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MME 2015 - PROGRAM AT A GLANCE

Sunday, 20 September

18:00-20:00	Registration at San Pedro Martir
19:00-21:00	Welcome Reception
22:00-	Live Concert: MAUREEN CHOI QUARTET. Plaza Ayuntamiento

Monday, 21 September

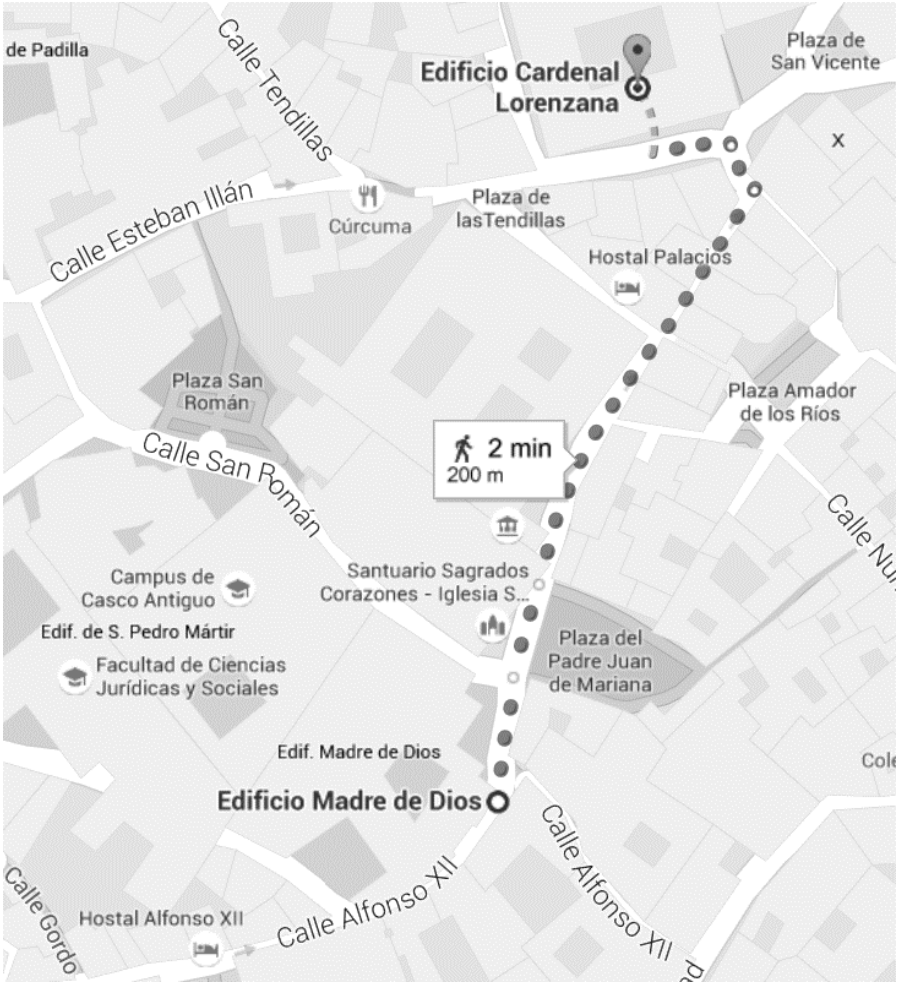
8:30-9:00	Registration and Welcome
9:00-10:15	Invited speaker I (Prof. John E. Sader, University of Melbourne)
10:15-11:00	Poster Flash presentations A
11:00-12:15	Poster session A
12:30-13:30	Lunch
13:45-14:30	Poster Flash presentations B
14:30-15:45	Poster session B
[*]16:15-18:00	Paper review session
[*]19:00-21:30	Conference Dinner

Tuesday, 22 September

8:30-9:00	Registration
9:00-10:00	Invited speaker II (Prof. Laura Lechuga, ICN2, Barcelona)
10:15-11:00	Poster Flash presentations C
11:00-12:15	Poster session C
12:30-13:30	Lunch
13:45-14:45	Invited speaker III (Prof. Ad Lagendijk, University of Twente)
14:45-15:15	Poster Flash presentations D
15:15-16:15	Poster session D
16:15-16:45	MME2016, poster award and closing remarks
17:00-21:30	Toledo guided tour and Tapas session

[*] Location: Cardenal Lorenzana Building

From Convent of San Pedro Mártir to Cardenal Lorenzana Building



INVITED SPEAKER I

(Monday 9:00-10:15)

Prof. John E. Sader, University of Melbourne
"FLUID-STRUCTURE INTERACTION OF MICRO/NANO DEVICES"

SESSION A

(Monday 10:15-12:15)

Laura Stöber	**A1:** HIGH TEMPERATURE BEHAVIOR OF SPUTTER DEPOSITED MOLYBDENUM NITRIDE THIN FILMS
Ilya Uvarov	**A2:** MEMS SWITCH WITH THE ACTIVE CONTACT BREAKING MECHANISM
Mohammad Beygi	**A3:** DESIGN AND MICROFABRICATION OF A STRAIN-GAUGE ARRAY ON POLYMER SUBSTRATE FOR TACTILE NEUROPROSTHESES IN RATS
Irene Sancho	**A4:** EXPERIMENTAL AND NUMERICAL ANALYSIS OF THE DEPOSITION OF MAGNETIC BEADS ON THE WALL OF A MICROCHANNEL
Conor O'Mahony	**A5:** SYSTEM MONITORING SENSORS FOR SMART MICRO TRANSDERMAL INTERFACE PLATFORMS (MICROTIPS)
Anette Wolff	**A6:** EVALUATION OF A NOVEL SEEDING TECHNIQUE IN MICROFLUIDIC CHIPS
Laura Geukens	**A7:** TOWARDS AN ELECTROWETTING-DRIVEN MICROCONVEYOR: USING DROPLETS FOR MOVING A PLATFORM
Seung Hee Jeong	**A8:** SOFT BENDABLE THERMOELECTRIC GENERATOR FOR UNEVEN SURFACE IMPLEMENTATION
Víctor Ruiz-Díez	**A9:** MODELLING AND CHARACTERIZATION OF THE ROOF TILE-SHAPED MODES OF ALN-BASED CANTILEVER RESONATORS IN LIQUID MEDIA
Gerard Cummins	**A10:** CARBON SCREEN PRINTED ELECTRODES ON LOW TEMPERATURE CO-FIRED CERAMICS FOR LABEL FREE MOLECULAR DIAGNOSTICS
Marc P.Pichel	**A11:** U-TURN TRAJECTORIES OF MAGNETOTACTIC BACTERIA IN MICROFLUIDICS

Anders Persson	**A12:** OPTOGALVANIC SPECTROSCOPY WITH MICROPLASMA SOURCES – CURRENT STATUS AND DEVELOPMENT TOWARDS LAB-ON-A-CHIP
Steffen Leopold	**A13:** THE ENGINEERED EYE - THREE-DIMENSIONAL SCANNING OF THE OBJECT-SPACE
Tiago Monteiro	**A14:** EFFECT OF ISOPROPANOL EVAPORATION ON ANISOTROPIC ETCHING OF SILICON IN AQUEOUS POTASSIUM HYDROXIDE SOLUTIONS

SESSION B

(Monday 13:45-15:45)

Akin Aydemir	**B1:** AN ULTIMATE CAPACITIVE MEMS ACCELEROMETER WITH DIFFERENTIAL SENSING CAPABILITY
Konstantin Grygoryev	**B2:** THE INFLUENCE OF SKIN-ELECTRODE CONTACT FORCE ON MICRONEEDLE-BASED ECG ELECTRODE PERFORMANCE
Rodica Voicu	**B3:** MEMS POLYSILICON CANTILEVERS FOR VIBRATIONAL APPLICATIONS
Vlastimil Rehacek	**B4:** DEPOSITION OF GOLD NANOPARTICLES FROM COLLOIDAL SUSPENSION ON NIO SURFACE
Martin Predanocy	**B5:** THERMO-MECHANICAL DESIGN, MODELING AND SIMULATION OF MICROSTRUCTURES FOR LOW DISSIPATION HOTPLATES
Tetsuya Hemmi	**B6:** BATCH INTEGRATION PROCESS OF A FREE-STANDING SILICON NANOWIRE TO MEMS
Per Loethman	**B7:** CROSSING THE POINT - ARCHITECTURES FOR NOVEL MAGNETIC MEMORIES VIA 3D MACROSCOPIC SELF-ASSEMBLY
Hannes Mehner	**B8:** MICROMECHANICAL BINARY COUNTER MECHANISM FOR STORING OFF-LIMIT CONDITIONS
Tijmen A.G. Hageman	**B9:** CHARACTERISATION OF A MACROSCOPIC SELF-ASSEMBLY REACTOR

Paulo J. Sousa	**B10:** FLEXIBLE GASTROINTESTINAL PRESSURE-SENSITIVE TUBE BASED ON ALUMINIUM THIN-FILM STRAIN-GAUGE ARRAYS
Berk Camli	**B11:** SPLIT RING RESONATOR MICROWAVE BIOSENSOR FOR GLUCOSE DETECTION
Jose Ángel Miguel Díaz	**B12:** CMD, AN AUTOMATED DESIGN TOOL FOR BLOOD PRESSURE SENSING CAPACITIVE MEMS

INVITED SPEAKER II

(Tueday 9:00-10:00)

Prof. Laura Lechuga, ICN2, Barcelona
"MICRO/NANO BIOSENSOR DEVICES FOR REAL APPLICATIONS"

SESSION C

(Tuesday 10:15-12:15)

Mohammadamir Ghaderi	**C1:** OPTOMECHANICAL CHARACTERIZATION OF ANNEALED THIN PECVD OXIDE MEMBRANES
Joan Barcelo	**C2:** TOWARDS AN ON-CHIP MEMS CHAOTIC GENERATOR IN A COMMERCIAL 0.35-MICRON CMOS TECHNOLOGY
Ruth Houlihan	**C3:** ANALYSIS OF THIN FILM STRESS IN ENERGY HARVESTER
Akin Aydemir	**C4:** DRIE PROCESS OPTIMIZATION TO ACHIEVE HIGH ASPECT RATIO FOR CAPACITIVE MEMS SENSORS
Eliana M F Vieira	**C5:** FLEXIBLE SOLID-STATE LI – ION BATTERY USING GE THIN FILM ANODE AND LICOO2 CATHODE
Guillaume Lehee	**C6:** DAMPED SPRING MODEL OF A PIEZORESISTIVE SILICON NANOWIRE COUPLED TO A LOW FREQUENCY MEMS RESONATOR
Sasha Hoshian	**C7:** SUPERHYDROPHOBIC SILICON WITHOUT HYDROPHOBIC COATING US-ING PLASMA-ENHANCED ATOMIC LAYER DEPOSITION OF PLATINUM NA-

