trends in Nanotechnology* TNT 2004
Source: orbit
Source-ID: 61660
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

A Nanoimprinted polymer microfluidic dye laser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nilsson, D., Balslev, S., Kristensen, A.
Publication date: 2004
Cyclic Olefin Copolymer (COC/Topas) - an exceptional material for exceptional lab-on-a-chip systems

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Pages: 372-374
Publication date: 2004

Dissolution Investigations of TOPAS for Homogeneous Imprints

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nielsen, T., Vogler, M., Reuther, F., Gruetzner, G., Kristensen, A.
Publication date: 2004

Flexible Stamp for Homegenous Large Area Thermal NIL

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nielsen, T., Pedersen, R., Hansen, O., Haatainen, T., Tollki, A., Ahopelto, J., Kristensen, A.
Publication date: 2004

Fully integrated optical system for lab-on-a-chip applications
We present a lab-on-a-chip device featuring a microfluidic dye laser, wave-guides, microfluidic components and photodetectors integrated on the chip. The microsystem is designed for wavelength selective absorption measurements in the visible range on a fluidic sample, which can be prepared/mixed on-chip. The laser structures, wave-guides and microfluidic handling system are defined in a single UV-lithography step on a 10 μm thick SU-8 layer on top of the substrate. The SU-8 structures are sealed by a Borofloat glass lid, using polymethylmethacrylate (PMMA) adhesive bonding.
High order Bragg grating microfluidic dye laser
We demonstrate a single mode distributed feedback liquid dye laser, based on a short 133 'rd order Bragg grating defined in a single polymer layer between two glass substrates.

Integration of optics and microfluidics for a lab-on-a-chip system

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Source: orbit
Source-ID: 61493
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

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Source: orbit
Source-ID: 61663
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

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Source: orbit
Source-ID: 61493
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004
Liquid droplet dye laser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Azzouz, H., Balslev, S., Kristensen, A.
Pages: 578-580
Publication date: 2004

Host publication information
Title of host publication: Proceedings of MicroTAS 2004, the eighth international Conference on Miniaturised Systems for Chemistry and Life Sciences
Volume: 1
Place of publication: Cambridge, United Kingdom
Publisher: Royal Society of Chemistry
Editors: Laurell, T., Nilsson, J., Jensen, K., Harrison, D., Kutter, J. P.
Source: orbit
Source-ID: 61652
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

Microfluidic dye laser with compact, low-cost liquid dye dispenser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Balslev, S., Roxhed, N., Griss, P., Stemme, G., Kristensen, A.
Publication date: 2004

Host publication information
Title of host publication: Proceedings of MicroTAS 2004, the eighth international Conference on Miniaturised Systems for Chemistry and Life Sciences
Volume: 2
Place of publication: Cambridge, United Kingdom
Publisher: Royal Society of Chemistry
Editors: Laurell, T., Nilsson, J., Jensen, K., Harrison, D., Kutter, J. P.
Source: orbit
Source-ID: 61656
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

Microtas with integrated optical transducers

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Pages: 369-371
Publication date: 2004

Host publication information
Title of host publication: Proceedings of MicroTas 2004
Volume: 2
Place of publication: Cambridge, UK
Publisher: Royal Society of Chemistry
Editors: Laurell, T., Nilsson, J., Jensen, K., Harrison, D., Kutter, J. P.
Source: orbit
Source-ID: 138360
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004
Nanoimprint lithography in the cyclic olefin copolymer, Topas, a highly ultraviolet-transparent and chemically resistant thermoplastic

Thermal nanoimprint lithography (NIL) of the cyclic olefin copolymeric thermoplast Topas® is demonstrated. Topas® is highly UV-transparent, has low water absorption, and is chemically resistant to hydrolysis, acids and organic polar solvents which makes it suitable for lab-on-a-chip applications. In particular, Topas® is suitable for micro systems made for optical bio-detection since waveguides for UV-light can be made directly in Topas®. In this article full process sequences for spin coating Topas® onto 4 in. silicon wafers, NIL silicon stamp fabrication with micro and nanometer sized features, and the NIL process parameters are presented. The rheological properties of Topas® are measured and the zero shear rate viscosity is found to be $2.16 \times 10^4$ Pa s at $170 \, ^\circ\text{C}$ and $3.6 \times 10^3$ Pa s at $200 \, ^\circ\text{C}$ while the dominant relaxation time is found to be $4.4 \, \text{s}$ and $0.9 \, \text{s}$, respectively. The etch rates of Topas® to two different reactive ion etch processes, an oxygen plasma, and an anisotropic silicon etch, is found to be $12.6 \, \text{nm/s}$ and $0.7 \, \text{nm/s}$, respectively. The etch rates are compared to the similar etch rates of 950 k PMMA, cross-linked SU-8, and standard AZ5214E photoresist. Finally, UV-lithography (UVL) followed by metal deposition and lift-off on top of a Topas® film patterned by NIL is demonstrated. This exploits the chemical resistance of Topas® to sodium hydroxide and acetone. The demonstrated UVL and lift-off on top of an imprinted Topas® film opens new possibilities for post-NIL processing.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, DTU Danchip, Department of Chemical and Biochemical Engineering, The Danish Polymer Centre, Optofluidics, Technical University of Denmark
Pages: 1770-1775
Publication date: 2004
Peer-reviewed: Yes
Nanoimprint lithography in Topas, a highly UV-transparent and chemically resistant thermoplast

