

MME 2016

Cork, Ireland

28-30th August 2016

Technical Programme



Fondúireacht Eolaíochta Éireann
Dá bhfuil romhainn

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Programme Summary

Sunday 28th August

- 18:00-20:00 Welcome, Registration & Poster Hanging
21:00 Traditional Irish music at 'An Spailpín Fánach'

Monday 29th August

- 08:30 Registration
09:00 Opening Address & Welcome
09.15 **Invited - Prof. Massimo De Vittorio (IIT, Italy)**
10:00 Flash Session A
11:00 Poster Session A & Coffee
12:30 *Lunch*
13.30 **Invited – Prof. Per Ohlckers (HBV, Norway)**
14.15 Flash Session B
15:00 Poster Session B & Coffee
16:00 Paper Review Session (The Sextant Pub, *www.thesextant.ie*)
17.45 *Close of Day 1*
- 18:15 Bus Transfer to Old Midleton Distillery
18.45 Distillery Tour & Whiskey Tasting, Gala Dinner & Entertainment
23:00 Return to Cork

Tuesday 30th August

- 09.00 **Invited - Prof. Martin Richter (Fraunhofer EMFT, Germany)**
09:45 Flash Session C
11:00 Poster Session C & Coffee
12:30 *Lunch*
13.30 **Invited– Mr. Ray Goggin (Analog Devices, Ireland)**
14.15 Flash Session D
15:15 Poster Session D & Coffee
16:30 Closing Remarks, Poster Awards and MME 2017
17.00 *Close of Day 1*
- 19:00 Informal Social Event

Technical Programme

Invited Speakers

We are delighted to welcome the following Invited Speakers to Cork for the 27th Micromechanics and Microsystems Europe Workshop, and we sincerely thank them for taking the time to share their insights into emerging trends and technologies in European microsystems.

Session	Presentation	Page
A	Soft Piezoelectric MEMS Technologies for Sensing and Energy Harvesting Prof. Massimo De Vittorio <i>Istituto Italiano di Tecnologia (IIT), Center for Bio-Molecular Nanotechnology, Università del Salento, Lecce, Italy</i>	11
B	"Publish or Perish": A Guide for Writing Scientific Papers in Natural Sciences Prof. Per Ohlckers <i>Department of Micro- and Nano Systems Technology, University College of Southeast Norway (HSN), Horten, Norway</i>	12
C	Applications and Technology of Piezo Driven Micropumps Prof. Martin Richter <i>Fraunhofer Research Institution for Microsystems and Solid State Technologies EMFT, Munich, Germany</i>	13
D	Successful Commercialisation and Release of the Analog Devices RF MEMS Switch Ray Goggin <i>Analog Devices, Cork, Ireland</i>	14

Soft Piezoelectric MEMS Technologies for Sensing and Energy Harvesting

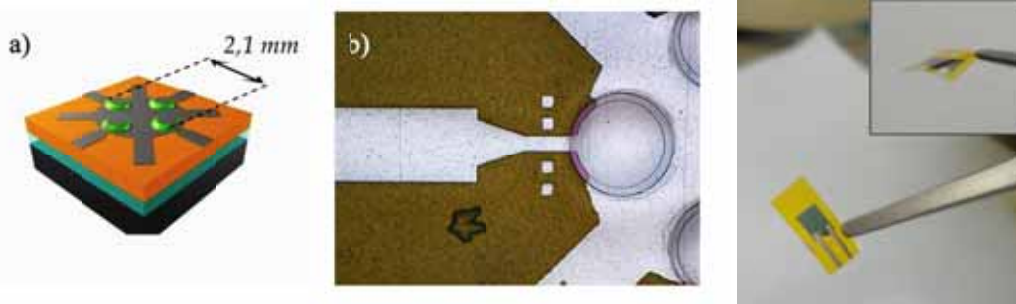
Massimo De Vittorio

Istituto Italiano di Tecnologia (IIT), Center for Bio-Molecular Nanotechnology, Università del Salento, Lecce, Italy

Abstract. Next generation remote sensors, wearable and implantable electronics applied to the internet of things (IoT) and of medical things (IoMT) requires advanced material and device properties including ultrahigh sensitivity, low power consumption, biocompatibility. Sensing and power management need to be embedded in a single flexible substrate to be integrated in textiles, on skin or even implanted in the human body.

