

26-28 April 2006

Symposium on

Design, Test, Integration
and Packaging of MEMS/MOEMS

Stresa, Lago Maggiore, Italy

DTIP 2006

Sponsored by



IEEE Components,
Packaging and
Manufacturing
Technology Society

Chair: B. Courtois, *TIMA Labs, Grenoble, France*

Co-Chair: K. Markus, *Zeus Strategies, LLC, Durham, USA*

C O N F E R E N C E S

CAD, Design and Test

Chair: S. Blanton, *Carnegie Mellon Univ., Pittsburgh, USA*

Co-Chair: J-M. Karam, *MEMSCAP, Bernin, France*

Microfabrication, Integration and Packaging

Chair: A. Bosseboeuf, *IEF, Paris-Orsay, France*

Co-Chair: V. Kempe, *SensorDynamics AG, Austria*

Including

Special sessions on Micro Power Generators

Co-locating with:

Workshop on Design for Reliability and Manufacturability in MNT → 25 April 2006

Ing. Alex Lozano
U.T. Microtecnologías
y Microsistemas

DTIP

of MEMS & MOEMS

**Design, Test, Integration
and Packaging of
MEMS/MOEMS 2006**

**Shawn Blanton
Alain Bosseboeuf
Bernard Courtois
Jean Michel Karam
Volker Kempe
Karen Markus**
Chairs/Editors

26-28 April 2006
Stresa, Lago Maggiore, Italy

Sponsored by:



Table of Contents

Symposium Committees.....	XI
Welcome Message	XIII

Wednesday, April 26th, 2006

Invited talk 1: MICROSYSTEM DEVELOPMENT

MICROSYSTEM PRODUCT DEVELOPMENT	1
<i>Marc A. Polosky and Ernest J. Garcia, Sandia National Laboratories, United States</i>	

Invited talk 2: MEMSCAP RECOVERY: THE STORY

MEMSCAP RECOVERY: THE STORY	8
<i>Jean Michel Karam, MEMSCAP, Bernin, France</i>	

Session 1: PACKAGING AND ASSEMBLY

3D ASSEMBLY TECHNOLOGY FOR HYBRID INTEGRATION OF HETEROGENOUS DEVICES	9
<i>Erik Jung, Fraunhofer IZM, Germany; Luca Magagni, University of Bologna, Italy; Stefan Schmitz, Karin Kaschlun, Fraunhofer IZM, Germany; Roberto Guerrieri, University of Bologna, Italy; Roberto Canegallo, STMicroelectronics FTM, Italy; and Alberto Fazzi, University of Bologna, Italy</i>	
ANALYSIS OF PACKAGING EFFECTS ON THE PERFORMANCE OF THE MICROFLOWN	14
<i>Joost van Honschoten, D. R. Yntema, M. Dijkstra, V. B. Svetovoy, R. J. Wiegerink and M. Elwenspoek, MESA+ Institute, University of Twente, Netherlands</i>	
ULTRA FINE PITCH FLAT PANEL DISPLAY PACKAGING USING 3 μ m CONDUCTIVE PARTICLES.....	20
<i>Gou-Jen Wang, National Chung-Hsing University, Taiwan; Yi-Chin Lin and Gwo-Sen Lin, Wintek Inc., Taiwan</i>	
PARASITIC EFFECTS REDUCTION FOR WAFER-LEVEL PACKAGING OF RF-MEMS.....	25
<i>Jacopo Iannacci, HiTeC-DIMES / ARCES-DEIS, Netherlands; Jason Tian, Saoer Sinaga, HiTeC-DIMES, Netherlands; Roberto Gaddi, Antonio Gnudi, ARCES-DEIS, Italy; and Marian Bartek, HiTeC-DIMES, Netherlands</i>	