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nielsen, T., Nilsson, D., Geschke, O., Shi, P., Kristensen, A.
Number of pages: 73
Publication date: 2004

**Host publication information**
Title of host publication: Conference Digests of the IEEE sponsored Conference on Nanoscale Devices & System Integration (NDSI)
Source: orbit
Source-ID: 61665
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

Nanoimprint lithography of PMMA lasers

**General information**
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nilsson, D., Nielsen, T., Kristensen, A.
Number of pages: 72
Publication date: 2004

**Host publication information**
Title of host publication: Conference Digests of the IEEE sponsored Conference on Nanoscale Devices & System Integration (NDSI)
Source: orbit
Source-ID: 61666
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

Nanoimprint lithography of Topas, a new thermoplast with excellent properties for lab-on-a-chip applications

**General information**
PMMA to SU-8 bonding for polymer based lab-on-a-chip systems with integrated optics

We present an adhesive bonding technique developed for SU-8 based "lab-on-a-chip"-systems with integrated optical components. Microfluidic channels and optical components (e.g. wave-guides) are defined in SU-8 photoresist on a Pyrex glass substrate. The microfluidic channels are sealed by a second Pyrex substrate, bonded on top of the cross-linked SU-8 structure using an intermediate layer of 950K molecular weight poly-methylmethacrylate (PMMA). Due to a lower refractive index of PMMA, this bonding technique offers optical waveguiding in the SU-8 structures in combination with good sealing of the microfluidic channels. The bonding technique is investigated with respect to bonding temperature in the range of 50 - 150 degr. C and at bonding forces of 1000 N and 2000 N on a 4-inch wafer. A maximum bonding strength of 16 MPa is achieved for the PMMA to SU-8 bonding at a bonding temperature of 110 degr. C and at a bonding force of 2000 N. Furthermore 950K PMMA shows no tendency to flow into the microfluidic channels due to its high viscosity.
*Polymer based lab-on-a-chip lasers*

**General information**

State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Kristensen, A., Balslev, S., Olsen, B. B., Gersborg-Hansen, M., Nilsson, D.
Publication date: 2004

**Host publication information**

Title of host publication: Proceedings of the Conference on Lab-on-a-Chip: Platforms, Devices, and Applications, part of the International Symposium on Optics East 2004
Smooth sub-30 nm stamps for nanoimprint lithography fabricated by standard UV-lithography and oxidation

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Publication date: 2004

Host publication information
Title of host publication: Proceedings of "Trends in Nanotechnology" TNT 2004
Source: orbit
Source-ID: 61659
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

Solid Polymer Dye Laser Based on a Single Mode SU-8 Planar Waveguide

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nilsson, D., Balslev, S., Kristensen, A.
Pages: 369-371
Publication date: 2004

Host publication information
Title of host publication: Proceedings of MicroTAS 2004, the eighth international Conference on Miniaturised Systems for Chemistry and Life Sciences
Volume: 2
Place of publication: Cambridge, United Kingdom
Publisher: Royal Society of Chemistry
Editors: Laurell, T., Nilsson, J., Jensen, K., Harrison, D., Kutter, J. P.
Source: orbit
Source-ID: 61654
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