	NOPARTICLES AND METAL-ASSISTED CHEMICAL ETCHING
Zihao Li	**C8:** MODELLING THE EFFECTS OF THE ELECTRODE SIZE AND SKIN PROPERTIES IN BIO-POTENTIAL MONITORING
Xiangping Li	**C9:** TEN THERMAL GRADIENTS OF MINIATURIZED REAL-TIME POLYMERASE CHAIN REACTION (PCR) DEVICE USING TWO THERMOELECTRIC COOLERS (TECS)
Frida Sjögren	**C10:** MICROPATTERNING OF PHOTOCROSSLINKABLE HYALURONIC ACID
Fernando Almazán	**C11:** FABRICATION OF MICRO CONCENTRATORS FOR VOLATILE ORGANIC COMPOUNDS SENSING AT TRACE-LEVEL APPLICATIONS
Francois Bernard	**C12:** CHARACTERIZATION OF A SMARTPHONE SIZE HAPTIC RENDERING SYSTEM BASED ON THIN-FILM ALN TRANSDUCTION ON GLASS

INVITED SPEAKER III

(Tuesday 13:45-14:45)

Prof. Ad Lagendijk, University of Twente
"SURVIVAL GUIDE FOR SCIENTISTS"

SESSION D

(Tuesday 14:45-16:15)

Tobias Frischmuth	**D1:** IMPACT OF SUBSTRATE TEMPERATURE AND INDUCTIVELY COUPLED PLASMA POWER ON A-SIC:H THIN FILM PROPERTIES
Javier Toledo	**D2:** OSCILLATOR CIRCUIT BASED ON HIGHER-ORDER OUT-OF-PLANE PIEZOELECTRIC RESONATORS FOR DENSITY-VISCOSITY SENSING UP TO 0.5 PA·S

Marino De Jesus Correia Maciel	**D3:** DESIGN AND WAFER-LEVEL FABRICATION OF A MICRO BEAM SPLITTER FOR APPLICATION IN OPTICAL COHERENCE TOMOGRAPHY
Seifeddine Maaroufi	**D4:** STUDY ON RELIABILITY OF THE PIEZOELECTRIC ENERGY HARVESTING MICRO-DEVICES
Ming Wu	**D5:** COMPARATIVE STUDY OF AU/TI, AU/V, AND AU/ZR FILMS GETTERING ABILITY FOR APPLICATION TO WAFER-LEVEL VACUUM PACKAGING
Oskar Z. Olszewski	**D6:** DESIGN AND MEASUREMENTS OF A MEMS LAMB WAVE RESONATOR FOR GHZ APPLICATIONS
Ivan Hotovy	**D7:** FABRICATION OF TITANIUM OXIDE NANOSTRUCTURES USING HSQ E-BEAM RESIST
Jiangtao Chu	**D8:** INFLUENCE OF SURFACE MODIFICATION AND STATIC PRESSURE ON MICRODIALYSIS PROTEIN EXTRACTION EFFICIENCY
Piotr Cegielski	**D9:** A FOUR LEVEL SILICON MICROSTRUCTURE FABRICATION BY DRIE
Suhas Mohite	**D10:** EXPERIMENTAL AND NUMERICAL STUDY OF TEMPERATURE DISTRIBUTION IN A NOVEL MICROCHANNEL HEAT SINK HAVING LEAF VENATION PATTERN

A1

High Temperature Behavior of Sputter Deposited Molybdenum Nitride Thin Films

L. Stöber[1], J.P. Konrath[2], V. Haberl[2], M. Schneider[1], U. Schmid[1]

[1]Institute of Sensor and Actuator Systems, Vienna University of Technology, Floragasse 7, A-1040 Vienna, Austria
[2]Infineon Technologies Austria AG, Siemensstraße 2, 9500 Villach, Austria

In this paper the high temperature behavior of molybdenum nitride (Mo_2N) thin films is reported. The films are synthesized from a pure Mo target by a reactive dc magnetron sputter process in an argon and nitrogen gas atmosphere. A sequence of Auger and effusion measurements is utilized up to 1000°C to investigate the amount and binding condition of the nitrogen in the thin film. At a sputtering gas nitrogen fraction of 40%, the Mo_2N layer consists of nearly 38% nitrogen, of which 87% is incorporated on lattice sites to form the cubic Mo_2N phase. Another 13% is incorporated on interstitial sites, which causes layer stress and a distortion of the crystallite lattice.

Keywords: Molybdenum, molybdenum nitride, reactive sputter deposition, effusion, Auger spectroscopy.

Notes:

A2

MEMS Switch with the Active Contact Breaking Mechanism

I.V. Uvarov[1], V.V. Naumov[1], O.M. Koroleva[1] and I.I. Amirov[1]

[1]Yaroslavl Branch of the Institute of Physics and Technology, Institution of Russian Academy of Sciences, 150007, Universitetskaya Street 21, Yaroslavl, Russia

Electrostatically actuated MEMS switch with the resistive contact is presented. Movable electrode of the switch is a beam suspended by torsion springs. Low stiffness of springs allows to achieve low values of the actuation voltage. Main feature of the switch is a mechanism of the active contact breaking, allowing to solve the problem of adhesive sticking of the beam to the signal electrode. Active opening of the switch is realized by the presence of two driving electrodes. The theoretical analysis, finite element simulation and experimental investigation of the switch characteristics are performed.

Keywords: MEMS switch, Electrostatic actuation, Resistive contact, Actuation voltage.

Notes:

A3

Design and Microfabrication of a Strain-Gauge Array on Polymer Substrate for Tactile Neuroprostheses in Rats

M. Beygi[1], S. Mutlu[1], and B. Güçlü[2]

[1]*Department of Electrical & Electronics Engineering, Boğaziçi University, Istanbul, Turkey*
[2]*Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Turkey*

In this study, we present the design and the microfabrication of a tactile sensor which can be used for sensory neuroprostheses in rats. The sensor is composed of an array of 2×7 sensing elements, each of which has a series combination of 4 strain gauges. Unlike most common tactile sensors based on silicon substrates, we used 3D-printed polylactic acid (PLA) as a substrate. Strain gauges were fabricated by depositing and patterning a thin aluminum film on a polyimide sheet with a thickness of 0.125 mm. A 1.3-mm-thick polydimethylsiloxane (PDMS) layer was bonded on the top surface of the polyimide membrane. The maximum allowable force is 4.5 N which corresponds to a 1-mm deflection of the central membrane in each sensing element. Each sensor element operates linearly in the range of 0 to 3 N force, with a resistance variation of 36 mΩ/N and an approximate nonlinearity of 3.5%. The static output of a representative sensing element was calibrated by using a micromanipulator and a digital balance. The dynamic response was characterized at several frequency values by using a vibrotactile stimulation system.

Notes:

A4

Experimental and Numerical Analysis of the Deposition of Magnetic Beads on the Wall of a Microchannel

I. Sancho[1], T. Sikanen[2], S. Tähkä[2], A. Bonabi[2], J. Pallarès[1], A. Vernet[1] and S. Cito[2]

[1]Department of Mechanical Engineering, Universitat Rovira i Virgili, Spain
[2]Division of Pharmaceutical Chemistry and Technology, Faculty of Pharmacy, University of Helsinki, Finland

In this study we analyse the deposition of magnetic micro-beads on the walls of microchannels. A permanent magnet is placed next to the channel to induce the deposition of the beads that are introduced at different flow rates. We tested paramagnetic and superparamagnetic micro-beads. We observed that paramagnetic micro-beads deposit on the wall forming a convex shape around the area adjacent to the permanent magnet. Additionally, we used a numerical model to simulate the deposition of the paramagnetic micro-beads and we observe that, at high flow rates, the experimental and numerical results are consistent. Both experimental and numerical results show that the higher the flow rate, the lower the accumulation rate of micro-beads. Finally we quantified the number of beads deposited on the wall and we observed that the number of deposited beads decreases exponentially with the flow rate. The behaviour of paramagnetic beads was experimentally compared to that of superparamagnetic beads. It was observed the number of the deposited superparamagnetic beads is independent of the flow rate and after removing the external magnet, they line-up forming parallel chains. Our results open the prospect for a versatile construction of magnetic bead compartments of different shape, e.g., for enzyme immobilization to study their kinetic parameters.

Keywords: Microchannel, micro-beads deposition, magnetic micro-beads.

Notes:

A5

System Monitoring Sensors for Smart Micro Transdermal Interface Platforms (MicroTIPs)

Conor O'Mahony[1], Antonio Ciarlone[1,2], Giuseppe Giannoni[1,2], Anan Kenthao[1,3], Gilberto Lo Re[1,2], Alan Blake[1], Jim Scully[1], John Kearney[1], Anthony J. P. Clover[4], Paul Galvin[1], Konstantin Grygoryev[1]

[1]Tyndall National Institute, University College Cork, Cork, Ireland.
[2]Dipartimento di Elettronica e delle Telecomunicazioni, Politecnico di Torino, Torino, Italy.
[3]Department of Biology, Khon Kaen University, Thailand.
[4]Department of Plastic and Reconstructive Surgery, Cork University Hospital, Cork, Ireland.

Wearable 'smart patches' of the future will incorporate microneedle technologies that painlessly interact with the body, using closed-loop theranostic systems to continuously monitor the physiological status of the body and deliver appropriate therapeutic agents when needed. Among other components, these Micro Transdermal Interface Platforms (MicroTIPs) will require embedded sensors to verify that the correct skin interface is maintained and that the patch is operating as intended. In this paper, we integrate hollow microneedles with miniaturized pressure and impedance sensors to create an inline sensor subsystem suitable for integration with such a smart patch. Preliminary experimental work using an *ex-vivo* skin model shows that the sensors are capable of detecting skin insertion and removal, of monitoring fluidic pressure during the delivery phase, and of sensing leak detection.

Keywords: MicroTIPS, microneedles, theranostics, smart patch; transdermal interface.