Soft piezoelectric technology can be a perfect match to these challenging goals. In this presentation it will be shown that thin film piezoelectrics on flexible polymers can be synthesized and processed to produce compact, high-sensitive arrays of pressure sensors, mimicking the functions of human skin, and can also be at the same time exploited to harvest mechanical energy. By virtue of their intrinsic softness and flexibility this technology can scavenge energy non-resonantly at very low frequencies, opening interesting opportunities for retrieving energy from motion, heartbeat, blood pressure or breath.

It will be also shown that small piezoelectric flags can efficiently act as harvesters of energy at extremely low wind or water flow speed in outdoor environments, with a cut-in flow speed of 0.1 m s^{-1} , more than one order of magnitude lower than wind turbines, and with a generated power of the order of mWs cm^{-3} at higher wind speed.



Left: 1 – a) Scheme and image of a tactile sensor array based on aluminum nitride on polyimide substrate for artificial skin applications. Right – Piezoelectric flags for energy harvesting.

Biography. Massimo De Vittorio is director of the Center for Biomolecular Nanotechnologies (CBN) of the Istituto Italiano di Tecnologia (IIT), associate professor at Università del Salento and co-founder of the national nanotechnology laboratory (NNL) of the Istituto Nanoscienze CNR. His research activity deals with the development of science and technology applied to nanophotonics, nanoelectronics and nano and micro electromechanical systems (NEMS/MEMS). Author of about 200 papers, 60 proceedings of international conferences, 13 patents and several invited/keynote talks to international conferences, he is also senior editor of the Journal IEEE Transactions on Nanotechnology and founder of several start-up companies, spin-off of his research activities.



“Publish or Perish”: A Guide for Writing Scientific Papers in Natural Sciences- with Some Subjective Recommendations

Per Ohlckers

Department of Micro- and Nano Systems Technology, University College of Southeast Norway (HSN), Horten, Norway

Abstract. Scientific writing is important in all sciences used to document research results. This presentation discusses scientific writing in natural science, where a major cornerstone is that all progresses of knowledge are made by proving hypotheses or establish facts by experiments or theoretical calculations or both. The quality of the content of the scientific writing is that your documented research work can be repeated as completely as needed for validation by any peers by following your descriptions of the work performed. This is an important inherent quality assurance scheme of natural science to assure that the achieved results are correct and can be used as an input to further expand the research frontiers. In addition, such peer reviews is used to evaluate the research originality compared to other published research work. Scientific writing is about documenting the research performed in this way. The contents of the different typical chapters of a scientific paper in natural sciences are outlined here with general guidelines and subjective recommendations. A suitable format is given as a template with guidelines for the structure and look: “The Gold Standard” (or IMRAD –Introduction, Methods And Discussions) The presentation is using a an electronic file template from Institute of electrical and Electronics Engineers (IEEE) as an example. It is a well-structured template, which is widely used also outside IEEE, including the Micromechanics and Microsystems Europe workshops. At the end, in a more unceremonious form, some practical advices for writing successful papers are presented and commented. In conclusion, subjective recommendations for scientific writing is given - use it or not.

Biography. Per Ohlckers is Professor at Department of Micro- and Nano Systems Technology at University College of Southeast Norway (HSN), Horten, Norway from September 2005. He is also Professor Emeritus at Department of Physics, University of Oslo. He received his M.Sc. degree in Physical Electronics from Norwegian Institute of Technology (NTH, now NTNU) in 1974.

Per Ohlckers has contributed to the development of several successful commercial products and he more than 150 international scientific publications with focus on silicon sensor technology and micro- & nanotechnologies, including two patents. He is lecturing in semiconductor devices at HSN, and earlier he lectured in Packaging & Interconnection Technology for Electronic Systems at HSN and at University of Oslo using a textbook he has co-authored, which were used at several other universities around the world.

His employment history includes positions as General Manager of the start-up microsystem company Diamond Nanomachines as, earlier Fifty-four point Seven (54.7) from 1999, Vice President, Research & Product Development at DAVIS A/S. Drammen, Norway from 1998 to 1999, R&D Coordinator at SensoNor, Horten, Norway from 1995 to 1998, and 15 years at SINTEF Instrumentation in different positions: Deputy Director, Research Manager, Microelectronics Section and Manager of Liaison Services Section. He had a 6 months stay as a visiting scientist at Electronics Design Center, Case Western Reserve University, Ohio in 1983-84. After graduation, he had a 5 years employment at Aksjeselskapet Mikro Elektronikk (ame), Horten, Norway. He was a member of the Steering Committee for the International Conference on Solid State Sensors and Actuators from 1997 to 2007, and a member of the organisation committee for this conference in Stockholm in 1995. He was Chairman of the Micromechanics and Microsystems Europe workshops in 1998 and in 2011.



