Biostable glucose permeable polymer

A new biostable glucose permeable polymer has been developed which is useful, for example, in implantable glucose sensors. This biostable glucose permeable polymer has a number of advantageous characteristics and, for example, does not undergo hydrolytic cleavage and degradation, thereby providing a composition that facilitates long term sensor stability in vivo. The versatile characteristics of this polymer allow it to be used in a variety of contexts, for example to form the body of an implantable glucose sensor. The invention includes the polymer composition, sensor systems formed from this polymer composition, and methods for making and using such sensor systems.

General information
State: Published
Organisations: Department of Electrical Engineering, Department of Photonics Engineering
Publication date: 22 Jun 2017

Publication information
Country: United States
IPC: C08G 71/02 A I
Patent number: US2017172471
Date: 22/06/2017
Priority date: 18/12/2015
Priority number: US201514974250
Original language: English
Electronic versions:
US2017172471A1.pdf
Main Research Area: Technical/natural sciences
Source: espacenet
Source-ID: US2017172471
Publication: Research > Patent – Annual report year: 2017

BDK-doped core microstructured PMMA optical fiber for effective Bragg grating photo-inscription

An endlessly single-mode doped microstructured poly(methyl methacrylate) (PMMA) optical fiber is produced for effective fiber Bragg grating (FBG) photo-inscription by means of a 400 nm femtosecond pulsed laser and the phase mask technique. The fiber presents a uniform benzyl dimethyl ketal (BDK) distribution in its core without drastic loss increase. It was produced using the selected center hole doping technique, and the BDK dopant acts as a photoinitiator. In this Letter, we report a rapidly growing process of the grating reflection band. For an 11 mW mean laser power, the FBG reflectivity reaches 83% in only 40 s.

General information
State: Published
Organisations: Department of Photonics Engineering, Fiber Sensors and Supercontinuum Generation, University of Mons
In this letter, we investigate the response of poly(methylmethacrylate) (PMMA) microstructured polymer optical fiber Bragg gratings (POFBGs) after immersion in methanol/water solutions at room temperature. As the glass transition temperature of solution-equilibrated PMMA differs from the one of solvent-free PMMA, different concentrations of methanol and water lead to various degrees of frozen-in stress relaxation in the fiber. After solvent evaporation, we observe a permanent blue-shift in the grating resonance wavelength. The main contribution in the resonance wavelength shift arises from a permanent change in the size of the fiber. The results are compared with conventional annealing. The proposed methodology is cost-effective as it does not require a climate chamber. Furthermore, it enables an easy-to-control tuning of the resonance wavelength of POFBGs.
Bragg grating photo-inscription in doped microstructured polymer optical fiber by 400 nm femtosecond laser pulses.

In this paper, we report the manufacturing of high-quality endlessly single-mode doped microstructured poly(methyl methacrylate) (PMMA) optical fibers. Bragg gratings are photo-inscribed in such fibers by means of 400 nm femtosecond laser pulses through a 1060-nm-period uniform phase mask. Preliminary results show a rapid growing process of the reflection band. To preserve a good spectral shape, the photo-inscription process was limited to ~20 seconds, yielding an FBG reflectivity close to 40%.

General information
State: Published
Organisations: Department of Photonics Engineering, Fiber Sensors and Supercontinuum Generation, University of Mons
Number of pages: 4
Publication date: 2016

Host publication information
Title of host publication: Proceedings of 25th International Conference on Plastic Optical Fibers 2016
Main Research Area: Technical/natural sciences
Publication: Research - peer-review → Article in proceedings – Annual report year: 2016

Investigation of the in-solution relaxation of polymer optical fibre Bragg gratings
We investigate the response of PMMA microstructured polymer optical fibre Bragg gratings when immersed in methanol/water solutions. Overall we observe a permanent blue-shift in Bragg grating wavelength after solvent evaporation. The main contribution in the resonance wavelength shift probably arises from a permanent change in the size...
of the fibre, as already reported for high-temperature annealing of polymer optical fibres. As a consequence of the solution concentration dependence of the glass transition temperature of polymers, different methanol/water solutions lead to various degrees of frozen-in stress relaxation with an overall blue-shift of the Bragg grating wavelength.