Notes:

A6

Evaluation of a Novel Seeding Technique in Microfluidic Chips

A. Wolff[1], B. Brodin[2] and M. Tenje[1,3,4]

[1]Lund University; Biomedical Engineering; Lund, Sweden
[2]University of Copenhagen; Department of Pharmacy; Copenhagen, Denmark
[3]Uppsala University; Department of Engineering Sciences; Uppsala, Sweden
[4]Science for Life Laboratory; Uppsala, Sweden

In this paper we have evaluated the permeability of an in vitro model of the blood-brain barrier (BBB) by studying the permeability for cells that have been allowed to grow in a regular Transwell culture cup before being inserted in a microfluidic chip. The microfluidic chips were made of PDMS, with Transwell membrane cut-outs sandwiched between. The concentrations have been evaluated using a D-mannitol colorimetric assay. We find that the endothelial cells do indeed create a barrier in this novel manner of culturing and the chips are functional for our intents and purposes.

Keywords: Blood-brain, barrier, Microfluidics, PDMS, Lab-on-a-chip, In vitro.

Notes:

A7

Towards an Electrowetting-Driven Microconveyor: Using Droplets for Moving a Platform

L. Geukens[1,2], R. Puers[2] and D. Reynaerts[1]

[1]KU Leuven, Department of Mechanical engineering, Division Production Engineering, Machine Design and Automation, Leuven, Belgium
[2]KU Leuven, Department of Electrical Engineering, Division of Microelectronics and sensors, Leuven, Belgium

Electrowetting-on-dielectric is a well-known method for micro-droplet manipulation. In systems using this method, droplets often serve as micro-reactors containing the products being analyzed. However, the surface tension makes this way of droplet handling interesting for very different applications, one of which will be discussed here. In this paper, we investigate the possibilities of using the droplets to support and move a platform, making use of the principle of electrowetting, both experimentally and theoretically. Thereby, a new way for making micro-conveyors is developed.

Keywords: Electrowetting-on-dielectric, microconveyor, surface tension.

Notes:

A8

Soft Bendable Thermoelectric Generator for Uneven Surface Implementation

S.H. Jeong[1], F.J. Cruz[1], Z.G. Wu[1,2], Z.-B. Zhang[1], S.-L. Zhang[1] and K. Hjort[1]

[1]Engineering Sciences, Uppsala University, Ångström Laboratoriet, Uppsala, Sweden
[2]State Key Laboratory of Digital Manufacturing Equipment and Technology, Huazhong University of Science and Technology, Wuhan, China

A soft and bendable thermoelectric generators (TEGs) is presented for energy harvesting from curved surfaces. Rigid bismuth telluride thermoelectric legs are integrated with soft materials which can allow compliant deformation following the shape of target applications. Liquid alloy interconnects are successfully implemented between bismuth telluride leg surfaces and elastomer surfaces with our recently reported tape transfer spraying technique. In addition, our recently developed thermal elastomer composite was applied to packaging layers for improving power generation from the soft and bendable TEG. The generated power from the device was of the hundred micro Watt level at 20 °C difference between the hot and cold sides of the device. This soft and bendable thermoelectric generator has potential use in wearable electronics and large area energy harvesting systems due to its soft, compliant deformation and easy processing for large areas.

Keywords: Thermoelectric Generator, Stretchable Electronics, Liquid Alloy, PDMS, Bismuth Telluride, Thermal Elastomer Composite, Hybrid Packaging.

Notes:

A9

Modelling and Characterization of the Roof Tile-Shaped Modes of AlN-Based Cantilever Resonators in Liquid Media

V. Ruiz-Díez[1], J. Toledo[1], T. Manzaneque[1], J. Hernando-García[1], M. Kucera[2], U. Schmid[2] and J.L. SánchezRojas[1]

[1]Group of Microsystems, Actuators and Sensors, E.T.S.I. Industriales, Universidad de Castilla-La Mancha, 13071 Ciudad Real, Spain.
[2]Institute of Sensor and Actuator Systems, Vienna University of Technology, 1040 Vienna, Austria.

In this paper, the first roof tile-shaped mode and higher orders are studied in cantilever structures of different sizes. These modes can be efficiently actuated by a thin piezoelectric film on top of the structure and a specific electrode design. The electrical and optical characterization of the different devices and modes is carried out in liquid media. The performance of the resonators is evaluated in terms of quality factor, resonant frequency and motional conductance. A quality factor as high as 125 was measured in isopropanol for a cantilever oscillating in a high order roof tile-shaped mode at 7 MHz. The effect of the fluid on the in-liquid response is studied using finite element method models. With the help of these tools, the applicability of the micro-resonators as viscosity and density sensors will be discussed.

Keywords: MEMS, FEM, piezoelectricity, out-ofplane motion.

Notes:

A10

Carbon Screen Printed Electrodes on Low Temperature Co-Fired Ceramics for Label Free Molecular Diagnostics

G.Cummins[1], H.Schulze[2], E.A. Obaje[2], S. Mahmood[1], T. Bachmann[2], and M.Y.P. Desmulliez[1]

[1]Heriot Watt University, School of Engineering and Physical Sciences, Edinburgh, UK
[2]University of Edinburgh, Division of Pathway Medicine, School of Medicine, Edinburgh, UK

In this paper we present the manufacturing and characterization of an inexpensive carbon screen-printed electrochemical sensor on a ceramic substrate for use in biomedical applications. The variation of electrochemical performance due to choice of carbon paste and curing conditions is examined. The role of dielectric paste on sensor sensitivity was also investigated by characterising the wetting and the susceptibility of unspecific DNA binding of various materials.

Keywords: Low Temperature Co-Fired Ceramic, Electrochemical Sensor, Carbon Electrodes, DNA, Binding.

Notes:

A11

U-Turn Trajectories of Magnetotactic Bacteria in Microfluidics

M. P. Pichel[1], T. A. G Hageman[1], M. O. Altmeyer[2] and L. Abelmann[1,2]

[1]KIST Europe, Germany
[2]University of Twente, The Netherlands

This study measured for the first time the relation between the u-turn trajectory of individual magnetotactic bacteria *Magnetospirillum Gryphiswaldense* and the magnitude of a superimposed magnetic field reversal in a microfluidic chip. This measurement was made possible using 5 micron deep microfluidic channels and a setup which allowed for alternating magnetic field directions at varying magnitudes.

Keywords: Magnetotactic Bacteria, Microfluidics, Magnetic Fields, U-turn.

Notes:

A12

Optogalvanic Spectroscopy with Microplasma Sources – Current Status and Development towards Lab-On-A-Chip

Anders Persson[1,2], Martin Berglund[1,2], Zahra Khaji[1], Peter Sturesson[1, 2, 3], Johan Söderberg[1,2], Greger Thornell[1,2]

[1]Uppsala University; Division of Microsystems Technology, Uppsala, Sweden
[2]Uppsala University; Ångström Space Technology Centre, Uppsala, Sweden
[3]Swedish Defence University, Div. of Military Technology, Dep. of Military Sciences, Stockholm, Sweden

Miniaturized optogalvanic spectroscopy shows excellent prospects of becoming a highly sensitive method for gas analysis in micro total analysis systems. Here, a status report on the current development of microplasma sources for optogalvanic spectroscopy is presented, together with the first comparison of the sensitivity of the method to conventional single-pass absorption spectroscopy. The stability and reproducibility of the microplasma source when used as a detector for optogalvanic spectroscopy is also investigated, and a roadmap of future developments is presented, with the particular focus of integrating sensors for measuring the pressure, temperature and flow of the sample gas through the detector, and combining the detector with a miniaturized combustor to allow for studies of solid samples.

Keywords: Optogalvanic spectroscopy, Microplasma sources, Split-ring resonator.

Notes:

A13

The Engineered Eye – Three-Dimensional Scanning of the Object-Space

S. Leopold[1], D. Paetz[2], S. Sinzinger[2], M. Hoffmann[1]

[1]Technische Universität Ilmenau, IMN MacroNano® Micromechanical Systems Group, Ilmenau, Germany
[2]Technische Universität Ilmenau, IMN MacroNano® Fachgebiet Technische Optik, Ilmenau, Germany

Tunable optical microsystems enable the three-dimensional scanning of the object-space. During imaging the relevant information is selected. This functionality is similar to the accommodation and movement of the human eye. The approach of this contribution uses tunable lenses and prisms. The lens selects the object-plane, which is scanned by the tunable prisms. The system enables the imaging of objects with a distance of 100 mm or more. The prisms shift the picture by 7 % and 14 % with respect to the sensor area. This corresponds to an increase of the overall transmitted information by 22 %.

Keywords: Tunable Optics, Aluminum Nitride.

Notes:

A14

Effect of Isopropanol Evaporation on Anisotropic Etching of Silicon in Aqueous Potassium Hydroxide Solutions

T.S.Monteiro[1,2], L.M.Gonçalves[2], G.Minas[2], S.Cardoso [1]

[1]INESC-Microsystems and Nanotechnologies, Lisbon, Portugal
[2]Microelectromechanical Systems Research Unit (CMEMS-UMinho), University of Minho,
Campus de Azurem, 4800-058, Guimaraes, Portugal

In this paper, Isopropanol (IPA) availability during the anisotropic etching of silicon in Potassium Hydroxide (KOH) solutions was investigated. Squares of 10 μm were patterned to {100} oriented Silicon wafers through DWL photolithography. The wet etching process was performed inside an open HDPE flask with ultrasonic agitation. IPA volume and evaporation was studied in a dynamic etching process, and subsequent influence on the silicon etching was inspected. Results demonstrate that IPA availability, and not concentration, plays an important role in the definition of the final structure.

Keywords: Isopropanol evaporation, Isopropanol availability, Silicon wet etching.

Notes:

B1

An Ultimate Capacitive Mems Accelerometer with Differential Sensing Capability

A. Aydemir[1] and T. Akin[1,2]

[1]MEMS Research and Applications Center, Middle East Technical University, Ankara, Turkey
[2]Dept. of Electrical and Electronics Eng. Middle East Technical University, Ankara, Turkey

In this paper we present a novel design and a fabrication approach for an out of plane capacitive MEMS accelerometer that is capable of differentially measuring the externally applied acceleration in the vertical axes direction. The accelerometer is fabricated on an SOI wafer which is eutectically bonded to a glass substrate. Proof mass of the vertical axis accelerometer is defined on the structural layer of the SOI wafer that is sandwiched between two stationary electrodes enabling differential sensing. Handle layer of the SOI wafer is used as a top electrode for the first time in this approach and the bottom electrode, a metal layer, is defined on the glass substrate. The proof mass of the accelerometer has 2 mm^2 perforated electrode area anchored to the glass substrate by four beams. Rest capacitance of the vertical axis accelerometer was designed to be 8.8 pF.