Solid state microcavity dye lasers fabricated by nanoimprint lithography
We present a solid state polymer microcavity dye laser, fabricated by thermal nanoimprint lithography (NIL) in a dye-doped thermoplastic. The thermoplastic poly-methylmethacrylate (PMMA) is used due to its high transparency in the visible range and its robustness to laser radiation. The laser dye is Rhodamine 6G ClO4. This dye is shown to withstand temperatures up to 240 °C without bleaching, which makes it compatible with the thermal nanoimprint lithography process. The 1.55 µm thick dye-doped PMMA devices are fabricated on a SiO2 substrate, yielding planar waveguiding in the dye-doped PMMA with two propagating TE–TM modes. The laser cavity has the lateral shape of a trapezoid, supporting lasing modes by reflection on the vertical cavity walls. The solid polymer dye lasers emit laterally through one of the vertical cavity walls, when pumped optically through the top surface by means of a frequency doubled, pulsed Nd:YAG laser. Lasing in the wavelength region from 560 to 570 nm is observed from a laser with a side-length of 50 µm. In this proof of concept, the lasers are multimode with a mode wavelength separation of approximately 1.6 nm, as determined by the waveguide propagation constant(s) and cavity dimensions. The stamps used in this work were fabricated by UV-lithography, limiting the lateral dimensional control of the devices. The resolution of NIL is ultimately limited by the quality of the stamps. Using electron beam lithography for stamp fabrication, the NIL process presented here offers the possibility for adding mode-selecting elements, e.g., diffractive- or sub-wavelength optical elements. ©2004 American Institute of Physics

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Nilsson, D., Nielsen, T., Kristensen, A.
Pages: 4481-4486
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Review of Scientific Instruments
null
A Micro-Cavity Fluidic Dye Laser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Helbo, B., Kristensen, A., Menon, A. K.
Pages: 307-311
Publication date: 2003
Peer-reviewed: Yes

Publication information
Journal: Journal of Micromechanics and Microengineering
Volume: 13
Issue number: 2
ISSN (Print): 0960-1317
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.02 SJR 0.554 SNIP 0.968
Web of Science (2017): Impact factor 1.888
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): Impact factor 1.794
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.96 SJR 0.687 SNIP 1.265
Web of Science (2015): Impact factor 1.768
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.84 SJR 0.802 SNIP 1.316
Web of Science (2014): Impact factor 1.731
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.74 SJR 0.737 SNIP 1.233
Web of Science (2013): Impact factor 1.725
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.92 SJR 0.936 SNIP 1.491
Web of Science (2012): Impact factor 1.79
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
A Nano-Imprinted Plastic Laser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nilsson, D., Nielsen, T., Kristensen, A.
Publication date: 2003

Host publication information
Title of host publication: Proceedings of the Micro and nanoengineering (MNE)
Source: orbit
Source-ID: 58994
Research output: Research - peer-review > Article in proceedings – Annual report year: 2003

Improved Microfluidic Design of an On-Chip Tunable Dye Laser

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Olsen, B. B., Kutter, J. P., Kristensen, A.
Pages: 1327-1330
Investigation of the dye concentration influence on the lasing wavelength and threshold for a micro-fluidic dye laser

We investigate a micro-fluidic dye laser, which can be integrated with polymer-based lab-on-a-chip microsystems without further processing steps. A simple rate-equation model is used to predict the lasing threshold. The laser device is characterised using the laser dye Rhodamine 6G dissolved in ethanol, and the influence of dye concentration on the lasing wavelength and threshold is investigated. The experiments confirm the predictions of the rate-equation model, that lasing can be achieved in the 10 µm long laser cavity with moderate concentrations of Rhodamine 6G in ethanol, starting from $5 \times 10^{-3}$ mol/l. We also find that the lasing wavelength can be tuned between 565 and 593 nm, controlled by the dye concentration. (C) 2003 Elsevier B.V. All rights reserved.
Micro-Cavity Fluidic Dye Laser
We have successfully designed, fabricated and characterized a micro-cavity fluidic dye laser with metallic mirrors, which can be integrated with polymer based lab-on-a-chip microsystems without further processing steps. A simple rate-equation model is used to predict the average pumping power threshold for lasing as function of cavity-mirror reflectance, laser dye concentration and cavity length. The laser device is characterized using the laser dye Rhodamine 6G dissolved in ethanol. Lasing is observed, and the influence of dye concentration is investigated.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, NSE-Optofluidics Group, NanoSystemsEngineering Section
Contributors: Helbo, B., Kristensen, A., Menon, A. K.
Pages: 235-238
Publication date: 2003

Host publication information
Place of publication: Kyoto, Japan
Publisher: IEEE
Miniaturized solid state dye lasers based on a photo-definable polymer

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Kragh, S., Kristensen, A.
Pages: 380-383
Publication date: 2003

Host publication information
Title of host publication: Proceedings of the 17th European Conference on Solid-State Transducers (Eurosensors)
Source: orbit
Source-ID: 58740
Research output: Research - peer-review › Article in proceedings – Annual report year: 2003

Nanoimprint lithography of polymer micro cavity dye lasers

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nilsson, D., Nielsen, T., Kristensen, A.
Publication date: 2003