Session 2: DESIGN, ANALYSIS AND FABRICATION OF MEMS COMPONENTS

3-D SELF ASSEMBLED SOI MEMS: AN EXAMPLE OF MULTIPHYSICS SIMULATION	31
<i>Carlos Mendez, C. Louis, S. Paquay, P. De Vincenzo, I. Klapka, Open Engineering, Belgium; V. Rochus, Université de Liège, Belgium; F. Iker, N. André and J.-P. Raskin, Université catholique de Louvain, Belgium</i>	
ANALYTIC MODEL FOR PERFORATED SQUEEZED-FILM DAMPERS	36
<i>Timo Veijola, Helsinki University of Technology, Finland</i>	
INFLUENCE OF THE FEEDBACK FILTER ON THE RESPONSE OF THE PULSED DIGITAL OSCILLATOR	42
<i>Manuel Dominguez, Joan Pons, Jordi Ricart, Technical University of Catalonia, Spain; Jerome Juillard and Eric Colinet, SUPELEC, France</i>	
DESIGN OF BOSSED SILICON MEMBRANES FOR HIGH SENSITIVITY MICROPHONE APPLICATIONS	47
<i>Paolo Martins, LPM, France; Sébastien Beclin, Sebastiano Brida, Sandrine Metivet, Olivier Stojanovic, Auxitrol, France; and Christophe Malhaire, LPM, France</i>	

Session 3: FABRICATION METHODS

CONCAVE MICROLENS ARRAY MOLD FABRICATION IN PHOTORESIST USING UV PROXIMITY PRINTING	52
<i>Tsung-Hung Lin, National Taiwan University of Science and Technology, Taiwan; Hsiharn Yang, National Chung Hsing University, Taiwan; and Ching-Kong Chao, National Taiwan University of Science and Technology, Taiwan</i>	
SURFACE CONDITIONING EFFECT ON VACUUM MICROELECTRONICS COMPONENTS FABRICATED BY DEEP REACTIVE ION ETCHING	58
<i>Alain Phommahaxay, Gaëlle Lissorgues, Lionel Rousseau, Tarik Bourouina, ESIEE Paris, France; and Pierre Nicole, Thales Systemes Aeroportes, France</i>	
EPITAXIAL PZT FILMS DEPOSITED BY PULSED LASER DEPOSITION FOR MEMS APPLICATION	63
<i>Zhanjie Wang, Hiroyuki Kokawa, Tohoku University, Japan; and Ryutaro Maeda, National Institute of Advanced Industrial Science and Technology (AIST), Japan</i>	
THE ANNEALING INDUCED EXTRAORDINARY PROPERTIES OF Si BASED ZnO FILM GROWN BY RF SPUTTERING	69
<i>Jing Li, MEMS Research Center of Xiamen Univ., China; Leilei Deng, Physics Dept. of Xiamen Univ., China; and Suntao Wu, MEMS Research Center of Xiamen Univ., China</i>	

Session 4: OPERATIONAL, YIELD AND RELIABILITY ANALYSIS OF MEMS

PARAMETRIC YIELD ANALYSIS OF MEMS VIA STATISTICAL METHODS	73
<i>Shyam Praveen Vudathu, Kishore Kumar Duganapalli, Rainer Laur, ITEM, University of Bremen, Germany; Dorota Kubalinska and Angelika Bunse-Gerstner, ZeTeM, University of Bremen, Germany</i>	
ELECTROMECHANICAL RELIABILITY TESTING OF THREE-AXIAL SILICON FORCE SENSORS	77
<i>Stefan Spinner, Julian Bartholomeyczik, Bernd Becker, Michael Doelle, Oliver Paul, Ilia Polian, U Freiburg, Germany; Roland Roth, Karl Seitz, Carl Zeiss, Oberkochen, Germany; and Patrick Ruther, U Freiburg, Germany</i>	
RESOLUTION LIMITS FOR RESONANT MEMS SENSORS BASED ON DISCRETE RELAY FEEDBACK TECHNIQUES	83
<i>Jerome Juillard, Eric Colinet, SUPELEC, France; Manuel Dominguez, Joan Pons and Jordi Ricart, UPC, Spain</i>	