Applications and Technology of Piezo Driven Micropumps

Martin Richter

Fraunhofer Research Institution for Microsystems and Solid State Technologies EMFT,
Munich, Germany.

Abstract. Piezo driven micropumps are the key component of microdosing systems, which enable new applications in consumer, medical, industry, automotive, chemistry and lab technology. They can be realized and manufactured by various materials, such as plastics, metal or silicon. Plastic micropumps can address cost efficient applications, metal micropumps mainly addresses high flow applications, and silicon micropumps can achieve high performance applications at a very small device size.

As the manufacturing cost of silicon micropumps at mass production scales linear with chip size, state of the art chip sizes of $7 \times 7 \text{ mm}^2$ prevent the use of micropumps in medical disposable applications, as well as in consumer electronic devices. One important step for silicon micropumps is to miniaturize the chip size to reduce manufacturing cost. The reduction of the chip size to $5 \times 5 \text{ mm}^2$, including strategies to realize mass production of silicon micropumps, will be explained in this presentation. A pilot application of a $5 \times 5 \text{ mm}^2$ micropump in a mobile phone will be demonstrated.



The Fraunhofer micropump family.

Biography. Martin Richter's mission is to enable microdosing systems for industrial applications. He completed his studies in technical physics at the Technical University of Munich, and gained his PhD at the University of Armed Forces in the area of microfluidics. Since 2000 he has been heading the Department Micromechanics, Actuators and Fluidics at Fraunhofer. His scientific focus is on microfluidic actuators such as micro pumps, micro valves, open jet dispensers or micro blenders, and integrating these in microfluidic systems. Such microfluidic actuators are deployed in varied applications, e.g. in medical technology (such as drug dosage, glaucoma therapy), laboratory technology or dosage of lubricants.



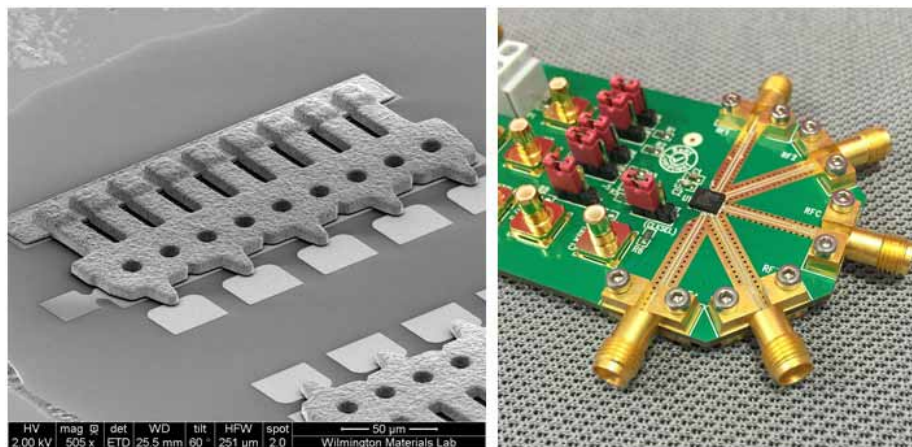
Successful Commercialisation and Release of the Analog Devices RF MEMS Switch

Ray Goggin

Analog Devices, Cork, Ireland

Abstract. The prospect of a highly reliable wide bandwidth compact MEMS switch being used in RF test instrumentation and other applications has been attractive for many years, and the road is littered with companies both large and small who have tried and failed to commercialize this illusive technology. Reliability and ease of use have been long standing challenges with the widespread adoption of MEMS switches and Analog Devices MEMS switch technology development in Ireland has concentrated on comprehensively addressing these issues.

In this talk, Ray Goggin, Design Engineering Manager and MEMS Switch technology champion within Analog Devices will share the story of how with constant focus on reliability Analog Devices has successfully commercialized an electrostatic MEMS switch in industry standard plastic packaging. He will share some of the important lessons learnt on this long journey to success and also discuss both the application level impact that MEMS switches are having on Analog's customers as well as the apprehension they had in adopting the technology. Finally the talk will show how in the future MEMS switches will be seen as game changing technology in multiple market segments.



The Analog Devices RF MEMS switch.