Host publication information
Title of host publication: Proceedings of the Second International Conference on Nanoimprint and Nanoprint Technology (NNT)
Source: orbit
Source-ID: 58995
Research output: Research - peer-review › Article in proceedings – Annual report year: 2003

Patternning of a highly UV-transparent and chemically resistant thermoplast, Topas, by nanoimprint lithography

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nielsen, T., Nilsson, D., Geschke, O., Kristensen, A.
Publication date: 2003
Peer-reviewed: Yes
Event: Paper presented at Second International Conference on Nanoimprint and Nanoprint Technology (NNT), Boston, MA, USA, .
Source: orbit
Source-ID: 58776
Research output: Research - peer-review › Paper – Annual report year: 2003

SU-8 Based Solid State Dye Lasers For Lab-on-a-Chip Microsystems

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Tunability of Microfluidic Dye Lasers

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Balslev, S., Azzouz, H., Olsen, B. B., Kristensen, A.
Publication date: 2003

Host publication information
Title of host publication: Proceedings of the 14th Micromechanics Europe Workshop (MME)
Source: orbit
Source-ID: 58992
Research output: Research - peer-review › Article in proceedings – Annual report year: 2003

Tunable Microfluidic Dye Laser

We present a tunable microfluidic dye laser fabricated in SU-8. The tunability is enabled by integrating a microfluidic diffusion mixer with an existing microfluidic dye laser design by Helbo et al. By controlling the relative flows in the mixer between a dye solution and a solvent, the concentration of dye in the laser cavity can be adjusted, allowing the wavelength to be tuned. Wavelength tuning controlled by the dye concentration was demonstrated with macroscopic dye lasers already in 1971, but this principle only becomes practically applicable by the use of microfluidic mixing. With presently available dyes, the lasing wavelength can be tuned in an interval between 400 nm and 900 nm, depending on the specific dye. In this first demonstration, the lasing wavelength was tuned between 568 nm and 574 nm, using a solution of 10-2 mol/L Rhodamine 6G in ethanol.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Olsen, B. B., Helbo, B., Kutter, J. P., Kristensen, A.
Pages: 206-209
Publication date: 2003

Host publication information
Title of host publication: Proceedings of the 12th Int. Conf. on Solid-State Sensors, Actuators and Microsystems, Transducers’ 03
Publisher: IEEE
ISBN (Print): 0-7803-7731-1
Electronic versions:
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Bibliographical note
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Source: orbit
Source-ID: 39220
Research output: Research › Article in proceedings – Annual report year: 2003

Bias dependent subband edges and the 0.7 conductance anomaly

The 0.7 (2e(2)/h) conductance anomaly is studied in strongly confined, etched GaAs/GaAlAs quantum point contacts by measuring the differential conductance G as a function of source-drain bias V-sd and gate-source bias V-gs as well as a function of temperature. In the V-gs - V-sd plane we use a grayscale plot of the transconductance dG/dV(gs) to map out the bias dependent transitions between the normal and anomalous conductance plateaus. Any given transition is interpreted as arising when the bias controlled chemical potential mu(d) (mu(s)) Of the drain (source) reservoir crosses a subband edge epsilon(x) in the point contact. From the grayscale plot we extract the constant normal subband edges.
epsilon(0), epsilon(1),... and most notably the bias dependent anomalous subband edge epsilon(0)(mu(d)) split off from epsilon(0). We show by applying a finite-bias version of the recently proposed BCF model, how the bias dependence of the anomalous subband edge is the key to analyze various experimental observations related to the 0.7 anomaly.
Observation of novel temperature dependencies in the conductance of quantum point contacts

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Hansen, A., Kristensen, A., Bruus, H.
Publication date: 2002

Host publication information
Title of host publication: Proceedings of the Nano-7/Ecoss-21
Source: orbit
Source-ID: 59645
Research output: Research - peer-review » Article in proceedings – Annual report year: 2002

Silicon mold for casting polymer optics

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Nilsson, D., Jensen, S., Kristensen, A., Menon, A. K.
Pages: 111-114
Publication date: 2002

Host publication information
Title of host publication: Proceedings of Micromechanics Europe (MME)
Source: orbit
Source-ID: 59661
Research output: Research - peer-review » Article in proceedings – Annual report year: 2002

Temperature dependent deviations from ideal quantization of plateau conductances in GaAs quantum point contacts

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Hansen, A. E., Kristensen, A., Bruus, H.
Publication date: 2002

Host publication information
Title of host publication: Proceedings of the 26th International Conference on the Physics of Semiconductors (ICPS-26)
Publisher: IOP publishing, Bristol ICPS-26 Edinburgh
Source: orbit
Source-ID: 55755
Research output: Research - peer-review » Article in proceedings – Annual report year: 2002