General information
State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Department of Photonics Engineering, Fiber Sensors and Supercontinuum Generation
Authors: Fasano, A. (Intern), Woyessa, G. (Intern), Janting, J. (Intern), Rasmussen, H. K. (Intern), Bang, O. (Intern)
Pages: 4
Publication date: 2016

Host publication information
Title of host publication: Proceedings of the 25th International Conference on Plastic Optical Fibers 2016
Publisher: University of Aston in Birmingham
ISBN (Electronic): 9781854494085
Main Research Area: Technical/natural sciences
Polymer, Microstructured polymer optical fibre, Fibre Bragg grating, Annealing, Solution
Electronic versions:
POF2016_conference_paper.pdf
Source: PublicationPreSubmission
Source-ID: 128125855
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

Polymer Optical Fiber Compound Parabolic Concentrator fiber tip based glucose sensor: In-Vitro Testing
We present in-vitro sensing of glucose using a newly developed efficient optical fiber glucose sensor based on a Compound Parabolic Concentrator (CPC) tipped polymer optical fiber (POF). A batch of 9 CPC tipped POF sensors with a 35 mm fiber length is shown to have an enhanced fluorescence pickup efficiency with an average increment factor of 1.7 as compared to standard POF sensors with a plane cut fiber tip. In vitro measurements for two glucose concentrations (40 and 400 mg/dL) confirm that the CPC tipped sensors efficiently can detect both glucose concentrations. It sets the footnote at the bottom of this column.

General information
State: Published
Organisations: Department of Photonics Engineering, Fiber Sensors and Supercontinuum Generation, Department of Micro- and Nanotechnology, Department of Informatics and Mathematical Modeling, Medtronic Research and Technology Bakken Research Center BV
Authors: Hassan, H. U. (Intern), Janting, J. (Intern), Aasmul, S. (Ekstern), Bang, O. (Intern)
Number of pages: 6
Pages: 8483 - 8488
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Sensors Journal
Volume: 16
Issue number: 23
Article number: 7562488
ISSN (Print): 1530-437X
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.12 SJR 0.706 SNIP 1.689
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.684 SNIP 1.908 CiteScore 2.85
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.799 SNIP 1.934 CiteScore 2.5
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.666 SNIP 1.811 CiteScore 2.6
Study of doping non-PMMA polymer fibre canes with UV photosensitive compounds

We propose a solution doping method for polycarbonate (PC) and TOPAS polymer optical fibre (POF) canes using different UV photosensitive dopants aiming to reduce the fibre Bragg grating inscription time at the typical Bragg grating inscription wavelength (325nm). Three-ring solid-core PC mPOF canes and hollow-core TOPAS canes were doped with a solution of dopants in acetone/methanol and hexane/methanol, respectively. Doping time, solvent mixture concentration and doping temperature were optimised. A long and stepwise drying process was applied to the doped canes to ensure complete solvent removal. This is required to avoid the formation of any bubbles during the fibre drawing process.

General information
State: Published
Organisations: Department of Photonics Engineering, Fiber Sensors and Supercontinuum Generation, Department of Mechanical Engineering, Manufacturing Engineering, Maria Curie-Skłodowska-University
Number of pages: 5
Publication date: 2016
Monitoring device for attachment to a surface of a subject.
The invention provides a monitoring device (1) for attachment to a surface of a subject. The device comprises a data collector (2) and a processor (3) as two separate parts which can be detachably joined such that physiological signals which are detected by the data collector can be transferred to the processor for signal processing and provision of monitoring data. At least one of the data collector and the processor comprises a transducer which can convert the physiological signal to a data signal which can be processed electronically. The data collector is adapted for adhesive contact with a skin surface, and may comprise an adapter (6) for the detachable attachment of the processor.

Microsystem reliability: Polymer adhesive and coating materials for packaging
Polymer microsystem packaging materials have been characterized and failure analysis methods have been developed with the aim of gaining higher microsystem reliability. The importance of this work stems from the fact that microsystem sensors due to small size are very sensitive to the often very aggressive surroundings. Focus is on how the adhesion of protective polymer adhesives and coatings can be characterized theoretically and practically and optimized regarding intrinsic properties, the surroundings and their mutual influences. The main conclusion is that the mutual influences make a system design approach to development of reliable microsystem packaging mandatory. Diffusion of water is identified as the most important parameter or physical mechanism lowering microsystem reliability due to corrosion, delamination etc. This topic is therefore treated thoroughly by mathematical modeling / practical calculations to find diffusivities and methods are given by which water can be kept away from critical areas in microsystems.
Direct media exposure of MEMS multi-sensor systems using a potted-tube packaging concept

A packaging concept for Data Storage Tags is presented. A potted-tube packaging concept, using a polystyrene tube and different epoxies as filling material that allows for direct sensor exposure is investigated. The curing temperature, water uptake and the diffusion coefficient for water in the filling material is measured. The packaging concept is used to encapsulate a microfabricated multi-sensor (measuring temperature, water conductivity, pressure and light intensity). The direct exposure of the sensors results in high sensitivity and fast response time. The design of an elongated multi-sensor is described and effectiveness of the packaging is demonstrated with the precise measurement of water conductivity using the packaged multi-sensor. The packaging concept is very promising for high accuracy measurements in harsh environments.
Reliability of polymer adhesive and coating materials for microsystem packaging