Biography. Ray has been with Analog Devices(ADI) in Ireland since 1997 when he joined as a graduate engineer from University College Cork with a 1H degree in Electrical & Electronic Engineering. Since that time Ray has held a number of roles in Test, Design, Marketing and Management in the Precision Products Group. Most recently Ray has been the champion and leader of ADI's MEMS switch technology and ADGM1304 product development,overseeing this innovative breakthrough product/technology's successful commercialization and release. Ray has presented technical papers on MEMS switches at multiple technical conferences, most recently at the International Microwave Symposium in 2015. Ray holds 10 US patents.



Technical Programme – Monday 29th August

Session A

Paper	Details	Page
Invited	Soft Piezoelectric MEMS Technologies for Sensing and Energy Harvesting Prof. Massimo De Vittorio <i>Istituto Italiano di Tecnologia (IIT), Center for Bio-Molecular Nanotechnology, Università del Salento, Lecce, Italy</i>	11
A1	A thin silicon thermoelectric nanowire characterization platform (TNCP) equipped with nanoporous electrodes for electrical contact formation S. Hoda Moosavi ¹ , Michael Kroener ¹ , Maxi Frei ² , Fabian Frick ¹ , Sven Kerzenmacher ² , and Peter Woias ¹ ¹ Laboratory for Design of Microsystems, Department of Microsystems Engineering – IMTEK, Freiburg, Germany ² Laboratory for MEMS Applications, Department of Microsystems Engineering – IMTEK, Freiburg, Germany	26
A2	Three step deep reactive ion etch for high density trench etching Bram Lips and Robert Puers <i>Department ESAT-MICAS, KU Leuven, Kasteelpark Arenberg 10, 3000 Leuven, Belgium.</i>	27
A3	DNA Nano Templating using Dielectrophoretic Force Sara Mahshid ^{1,2} , Mohammed Jalal Ahamed ³ , Jia Lu ¹ , Rob Sladek ² , Walter Reisner ¹ ¹ Department of Physics, McGill University, Montreal, QC Canada ² Department of Human Genetics, McGill University, Montreal, QC Canada ³ Mechanical, Automotive and Materials Engineering, University of Windsor, Windsor, ON, Canada	28
A4	High Aspect-Ratio Neural Probes using Conventional Blade Dicing S. B. Goncalves ¹ , J. F. Ribeiro ² , A. F. Silva ¹ , J. H. Correia ² ¹ MIT Portugal Program, School of Engineering, University of Minho, Guimaraes, Portugal ² Department of Industrial Electronics, University of Minho, CMEMS-UMINHO, Guimaraes, Portugal	29
A5	Design, numerical simulation and experimental investigation of an SU-8 microgripper based on the cascaded V-shaped electrothermal actuators Rodica-Cristina Voicu <i>National Institute for Research and Development in Microtechnologies-IMT Bucharest, Erou Iancu Nicolae str., 126A, 077190, Romania</i>	30
A6	Characterizing coupled MEMS resonators with an electrical resonator Guowei Tao ^{1,2} , Bhaskar Choubey ¹ ¹ Department of Engineering Science, University of Oxford, Oxford OX1 3PJ, UK ² Vlatacom d.o.o., Bul. Milutina Milankovica 5, 11000 Belgrade, Serbia	31