Decoherence in Aharonov-Bohm rings

General information
State: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Hansen, A., Kristensen, A., Pedersen, S., Sørensen, C., Lindehof, P.
Publication date: 2001

Host publication information
Title of host publication: Proceedings of EP2DS-14 conference
Source: orbit
Source-ID: 61256
Research output: Research - peer-review » Article in proceedings – Annual report year: 2001
Decay Lengths for Diffusive Transport Activated by Andreev Reflections in Al/n-GaAs/Al Superconductor-Semiconductor-Superconductor Junctions

In a highly doped GaAs semiconductor with superconducting contacts of Al, clear conductance peaks are observed at zero voltage bias and at $V = \pm /-2 \Delta/e$, $\Delta/e$. The subharmonic energy gap structure originates from Andreev scattering with diffusive, but energy conserving, transport in the GaAs. The zero bias excess conductance is due to phase-coherent transport. Both effects are suppressed when the distance between the superconducting electrodes exceeds the inelastic diffusion length in the GaAs normal channel.
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
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 4.781 SNIP 2.443
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 4.082 SNIP 2.101
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 3.847 SNIP 2.122
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 4.661 SNIP 2.651
Web of Science (2003): Indexed yes
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 5.884 SNIP 3.375
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 5.618 SNIP 3.135
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 5.771 SNIP 2.941
Original language: English
Keywords: ENERGY-GAP STRUCTURE, CONDUCTANCE, CONSTRUCTIONS
Electronic versions:
Jonathan.pdf
DOIs:
10.1103/PhysRevLett.78.931
URLs:
http://link.aps.org/doi/10.1103/PhysRevLett.78.931

Bibliographical note
Source: orbit
Source-ID: 171724
Research output: Research - peer-review › Journal article – Annual report year: 1997

Projects:

**Electron energy-loss spectroscopy of reconfigurable meta-atoms**
Assadilayev, A., PhD Student
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Raza, S., Supervisor, Department of Micro- and Nanotechnology
Wagner, J. B., Supervisor, Center for Electron Nanoscopy
Assadilayev, A., PhD Student, Department of Micro- and Nanotechnology
Booth, T., Main Supervisor, Department of Micro- and Nanotechnology
Samfinansieret - Andet
01/09/2018 → 31/08/2021
Award relations: Electron energy-loss spectroscopy of reconfigurable meta-atoms
Project: PhD

**Smart Colour: Remotely Adjustable Structural Plasmonic Colour**
Keshavarz Hedayati, M., Project Participant, Department of Micro- and Nanotechnology, Optofluidics
Kristensen, A., Project Participant, Department of Micro- and Nanotechnology, Optofluidics
Mortensen, N. A., Project Participant, Center for Nanostructured Graphene, Department of Photonics Engineering, Structured Electromagnetic Materials
Optofluidics for the Analysis of Turbid Liquids
Matthiae, M., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Raza, S., Supervisor, Department of Micro- and Nanotechnology
Zhu, X., Supervisor, Department of Micro- and Nanotechnology
Offentlig finansiering
01/12/2015 → 30/11/2018
Award relations: Optofluidics for the Analysis of Turbid Liquids
Project: PhD

Evanescent wave absorption spectroscopy for hemolysis detection
Zhou, C., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Keshavarz Hedayati, M., Supervisor, Department of Micro- and Nanotechnology
Taborsky, R. J., Examiner, Department of Micro- and Nanotechnology
Jensen, J. R., Examiner, Department of Micro- and Nanotechnology
Schift, H., Examiner
Schift, H., Examiner
Samfinansieret - Andet
15/08/2015 → 07/11/2018
Award relations: Evanescent wave absorption spectroscopy for hemolysis detection
Project: PhD

Low Cost polymer photonic crystal laser intra-cavity sensors
Sørensen, K. T., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Lindvold, L. R., Examiner
Lindvold, L. R., Examiner
Mortensen, N. A., Examiner, Department of Micro- and Nanotechnology
Mortensen, N. A., Examiner, Department of Micro- and Nanotechnology
Samfinansieret - Andet
01/08/2014 → 03/05/2018
Award relations: Low Cost polymer photonic crystal laser intra-cavity sensors
Project: PhD

Design, fabrication and testing of support structures for biomimetic water filters
Vogel, J., PhD Student, Department of Chemistry
Emnés, J., Main Supervisor, Department of Micro- and Nanotechnology
Geschke, O., Supervisor, Department of Micro- and Nanotechnology
Hélix-Nielsen, C., Supervisor, Department of Physics
Kristensen, A., Examiner, Department of Micro- and Nanotechnology
Thomsen, P. T., Examiner
Verpoorte, E. M. J., Examiner
ErhvervsPhD-ordningen VTU
01/01/2008 → 20/04/2011
Award relations: Design, fabrication and testing of support structures for biomimetic water filters
Project: PhD