Posters: INTRODUCTION SESSION I

PACKAGING OF RF MEMS SWITCHING FUNCTIONS ON ALUMINA SUBSTRATE	88
<i>Mohamad-Kazem El Khatib, Arnaud Pothier and Pierre Blondy, XLIM Research Institute, France</i>	
INFLUENCE OF MICRO-CANTILEVER GEOMETRY AND GAP ON PULL-IN VOLTAGE	92
<i>Waleed Faris, International Islamic University Malaysia, Malaysia; Hazem Mohammed, Nottingham University Malaysia, Malaysia; Mostafa Abdalla, Technical University of Delft, Netherlands; and C. H. Ling, Nottingham University Malaysia, Malaysia</i>	
DESIGN AND DEVELOPMENT OF NOVEL ELECTROPLATING SPRING FRAME MEMS STRUCTURE SPECIMENS FOR THE MICROTENSILE TESTING OF THIN FILM MATERIALS	99
<i>Ming-Tzer Lin, Chi-Jia Tong and Chung-Hsun Chiang, National Chung Hsing University, Taiwan</i>	
A NOVEL CONTACT RESISTANCE MODEL OF ANISOTROPIC CONDUCTIVE FILM FOR FPD PACKAGING	105
<i>Gou-Jen Wang, National Chung-Hsing University, Taiwan; Yi-Chin Lin and Gwo-Sen Lin, Wintek Inc., Taiwan</i>	

MICRO-BALL LENS ARRAY FABRICATION IN PHOTORESIST USING PTFE HYDROPHOBIC EFFECT . <i>Ruey Fang Shyu, National Formosa University, Taiwan; Hsiharng Yang, Wen-Ren Tsai, National Chung Hsing University, Taiwan; and Jhy-Cherng Tsai, National Chung Hsing Univeristy, Taiwan</i>	110
QUALITY FACTOR OF PZT THIN FILM TRANSDUCED MICRO CANTILEVERS <i>Jian Lu, Tsuyoshi Ikehara, Takeshi Kobayashi, Ryutaro Maeda, MEMS and Packaging Research Group, National Institute of Advanced Industrial Science and Technology (AIST), Japan; and Takashi Mihara, Future Creation Lab., Olympus Corporation, Japan</i>	116
A GENERIC SURFACE MICROMACHINING MODULE FOR MEMS HERMETIC PACKAGING AT TEMPERATURES BELOW 200 C <i>Raquel Hellin Rico, IMEC, Belgium; Jean Pierre Celis, MTM, Belgium; Kris Baert, Chris Van Hoof and Ann Witvrouw, IMEC, Belgium</i>	121
IMPACT OF THERMAL BEHAVIOR ON OFFSET IN A HIGH-Q GYROSCOPE <i>Fei Duan, Shanghai Institute of Microsystem & Information Tech., China; Jiwei Jiao and Yuelin Wang, SIMIT, China</i>	127
EFFECT OF SURFACE FINISH OF SUBSTRATE ON MECHANICAL RELIABILITY OF IN-48SN SOLDER JOINTS IN MOEMS PACKAGE <i>Ja-Myeong Koo and Seung-Boo Jung, Sungkyunkwan University, South Korea</i>	131
HIGH VISCOUS LIQUIDS AS A SOURCE IN MICRO-HEAT EXCHANGER: SIMULATION AND EXPERIMENTS <i>Haifa El-Sadi and Nabil Esmail, Concordia University, Canada</i>	137
 Posters: INTRODUCTION SESSION II	
THE DESIGN AND FABRICATION OF PLATFORM DEVICE FOR DNA AMPLIFICATION <i>Chien Chao-Heng and Yu Hui-Min, Tatung University, Taiwan</i>	138
IMPROVEMENT OF THE PHOTOVOLTAIC CURRENT FOR THE NON-BIAS OPTICAL SENSOR IN A LAYERED FILM STRUCTURE. <i>Masaaki Ichiki, Harumi Furue, Takeshi Kobayashi, Yasushi Morikawa, National Institute of Advanced Industrial Science and Technology, Japan; Takeshi Nakada, Tokyo Denki University, Jordan; Kazuhiro Nonaka and Ryutaro Maeda, National Institute of Advanced Industrial Science and Technology, Japan</i>	142
AU-SN FLIP-CHIP SOLDER BUMP FOR MICROELECTRONIC AND OPTOELECTRONIC APPLICATIONS <i>Jeong-Won Yoon, Hyun-Suk Chun, Ja-Myeong Koo and Seung-Boo Jung, Sungkyunkwan University, South Korea</i>	148
CONTACTLESS THERMAL CHARACTERIZATION METHOD OF PCB-S USING AN IR SENSOR ARRAY <i>Gyorgy Bognar, Vladimir Szekeley and Marta Rencz, Department of Electron Devices BUTE, Hungary</i>	154
AFM, SEM AND NANO/MICRO-INDENTATION STUDIES OF THE FIB-MILLED GLASSY CARBON SURFACE HEAT-TREATED AT DIFFERENT CONDITIONS <i>Sung Won Youn, M. Takahashi, H. Goto, T. Kobayashi and R. Maeda, National Institute of AIST, Japan</i>	159
ELECTRO HYDRODYNAMIC PUMPING OF LIQUIDS IN MICROCHANNELS <i>Nithin Narayanan, Sandeep Akkaraju, John Bloomsburgh and Lei Zhou, IntelliSense Corporation, China</i>	165
HIGH QUALITY FACTOR COPPER INDUCTORS INTEGRATED IN DEEP DRY ETCHED QUARTZ SUBSTRATES <i>Christine Leroy, Marcelo Bento Pisani, Cyrille Hibert, Didier Bouvet, Swiss Federal Institute of Technology (EPFL), Switzerland; Michel Puech, Alcatel Vacuum Technology, France; and Adrian Mihai Ionescu, Swiss Federal Institute of Technology (EPFL), Switzerland</i>	168