General information
State: Published
Organisations: Aalborg Universitet
Authors: Janting, J. (Intern)
Number of pages: 320
Publication date: 2008

Publication information
Publisher: Aalborg Universitet
ISBN (Print): 978-87-7606-031-2
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
PhDThesis_Janting_WEB.pdf
Source: PublicationPreSubmission
Source-ID: 113015051
Publication: Research › Ph.D. thesis – Annual report year: 2008

Water Penetration Study for a 3D Electronic Patch

General information
State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic
Authors: Janting, J. (Intern)
Pages: 41-46
Publication date: 2008
Water penetration study for a wireless 3D Electronic Patch

The studied 3D electronic patch which is a three electrode sensor for measurement of muscle activity consists of two main parts: a two part housing for the electronics together with a battery frame cap embedded in an adhesive patch. The two parts are held together with snap latches. Adhesive (Loctite 4031) is used for assembly of the PCB in the housing and the battery in the battery frame. Housing and battery frame are prototypes of nylon 12 (polylaurinlactam) and made by SLS. The presented work aims at qualifying the prototype device for clinical test. Design changes of the first SLS prototype to minimize water penetration to the electronics are explained. The most important 3 design changes address the direct access for water (sweat) in the crevice between the housing and battery frame to the button cell battery area. By lowering the battery frame profile the patch adhesive can adhere to the house and thereby delay the water ingress. Likewise the water is delayed by an o-ring (Polyjet TANGO+ prototype material) placed in the battery frame close to the button cell battery. Between these two delays 124 square cavities capture / divert and delay the water on its way to the battery region. The capture is explained in terms of the Kelvin equation and wetting angles. Due to the potential corrosion and sensor signal dampening Nylon 12, Loctite 4031, TANGO+ and future potential housing and battery frame materials have been characterized concerning water uptake, diffusivity and wetting angle. Current preliminary environmental testing (damp/heat, sweat) is reported.

Direct exposure of MEMS multi-sensor systems using a potted-tube packaging concept

Sensor Packaging for Harsh Environments
SU-8 cantilever chip interconnection
The polymer SU-8 is becoming widely used for all kinds of micromechanical and microfluidic devices, not only as a photoresist but also as the constitutional material of the devices. Many of these polymeric devices need to include a microfluidic system as well as electrical connection from the electrodes on the SU-8 chip to a printed circuit board. Here, we present two different methods of electrically connecting an SU-8 chip, which contains a microfluidic network and free-hanging mechanical parts. The tested electrical interconnection techniques are flip chip bonding using underfill or flip chip bonding using an anisotropic conductive film (ACF). These are both widely used in the Si industry and might also be used for the large scale interconnection of SU-8 chips. The SU-8 chip, to which the interconnections are made, has a microfluidic channel with integrated micrometer-sized cantilevers that can be used for label-free biochemical detection. All the bonding tests are compared with results obtained using similar Si chips. It is found that it is significantly more complicated to interconnect SU-8 than Si cantilever chips primarily due to the softness of SU-8.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Bioprosbes, DELTA Microelectronics
Authors: Johansson, A. C. (Intern), Janting, J. (Intern), Schultz, P. (Intern), Hoppe, K. (Ekstern), Hansen, I. (Ekstern), Boisen, A. (Intern)
Pages: 314-319
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Micromechanics and Microengineering
Volume: 16
Issue number: 2
ISSN (Print): 0960-1317
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.74 SJR 0.595 SNIP 1.017
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.64 SNIP 1.211 CiteScore 1.96
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.725 SNIP 1.224 CiteScore 1.84
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.611 SNIP 1.055 CiteScore 1.74
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.856 SNIP 1.402 CiteScore 1.92
ISI indexed (2012): ISI indexed yes
Techniques in Scanning Acoustic Microscopy for Enhanced Failure and Material Analysis of Microsystems

Acoustic microscopy is a widely used Non Destructive Testing (NDT) method for micro-inspection. Introductions to ultrasonic NDT in general and acoustic microscopy is given in [1]-[5] and [6]-[9] respectively.