A7	Piezoelectric MEMS resonators for monitoring grape must fermentation J. Toledo ¹ , F. Jiménez-Márquez ¹ , J. Úbeda ² , V. Ruiz-Díez ¹ , G. Pfusterschmied ³ , U. Schmid ³ and J. L. Sánchez-Rojas ¹ <i>¹Microsystems, Actuators and Sensors Group, Universidad de Castilla-La Mancha, Ciudad Real, Spain</i> <i>²Tecnología de los Alimentos, Universidad de Castilla-La Mancha, Ciudad Real, Spain</i> <i>³Institute of Sensor and Actuator Systems, TU Wien, Vienna, Austria</i>	32
A8	A 3D Polymer Based Printed Two-Dimensional Laser Scanner H. A. Oyman ^{1,2} , Y. D. Gokdel ² , O. Ferhanoglu ³ and A. D. Yalcinkaya ¹ <i>¹Bogazici University, Department of Electrical and Electronics Engineering, Bebek, 34342, Istanbul, Turkey</i> <i>²Istanbul Bilgi University, Department of Electrical and Electronics Engineering, Eyup, 34060, Istanbul, Turkey</i> <i>³Istanbul Technical University, Department of Electronics and Communication Engineering, Maslak, 34469, Istanbul, Turkey</i>	33
A9	Micro-Venturi injector: design, experimental and simulative examination Sarah Degenhardt, Yahia Cheriguen, Thomas Geiling and Martin Hoffmann <i>Micromechanical Systems Group, IMN MacroNano®, Technische Universität Ilmenau 98694 Ilmenau, PF 100565, Germany</i>	34
A10	Geometric optimization of magnetically actuated MEMS micromirrors Francesco Pieri <i>Dipartimento di Ingegneria dell'Informazione, Università di Pisa, Pisa, Italy</i>	35
A11	Design and fabrication of ultrathin silicon-nitride membranes for use in UV-visible airgap-based MEMS optical filters Mohammad Amir Ghaderi and Reinoud F. Wolffenbuttel <i>Electronic Instrumentation Laboratory, Microelectronics Department, Faculty of EEMCS, Delft University of Technology, Delft, The Netherlands</i>	36
A12	A refined model for piezoelectric composite beams Luca Luschi, Francesco Pieri <i>Dipartimento di Ingegneria dell'Informazione, Università di Pisa, Pisa, Italy</i>	37
A13	Towards measuring motile magnetic fractions of magnetotactic bacterial cultures M. P. Pichel ^{1,2} , T. A. G. Hageman ^{1,2} , A. Manz ¹ and L. Abelman ^{1,2} <i>¹KIST Europe, Saarbrücken, Germany</i> <i>²University of Twente, Enschede, The Netherlands</i>	38
A14	A low frequency MEMS energy harvester scavenging energy from magnetic field surrounding an AC current-carrying wire Oskar Z. Olszewski, Ruth Houlihan, Alan Mathewson and Nathan Jackson <i>Tyndall National Institute, University College Cork, Cork, Ireland</i>	39
A15	Design, modelling and preliminary characterisation of microneedle-based electrodes for tissue electroporation <i>in vivo</i> Conor O'Mahony ¹ , Ruth Houlihan ¹ , Konstantin Grygoryev ¹ , Zhenfei Ning ² , John Williams ² and Tom Moore ² <i>¹Tyndall National Institute, University College Cork, Cork, Ireland</i> <i>²School of Biochemistry and Cell Biology, University College Cork, Ireland.</i>	40

11.00 *Poster Session A & Coffee*

12.30 *Lunch*

Session B

Paper	Details	Page
Invited	"Publish or Perish": A Guide for Writing Scientific Papers in Natural Sciences Prof. Per Ohlckers <i>Department of Micro- and Nano Systems Technology, University College of Southeast Norway (HSN), Horten, Norway</i>	12
B1	Electrochemical microsensor system for cancer research on photodynamic therapy <i>in vitro</i> J. Marzioch ¹ , J. Kieninger ¹ , J. A. Sandvik ² , E. O. Pettersen ² , Q. Peng ³ and G. Urban ¹ ¹ <i>University of Freiburg-IMTEK, Georges-Köhler-Allee 103, 79110 Freiburg, Germany</i> ² <i>University of Oslo, P.O.Box 1072 Blindern, 0316 Oslo, Norway</i> ³ <i>The Norwegian Radium Hospital, Ullernchauseen 70, 0310 Oslo, Norway</i>	41
B2	Asymmetric resonance frequency analysis of in-plane electrothermal silicon cantilevers for nanoparticle sensors Maik Bertke ^{1,2} , Gerry Hamdana ^{1,2} , Wenze Wu ^{1,2} , Markus Marks ¹ , Hutomo Suryo Wasisto ^{1,2} and Erwin Peiner ^{1,2} ¹ <i>Institute of Semiconductor Technology (IHT), Braunschweig University of Technology, Hans-Sommer-Strasse 66, D-38106 Braunschweig, Germany</i> ² <i>Laboratory for Emerging Nanometrology (LENA), Langer Kamp 6a, D-38106 Braunschweig, Germany</i>	42
B3	A micropump driven by electrochemically produced short-lived bubbles I. V. Uvarov ¹ , S. S. Lemekhov ¹ , A. E. Melenev ¹ and V. B. Svetovoy ^{1,2} ¹ <i>Yaroslavl Branch of the Institute of Physics and Technology RAS, 150007, Universitetskaya 21, Yaroslavl, Russia</i> ² <i>MESA+ Institute for Nanotechnology, University of Twente, PO 217, Enschede 7500 AE, The Netherlands</i>	43
B4	Circuit Modeling of a MEMS Varactor Including Dielectric Charging Dynamics P. Giounanlis ¹ , D. Andrade-Miceli ¹ , S. Gorreta ² , J. Pons-Nin ² , M. Dominguez-Pumar ² and E. Blokhina ¹ ¹ <i>School of Electrical, Electronic and Communications Engineering, University College Dublin, Dublin, Ireland</i> ² <i>Micro and Nano Technologies Group Electronic Engineering Department, Technical University of Catalonia, Barcelona, Spain</i>	44
B5	High pressure glass microfluidics for supercritical CO₂ with aqueous solutions M Andersson, K. Hjort and L. Klintberg <i>Department of Engineering Sciences, Uppsala University, Box 534, 751 21, Sweden</i>	45
B6	Design and fabrication of 45° inclined mirrors for wafer-level optical absorption spectroscopy N. P. Ayerden, M. Ghaderi and R. F. Wolffenbuttel <i>Faculty of EEMCS, Delft University of Technology, Mekelweg 4, 2628 CD, Delft, Netherlands</i>	46
B7	Direct 3D printed shadow mask on Silicon S. Rahiminejad, E. Kohler and P. Enoksson <i>Chalmers University of Technology, Department of Micro and Nanotechnology, Sweden</i>	47