A MICRO TURBINE DEVICE WITH ENHANCED MICRO AIR-BEARINGS	173
<i>X.C. Shan, Singapore Institute of Manufacturing Technology, Singapore; Qide Zhang, DSI Institute, Singapore; Y. F. Sun, SIMTech, Singapore; and Ryutaro Maeda, AIST, Japan</i>	
MEMS TUNABLE CAPACITORS WITH FRAGMENTED ELECTRODES AND ROTATIONAL ELECTRO-THERMAL DRIVE	179
<i>Alexander Mehdaoui, Marcelo Bento Pisani, D. Tsamados, EPFL, Switzerland; Fabrice Casset, CEA-LETI, France; Pascal Ancey, STMicroelectronics, France; and Adrian Mihai Ionescu, EPFL, Switzerland</i>	
FABRICATION OF SILICON-ON-INSULATOR MEM RESONATORS WITH DEEP SUB-MICRON TRANSDUCTION GAPS	185
<i>Nicoleta Diana Badila, Swiss Federal Institute of Technology, Switzerland; Cyrille Hibert, Marco Mazza and Adrian Mihai Ionescu, Swiss Federal Institute of Technology, Switzerland</i>	
NEW INTERNAL STRESS DRIVEN ON-CHIP MICROMACHINES FOR EXTRACTING MECHANICAL PROPERTIES OF THIN FILMS	189
<i>Damien Fabrègue, Nicolas André, Thomas Pardoën and Jean Pierre Raskin, Université Catholique de Louvain, Belgium</i>	

Thursday, April 27th, 2006

Session 5: HOT EMBOSSING

PROCESS ISSUES FOR A MULTI-LAYER MICROELECTROFLUIDIC PLATFORM	195
<i>Sum Huag Ng, Z. F. Wang, R. T. Tjeung, Singapore Institute of Manufacturing Technology, Singapore; and N. F. de Rooij, University of Neuchatel, Switzerland</i>	
DESIGN AND FABRICATION OF A NOVEL LIGHT GUIDING PLATE FOR BACKLIGHT SYSTEM BY MEMS TECHNOLOGY	201
<i>Chien Chao-Heng and Chen Zhi Peng, Tatung University, Taiwan</i>	
FABRICATION OF SWITCHES ON POLYMER-BASED BY HOT EMBOSSING	206
<i>Chien Chao-Heng and Yu Hui-Min, Tatung University, Taiwan</i>	