General information

State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic
Authors: Janting, J. (Intern)
Pages: 293-309
Publication date: 2006

Host publication information

Title of host publication: MEMS/NEMS : Manufacturing Methods.
Volume: 3
Editor: Leondes, C. T.
ISBN (Print): 978-0-387-24520-1
Chapter: 7
Main Research Area: Technical/natural sciences
DOIs:
10.1007/0-387-25786-1_23
Surface tension driven shaping of adhesive microfluidic channel walls

The feasibility of making microfluidic channels with different wall geometries using adjacent lines of dispensed adhesive between substrates has been studied. Important parameters for the geometry have been identified to be: surface tension (adhesive / substrates), adhesive viscosity / thixotropy, line height and distance, and temperature. Focus of the work has been on predicting the equilibrium geometries with FEM simulations using as input measured adhesive wetting angles, different adhesive line distances and height. The studied substrates are glass microscope slides, PEEK and PMMA. The studied adhesives are DYMAX 9-20318-F, 3070, 9001 version 3.5, and Sylgard 184 PDMS.

General information
State: Published
Organisations: Polymeric Enabling Microsystems Group, Polymer Micro and Nano Engineering Section, Department of Micro- and Nanotechnology, Aarhus University
Authors: Janting, J. (Intern), Storm, E. K. (Ekstern), Geschke, O. (Intern)
Pages: 378-380
Publication date: 2005

Host publication information
Title of host publication: Micro Total Analysis Systems 2004
Volume: Vol 2
Publisher: Royal Society of Chemistry
ISBN (Print): 0-85404-896-0
Series: Royal Society of Chemistry. Special Publications
Number: 297
ISSN: 0260-6291
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 61633
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004

Adhesive Bonding Methods for Polymer microTAS Components.

General information
State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic, Oticon A/S
Authors: Friis, P. (Ekstern), Storm, E. K. (Ekstern), Hoppe, K. (Ekstern), Janting, J. (Intern)
Pages: 354-356
Publication date: 2004

Host publication information
Title of host publication: Proceedings of µTAS 2004 : 8th International Conference on Miniaturised Systems for Chemistry and Life Sciences.
Publisher: Royal Society of Chemistry
Editors: Laurell, T., Nilsson, J., Jensen, K., Harrison, D. J., Kutter, J. P.
ISBN (Print): 0-85404-643-7
Main Research Area: Technical/natural sciences
Source: PublicationPreSubmission
Source-ID: 114846653
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004

Correlation between MEMS Adhesive cure Degree and acoustic Impedance determined with Differential Scanning Calorimetry and Scanning Acoustic Microscopy

General information
State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic, Technical University of Denmark
FEM Simulation of Influence of Protective Encapsulation on MEMS Pressure Sensor

The objective of the work is to evaluate the feasibility of packaging a MEMS silicon pressure sensor by using either a polymer encapsulation or a combination of a polymer encapsulation and a metallic protection Membrane (fig. 1). The potential application of the protected sensor is for harsh environments. Several steps of simulation are carried out: 1) Comparisons of the sensitivities are made among the non-encapsulated silicon sensor, the polymer encapsulated and polymer with metal encapsulated sensor. This is for evaluating whether the encapsulating materials reduce the pressure sensitivity compared to the conventionally exposed sensor. 2) Stress concentration calculations are performed to investigate if the encapsulation could lead to increased stress concentration in the silicon structure. The reliability of the adhesion of the metallic encapsulating membrane is assessed by investigating whether the metallic membrane / coating will peel off when applying the maximum pressure, which is 4000 bar leading to high shear stress between the metallic membrane and the polymer encapsulation material. 3) Thermal calculations are made to evaluate the influence of the environment on the packaged sensor. Sensitivity related conclusion remarks: • The polymer and the metallic encapsulation would not lead to a significant reduction of the sensitivity of the silicon sensor. • Metallic encapsulation has a negligible influence on the sensitivity compared to the polymer-encapsulated design without the metal protection membrane. Stress concentration related conclusion remarks: • The coating leads to larger stresses on the interface between the two silicon parts of the sensor die. • The coating leads to larger stresses in the junction region between the silicon sensor die and the mounting material. • Whether the stress concentration on the interface between the metallic membrane and the polymer lead to a reliability risk depends on the adhesion of the membrane. • The polymer encapsulation leads to much larger vertical displacement of the silicon sensor, which might harm the reliability of the mounting of the sensor die to the substrate. Thermal related conclusion remarks: • For the currently selected polymer encapsulation material with a thermal expansion coefficient of 5·10⁻⁵, the temperature-induced deformation has significant influence on the sensitivity. A temperature change of 15 °C will give a signal as a pressure of 40 bars.

General information
State: Published
Organisations: Department of Photonics Engineering, Fiber Sensors and Supercontinuum Generation, SensoAsian Industrial Consulting, DELTA Danish Electronics, Light & Acoustic
Authors: Yao, Q. (Ekstern), Janting, J. (Intern), Branebjerg, J. (Ekstern)
Number of pages: 2
Publication date: 2003

Scanning Acoustic Microscopy for Quality Assurance of MEMS Sensors

General information
State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic
Authors: Janting, J. (Intern)
Pages: 255-260
Scanning Acoustic Microscopy Investigation of Adhesive Cure Degree.