B8	Alumina-based monopropellant microthruster with integrated heater, catalytic bed and temperature sensors Zahra Khaji ¹ , Lena Klintberg ¹ , Dhananjay Barbade ² , Kristoffer Palmer ³ and Greger Thornell ^{1,2} <i>¹Div. of Microsystems Technology, Dept. of Engineering Sciences, Uppsala University, Uppsala, Sweden</i> <i>²Ångström Space Technology Centre, Dept. of Engineering Sciences, Uppsala University, Uppsala, Sweden</i> <i>³SSC Nanospace, Uppsala, Sweden</i>	48
B9	Inertial focusing of microparticles and its limitations F. J. Cruz ¹ , S. Hooshmand Zadeh ¹ , Z. G. Wu ^{1,2} and K. Hjort ¹ <i>¹Engineering Sciences, Uppsala University, Ångström Laboratoriet, Uppsala, Sweden</i> <i>²State Key Laboratory of Digital Manufacturing Equipment and Technology, Huazhong University of Science and Technology, Wuhan, China</i>	49
B10	Magnetic Multilayer Fabrication Technology with Selective Activation of SU-8 Films R. Anthony ^{1,2} , C. Ó Mathúna ^{1,2} and J. F. Rohan ¹ <i>¹Tyndall National Institute, Lee Maltings, University College, Cork, Ireland</i> <i>²Electrical and Electronics Engineering, University College Cork, Ireland</i>	50
B11	CMOS-compatible fabrication of metamaterial-based absorbers for the mid-IR spectral range Ehsan Karimi Shahmarvandi, Mohammadamir Ghaderi and Reinoud F. Wolffenbuttel <i>Faculty EEMCS, Delft University of Technology, Mekelweg 4, 2628 CD Delft, Netherlands</i>	51
B12	High resolution patterning of liquid alloy by shrinking the substrate Seung Hee Jeong ¹ , Albin Berglund ² , Frida Nilsson ² , Arne Sahlberg ² , Hugo Nguyen ¹ , Zhigang Wu ^{1,3} and Klas Hjort ¹ <i>¹Division of Microsystems Technology, Department of Engineering Sciences, The Angstrom Laboratory, Uppsala University, Box 534, 751 21, Sweden</i> <i>²The Angstrom Laboratory, Uppsala University, Box 534, 751 21, Sweden</i> <i>³State Key Laboratory of Digital Manufacturing Equipment and Technology, Huazhong University of Science and Technology, Wuhan, China</i>	52
15:00	<i>Poster Session B & Coffee</i>	
16:00	<i>Paper Review Session @ The Sextant</i>	
17.45	<i>Close of Day 1</i>	
18:15	<i>Bus Transfer to Old Midleton Distillery</i>	
18.45	<i>Distillery Tour & Tasting, Gala Dinner & Entertainment</i>	
~23:00	<i>Return to Cork</i>	