Session 6: ELECTROSTATIC ACTUATION MODELS

A NEW MODEL OF FRINGING CAPACITANCE AND ITS APPLICATION TO THE CONTROL OF PARALLEL-PLATE ELECTROSTATIC MICRO ACTUATORS	211
<i>Mehran Hosseini, Guchuan Zhu and Yves-Alain Peter, Ecole Polytechnique de Montreal, Canada</i>	
MODEL OF ELECTROSTATIC ACTUATED DEFORMABLE MIRROR USING STRONGLY COUPLED ELECTRO-MECHANICAL FINITE ELEMENT	217
<i>Véronique Rochus, Université de Liège, Vibrations et Identification des structures, Belgium; Jean-Claude Golinval, Université de Liège, Vibrations et Identification des Structures, Belgium; Christophe Louis, Carlos Mendez and Igor Klapka, Open Engineering, Belgium</i>	
REDUCED-ORDER MODELLING OF THE BENDING OF AN ARRAY OF TORSIONAL MICROMIRRORS	223
<i>Antonio Molfese, IEIIT- Sezione di Pisa, Italy; Andrea Nannini and Francesco Pieri, Università di Pisa, Italy</i>	

Session 7: MICRO DEVICES I

HIGH CURRENT DENSITIES IN COPPER MICROCOILS: INFLUENCE OF SUBSTRATE ON FAILURE MODE	227
<i>Johan Moulin, Marion Woytasik, Jean-Paul Grandchamp, Elisabeth Dufour-Gergam and Alain Bosseboeuf, IEF, France</i>	
INTEGRATION OF MICRO-ELECTRO-MECHANICAL DEFORMABLE MIRRORS IN DOPED FIBER AMPLIFIERS	233
<i>David Bouyge, David Sabourdy, Aurelian Crunteanu, Pierre Blondy, Vincent Couderc, Jerome Lhermite, Ludovic Grossard and Alain Barthélemy, XLIM Research Institute, France</i>	
CHARACTERIZATION OF FLEXIBLE RF MICROCOIL DEDICATED TO SURFACE MRI	239
<i>Marion Woytasik, IEF / Université Paris XI, France; Jean-Christophe Ginefri, U2R2M Université Paris XI, France; Jean-Sébastien Raynaud, Guerbet Research, France; Marie Poirier-Quinot, U2R2M Université Paris, France; Elisabeth Dufour-Gergam, Jean-Paul Grandchamp, IEF Université Paris XI, France; Luc Darrasse, U2R2M Université Paris XI, France; Philippe Robert, Guerbet Research, France; Jean-Paul Gilles, Emile Martincic, IEF Université Paris XI, France; and Olivier Girard, U2R2M Université Paris sud, France</i>	

Session 8: MEMS IN BIOSYSTEMS

ELECTROSTATIC ACTUATORS OPERATING IN LIQUID ENVIRONMENT : SUPPRESSION OF PULL-IN INSTABILITY AND DYNAMIC RESPONSE	244
<i>Anne-Sophie Rollier, Marc Faucher, Bernard Legrand, Dominique Collard and Lionel Buchaillot, IEMN, France</i>	
MINIATURIZED FLUORESCENCE EXCITATION PLATFORM WITH OPTICAL FIBER FOR BIO-DETECTION CHIPS	250
<i>Hsiharng Yang and Chung-Tze Lee, National Chung Hsing University, Taiwan</i>	
DESIGN AND MODELING OF A MEMS-BASED VALVELESS PUMP DRIVEN BY AN ELECTROMAGNETIC FORCE	255
<i>Hsien-Tsung Chang, Chia-Yen Lee and Chih-Yung Wen, Da-Yeh University, Taiwan</i>	