*General information*

State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, DELTA Danish Electronics, Light & Acoustic
Authors: Janting, J. (Intern), Petersen, D. H. (Intern)
Number of pages: 2
Publication date: 2003

Simulated SAM A-scans on multilayer MEMS components

*General information*

State: Published
Organisations: Department of Photonics Engineering, Fiber Sensors and Supercontinuum Generation, Department of Micro- and Nanotechnology, Nanocarbon, Danfoss A/S
Authors: Janting, J. (Intern), Petersen, D. H. (Intern), Greisen, C. (Intern)
Number of pages: 2
Publication date: 2003

Water Uptake of Polymeric MEMS Packaging Materials.

*General information*

State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic
Authors: Janting, J. (Intern), Storm, E. K. (Ekstern)
Pages: 520-522
Publication date: 2003
Water Uptake of Polymeric Packaging Materials

General information
State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic
Authors: Janting, J. (Intern), Storm, E. K. (Ekstern)
Number of pages: 2
Publication date: 2003

Host publication information
Title of host publication: Proceedings of Workshop on MEMS Sensor Packaging
ISBN (Print): 87-89935-46-2
Main Research Area: Technical/natural sciences
Conference: Workshop on MEMS Sensor Packaging, Lyngby, Denmark, 20/03/2003 - 20/03/2003
Electronic versions: Paper19_2.pdf
Source: PublicationPreSubmission
Source-ID: 114606931
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Scanning Acoustic Microscopy Study of Flip-Chip Underfill Cure Degree

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanocarbon, DELTA Danish Electronics, Light & Acoustic
Authors: Janting, J. (Intern), Petersen, D. H. (Intern), Schonwandt, B. V. (Ekstern)
Number of pages: 8
Publication date: 2002

Host publication information
Title of host publication: Proceedings of Materials Week conference
Main Research Area: Technical/natural sciences
Conference: European Conference on Advanced Materials, Munich, Germany, 30/09/2002 - 30/09/2002
Electronic versions: Scanning_Acoustic_Microscopy_Study_of_Flip_Chip_Underfill_Cure_Degree.pdf
Source: PublicationPreSubmission
Source-ID: 114518318
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

Scanning Acoustic Microscopy Study of the Adherence of Coatings on Gas Turbine Components.

General information
State: Published
Organisations: Department of Management Engineering, Department of Mechanical Engineering, Materials and Surface Engineering, DELTA, SydTek AB
Authors: Janting, J. (Intern), Borggreen, K. (Ekstern), Horsewell, A. (Intern), Grumsen, F. B. (Intern)
Number of pages: 8
Publication date: 2002

Host publication information
Title of host publication: Proceedings of Materials Week conference
Main Research Area: Technical/natural sciences
Conference: European Conference on Advanced Materials, Munich, Germany, 30/09/2002 - 30/09/2002
Links: http://www.ipl.dtu.dk/publikation/7702/dk/
Simulated SAM A-scans on multilayer MEMS components

A spreadsheet program for simulation of Scanning Acoustic Microscopy (SAM) A-scans on multilayer structures has been developed. Using this program, structure variations in samples can be analysed better. Further samples can be prepared to get optimal signal for enhanced failure and materials analysis. Input values for the sample materials are acoustic impedance, speed of sound, and thickness. The simulation is based on calculations of reflection, transmission coefficients, and number N of waves received by the transducer at the same time by reflection at the same interfaces in different order. The calculation of N, the program interface, and simulated A-scans on MEMS test structures for a pressure sensor are presented. (C) 2002 Elsevier Science Ltd. All rights reserved.
Encapsulation for a three-dimensional microsystem

The present invention relates to an encapsulation for a microsystem. The microsystems may comprise a sensor, transducer, actuator, MEMS or other three-dimensional microsystems. The encapsulation may serve as a protection against environments such as, chemical attack, physical attack, fluid penetration and Electro Magnetic Interference. The choice of materials of the encapsulation depends on the object of encapsulation. The actual encapsulation may be applied by providing a first layer of a first material onto at least part of an outer surface of the microsystem, providing a second layer of a second material onto the first layer.

Chip-size-packaged silicon microphones [for hearing instruments]

The first results of silicon microphones that are completely batch-packaged and integrated with signal conditioning circuitry in a chip stack are discussed. The chip stack is designed to be directly mounted into a system, such as a hearing instrument, without further single-chip handling or wire bonding. The devices are fully encapsulated and provided with a well-determined interface to the environment. The integrated microphones operate at a bias of 1.5 V and are expected to reach a sensitivity of 5 mV/Pa, an A-weighted equivalent input noise of 24 dB sound pressure level, and a power consumption of about 50 μW in the near future, thereby living up to the tight specifications of microphones for hearing instruments. Other potential applications include mobile phones, headsets, and wearable computers, in which space is constrained.