Fluid Control and Manoliter Dispensing in a Chip for Single Cell Array Analysis
Bouaidat, S., PhD Student, Department of Micro- and Nanotechnology
Wolff, A., Main Supervisor, Department of Micro- and Nanotechnology
Jonssmann, J., Supervisor, Department of Micro- and Nanotechnology
Kristensen, A., Examiner, Department of Micro- and Nanotechnology
Gravesen, P., Examiner
Manz, A., Examiner
Erhvervsforskeroordningen
01/11/2001 → ...
Award relations: Fluid Control and Manoliter Dispensing in a Chip for Single Cell Array Analysis
Project: PhD
Nano-structured filters
Pu, M., PhD Student, Department of Photonics Engineering
Hvam, J. M., Main Supervisor, Department of Photonics Engineering
Ou, H., Supervisor, Department of Photonics Engineering
Yvind, K., Supervisor, Department of Photonics Engineering
Kristensen, A., Examiner, Department of Micro- and Nanotechnology
Borel, P. I., Examiner, Department of Photonics Engineering
Van Thourhout, D., Examiner
Programbevilling
01/09/2007 → 20/04/2011
Award relations: Nano-structured filters
Project: PhD

Optofluidic Applications of Diblock Copolymer Derived Nanoporous Polymers
Gopalakrishnan, N., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Christiansen, M. B., Supervisor, Department of Micro- and Nanotechnology
Thomsen, P. T., Supervisor
Bruus, H., Examiner, Department of Micro- and Nanotechnology
Balslev, S., Examiner, Department of Micro- and Nanotechnology
Marcel Joachim Mappes, T., Examiner
Forskningsrådsfinansiering
01/06/2008 → 14/09/2011
Award relations: Optofluidic Applications of Diblock Copolymer Derived Nanoporous Polymers
Project: PhD

Metamaterials for on-chip-nano-manipulation and imaging
Nielsen, R. B., PhD Student, Department of Micro- and Nanotechnology
Hvam, J. M., Main Supervisor, Department of Photonics Engineering
Boltasseva, A., Supervisor, Department of Photonics Engineering
Kristensen, A., Supervisor, Department of Micro- and Nanotechnology
Lavrinenko, A., Examiner, Department of Photonics Engineering
Maier, S., Examiner
Rubahn, H., Examiner
Forskningsrådsfinansiering
01/10/2007 → 25/05/2011
Award relations: Metamaterials for on-chip-nano-manipulation and imaging
Project: PhD

Polymer Dye Micro-Cavity Lasers
Balslev, S., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Mørk, J., Examiner, Department of Micro- and Nanotechnology
Lading, L., Examiner, Department of Micro- and Nanotechnology
Turnbull, G. A., Examiner
Forskningsrådsfinansiering
01/02/2003 → 31/05/2006
Award relations: Polymer Dye Micro-Cavity Lasers
Project: PhD

Fabrication and Characterization of Semiconductor Optical Devices
Larsson, D., PhD Student, Department of Photonics Engineering
Hvam, J. M., Main Supervisor, Department of Photonics Engineering
Yvind, K., Supervisor, Department of Photonics Engineering
Kristensen, A., Examiner, Department of Micro- and Nanotechnology
McInerney, J., Examiner
Petersen, P. M., Examiner, Department of Photonics Engineering
Forskningsrådsfinansiering
15/01/2003 → 30/04/2007
Award relations: Fabrication and Characterization of Semiconductor Optical Devices
Project: PhD
Window Pane Coating for photon harvesting
Buss, T., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Smith, C., Supervisor, Department of Micro- and Nanotechnology
Petersen, P. M., Examiner
Buchwald, K., Examiner
Tumbull, G. A., Examiner
Institut, samfinansiering
15/11/2009 → 04/04/2013
Award relations: Window Pane Coating for photon harvesting
Project: PhD

Programable Wavelength Selective MDEMS Devices
Nilsson, J. D. G., PhD Student, Department of Micro- and Nanotechnology
Menon, A. K., Main Supervisor, Department of Micro- and Nanotechnology
Kristensen, A., Supervisor, Department of Micro- and Nanotechnology
Hansen, O., Examiner
Torres, C. M. S., Examiner
DTU, Samfinansiering
01/02/2002 → 16/05/2005
Award relations: Programable Wavelength Selective MDEMS Devices
Project: PhD