Keywords: Out of plane accelerometer, Vertical axis accelerometer, Capacitive MEMS accelerometer, Differential sensing.

Notes:

B2

The Influence of Skin-Electrode Contact Force on Microneedle-Based ECG Electrode Performance

Konstantin Grygoryev[1], Anan Kenthao[1,2], Antonio Ciarlone[1,3], Giuseppe Giannoni[1,3], Paul Galvin[1], and Conor O'Mahony[1]

[1]Tyndall National Institute, University College Cork, Cork, Ireland.
[2]Department of Biology, Khon Kaen University, Thailand.
[3]Dipartimento di Elettronica e delle Telecomunicazioni, Politecnico di Torino, Torino, Italy.

Microneedle-based 'dry electrodes' have immense potential for use in such as electrocardiography (ECG) diagnostic procedures, as they lack several of the drawbacks associated with conventional gel-based 'wet' electrodes. To be successful in such a competitive market, it is essential that dry electrodes are manufacturable in high volumes and at low cost. In addition, the topographical nature of the devices means that electrode performance is likely to be dependent on the quality of the skin-electrode contact. This paper presents a low-cost, wafer-level micromoulding process for the fabrication of polymeric ECG electrodes. In addition, measurement techniques have been developed to characterize the skin-electrode contact force. We perform the first analysis of signal-to-noise ratio dependency on contact force, and show that although MN electrodes can outperform conventional 'wet' electrodes, signal quality is significantly dependent on the skin-electrode interface.

Keywords: microneedles, dry electrodes, ECG.

Notes:

B3

MEMS Polysilicon Cantilevers for Vibrational Applications

R. Voicu[1], C. Obreja[1], A. Baracu[1,2], A. Avram[1], R. Muller[1], J. Rochet[3], M. Pustan[4]

[1] Laboratory of Modeling, Simulation and CAD, National Institute for R&D in Microtechnologies – IMT Bucharest, Erou Iancu Nicolae str. 126 A, 077190, Bucharest, Romania
[2]University "Politehnica"of Bucharest, Splaiul Independentei 313, 060042, Bucharest, Romania
[3]V2i s.a. Av du Pré Aily 25 4031 Angleur, Belgium
[4]Technical University of Cluj-Napoca, Bd. Muncii 103-105, Romania

In this paper we present the design, simulation, fabrication and experimental characterization of MEMS polysilicon clamped beams at one end used for vibrational, sensing, and switching applications. Modal finite-element simulations were performed in order to describe the fundamental vibration frequencies of MEMS devices. The clamped beams have been fabricated in polysilicon, as structural material, by surface micromachining processes. Measurements tests were carried out using the Scanning Laser-Doppler Vibrometry technique. The measurements results are in good agreement with the analytical and simulations results. The influence of the design parameters and of the fabrication process involved is also analyzed.

Keywords: MEMS, cantilever, polysilicon, vibration.

Notes:

B4

Deposition of Gold Nanoparticles from Colloidal Suspension on NiO Surface

V. Rehacek[1], I. Hotovy[1], M. Vojs[1] and M. Marton[1]

[1]Slovak University of Technology, Faculty of Electrical Engineering and Information Technology, Ilkovicova 3, 81219 Bratislava, Slovakia

In this paper, experimental knowledge is presented on the deposition of gold nanoparticles from a colloidal solution on the surfaces of NiO prepared on silicon wafers. Important procedures, such as NiO surface hydrophilization and functionalization by silane coupling agent (3-mercapto-propyl-trimetoxysilane) were investigated in order to obtain NiO surface with optimum properties for immobilization of Au nanoparticles with a close-packed structure.

Keywords: gold nanoparticles, nickel oxide, hydrophilization, MPTMS.

Notes:

B5

Thermo-Mechanical Design, Modeling and Simulation of Microstructures for Low Dissipation Hotplates

M. Predanocy[1], I. Hotovy[1], V. Rehacek[1]

[1]*Institute of Electronics and Photonics, Slovak University of Technology, Ilkovicova 3, Bratislava, Slovakia*

In this paper we present electro-thermal and thermo-mechanical simulation results of developed hotplate as microstructure. Electro–thermal and electrical simulations by FEM (finite element method) analysis for design and optimizing of the Pt hotplates were performed. Simulation parameters involved various membrane dimensions (50×50, 150×150 and 300×300 μm^2) and ratio between width heater's lines and spacing between them in the range from 9/3 μm to 18/6 μm. Mechanical simulation analyses are focused on thickness of PI membrane from 3 μm to 12 μm and various dimensions width each of microbridges from 15 μm to 60 μm. Calculated von Misses stress in centre of hotplate was reached from 130 MPa to 200 MPa for all simulated structures.

Keywords: hotplate, polyimide membrane, FEM simulation.

Notes:

B6

Batch Integration Process of a Free-Standing Silicon Nanowire to MEMS

T. Hemmi[1], Y. Hirai[1], T. Tsuchiya[1] and O. Tabata[1]

[1]*Department of Micro Engineering, Kyoto University, Kyoto, Japan*

In this report, a new batch integration process of silicon nanowire (SiNW) to a MEMS device structure has been proposed and was demonstrated for the first time. This process consists of Bosch process, isotropic silicon etching and thermal oxidation, which enables to fabricate, assemble and fix a free-standing SiNW without complicated nanowire handling operations to overcome the difficulty in integrating nano-scale components to micro-scale devices. The process was applied to tensile testing device using silicon-on-insulator wafer to evaluate mechanical properties of the nanowire. Consequently, a free-standing SiNW of 223 nm wide and 5 μm long with smooth surface was successfully integrated to the 5-μm-thick device without any damages.

Keywords: silicon nanowire, free-standing, integration, thermal oxidation.

Normal:

B7

Crossing the Point – Architectures for Novel Magnetic Memories via 3D Macroscopic Self-Assembly

P.A. Löthman[1,2], T.A.G. Hagemann[1,2], A, Manz[1], L. Abelmann[1,2]

[1]*Universität des Saarlandes, D-66123 Saarbrücken, Germany*
[2]*University of Twente, MESA+, Twente, The Netherlands*

By applying magnetic forces and turbulent flow we performed self-assembly studies at the macroscopic level. We showed that the interactions can be described by the same chemical reaction kinetics valid for the micro- and nanoscale. We used this macroscale model to acquire insight in the self-assembly of networks of bacterial pili by viral infection as well as multisphere assemblies. We envision that assemblies of functional 3D nanostructures can be achieved by replacing the pili by conducting nanotubes. The high biological specificity of the viral infection process, i.e. pili and virus or nanotube and virus) will be instrumental to achieve reliable and accurate self-assembly into large scale nanoscopic structures. On the long term, such a structure may be used as a scaffold for 3D electronic memory crystals as nanovires and viruses self-assemble into a cross-point architecture. Multisphere assembly provide insight into the directed crystallization processes of associative networks which similarly may lead to 3D ordered nanoscopic memory materials.

Keywords: Self-assembly, magentic memory, cross-point-architecture, virus, pilus, mediated crystallization.

Notes:

B8

Micromechanical Binary Counter Mechanism for Storing Off-Limit Conditions

H. Mehner[1], S. Schwekbe[1], S. Leopold[1] and M. Hoffmann[1]

[1]*Technische Universität Ilmenau, Micromechanical Systems Group, DE-98693 Ilmenau, Germany*

A micromechanical binary counter mechanism is presented that can be used to detect and store off-limit conditions in a non-electrical way. Binary counting is realized utilizing mechanical coupling elements between bit elements. The system design and the mechanical characterization of fabricated demonstrators are shown. The mechanical energy for switching the first bit to the state “high” was found to be 0.1 µJ by moving the entrance 37 µm and applying a force of up to 8.2 mN. 0.36 µJ was determined for switching it back to the state “low” by applying a 69 µm distance and a force of up to 10.2 mN. The system needs input energy (non-electrical) for counting only, not for storing the counter value. It is suitable for counting any physical event that can be converted into an adequate force-travel characteristic. The design can be expanded to realize an electrical read-out of the counter value.

Keywords: ratcheting mechanism, SOI, counter mechanism, ratchet, passive, autonomous, microsystem, binary.

Notes:

B9

Characterization of a Macroscopic Self-Assembly Reactor

T.A.G. Hageman[1,2], P.A. Lothman[1,2], T.G. Janson[1], A. Manz[1] and L. Abelmann[1,2]

[1]KIST Europe, Saarbrucken, Germany
[2]University of Twente, Enschede, The Netherlands

This work presents a new way of simulating how magnetic particles on small scale self-assemble by means of a macroscopic reactor. By trajectory analysis we prove that the particles show similar behaviour as if subject to random motion. We further present three ways of obtaining the effective thermal energy k_BT, all in the same order size, which is dependent on the particle size. Multiparticle systems qualitatively fit to Maxwell-Boltzmann statistics and end up in both local and global energy minima while exploring the energy landscape.

Keywords: Self-assembly, magnetics, machine vision, Brownian motion, random walk.

Notes:

B10

Flexible Gastrointestinal Pressure-Sensitive Tube Based on Aluminium Thin-Film Strain-Gauge Arrays

P. J. Sousa[1], L. R. Silva[1], V. C. Pinto[1], L. M. Goncalves[1] and G. Minas[1]

[1]Microelectromechanical Systems Research Unit (CMEMS-UMinho), University of Minho, Campus de Azurem, 4800-058, Guimaraes, Portugal

This paper presents an innovative approach to measure the pressure patterns associated with the motility and peristaltic movements in the upper gastrointestinal tract (GI). This approach is based on inexpensive thin-film aluminum strain gauge pressure sensors using a flexible polyimide film (Kapton) as substrate. These sensors are fabricated using well-established and standard photolithographic and wet etching techniques. The sensor has an almost linear response (R^2 = 0.9945) and an overall sensibility of 6.4 mV/mmHg. Moreover, since each sensor has a 3.4 mm^2 area, the fabrication process allows a high level of sensors integration. Furthermore, the sensors readout electronics is also integrated in another Kapton membrane. The sequential acquisition of the different signals is carried by a microcontroller with a 10 bit ADC at a sample rate of 250 Hz/per sensor. The signals are presented in a user friendly interface developed using the QtCreator IDE software.