General information

State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic
Authors: Janting, J. (Intern), Branebjerg, J. A. (Ekstern), Rombach, P. (Ekstern)
Publication date: 12 Apr 2001

Publication information
IPC: B81B7/00; G01L9/00
Patent number: WO200126136
Date: 12/04/2001
Priority date: 05/10/1999
Priority number: DK19990001428
Original language: English
Electronic versions:
WO0126136A2.pdf

Bibliographical note
Also published as: WO0126136 (A3) & AU7645300 (A)
Main Research Area: Technical/natural sciences
Publication: Research › Patent – Annual report year: 2001

Chip-size-packaged silicon microphones [for hearing instruments]

The first results of silicon microphones that are completely batch-packaged and integrated with signal conditioning circuitry in a chip stack are discussed. The chip stack is designed to be directly mounted into a system, such as a hearing instrument, without further single-chip handling or wire bonding. The devices are fully encapsulated and provided with a well-determined interface to the environment. The integrated microphones operate at a bias of 1.5 V and are expected to reach a sensitivity of 5 mV/Pa, an A-weighted equivalent input noise of 24 dB sound pressure level, and a power consumption of about 50 μW in the near future, thereby living up to the tight specifications of microphones for hearing instruments. Other potential applications include mobile phones, headsets, and wearable computers, in which space is constrained.

General information

State: Published
Organisations: Department of Micro- and Nanotechnology, Microtronic A/S, Technical University of Denmark, DELTA, Centre Suisse d'Electronique et de Microtechnique S.A., Microcosm Technologies B.v.
Pages: 23-29
Publication date: 2001
Main Research Area: Technical/natural sciences
Conformal coatings for 3D multichip microsystem encapsulation

Materials and methods for low cost minimum volume protective encapsulation of microsystems have been investigated. The focus has been on a 3D conformal multilayer coating of silicon microphones. Materials with different properties, e.g., insulating and conductive, can be applied and combined as multilayers around the sharp edges of single crystalline silicon giving a protection which cannot be matched by a single material. A 50 mum thick insulating layer with volume resistivity above 10(16) Ohm cm with a 150 mum thick conductive layer on top is reported to have an EMI E-field damping higher than 55 dB in the 50 MHz-1 GHz frequency range.

General information
State: Published
Organisations: DELTA Danish Electronics, Light & Acoustic, Microtronic A/S
Authors: Janting, J. (Intern), Branebjerg, J. (Intern), Rombach, P. (Intern)
Pages: 229-234
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Sensors and Actuators A: Physical
Volume: 92
Issue number: 1-3
ISSN (Print): 0924-4247
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 0.803 SNIP 1.655 CiteScore 2.79
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.848 SNIP 1.599 CiteScore 2.73
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.878 SNIP 1.798 CiteScore 2.41
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.827 SNIP 1.802 CiteScore 2.53
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.915 SNIP 2.113 CiteScore 2.34
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.907 SNIP 2.111 CiteScore 2.5
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.106 SNIP 1.834
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.029 SNIP 1.674
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.973 SNIP 1.612
Web of Science (2008): Indexed yes
Conformal Coatings for 3D Multichip Microsystems Encapsulation
Materials and methods for low cost minimum volume protective encapsulation of microsystems have been investigated. Focus has been on a 3D conformal multilayer coating of silicon microphones. Materials with different properties, e.g. insulating and conductive, can be applied and combined as multilayers around the sharp edges of single crystalline silicon giving a protection which can not be matched by a single material. A 50 μm thick insulating layer with volume resistivity above 1016 Wcm with a 150 μm thick conductive layer on top is reported to have an EMI damping higher than 55 dB in the 50 MHz to 1 GHz frequency range.