Nanofluidic Devices for DNA Analysis
Persson, K. F., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Hassager, O., Examiner, Department of Chemical and Biochemical Engineering
Eijkel, J. C. T., Examiner
Mortensen, K., Examiner, Department of Chemical and Biochemical Engineering
DTU-lønnet stipendie
01/03/2006 → 24/06/2009
Award relations: Nanofluidic Devices for DNA Analysis
Project: PhD

Polymer Based Nano Optics for Lab-On-A-Chip Micro System
Gersborg-Hansen, M., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Petersen, P. M., Examiner
Drewsen, M., Examiner
Levy, U., Examiner
DTU-lønnet stipendie
15/12/2004 → 30/04/2008
Award relations: Polymer Based Nano Optics for Lab-On-A-Chip Micro System
Project: PhD

Pinched flow fractionation - Technology and Application
Vig, A. L., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Kutter, J. P., Examiner, Department of Micro- and Nanotechnology
Nikolajeff, F., Examiner
Pedersen, S., Examiner
DTU-lønnet stipendie
15/12/2006 → 30/06/2010
Award relations: Pinched flow fractionation - Technology and Application
Project: PhD

Nanofluidics for ssDNA analysis
Thamdrup, L. H. E., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Larsen, N. B., Supervisor, Department of Micro- and Nanotechnology
Berg-Sørensen, K., Examiner, Department of Physics  
Erickson, D., Examiner  
Schweitz, K. O., Examiner  
DTU-lønnet stipendie  
15/11/2006 → 24/03/2010  
Award relations: Nanofluidics for ssDNA analysis  
Project: PhD

**Metamaterialer til lab-on-a-chip applikationer**  
Jeppesen, C., PhD Student, Department of Micro- and Nanotechnology  
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology  
Boltasseva, A., Supervisor  
Mortensen, N. A., Supervisor, Department of Micro- and Nanotechnology  
Mark, J., Examiner, Department of Micro- and Nanotechnology  
Bozhevolnyi, S. I., Examiner, Department of Micro- and Nanotechnology  
Levy, U., Examiner  
DTU-lønnet stipendie  
15/12/2007 → 20/04/2011  
Award relations: Metamaterialer til lab-on-a-chip applikationer  
Project: PhD

**Carbon Nanotube Force Sensors Integrated in Microcantilevers**  
Kjelstrup-Hansen, J., PhD Student, Department of Micro- and Nanotechnology  
Bøggild, P., Main Supervisor, Department of Micro- and Nanotechnology  
Brandbyge, M., Supervisor, Department of Micro- and Nanotechnology  
Kristensen, A., Examiner, Department of Micro- and Nanotechnology  
Lindøf, P. E., Examiner  
Walzer, K., Examiner, Department of Micro- and Nanotechnology  
DTU-lønnet stipendie  
01/10/2003 → 30/01/2007  
Award relations: Carbon Nanotube Force Sensors Integrated in Microcantilevers  
Project: PhD

**Kvanteprikbaserede lyskilder til polymer lab-on-a-chip**  
Christiansen, M. B., PhD Student, Department of Micro- and Nanotechnology  
Hvam, J. M., Examiner, Department of Photonics Engineering  
Eggleton, B. J., Examiner  
Nørregaard, J., Examiner, Department of Photonics Engineering  
Nørregaard, J., Examiner  
DTU-lønnet stipendie  
15/12/2005 → 29/04/2009  
Award relations: Kvanteprikbaserede lyskilder til polymer lab-on-a-chip  
Project: PhD

**MEMS-Teknologi i Nanoimprint Litografi**  
Pedersen, R. H., PhD Student, Department of Micro- and Nanotechnology  
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology  
Hansen, O., Supervisor, Department of Micro- and Nanotechnology  
Jensen, F., Examiner  
Bozhevolnyi, S. I., Examiner, Department of Micro- and Nanotechnology  
Scheer, H., Examiner  
DTU-lønnet stipendie  
01/10/2005 → 03/03/2010  
Award relations: MEMS-Teknologi i Nanoimprint Litografi  
Project: PhD

**All-Polymer Biosensors in Microfluidic System**  
Matschuk, M., PhD Student, Department of Micro- and Nanotechnology  
Larsen, N. B., Main Supervisor, Department of Micro- and Nanotechnology  
Bruus, H., Supervisor, Department of Micro- and Nanotechnology  
Kristensen, A., Examiner, Department of Micro- and Nanotechnology
Microfluidics for single cell analysis
Jensen, M. P., PhD Student, Department of Micro- and Nanotechnology
Marie, R., Main Supervisor, Department of Micro- and Nanotechnology
Kristensen, A., Supervisor, Department of Micro- and Nanotechnology
Bruus, H., Examiner, Department of Micro- and Nanotechnology
Kutter, J. P., Examiner, Department of Micro- and Nanotechnology
Laurell, T., Examiner
Grundforskningsfonden
15/09/2012 → 09/12/2015
Award relations: Microfluidics for single cell analysis
Project: PhD