Keywords: Pressure sensors, thin-film strain gauge, Kapton membrane, SU-8 diaphragm, GI motility.

Notes:

B11

Split Ring Resonator Microwave Biosensor for Glucose Detection

B. Camli[1], E. Kusakci[1], H. Torun[1,2] and A. D. Yalcinkaya[1,2]

[1]Bogazici University; Department of Electrical and Electronics Engineering; Istanbul, Turkey
[2]Bogazici University; Center for Life Sciences and Technologies; Istanbul, Turkey

A split ring resonator based microwave biosensor for detection of glucose in ambient liquid environment is investigated. 2GHz resonator structures were designed and fabricated. GOx is used as the sensing agent. Operation is evaluated by the observation of scattering parameters of the resonator structure, indicating a change in the electric properties of the environment. In the presence of DI water and glucose solution, resonant frequency shifts to lower frequencies. Enzymatic activity is observed to shift the resonant frequency to higher frequencies in contrast. Amounts of dip frequency and dip magnitude shifts are positively correlated with increased glucose concentrations. A frequency-based sensitivity of glucose concentration of 15.5 μg/ml per kHz is observed.

Keywords: Split ring resonators, Metamaterials, Biosensing, Glucose detection.

Notes:

B12

CMD, an Automated Design Tool for Blood Pressure Sensing Capacitive MEMS

J.A. Miguel[1], D. Rivas[1], Y. Lechuga[1], M. A. Allende[1], M.Martinez[1]

[1]Universidad de Cantabria; GIM, Dpto. TEISA, Av. Los Castros s/n, Santander, Spain

Implantable biomedical devices may comprise MEMS-type sensors used to acquire physiological signals, as well as CMOS electronics to perform powering, signal conditioning and data transmission. This work targets the development of a new capacitive MEMS pressure sensor modeling tool, to provide an initial sensor design based on a set of user-specified input constraints. This tool generates two output folders with all the files required to perform an electromechanical analysis of the sensor, as well as to create a layout cell ready to be included in a larger design.

Keywords: Biomedical transducers, implantable biomedical devices, cardiology.

Notes:

C1

Optomechanical Characterization of Annealed Thin PECVD Oxide Membranes

M. Ghaderi[1], G. de Graaf[1], R. F. Wolffenbuttel[1]

[1]*Electronic Instrumentation Laboratory, Microelectronics Department, Faculty of EEMCS, Delft University of Technology, 2628CD Delft, the Netherlands*

This paper investigates the mechanical and optical properties of thin PECVD oxide layers for optical applications. The various factors in the PECVD deposition provide a promising tool to manipulate and control the film structure. The effect of the process thermal budget on the deposited films was studied to predict the membrane rigidity and flatness. Films with compressive stress ranging from -100 to 0 MPa were deposited. Multiple thermal annealing was applied on wafers and the *in-situ* residual stress, and *ex-situ* optical properties were measured. The residual stress in the films was found to be highly temperature dependent. Annealing during the future processes results in a tensile-stress films from 100 to 300 MPa. Future studies are aimed at membrane fabrication and the structural analysis of thin-film membranes.

Keywords: Thin oxide membrane, PECVD, Silane oxide, silicon oxide, Optical filters.

Notes:

C2

Towards an On-Chip MEMS Chaotic Generator in a Commercial 0.35-Micron CMOS Technology

J. Barcelo[1], S. Bota[1], J. Segura[1] and J. Verd[1]

[1]Universitat de les Illes Balears, Electronic System Group (GSE-UIB), 07122 Palma, Spain

This paper presents follow-up steps and considerations to design a CMOS-MEMS resonator to work as an on-chip chaotic signal generator. Biasing conditions and dimensional parameters to obtain cross-well chaotic motion for an in-plane electrostatically driven 1-MHz polysilicon resonator are provided. Numerical simulations confirm the achievement of extensive chaotic behavior with the predicted parameters. The proposal is conceived to be fabricated in a commercial 0.35-micron CMOS technology.

Keywords: MEMS resonators, Chaos, Nonlinear Dynamics, Electromechanical Nonlinearity.

Notes:

C3

Analysis of Thin Film Stress in Energy Harvester

R. Houlihan[1], O. Olszewski[1], A. Sharma[2], N. Jackson[1] A. Blake[1] and A. Mathewson[1]

[1]Tyndall National Institute; University College Cork, Lee Maltings, Cork, Ireland
[2]Department of Electronic Science, Kurukshetra University, Kurukshetra, India

In this paper we present an analysis of the stresses in the thin films used to define the capacitor in a micromachined piezoelectric energy harvester process. The stresses have been measured using wafer curvature techniques and using dedicated cantilever test structures. The Stoney formula is used to convert the wafer curvature and tip deflection measurements into stresses. Finite element modelling has been performed and the results are compared with the analytical model. The net stress in the thin films is found to be tensile and so a compressive silicon nitride layer is successfully used to passivate these stresses.

Keywords: Vibration Energy Harvesters, Thin Film Stress, Aluminium Nitride, Cantilevers.

Notes:

C4

DRIE Process Optimization to Achieve High Aspect Ratio for Capacitive MEMS Sensors

A. Aydemir[1] and T. Akin[1,2]

[1]MEMS Research and Applications Center, Middle East Technical University, Ankara, Turkey
[2]Dept. of Electrical and Electronics Eng. Middle East Technical University, Ankara, Turkey

This paper focuses on process optimization of deep reactive ion etching (DRIE) to achieve high aspect ratio structures, specifically the fabrication of capacitive sensors. Very high aspect ratios up to 70:1 on trenches of 1.0 µm and have been achieved using the Bosch process by optimizing the process parameters. Effects of the process parameters on the etch rate, profile angle, and selectivity to the masking material are investigated in detail. This approach can be easily integrated on conventional ICP equipment to achieve high aspect ratio structures on any trench dimension.

Keywords : DRIE, High Aspect Ratio, Process Optimization, Silicon Etching.

Notes:

C5

Flexible Solid-State Li–Ion Battery Using Ge Thin Film Anode and $LiCoO_2$ Cathode

E. M. F. Vieira[1], J. F. Ribeiro[2], M. M. Silva[3], L. Dupont[4], J. H. Correia[1], L. M. Goncalves[1]

[1]University of Minho, MEMS UMINHO, Guimaraes, Portugal
[2]University of Minho, Algoritmi Center, Guimaraes, Portugal
[3]University of Minho, Chemistry Center, Braga, Portugal
[4]Université de Picardie Jules Verne, LRCS, UMR CNRS 7314, Amiens, France

Flexible and solid – state Li-ion batteries (LIBs) can offer flexibility, lightweight and easy portability in large-scale energy storage, with significantly higher power and long cycle life. The anode is a crucial component affecting the performance of LIBs. Here, we investigate the electrochemical performance of e-beam deposited Ge anode (300 nm thick) coupled with $LiCoO_2$/LiPON (cathode/solid-state electrolyte) in a microbattery system fabricated only by PVD techniques. $LiCoO_2$ cathode was deposited by rf-sputtering with 120 W of power source and 17/3 sccm of Ar/O_2, respectively. The LIPON was also deposited by rf-sputtering at 100 W of RF power. Microstructure and battery performance were investigated by scanning electron microscopy (SEM) and electrochemical measurements (open circuit potential (OCP), charge/discharge cycles and electrochemical impedance spectroscopy.

Keywords: Design, flexible Li-ion batteries, germanium, LIPON electrolyte.

Notes:

C6

Damped Spring Model of a Piezoresistive Silicon Nanowire Coupled to a Low Frequency MEMS Resonator

G. Lehée[1,2], Y. Deimerly[3,4], P. Rey[3,4], A. Berthelot[3,4], J. C. Riou[2], A. Bosseboeuf[1], G. Jourdan[3,4]

[1]*Institut d'Electronique Fondamentale, Université Paris-Sud, Bat. 220, 91405 Orsay, France*
[2]*SAGEM Defense Security, Safran Corp., 95 route de Montélier, 26000 Valence, France*
[3]*Univ. Grenoble Alpes, F-38000 Grenoble, France*
[4]*CEA, LETI, MINATEC Campus, F-38054 Grenoble, France.*

Nanowire strain gages are attractive for high performance transduction of the motion of MEMS resonators. In this paper we develop a model to investigate their impact on the mechanical response of a low frequency (~4kHz) MEMS resonator. It is shown that, despite their low dimensions, nanowire strain gages can largely modify the resonance frequency and vacuum quality factor of a MEMS resonator and thus the sensitivity and resolution of resonant sensors. This study demonstrates that nanowires exhibit a damped spring behavior, in agreement with experimental results obtained for various nanowire positions along the resonator. Finally, as expected, we found that longitudinal thermoelastic damping is not the dominant damping mechanism, the quality factor being likely limited by anchor and surfaces losses.

Keywords: nanowire, viscous damping, damped spring model, MEMS resonator, thermoelastic damping, anchor stiffness.

Notes

C7

Superhydrophobic Silicon without Hydrophobic Coating Using Plasma-Enhanced Atomic Layer Deposition of Platinum Nanoparticles and Metal-Assisted Chemical Etching

S. Hoshian[1], S. Franssila[1]

[1]*Aalto University of Technology, School of Chemical Technology, Department of Materials Science and Engineering, Espoo, Finland*

This paper reports for the first time a systematic study of deposition of platinum (Pt) nanoparticles using plasma-enhanced atomic layer deposition (PEALD) on silicon substrate with controllable dimensions and particle density. Nanoparticles will act as seed layer for metal assisted chemical etching (MaCE) to produce superhydrophobic silicon surfaces without hydrophobic coatings. Four samples have been prepared using 25, 50, 100 and 200 PEALD cycles to study the effect of cycles on concentration and size of the particles. Then MaCE has been done in HF: H2O2 solution to produce the silicon nanowires. Contact angle measurements of samples revealed all the samples become very hydrophobic but the sample with 100 cycles became superhydrophobic with low contact angle hysteresis. The robustness of superhydrophobic surface has been studied against UV and IR exposure, mechanical abrasion, chemical exposure and water shower.

Keywords: ALD, water repellent, MaCE, robust superhydrophobic, coating-less.