Stacked Silicon Microphones
This paper presents results on the first silicon microphones that are completely batchpackaged and integrated with signal conditioning circuitry in a chip stack. The chip stack is designed to be directly mountable into a system, such as a hearing instrument, without further single-chip handling or wire bonding. The devices are fully encapsulated and provided with a well-determined interface to the environment. The integrated microphones operate at a bias of 1.5 V and are expected to reach a sensitivity of 5 mV/Pa, an equivalent input noise of 24 dBA SPL, and a power consumption of about 50 μW in the near future, thereby living up to the tight specifications of microphones for hearing instruments. Other potential applications include mobile phones, headsets, and wearable computers, in which space is constrained.
Reliability of industrial packaging for microsystems

Packaging concepts for silicon-based micromachined sensors exposed to harsh environments are explored. By exposing the sensors directly to the media and applying protection at the wafer level the packaging and assembly will be simplified as compared to conventional methods of fabrication. Protective coatings of amorphous silicon carbide and tantalum oxide are suitable candidates with etch rates below 0.1 Ångstrom/h in aqueous solutions with pH II at temperatures up to 140 degrees C. Si-Ta-N films exhibit etch rates around 1 Ångstrom/h. Parylene C coatings did not etch but peeled off after extended exposure times at elevated temperatures. The best diamond-like carbon films we tested did not etch, but delaminated due to local penetration of the etchants. Several glue types were investigated for chip mounting of the sensors. Hard epoxies, such as Epo-tek H77, on the one hand exhibit high bond strength and least degradation and leakage, but on the other hand introduce large sensor output drift with temperature changes. Softening of the Epo-tek H77 was observed at 70 degrees C. An industrially attractive thin-film anodic silicon-to-silicon wafer bonding process was developed. Glass layers are deposited at 20 nm/s (1.2 μm/min) by electron-beam evaporation and bond strengths in excess of 25 N/mm(2) are obtained for bonding temperatures higher than 300 degrees C. Through-hole electrical feedthroughs with a minimum line width of 20 μm and a density of 250 wires per cm were obtained by applying electro-depositable photo-resist. Hermetically sealed feedthroughs were obtained using glass frits, which withstand pressures of 4000 bar. (C) 1998 Elsevier Science Ltd. All rights reserved.
Friction and wear characteristics of ion-beam modified graphite coatings.
Solid lubricated surfaces are now widely used in the tool industry, and the new concept of 'soft tools' recently introduced has emphasized low-friction surfaces. The present paper deals with a novel 'burnishing' process based on ionic bombardment of powder graphite coating/substrate systems. This process may influence both the coating and the coating/substrate interface, and it is effective for improving lubrication even at low doses of bombarding ions. The present study will discuss the friction and wear properties of graphite-powder coatings on a silicon wafer bombarded with 200 keV ion beams of argon, nitrogen and hydrogen ions, the last two as molecular ions. The coefficients of friction and wear rates of the coatings were found to be strongly dependent on the ion-bombarding species and ion dose. The argon ion bombardment increased the coefficient of friction and wear rate of the powder coating. However, at the interface of the silicon substrate, the ion-induced burnishing improved the tribological behaviour of the silicon material. Bombardment with nitrogen and hydrogen ions showed a marked improvement in the tribological properties of the graphite powder coating. Thus a reduction in wear rate by three orders of magnitude was observed in the case of nitrogen, and for both ions it was noted that ion-beam burnished graphite was lubricating in a dry environment, which has not been reported previously. The perspectives of ion bombardment as a burnishing process will be discussed and the observed effects will be qualitatively explained in the context of the theory for ionic penetration into solids.

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Organisations: Ohio State University, Aarhus University
Authors: Gupta, B. (Ekstern), Janting, J. (Intern), Sorensen, G. (Ekstern)
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Improvement of wear-resistance of solid lubricants by ionic impact

A solid lubricating material, preferentially as a coating, deposited on a substrate surface by conventional technique such as dipping in a suspension, painting, or spraying is bombarded with energetic ions from an ion accelerator or in a plasma discharge. By such a treatment the wear resistance of said lubricating material is improved considerably due to changes in the crystalline structure of the surface layer, and further the adherence to the component to be lubricated can be improved. The effect according to the invention, which can be both a reduced friction coefficient and a longer sliding-life can be verified in an experiment with a ball with a certain load oscillating on the surface layer to be tested measuring the time dependence of the friction coefficient. The ion-induced changes in the surface crystallinity can be recognized by a reduced reflection of X-rays from the sliding crystalline planes which are parallel to the component surface to be lubricated.

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State: Published
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Ion-induced modification of graphite coatings.

Burnished graphite powders and physical vapor-deposition (PVD) coatings of layered crystalline materials such as MoSx have often been used as solid lubricants. This letter will report on a novel ion-induced modification of a graphite-powder coating on a silicon surface. Even at very low ion doses, the bombardment results in structural modifications observed as a considerable reduction in X-rays reflected from the (002) sliding planes, which indicates an amorphization process. Transmission electron microscopy (TEM) studies have confirmed almost complete amorphization with 200 keV Ar ions at 10^16 ions cm^-2. A commercial scanning tunneling microscope (STM) was used as an advanced profilometer to study ion-induced changes in the surface morphology at the powder surface. The mechanical properties of the combined graphite-coating/silicon system were studied by nanoindentation technique, and the perspectives in ion-beam burnishing of graphite coatings will be discussed.