Session 9: MICRO DEVICES II

AN ACTIVE CHAOTIC MICROMIXER INTEGRATING THERMAL ACTUATION ASSOCIATING PDMS AND SILICON MICROTECHNOLOGY	260
<i>Olivier Français, CNAM, France; Marie Caroline Jullien, ENS de Cachan, France; Lionel Rousseau, Patrick Poulichet, ESIEE, France; Serge Desportes, Assia Chouai, Jean Pierre Lefevre and Jacques Delaire, ENS de Cachan, France</i>	
A KU-BAND NOVEL MICROMACHINED BANDPASS FILTER WITH TWO TRANSMISSION ZEROS	266
<i>Zhang Yong, Zhu Jian, Yu Yuanwei, Chen Chen and Jia Shi Xing, Nanjing University, China</i>	
DEVELOPMENT OF SCANNING MEMS MIRROR WITH NEW ASSEMBLY STRUCTURE	270
<i>Z. F. Wang, Singapore Institute of Manufacturing Technology, Singapore; W. Noell, M. Zickar, N. de Rooij, University of Neuchatel, Switzerland; and S. P. Lim, National University of Singapore, Singapore</i>	
ELECTROSTATICALLY-DRIVEN RESONATOR ON SOI WITH IMPROVED TEMPERATURE STABILITY	274
<i>Archit Giridhar, Fabrice Verjus, Philips Semiconductors, France; Frédéric Marty, ESIEE / ESYCOM Lab, France; Alain Bosseboeuf, IEF UMR8622 CNRS, France; and Tarik Bourouina, ESIEE / ESYCOM Lab, France</i>	

Session 10: DESIGN AND ANALYSIS OF VIBRATION POWERED MICROGENERATORS

SCALING EFFECTS FOR ELECTROMAGNETIC VIBRATIONAL POWER GENERATORS	279
<i>T. O'Donnell, C. Saha, Tyndall National Institute, Ireland; S. P. Beeby and M. J. Tudor, University of Southampton, United Kingdom</i>	
MACRO AND MICRO SCALE ELECTROMAGNETIC KINETIC ENERGY HARVESTING GENERATORS .	286
<i>S. P. Beeby, M. J. Tudor, R. N. Torah, E. Koukharenko, Univ. of Southampton, United Kingdom; S. Roberts, Perpetuum Ltd, United Kingdom; T. O'Donnell and S. Roy, Tyndall National Institute, Ireland</i>	
VIBRATIONAL ENERGY SCAVENGING WITH SI TECHNOLOGY ELECTROMAGNETIC INERTIAL MICROGENERATORS	292
<i>C. Serre, A. Pérez-Rodríguez, N. Fondevilla, J.R. Morante, Univ. de Barcelona, Spain; J. Montserrat and J. Esteve, CNM-CSIC, Bellaterra, Spain</i>	
DESIGN AND FABRICATION OF A MICRO ELECTROSTATIC VIBRATION-TO-ELECTRICITY ENERGY CONVERTER	298
<i>Yi Chiu, Chiung-Ting Kuo and Yu-Shan Chu, National Chiao Tung Univ., Taiwan</i>	

Friday, April 28th, 2006

Invited talk 3: INDUSTRIAL WAFER LEVEL VACUUM ENCAPSULATION OF RESONATING MEMS DEVICES

INDUSTRIAL WAFER LEVEL VACUUM ENCAPSULATION OF RESONATING MEMS DEVICES	304
<i>Wolfgang Reinert, Fraunhofer Institute for Silicon Technology, Germany</i>	