Structural Colors in Plastic
Højlund-Nielsen, E., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Mortensen, N. A., Supervisor, Department of Micro- and Nanotechnology
Hansen, O., Examiner, Department of Micro- and Nanotechnology
Schift, H., Examiner
Yang, J., Examiner
1/3 FUU, 1/3 inst 1/3 Andet
01/09/2012 → 16/03/2016
Award relations: Structural Colors in Plastic
Project: PhD

Plasmonic nanostructures for energy harvesting
Zhu, X., PhD Student, Department of Photonics Engineering
Xiao, S., Main Supervisor, Department of Photonics Engineering
Hansen, O., Supervisor, Department of Micro- and Nanotechnology
Mortensen, N. A., Supervisor, Department of Photonics Engineering
Kristensen, A., Examiner, Department of Micro- and Nanotechnology
Fang, N. X., Examiner
Levy, U., Examiner
Fang, N. X., Examiner
Levy, U., Examiner
Institut stipendie (DTU) Samf.
01/10/2011 → 12/12/2014
Award relations: Plasmonic nanostructures for energy harvesting
Project: PhD

Structural color effects on plastic surfaces
Christiansen, A. B., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Mortensen, N. A., Supervisor, Department of Micro- and Nanotechnology
Lavrinenko, A., Examiner
Ahopelto, J. K., Examiner
Sutherland, D., Examiner
Institut stipendie (DTU) Samf.
01/04/2011 → 20/08/2014
Award relations: Structural color effects on plastic surfaces
Project: PhD

Nanostructured polymer surfaces for optical functionality
Clausen, J. S., PhD Student, Department of Photonics Engineering
Mortensen, N. A., Main Supervisor, Department of Photonics Engineering
Kristensen, A., Supervisor
Hansen, O., Examiner
Bozhevolnyi, S. I., Examiner, Department of Photonics Engineering
Shin, J. H., Examiner
Institut stipendie (DTU) Samf.
01/08/2011 → 30/09/2014
Award relations: Nanostructured polymer surfaces for optical functionality
Project: PhD

Reconfigurable photonic crystals
Hermannsson, P. G., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Smith, C., Supervisor, Department of Micro- and Nanotechnology
Vannahme, C., Supervisor, Department of Micro- and Nanotechnology
Wubs, M., Examiner
Gerken, M., Examiner
Svavarsson, H. G., Examiner
Institut stipendie (DTU) Samf.
01/10/2011 → 23/09/2015
Award relations: Reconfigurable photonic crystals
Project: PhD

Opto-Thermal actuation in micro and fluidics
Lüscher, C. J., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Marie, R., Supervisor, Department of Micro- and Nanotechnology
Mortensen, N. A., Examiner, Department of Micro- and Nanotechnology
Levy, U., Examiner
Montelius, L., Examiner
Institut stipendie (DTU)
01/10/2010 → 15/01/2014
Award relations: Opto-Thermal actuation in micro and fluidics
Project: PhD

Nanoimprint lithography for optofluidics
Mikkelsen, M. B. L., PhD Student, Department of Micro- and Nanotechnology
Kristensen, A., Main Supervisor, Department of Micro- and Nanotechnology
Eijkel, J. C. T., Examiner
Montelius, L., Examiner
Forskningsrådsfinansiering
01/09/2008 → 21/02/2012
Award relations: Nanoimprint lithography for optofluidics
Project: PhD

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.
Polymere farvestof mikrokavitets lasere
Kristensen, A., Project Participant, Department of Micro- and Nanotechnology
Project ID: 65096
Forskningsrådene - STVF: DKK1,500,000.00
26/07/2002 → 31/07/2005
Award relations: Polymer farvestof mikrokavitets lasere
Project: Research

Activities:

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
   14th Annual Conference on Commercializing Micro- and Nanotechnology
   30/08/2009 → 04/09/2009
   Copenhagen, Denmark
   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

   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 "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

**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

**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 "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
Anders Kristensen (Participant)
Department of Micro- and Nanotechnology
NanoSystemsEngineering Section
NSE-Optofluidics Group

**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

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

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

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 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

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 "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

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

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

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

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

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

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
2008 APS March Meeting
10/03/2008 → 14/03/2008
New Orleans, United States
Activity: Attending an event › Participating in or organising a conference