General information
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Organisations: Aarhus University
Authors: Gupta, B. K. (Ekstern), Janting, J. (Intern), Jensen, U. M. (Ekstern), Pedersen, G. N. (Ekstern), Sorensen, G. (Ekstern)
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On the chemical diffusion in layered thin films containing amorphous Co-Zr, Ni-Zr, and Fe-Zr

The chemical diffusion in thin trilayer films of TM-TM100−xZrx-TM with an amorphous middle layer where TM=Co, Hi, or Fe and in amorphous Fe-Zr and Ni-Zr films with composition gradients has been investigated using Rutherford backscattering spectrometry. The growth of the amorphous layer in the trilayers, due to in-diffusion of cobalt and nickel, is initially found to be proportional to the square root of the time, $t^{1/2}$, and subsequently found to level off before the compositions corresponding to metastable equilibria are reached. Irradiation, with 500 keV Xe$^+$ ions, is found to promote the in-diffusion. This behavior is discussed in terms of structural relaxation effects and their influence on the metastable equilibrium. In amorphous Fe-Zr the chemical diffusivity is observed to be very sluggish. Contrary to the behavior in Co-Zr and Ni-Zr trilayers, the direction of the iron diffusion in Fe-Zr trilayers suggests a broad positive peak in the Gibbs free energy at a composition around 50 at.% Zr.
Crystallization of amorphous thin films during heavy-ion irradiation.
Crystallization of amorphous thin films of Ni-Zr, Ni-Ti and Fe-Zr during heavy-ion irradiation with 500 keV Xe+ ions and without irradiation has been studied. The crystallization temperatures are found to be significantly lowered by ion irradiation. In particular, this effect is pronounced for compositions close to elemental ones, where the crystallization is found to take place through nucleation and growth of terminal solid solutions. A close agreement is found between the onset temperature of crystallization and the upper temperature limit for amorphization of a crystalline elemental multilayer with the same heavy-ion irradiation.

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Organisations: Aarhus University
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Evidence for phase separation in amorphous Fe-Zr from chemical diffusion.
The chemical diffusion of iron in layered films of amorphous Fe-Zr and b.c.c. Fe and in amorphous Fe-Zr films with a composition profile have been investigated using Rutherford backscattering spectrometry. The compositional changes after annealing observed in these films provide evidence for a broad positive peak in the Gibbs free energy of amorphous Fe-Zr at around 50 at.% Zr consistent with phase separation of the amorphous state.

General information
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Organisations: Aarhus University
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Indiffusion of cobalt in amorphous Co-Zr

By use of trilayers consisting of ~35 nm cobalt, ~45 nm amorphous Co-Zr, and ~35 nm cobalt, the indiffusion of cobalt into the amorphous structure was studied by means of Rutherford backscattering spectroscopy (RBS). At temperatures between 650 K and 690 K, an initially high diffusion essentially stopped after 20-40 min. annealing before equilibrium was reached. It is proposed that the effect is related to the diffusional asymmetry in the amorphous phase. The relatively immobile zirconium atoms cannot relax their configuration to permit cobalt indiffusion up to the equilibrium value.

General information

State: Published
Organisations: Aarhus University, University of Cambridge
Authors: Andersen, L. A. (Intern), Bøttiger, J. (Intern), Janting, J. (Intern), Karpe, N. (Ekstern), Larsen, K. K. (Ekstern), Greer, A. L. (Ekstern), Somekh, R. E. (Ekstern)
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**Diffusional asymmetry in amorphous alloys: Implications for interfacial reactions**

Early bivalent transition metal systems such as Ni-Zr and Co-Zr exhibit solid state amorphization (SSA) in which the amorphous phase is formed by reaction between the crystalline elements. The rate of the amorphization is governed by the diffusion of the faster species, Ni or Co. Here results are presented on the homogenization of compositionally modulated thin films which show that the Zr diffusion is up to 10^6 times slower. The difference in diffusivities is correlated with atomic size. The consequences of the marked diffusional asymmetry are considered, particularly for the interpretation of results on the indiffusion of Co into amorphous Co-Zr. It is proposed that for amorphous alloys such as Ni-Zr and Co-Zr, changes in composition by rapid diffusion of Ni or Co can yield structures which are not in internal equilibrium. This would affect, for example, the validity of the common tangent construction as applied to predict the limiting compositions of the amorphous phase in contact with the elemental layers during SSA.

**General information**

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Number of participants: 4
Phd Student:
Inglev, Rune (Intern)
Supervisor:
Janting, Jakob (Intern)
Nielsen, Kristian (Intern)
Main Supervisor:
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