Notes:

C8

Modelling the Effects of the Electrode Size and Skin Properties in Biopotential Monitoring

Z. Li[1], R. Torah[1], J. Tudor[1]

[1]*Electronics and Computer Science, University of Southampton, UK*

In this paper, we present a platform COMSOL-based, finite element simulation, which connects the skin-electrode interface's structure to its electrical properties. The effect of changing the electrode size and skin properties are simulated to identify their effects on the bio-potential signals (e.g. electroencephalogram (EEG) or electrocardiogram (ECG)). In the simulation, the capacitance between the electrode and the body is used to describe the electrical properties of the model. As the electrode size increases from 0.5 cm^2 to 2.5cm^2, the capacitance between the electrode and the body increases by ~18% for each 0.5 cm^2 increment. However, when increasing from 2.5 cm^2 to 3.5 cm^2, the capacitance increases ~8% for each 0.5 cm^2 increment. In addition, the effects of the Young's Modulus on the electrical properties of the main skin layers, Stratum, Corneum, Epidermis and Dermis, have been modelled. The results show that when varying the Young's Modulus of these three skin layers with variations found in the literature, the capacitance between the electrode and skin changes less than 1%. This model can therefore be used to determine the optimum size and materials for the development of new bio-potential electrodes.

Keywords: Materials simulation, Bio MEMS.

Notes:

C9

Ten Thermal Gradients of Miniaturized Real-Time Polymerase Chain Reaction (PCR) Device Using Two Thermoelectric Coolers (TECs)

Xiangping Li[1,2], Wenming Wu[1,2], Andreas Manz[1]

[1]*Kist-Europe, Campus E7 1, Saarbruecken, Germany D-66123*
[2]*Saarland University, Saarbruecken, Germany D-66123*

In this paper we present a new type real-time thermal gradient micro polymerase chain reaction (micro PCR) system. It is a droplet microfluidic platform and fluorescence imaging set up designed to better meet the needs of high-throughput and high-dynamic-range by integrating thermal gradients processing schemes on the chip. It consists of a microscope glass cover slip placed on top of a micro machined silicon chip integrated with thermalelectric cooler (TEC) and temperature sensor. The thermal gradients are realized using 2 TECs. A 0.5 (or smaller) microliter of water based sample containing DNA was placed on the glass and encapsulated with mineral oil to prevent evaporation, forming a virtual reaction chamber. The design is capable of generating over 10 different thermal gradients across its block when undergoing on-chip PCR amplification. Wide-field fluorescence images are captured using a digital single lens reflex camera mounted with a specific green filter to digitally quantify the sample's nucleic acid contents. As the glass slip is disposable, cross-contamination from sample to sample is eliminated. The cost of running PCR is given only by the value of the cover slip and its treatment.

Keywords: droplet, thermal gradient, micro PCR, TEC, wide-field fluorescence detection.

Notes:

C10

Micropatterning of Photocrosslinkable Hyaluronic Acid

F. Sjögren[1], D.Bermejo[2], V.Sehlstedt[1], J. Hilborn[2], D. Ossipov[2] and M. Tenje[1,3,4]

[1]Uppsala University, Department of Engineering Sciences, Uppsala, Sweden
[2] Uppsala University, Department of Chemistry -Ångström, Uppsala, Sweden
[3] Lund University, Department of Biomedical Engineering, Lund, Sweden
[4]Science for Life Laboratory, Uppsala, Sweden

In this paper we investigate the patterning of hyaluronic acid using UV-lithography. Different UV-light doses as well as pattern shapes and sizes have been evaluated. Hyaluronic acid is a suitable material for 3D cell cultures, which motivates this work. It is found that a UV-light dose of 0.25 J/cm^2 is enough to pattern the hyaluronic acid and that the optimal dose is a tradeoff between structure integrity and successful pattern transfer with the method used. Structures down to 20 µm were successfully patterned, but even smaller structures, down to 1.5 µm, should be possible by fine tuning of process parameters.

Keywords: UV-lithography, Hyaluronic acid, Photoinitiator Irgacure 2959, cell culture scaffold.

Notes:

C11

Fabrication of Microconcentrators for Volatile Organic Compounds Sensing At Trace-Level Applications

Fernando Almazán[1], Ismael Pellejero[1], Alberto Almonda[1], Miguel A. Urbiztondo[1,2], Javier Sesé[1], M. Pilar Pina[1,3], Jesús Santamaría[1,3]

[1]Nanoscience Institute of Aragón (INA); University of Zaragoza; Edif. I+D+i, Campus Rio Ebro, c/Mariano Esquillor s/n, 50018 Zaragoza, Spain.
[2] Centro Universitario de la Defensa, Academia General Militar, 50090 Zaragoza, Spain.
[3]Networking Research Center on Bioengineering, Biomaterials and Nanomedicine, CIBER-BBN, 50018 Zaragoza, Spain.

In this paper we present the fabrication of microconcentrators with zeolites as active layers for gas trace detection, in particular for volatile organic compounds (VOCs). Microcantilevers functionalized with in situ synthesis of nanoporous material (pure silica MFI zeolite) are used as selective and high sensitivity sensors. Combination of pre-concentration and high sensitive sensor improves the limit of detection of the sensor.

Keywords: Microconcentrator, Zeolite, Cantilevers, VOCs.

Notes:

C12

Characterization of a Smartphone Size Haptic Rendering System Based on Thin-Film AlN Transduction on Glass

F. Bernard[1, 2], F. Casset[3], J.S Danel[3], C. Chappaz[2], S. Basrour[1]

[1]Univ. Grenoble Alpes, TIMA Laboratory, F-38031 Grenoble, France
CNRS, TIMA Laboratory, F-38031 Grenoble, France
[2]STMicroelectronics, 850 rue Jean Monnet, 38926 Crolles, France
[3]CEA, LETI, MINATEC Campus, 38054 Grenoble, France

This paper presents for the first time the characterization of a smartphone-size haptic rendering system based on the friction modulation. According to previous work and finite element model, the A_0 Lamb wave modes are needed to get the haptic feedback effect. The device studied consists of a thin film AlN transducers deposited on an 110×65 mm^2 glass substrate. The transducer repartition on the glass slab allows a clear central area of 90×49 mm^2. Electrical and mechanical parameters of the system are extracted from measurement. AlN transducers used as sensors introduce the first step to a feedback loop.

Keywords: Haptic rendering system, Glass substrate, AlN transduction.

Notes:

D1

Impact of Substrate Temperature and Inductively Coupled Plasma Power on a-SiC:H Thin Film Properties

T. Frischmuth[1], D. Maurer[2], M. Schneider[1], T. Grille[2] and U. Schmid[1]

[1]Vienna University of Technology, Institute of Sensor and Actuator Systems, Vienna, Austria
[2]Infineon Technologies Austria AG, Villach, Austria

In recent years, hydrogenated amorphous silicon carbide (a-SiC:H) with its high thermal stability and mechanical robustness has become a material of interest for high performance micro electromechanical systems. In this study, the impact of plasma power and substrate temperature of inductively coupled chemical vapor deposited a-SiC:H thin films is discussed. The changes of the refractive index and mechanical thin film parameters like residual stress and mass density are shown and its correlation with the chemical composition taken from Fourier transformed infrared spectra is explained. Measurements are linked with deposition kinetics, revealing an increase of compressive film stress as well as mass density independent which of the two deposition parameter is increased. Refractive index on the other hand decreases with increasing plasma power, but increases at higher substrate temperatures.

Keywords: Silicon carbide, CVD, inductively coupled, infrared spectroscopy, mass density, residual stress, refractive index.

Notes:

D2

Oscillator Circuit Based on Higher-Order Out-Of-Plane Piezoelectric Resonators for Density-Viscosity Sensing up to 0.5 Pa·s

J. Toledo[1], T. Manzaneque[1], V. Ruiz-Díez[1], M. Kucera[2,3], G. Pfusterschmied[2], E. Wistrela[2], U. Schmid[2], J.L. Sánchez-Rojas[1].

[1]Microsystems, Actuators and Sensors Group, Universidad de Castilla-La Mancha, Ciudad Real, Spain;
[2]Institute of Sensor and Actuator Systems, Vienna University of Technology, Vienna, Austria;
[3]Austrian Centre of Competence for Tribology, AC2T research GmbH, Wr. Neustadt, Austria

We report the use of two AlN-based piezoelectric microresonators for the monitoring of lubricant oil dilution with diesel. Two devices designed to resonate with the 5th-order out-of-plane modal vibration, but with different anchor schemes, were fabricated. Interface circuits were designed to convert the one-port impedance into a resonant two-port transfer function. This allowed us to design a PLL-based oscillator circuit implemented with a commercial lock-in amplifier. Our results demonstrate the performance of the resonators in fluids having viscosities up to 500 mPa·s. The performance of the sensors in terms of sensitivity and resolution are compared for both configurations.

Keywords: Microresonators, piezoelectric, density, viscosity, rheology, AlN, lubricant oil, oscillator circuits.

Notes:

D3

Design and Wafer-Level Fabrication of a Micro Beam Splitter for Application in Optical Coherence Tomography

M.J. Maciel[1], M.F. Silva[1], A.C. Peixoto[1], C.G. Costa[1], R.F. Wolffenbuttel[2] and J.H. Correia[1]

[1] University of Minho; CMEMS-UMinho; Guimaraes, Portugal
[2]Delft University of Technology; Faculty of EEMCS; Delft, The Netherlands

The wafer-level fabrication of a micro beam splitter (MBS) is presented. The intended application is in Optical Coherence Tomography (OCT), which includes a Michelson interferometer, with the MBS as an essential component. The proposed fabrication method is based on 45º saw-dicing of glass substrates and subsequent deposition of a thin-film multilayer by RF magnetron sputtering. The MBS was designed for the near-infrared spectral range of 800-900 nm, which is typically used in OCT applications. The cuts, which were performed by conventional rectangular-shape blades, result in smooth slopes close to the intended 45º inclination. A TiO_2/SiO_2 multilayer using only 4 layers was designed in TFCalc™ to obtain the required 50/50 non-polarized split ratio. Preliminary experimental validation confirms operation and indicates a transmittance range of 56-68%. This is a first steps towards OCT miniaturization.

Keywords: Micro beam-splitter, 45º saw dicing, RF magnetron sputtering, OCT miniaturization.