Technical Programme – Tuesday 30th August

Session C

Paper	Details	Page
Invited	Applications and Technology of Piezo Driven Micropumps Prof. Martin Richter <i>Fraunhofer EMFT, Munich, Germany</i>	13
C1	Crystalline growth of AlN thin films by atomic layer deposition S. Sadeghpour, F. Ceyskens and R. Puers <i>ESAT-MICAS, KU Leuven, Leuven, Belgium</i>	53
C2	Electro Active Polymer actuator design for a rectangular haptic plate using the squeeze-film effect F. Casset ^{1, 2} , P. Poncet ^{1, 2} , A. Latour ^{1, 3} , F. Domingues Dos Santos ⁴ , S. Pawlak ⁵ , R. Gwoziecki ^{1, 3} and S. Fanget ^{1, 2} ¹ <i>Univ. Grenoble Alpes, F-38000 Grenoble, France</i> ² <i>CEA-LETI, MINATEC Campus, 38054 Grenoble, France</i> ³ <i>CEA, LITEN, DTNM, LCEI, F-38054 Grenoble, France</i> ⁴ <i>ARKEMA-PIEZOTECH, F-69493 Pierre Benite, France</i> ⁵ <i>WALTER PACK, S-48140 Bizkaia, Spain.</i>	54
C3	Experimental study of PDMS mechanical properties for the optimization of polymer based flexible pressure micro-sensors T. H. N. Dinh, E. Martincic, E. Dufour-Gergam and P.-Y. Joubert <i>Institut d'Electronique Fondamentale (IEF), CNRS, Université Paris Sud, Université Paris-Saclay, Orsay, France</i>	55
C4	Automation of Silica Bead-based Nucleic Acid Extraction on a Centrifugal Lab-on-a-Disc Platform David J. Kinahan, Faith Mangwanya, Robert Garvey, Danielle WY Chung, Artur Lipinski, Lourdes AN Julius, Damien King, Mehdi Mohammadi, Rohit Mishra, May Al-Ofi, Celina Miyazaki and Jens Ducreé <i>National Centre for Sensor Research, Dublin City University, Ireland</i>	56
C5	Acoustophoretic particle manipulation in droplet microfluidics at higher resonance modes Anna Fornell ¹ , Fabio Garofalo ¹ , Johan Nilsson ¹ and Maria Tenje ^{1,2} ¹ <i>Lund University, Lund, Sweden</i> ² <i>Uppsala University, Science for Life Laboratory, Uppsala, Sweden</i>	57
C6	Split-Ring Resonator-Based Strain Sensor on Flexible Substrates for Glaucoma Detection Gizem Ekinci ¹ , Arda Deniz Yalcinkaya ^{1,2} , Gunhan Dunder ¹ and Hamdi Torun ^{1,2} ¹ <i>Dept. Electrical and Electronics Engineering, Bogazici University, Turkey</i> ² <i>Center for Life Sciences and Technologies, Bogazici University, Turkey</i>	58
C7	Process flow to integrate nanostructures on silicon grass in surface micromachined systems H. Mehner ¹ , L. Müller ¹ , S. Biermann ² , F. Hänschke ³ , M. Hoffmann ¹ ¹ <i>Micromechanical Systems Group, IMN MacroNano®, Technische Universität Ilmenau, 98693 Ilmenau, Germany</i> ² <i>Micro-Hybrid Electronic GmbH, 07629 Hermsdorf, Germany</i> ³ <i>Leibniz-Institut für Photonische Technologien e.V., 07702 Jena, Germany</i>	59

Session D

Paper	Details	Page
Invited	<p>Successful Commercialisation and Release of the Analog Devices RF MEMS Switch</p> <p>Ray Goggin <i>Analog Devices, Cork, Ireland.</i></p>	14
D1	<p>HF-Release of Sacrificial Layers in CMOS-integrated MOEMS structures</p> <p>S. Döring, M. Friedrichs, W. Pufe and M. Schulze <i>Fraunhofer Institute for Photonic Microsystems (IPMS), Maria-Reiche-Str. 2, 01109 Dresden, Germany</i></p>	69
D2	<p>Design and Simulation of Bistable Microsystem with Frequency-up Conversion Effect for Electrostatic Energy Harvesting</p> <p>Bogdan Vysotskyi^{1,2}, Fabien Parrain¹, Elie Lefeuvre¹, Xavier Leroux¹, Denis Aubry² and Philippe Gaucher² ¹<i>IEF, University Paris XI - Paris-Sud, Orsay, France</i> ²<i>MSSMat, CentraleSupélec, Châtenay-Malabry, France</i></p>	70
D3	<p>Single cell array impedance analysis in a microfluidic device</p> <p>Emre Altinagac¹, Selen Taskin² and Huseyin Kizil² ¹<i>Department of Nanoscience & Nanotechnology, Istanbul Technical University, Istanbul, Turkey.</i> ²<i>Faculty of Chemical and Metallurgical Engineering, Istanbul Technical University, Istanbul, Turkey.</i></p>	71
D4	<p>Micro system comprising 96 micro valves on a titer plate</p> <p>S. Krabbe¹, D. Flitsch², J. Büchs² and W.K. Schomburg¹ <i>RWTH Aachen University, 52074 Aachen, Germany</i> ¹<i>Konstruktion und Entwicklung von Mikrosystemen, KEmikro, Steinbachstraße 53 B</i> ²<i>Aachener Verfahrenstechnik, AVT, Biochemical Engineering, Worringer Weg 1</i></p>	72
D5	<p>Development and fabrication of a very High-G sensor for very high impact applications</p> <p>Xiaodong Hu¹, Piotr Mackowiak², Biswajit Mukhopadhyay², Oswin Ehrmann^{1, 2}, Klaus-Dieter Lang^{1, 2}, Stefan Linke³, Anthony Chu³ and Ha-Duong Ngo^{2, 4} ¹<i>Technical University Berlin, Germany</i> ²<i>Fraunhofer Institute for Reliability and Microintegration, Germany</i> ³<i>Measurement Specialties Inc.</i> ⁴<i>University of Applied Sciences Berlin, Germany</i></p>	73
D6	<p>Photopatterning of hyaluronic acid hydrogels for cell culture scaffolds</p> <p>Ana Maria Porras¹, Frida Sjögren¹, Liyang Shi², Dmitri Ossipov² and Maria Tenje^{1,3,4} ¹<i>Dept. of Engineering Sciences Uppsala University, Uppsala, Sweden.</i> ²<i>Dept. of Chemistry, Uppsala University, Uppsala Sweden.</i> ³<i>Dept. of Biomedical Engineering, Lund University, Lund, Sweden.</i> ⁴<i>Science for Life Laboratory, Uppsala, Sweden.</i></p>	74