Session 11: CHARACTERIZATION

CAPACITIVE TEST-STRUCTURES DESIGN METHODOLOGY FOR THE EXTRACTION OF AIR-GAP AND DIELECTRIC THICKNESS OF A MEMS PROCESS	305
<i>Marco Bellei, ARCES - Univ. of Bologna, Italy; Benno Margesin, ITC - irst, Italy; Roberto Gaddi, Antonio Gnudi, ARCES - Univ. of Bologna, Italy; and Flavio Giacomozzi, ITC - irst, Italy</i>	
MEASUREMENT TECHNIQUE FOR ELASTIC AND MECHANICAL PROPERTIES OF POLYCRYSTALLINE SILICON-GERMANIUM FILMS USING SURFACE ACOUSTIC WAVES AND PROJECTION MASKS	310
<i>Abdelali Bennis, Christina Leinenbach, Carsten Raudzis, Roland Müller-Fiedler and Silvia Kronmüller, Robert Bosch GmbH, Germany</i>	
THE EFFECTS OF ADDITIVES ON THE PHYSICAL PROPERTIES OF ELECTROFORMED NICKEL AND ON THE STRETCH OF PHOTOELECTROFORMED NICKEL COMPONENTS	316
<i>David Allen, Nicolas Duclos, Cranfield University, United Kingdom; Ian Garbutt, Tecan Ltd, United Kingdom; Monika Saumer, Ch. Dhum, M. Schmitt and J. E. Hoffmann, University of Applied Sciences Kaiserslautern, Germany</i>	
CHARACTERISATION OF THE ETCHING QUALITY IN MICRO-ELECTRO-MECHANICAL SYSTEMS BY THERMAL TRANSIENT METHODOLOGY	322
<i>Peter Szabo, Balazs Nemeth, BUTE, Hungary; Marta Rencz, BUTE, MicReD, Hungary; and Bernard Courtois, TIMA Lab - CMP, France</i>	

Session 12: INTEGRATION OF MICRO POWER GENERATORS

MOTION-BASED GENERATORS FOR INDUSTRIAL APPLICATIONS	328
<i>T. Sterken, P. Fiorini and R. Puer, IMEC, Leuven, Belgium</i>	
POWER PROCESSING CIRCUITS FOR MEMS INERTIAL ENERGY SCAVENGERS	332
<i>P.D. Mitcheson, T.C. Green and E.M. Yeatman, Imperial College London, United Kingdom</i>	
OPTIMIZATION OF PIEZOELECTRIC ELECTRICAL GENERATORS POWERED BY RANDOM VIBRATIONS	338
<i>Elie Lefevre, Adrien Badel, Claude Richard, Lionel Petit and Daniel Guyomar, LGEF-INSA, Lyon, France</i>	
NON LINEAR TECHNIQUES FOR INCREASING HARVESTING ENERGY FROM PIEZOELECTRIC AND ELECTROMAGNETIC MICRO-POWER-GENERATORS	344
<i>Yasser Ammar and Skandar Basrour, TIMA Labs, Grenoble, France</i>	
THERMOELECTRIC AND MICROBATTERY HYBRID SYSTEM WITH ITS POWER MANAGEMENT	349
<i>R. Salot, S. Bancel, S. Martin, G. Salvelli, C. Salvi and Marc Plissonnier, CEA-Grenoble, France</i>	

Session 13: MINIATURIZED POWER GENERATORS

RECENT DEVELOPMENTS IN MEMS-BASED MICRO FUEL CELLS	354
<i>Tristan Pichonat, FEMTO-ST/LPMO, Besançon, France; and Bernard Gauthier-Manuel, FEMTO-ST/LPMO, Besançon, France</i>	
APPLICATION OF MEMS TECHNOLOGY TO MICRO DIRECT METHANOL FUEL CELL	360
<i>Xiaowei Liu, Chunguang Suo, Yufeng Zhang, Haifeng Zhang, Weiping Chen and Xuebin Lu, Harbin Institute of Technology, China</i>	
ABOVE IC MICRO-POWER GENERATORS FOR RF-MEMS	365
<i>S. Oukassi, STMicroelectronics/CEA/LESCO, France; X. Gagnard, STMicroelectronics, France; R. Salot, S. Bancel, CEA-Grenoble, France; and J. P. Pereira-Ramos, LECOS/CNRS, France</i>	
ENERGY CONVERSION USING NEW THERMOELECTRIC GENERATOR	369
<i>Guillaume Savelli, Marc Plissonnier, Jacqueline Bablet, C. Salvi and J.M. Fournier, CEA-Grenoble, France</i>	
A SILICON-BASED MICRO GAS TURBINE ENGINE FOR POWER GENERATION	375
<i>X.C. Shan, Z. F. Wang, Singapore Inst. of Manufacturing Technology, Singapore; Ryutaro Maeda, MEMS & Packaging Research Lab, Japan; Y. F. Sun, Singapore Inst. of Manufacturing Technology, Singapore; M. Wu and J. S. Hua, Institute of High Performance Computing, Singapore</i>	