Notes:

D4

Study on Reliability of the Piezoelectric Energy Harvesting Micro-Devices

S. Maaroufi[1,2], F. Parrain[1], G. Letrionnaire[1], E. Lefeuvre[1], B. Boutaud[2], R. Dal Molin[2]

[1]*University Paris-Sud: Institute of Fundamental Electronic (IEF) Orsay, France*
[2]*SORIN CRM: Advanced research department, Clamart, France*

This paper presents an approach to study the reliability of energy harvesting microdevices in autonomous systems and more particularly active medical implants (pacemakers). The structure is designed as a cantilever and will be submitted to a low frequency mechanical force (~ 10 Hz). Piezoelectric transduction converts mechanical energy provided by heartbeat into electrical energy. Knowing the electromechanical characteristics of the structure is made possible through its analytical modeling and FEM simulations as a function of different types of excitation. To study the reliability and durability of the structure we propose to establish an accelerated test bench, massively parallel, where the environment and stimuli can be precisely controlled over a wide period of time. This will permit the characterization of potential failure modes through a regular review by mechanical and / or electrical system.

Keywords: Reliability, energy harvesting, piezoelectric transducer.

Notes:

D5

Comparative Study of Au/Ti, Au/V, and Au/Zr Films Gettering Ability for Application to Wafer-Level Vacuum Packaging

M. Wu[1], J. Moulin[1], P. Coste[1], S. Perrot[1,2], J-L Perrossier[1], A. Bosseboeuf[1]

[1]Institut d'Electronique Fondamentale, CNRS, Université Paris-Sud, 91405 Orsay Cedex, France
[2]Fogale nanotech, 125 Rue de l'Hostellerie-Bât. A, Nîmes, F-30900, France

In this work, thermal diffusion of titanium, vanadium and zirconium through an ultrathin capping gold layer has been investigated and compared in terms of gettering ability after activation at low temperature. The changes of sheet electrical resistance, SEM cross section observation and mechanical stress have been studied. The results show that Au/Zr system might be the best candidate for a low activation temperature getter material.

Keywords: getter, diffusion, oxide, vacuum packaging.

Notes:

D6

Design and Measurements of a MEMS Lamb Wave Resonator for GHz Applications

O. Z. Olszewski[1], N. Jackson[1], A. Blake[1], and A. Mathewson[1]

[1]*Tyndall National Institute, University College Cork, Lee Maltings, Dyke Parade, Cork, Ireland*

This paper presents the design, fabrication and measurement results from a Lamb Wave Resonator (LWR). The resonator is composed of 0.5µm thick aluminium nitride (AlN) piezoelectric film on 3µm silicon and is fabricated from an SOI wafer. The center frequency measured on the device agrees well with that predicted by FEM simulation, i.e. 885MHz and 833MHz, respectively. The acoustic wave velocity and electromechanical coupling factor were evaluated from measurements to be 8851m/s and 1.1%, respectively. The measured Q-factor of the resonator is low (Q□213). The interferometry analysis indicates that there is a high residual stress within the resonator stack that may be the primary mechanism of energy loss in the resonator.

Keywords: MEMS, lamb waves, resonators, oscillators, filters, aluminium nitride, silicon on insulator.

Notes:

D7

Fabrication of Titanium Oxide Nanostructures Using HSQ E-Beam Resist

I. Hotovy[1], I. Kostic[2], P. Nemec[2], M. Predanocy[1], V. Rehacek[1]

[1]*Institute of Electronics and Photonics, Slovak University of Technology, Ilkovicova 3, 812 19 Bratislava, Slovakia*
[2]*Institute of Informatics, Slovak Academy of Sciences Bratislava, Slovakia*

Fabrication of metal oxide nanostructures with precisely controlled geometries and spacings can play an important role in the improvement of sensors for gas detection. Titanium oxide thin films were deposited on oxidized silicon substrates by reactive magnetron sputtering at room temperature. Fabrication of TiO_2 nanostructures was conducted by electron beam lithography combined with plasma etching. It was found that for 120 nm thick TiO_2 nanostructure formation HSQ e-beam resists prove to be suitable mask materials. TiO_2 nanostructures with a minimal diameter of 70 nm and spacing of 200 nm were successfully fabricated by ICP etching in CF_4/Ar plasma through negative e-beam resist HSQ.

Keywords: TiO_2 nanostructures, EB lithography, HSQ resist, ICP etching.

Notes:

D8

Influence of Surface Modification and Static Pressure on Microdialysis Protein Extraction Efficiency

Jiangtao Chu[1], Torgny Undin[2], Sara Bergström Lind[2], Klas Hjort[1] and Andreas P. Dahlin[1]

[1]Uppsala University, Department of Engineering Sciences, Uppsala, Sweden
[2]Uppsala University, Department of Chemistry-BMC, Analytical Chemistry and Science for Life Laboratory, Uppsala, Sweden

There is growing interest in using microdialysis (MD) for monitoring larger and more complex molecules such as neuropeptides and proteins. This promotes the use of MD membranes with molecular weight cut off (MWCO) of 100 kDa or above. The hydrodynamic property of the membrane goes to ultrafiltration or beyond, making the MD catheters more sensitive to pressure. In the meantime, despite the large pore size, studies have shown that membrane biofouling still lead to unstable catheter performance. The objective is to study in vitro how 500 kDa dextran and Poloxamer 407 surface modification affect the fluid recovery (FR) and extraction efficiency (EE) of 100 kDa MWCO MD catheters. A pressure chamber was designed to facilitate the tests, using as MD sample a protein standard with similar concentrations as in human cerebral spinal fluid, comparing native and Poloxamer 407 modified MD catheters. The collected dialysate fractions were examined for FR and protein EE, employing Dot-it Spot-it Protein Assay for total protein EE and targeted mass spectrometry (MS) for EE of individual proteins and peptides. The FR results suggested that the surface modified catheters were less sensitive to the pressure and provide higher precision, and provided a FR closer to 100%. The surface modification did not show a significant effect on the protein EE. […]

Keywords: Microdialysis, surface modification, poloxamer, protein, extraction efficiency.

Notes:

D9

A Four Level Silicon Microstructure Fabrication by DRIE

P. Cegielski[1], S. Rahiminejad[1], S. Carpenter[1], M. Abassi[1], P. Enoksson[1]

[1]Chalmers University of Technology, Department of Micro and Nanotechnology, Sweden

We present a one-sided micromachining process for four level silicon microstructures, with focus on depth greater 200 µm and a low surface roughness. The process is based on deep reactive ion etching. Four hard masks are patterned. Suitable masking materials, which have a high selectivity with respect to silicon and can be removed selectively with respect to each other, have been found (SiO_2, Al, AZ 4562 resist, Al). As a result, a four level structure with a total depth of 1 mm, a surface roughness below 200 nm RMS, and an aspect ratio of 7:1 (for 1 mm walls) has been obtained.

Keywords: MEMS, DRIE, Micromachining.

Notes:

D10

Experimental and Numerical Study of Temperature Distribution in a Novel Microchannel Heat Sink Having Leaf Venation Pattern

S. S. Mohite[1] and V. P. Gaikwad[2]

[1]*Government College of Engineering, Karad, Maharashtra, India*
[2]*Textile and Engineering Institute, Ichalkaranji, Maharashtra, India*

Microchannel based heat exchangers for electronic cooling are the area of current interest. In this paper, the thermal and hydrodynamic behaviour of a novel microchannel heat sinks, inspired by leaf venation, is investigated. The potential of this innovative cooling technology for removal of large amount of heat from a small area with increased mechanical integrity is assessed. First, the concept of leaf venation is explained. This is followed by design and fabrication of microchannel heat sink having leaf venation pattern. Next, the performance of microchannel heat sinks is analysed experimentally and numerically. Finally, the results are compared with recent research work.

Keywords: microchannel, leaf venation.

Notes:

MME 2015 – ALL AUTHORS			
Author	**Contr.**	**Country**	**Affiliation**
Abelmann, Leon	A11-B7-B9	Germany	KIST Europe / Twente University
Akin, Tayfun	B1-C4	Turkey	Middle East Technical University
Allende, Miguel A.	B12	Spain	Universidad de Cantabria
Almazán, Fernando	C11	Spain	Universidad de Zaragoza
Almonda, Alberto	C11	Spain	Universidad de Zaragoza
Altmeyer, Matthias O.	A11	Germany	KIST Europe / Twente University
Amirov, Ildar	A2	Russia	Institute of Physics and Technology
Aydemir, Akin	B1-C4	Turkey	METU-MEMS
Bachmann, Till	A10	United K.	University of Edinburgh
Baracu, Angela	B3	Romania	National Institute for R&D in Microtechnologies
Barcelo, Joan	C2	Spain	Universitat de les Illes Balears
Basrour, Skandar	C12	France	Univ. Grenoble Alpes
Berglund, Martin	A12	Sweden	Uppsala University
Bermejo, Daniel	C10	Sweden	Uppsala University
Bernard, Francois	C12	France	STMicroelectronics
Berthelot, Audrey	C6	France	CEA-LETI
Beygi, Mohammad	A3	Turkey	Bogazici University
Blake, Alan	A5-C3-D6	Ireland	Tyndall National Institute
Bonabi, Ashkan	A4	Finland	University of Helsinki
Bosseboeuf, Alain	C6-D5	France	Université Paris-Sud/CNRS
Bota, Sebastià	C2	Spain	Universitat de les Illes Balears
Brodin, Birger	A6	Denmark	University of Copenhagen
Camli, Berk	B11	Turkey	Bogazici University
Cardoso, Susana	A14	Portugal	INESC-MN
Carpenter, Sona	D9	Sweden	Chalmers University of Technology
Casset, Fabrice	C12	France	CEA, LETI, MINATEC Campus
Cegielski, Piotr	D9	Poland	Chalmers University of Technology
Chappaz, Cedrick	C12	France	STMicroelectronics
Chu, Jiangtao	D8	Sweden	Uppsala University
Ciarlone, Antonio	A5-B2	Italy	Politecnico di Torino
Cito, Salvatore	A4	Finland	University of Helsinki
Clover, Anthony	A5	Ireland	Cork University Hospital
Correia, José H	C5	Portugal	University of Minho
Correia Maciel, Marino De Jesus	D3	Portugal	University of Minho
Costa, Catarina G.	D3	Portugal	University of Minho
Coste, Philippe	D5	France	Université Paris-Sud/CNRS
Cruz, Francisco Javier	A8	Sweden	Uppsala University
Cummins, Gerard	A10	United K.	Heriot Watt University
Dahlin, Andreas	D8	Sweden	Uppsala University
Danel, Jean-Sebastien	C12	France	CEA, LETI, MINATEC Campus
de Graaf, Ger	C1	Netherlands	Delft University of Technology
Deimerly, Yannick	C6	France	CEA-LETI
Desmulliez, Marc	A10	United K.	Heriot Watt University
Dupont, Loic	C5	France	Université de Picardie Jules Verne, LRCS
Franssila, Sami	C7	Finland	Aalto University
Frischmuth, Tobias	D1	Austria	TU WIEN
Gaikwad, Vinayak	D10	India	DKTES Textile and Engineering Institute Ichalkaranji
Galvin, Paul	A5-B2	Ireland	Tyndall
Geukens, Laura	A7	Belgium	KULeuven
Ghaderi, Mohammadamir	C1	Netherlands	Delft University of Technology
Giannoni, Giuseppe	A5-B2	Italy	Politecnico di Torino
Gomes Correia, José Higino	D3	Portugal	University of Minho