D7	MEMS gas ionization sensor with palladium nanostructures for use at ambient pressure	75
	L. Müller, H. Mehner and M. Hoffmann <i>Micromechanical Systems Group, IMN MacroNano®, Technische Universität Ilmenau, 98693 Ilmenau, Germany</i>	
D8	Turbulence as the disturbing force in macroscopic self-assembly	76
	P.A. Lothman ^{1,2} , T.A.G. Hageman ^{1,2} , A. Manz ¹ and L. Abelman ^{1,2} ¹ <i>KIST Europe, Saarbrücken, Germany</i> ² <i>University of Twente, Enschede, The Netherlands</i>	
D9	Extreme-temperature lab on a chip for optogalvanic spectroscopy of ultra small samples – key components and a first integration attempt	77
	Martin Berglund ^{1,2} , Zahra Khaji ^{1,2} , Lena Klintberg ² , Anders Persson ^{1,2} , Peter Stureson ¹⁻³ , Johan Söderberg Breivik ^{1,2} and Greger Thornell ^{1,2} ¹ <i>Ångström Space Technology Centre, Uppsala University, Sweden</i> ² <i>Div. of Microsystems Technology, Dept. of Engineering Sciences, Uppsala University, Sweden</i> ³ <i>Dept. of Military Studies, The Swedish Defence University, Sweden</i>	
D10	Characterization of a macroscopic self-assembly reactor	78
	T.A.G. Hageman ^{1,2} , P.A. Lothman ^{1,2} , A. Manz ¹ and L. Abelman ^{1,2} ¹ <i>KIST Europe, Saarbrücken, Germany</i> ² <i>University of Twente, Enschede, The Netherlands</i>	
D11	MEMS Based Micro Aerial Vehicles	79
	Niranjan Joshi, Elof Kohler and Peter Enoksson <i>Department of Micro and Nanotechnology, Chalmers University of Technology, Sweden</i>	
D12	Frequency adjustable MEMS vibration energy harvester	80
	P. Podder ¹ , P. Constantinou ¹ , A. Amann ^{2, 3} and S. Roy ^{1, 4} ¹ <i>Micro-Nano Systems Centre, Tyndall National Institute, Cork, Ireland</i> ² <i>Photonics Centre, Tyndall National Institute, Cork, Ireland</i> ³ <i>School of Mathematical Sciences, University College Cork, Cork, Ireland</i> ⁴ <i>A.S. Paintal Chair Professor in Engineering, Indian National Science Academy</i>	
D13	Location Dependence of a MEMS Electromagnetic Transducer with respect to an AC Power Source	81
	Ruth Houlihan, Oskar Olszewski, Nathan Jackson, Finbarr Waldron, Mike O'Neill, Alan Matthewson <i>Tyndall National Institute, Lee Maltings, Cork, Ireland</i>	
15:15	Poster Session D & Coffee	
16:30	Closing Remarks, Poster Awards and MME 2017	
17:00	Close of Day 1	
19:00	Informal Social Event (TBC)	