MME 2015 – ALL AUTHORS

Author	Contr.	Country	Affiliation
Goncalves, Luis M.	B10-C5	Portugal	University of Minho
Gonçalves, Luís	A14	Portugal	University of Minho
Grille, Thomas	D1	Austria	Infineon Technologies Austria AG
Grygoryev, Konstantin	A5-B2	Ireland	Tyndall National Institute
Güçlü, Burak	A3	Turkey	Bogazici University
Haberl, Verena	A1	Austria	Infineon Technologies Austria AG
Hageman, Tijmen A. G.	A11-B7-B9	Germany	KIST Europe / Twente University
Hemmi, Tetsuya	B6	Japan	Kyoto University
Hernando-García, Jorge	A9	Spain	University of Castilla-La Mancha
Hilborn, Jöns	C10	Sweden	Uppsala university
Hirai, Yoshikazu	B6	Japan	Kyoto University
Hjort, Klas	A8-D8	Sweden	Uppsala University
Hoffmann, Martin	A13-B8	Germany	Technische Universität Ilmenau
Hoshian, Sasha	C7	Finland	Aalto university
Hotovy, Ivan	B4-B5-D7	Slovakia	Slovak University of Technology in Bratislava
Houlihan, Ruth	C3	Ireland	Tyndall National Institute
Jackson, Nathan	C3-D6	Ireland	Tyndall National Institute
Janson, Thomas G.	B9	Germany	KIST Europe
Jeong, Seung Hee	A8	Sweden	Uppsala University
Jourdan, Guillaume	C6	France	CEA-LETI
Kearney, John	A5	Ireland	Tyndall National Institute
Kenthao, Anan	A5-B2	Thailand	Khon Kaen University
Khaji, Zahra	A12	Sweden	Uppsala University
Konrath, Jens Peter	A1	Austria	Infineon Technologies Austria AG
Koroleva, Olga	A2	Russia	Institute of Physics and Technology
Kostic, Ivan	D7	Slovakia	Slovak Academy of Sciences
Kucera, Martin	A9-D2	Austria	Vienna University of Technology
Kusakci, Emre	B11	Turkey	Bogazici University
Lechuga, Yolanda	B12	Spain	University of Cantabria
Lehee, Guillaume	C6	France	Instiut d'Eléctronique Fondamentale
Leopold, Steffen	A13-B8	Germany	Technische Universität Ilmenau
Li, Zihao	C8	United K.	University of Southampton
Li, Xiangping	C9	Germany	KIST europe
Lind, Sara	D8	Sweden	Uppsala University
Lo Re, Gilberto	A5	Italy	Politecnico di Torino
Löthman, Per A.	B7-B9	Germany	KIST Europe
Maaroufi, Seifeddine	D4	France	Insitut Electronique Fondamentale
Mahmood, Salman	A10	United K.	Heriot Watt University
Manz, Andreas	B7-B9-C9	Germany	KIST Europe
Manzaneque, Tomás	A9-D2	Spain	University of Castilla-La Mancha
Martinez, Mar	B12	Spain	University of Cantabria
Marton, Marian	B4	Slovakia	STU
Mathewson, Alan	C3-D6	Ireland	Tyndall National Institute
Maurer, Daniel	D1	Austria	Infineon Technologies Austria AG
Mehner, Hannes	B8	Germany	Technische Universität Ilmenau
Miguel Díaz, Jose Ángel	B12	Spain	University of Cantabria
Minas, Graça	A14-B10	Portugal	University of Minho
Mohite, Suhas	D10	India	Government College of Engineering Karad
Monteiro, Tiago	A14	Portugal	UMinho/INESC-MN
Moulin, Johan	D5	France	Université Paris-Sud/CNRS
Muller, Raluca	B3	Romania	National Institute for R&D in Microtechnologies
Mutlu, Senol	A3	Turkey	Bogazici University
Naumov, Victor	A2	Russia	Institute of Physics and Technology
Nemec, Pavol	D7	Slovakia	Slovak Academy of Sciences

MME 2015 – ALL AUTHORS			
Author	**Contr.**	**Country**	**Affiliation**
Obaje, Ele	A10	United K.	University of Edinburgh
Olszewski, Oskar Z.	C3-D6	Ireland	Tyndall National Institute
O'Mahony, Conor	A5-B2	Ireland	Tyndall National Institute
Ossipov, Dmitri	C10	Sweden	Uppsala University
Pallares, Jordi	A4	Spain	Universitat Rovira i Virgili
Parrain, Fabien	D4	France	Institute of Fundamental Electronic (IEF)
Pätz, Daniel	A13	Germany	Technische Universität Ilmenau
Peixoto, Alexandre C.	D3	Portugal	University of Minho
Pellejero, Ismael	C11	Spain	Universidad de Zaragoza
Perrossier, Jean-Luc	D5	France	Université Paris-Sud/CNRS
Perrot, Sylvain	D5	France	Fogale nanotech
Persson, Anders	A12	Sweden	Uppsala University
Pfusterschmied, Georg	D2	Austria	Vienna University of Technology
Pichel, Marc P.	A11	Germany	KIST EUROPE
Pina, M. Pilar	C11	Spain	Universidad de Zaragoza
Pinto, Vania C.	B10	Portugal	University of Minho
Predanocy, Martin	B5-D7	Slovakia	Slovak University of Technology in Bratislava
Puers, Robert	A7	Belgium	K.U.Leuven ESAT-MICAS
Rahiminejad, Sofia	D9	Sweden	Chalmers University of Technology
Rehacek, Vlastimil	B4-B5	Slovakia	Slovak University of Technology in Bratislava
Rehacek, Vlastimil	D7	Slovakia	Slovak University of Technology in Bratislava
Rey, Patrice	C6	France	CEA-LETI
Reynaerts, Dominiek	A7	Belgium	KULeuven
Ribeiro, João F	C5	Portugal	University of Minho
Riou, Jean-Christophe	C6	France	SAGEM
Rivas Marchena, David	B12	Spain	Universidad de Cantabria
Ruiz-Díez, Víctor	A9-D2	Spain	University of Castilla-La Mancha
Sánchez-Rojas, José Luis	A9-D2	Spain	University of Castilla-La Mancha
Sancho, Irene	A4	Spain	Universitat Rovira i Virgili
Santamaria, Jesus	C11	Spain	Universidad de Zaragoza
Schmid, Ulrich	A1-A9-D1-D2	Austria	Vienna UT, Institute of Sensor and Actuator Systems
Schneider, Michael	A1-D1	Austria	Vienna UT, Institute of Sensor and Actuator Systems
Schulze, Holger	A10	United K.	University of Edinburgh
Schwebke, Silvan	B8	Germany	Technische Universität Ilmenau
Scully, Jim	A5	Ireland	Tyndall National Institute
Segura, Jaume	C2	Spain	Universitat de les Illes Balears
Sehlstedt, Viktor	C10	Sweden	Uppsala University
Sese, Javier	C11	Spain	Universidad de Zaragoza
Sharma, Anurekha	C3	India	Tyndall National Institute
Sikanen, Tiina	A4	Finland	University of Helsinki
Silva, Luis R.	B10	Portugal	University of Minho
Silva, Manuela M	C5	Portugal	University of Minho
Silva, Manuel F.	D3	Portugal	University of Minho
Sinzinger, Stefan	A13	Germany	Technische Universität Ilmenau
Sjögren, Frida	C10	Sweden	Uppsala University
Söderberg, Johan	A12	Sweden	Uppsala University
Sousa, Paulo J.	B10	Portugal	University of Minho
Stöber, Laura	A1	Austria	Vienna UT, Institute of Sensor and Actuator Systems
Sturesson, Peter	A12	Sweden	Uppsala University
Tabata, Osamu	B6	Japan	Kyoto University
Tähkä, Sari	A4	Finland	University of Helsinki
Tenje, Maria	A6-C10	Sweden	Uppsala University / Lund University
Thornell, Greger	A12	Sweden	Uppsala University

MME 2015 – ALL AUTHORS			
Author	**Contr.**	**Country**	**Affiliation**
Toledo, Javier	A9-D2	Spain	University of Castilla-La Mancha
Torah, Russel	C8	United K.	University of Southampton
Torun, Hamdi	B11	Turkey	Bogazici University
Tsuchiya, Toshiyuki	B6	Japan	Kyoto University
Tudor, John	C8	United K.	University of Southampton
Undin, Torgny	D8	Sweden	Uppsala University
Urbiztondo, Miguel A.	C11	Spain	Centro Universitario de la Defensa
Uvarov, Ilya	A2	Russia	Institute of Physics and Technology
Verd, Jaume	C2	Spain	Universitat de les Illes Balears
Vernet, Anton	A4	Spain	Universitat Rovira i Virgili
Vieira, Eliana M F	C5	Portugal	University of Minho
Voicu, Rodica	B3	Romania	National Institute for R&D in Microtechnologies
Vojs, Marian	B4	Slovakia	STU
Wistrela, Elisabeth	D2	Austria	Vienna University of Technology
Wolff, Anette	A6	Sweden	Lund University
Wolffenbuttel, Reinoud	C1-D3	Netherlands	Delft University of Technology
Wu, Zhigang	A8	Sweden	Uppsala University
Wu, Wenming	C9	Germany	KIST europe
Wu, Ming	D5	France	Université Paris-Sud/CNRS
Yalcinkaya, Arda Deniz	B11	Turkey	Bogazici University
Zhang, Zhi-Bin	A8	Sweden	Uppsala University
Zhang, Shi-Li	A8	Sweden	Uppsala University