LATE MANUSCRIPT

CHARACTERIZATION OF FRICTION DURING THE DEMOLDING OF MICROSTRUCTURES MOLDED BY HOT EMBOSSING	380
<i>Matthias Worgull, Forschungszentrum Karlsruhe, Germany; J.-F. Héту, K. K. Kabanemi, National Research Council of Canada, Canada; and Mathias Hecke, Forschungszentrum Karlsruhe, Germany</i>	
Author Index	389

Authors Index

Abdalla, Mostafa	92	Duan, Fei	127
Akkaraju, Sandeep	165	Duclos, Nicolas	316
Allen, David	316	Dufour-Gergam, Elisabeth	227, 239
Ammar, Yasser	344	Duganapalli, Kishore Kumar	73
Ancey, Pascal	179	El Khatib, Mohamad-Kazem	88
André, N.	31	El-Sadi, Haifa	137
André, Nicolas	189	Elwenspoek, M.	14
Bablot, Jacqueline	369	Esmail, Nabil	137
Badel, Adrien	338	Esteve, J.	292
Badila, Nicoleta Diana	185	Fabrègue, Damien	189
Baert, Kris	121	Faris, Waleed	92
Bancel, S.	349, 365	Faucher, Marc	244
Bartek, Marian	25	Fazzi, Alberto	9
Barthélemy, Alain	233	Fiorini, P.	328
Bartholomeyczik, Julian	77	Fondevilla, N.	292
Basrour, Skandar	344	Fournier, J.M.	369
Becker, Bernd	77	Français, Olivier	260
Beclin, Sébastien	47	Furue, Harumi	142
Beeby, S. P.	279, 286	Gaddi, Roberto	25, 305
Bellei, Marco	305	Gagnard, X.	365
Bennis, Abdelali	310	Garbutt, Ian	316
Blondy, Pierre	88, 233	Garcia, Ernest J.	1
Bloomsburgh, John	165	Gauthier-Manuel, Bernard	354
Bognar, Gyorgy	154	Giacomozzi, Flavio	305
Bosseboeuf, Alain	227, 274	Gilles, Jean-Paul	239
Bourouina, Tarik	58, 274	Ginefri, Jean-Christophe	239
Bouvet, Didier	168	Girard, Olivier	239
Bouyge, David	233	Giridhar, Archit	274
Brida, Sebastiano	47	Gnudi, Antonio	25, 305
Buchaillot, Lionel	244	Golinval, Jean-Claude	217
Bunse-Gerstner, Angelika	73	Goto, H.	159
Canegallo, Roberto	9	Grandchamp, Jean-Paul	227, 239
Casset, Fabrice	179	Green, T.C.	332
Celis, Jean Pierre	121	Grossard, Ludovic	233
Chang, Hsien-Tsung	255	Guerrieri, Roberto	9
Chao, Ching-Kong	52	Guyomar, Daniel	338
Chao-Heng, Chien	138, 201, 206	Heckele, Mathias	380
Chen, Chen	266	Hellin Rico, Raquel	121
Chen, Weiping	360	Hétu, J.-F.	380
Chiang, Chung-Hsun	99	Hibert, Cyrille	168, 185
Chiu, Yi	298	Hoffmann, J. E.	316
Chouai, Assia	260	Hosseini, Mehran	211
Chu, Yu-Shan	298	Hua, J. S.	375
Chun, Hyun-Suk	148	Huag Ng, Sum	195
Colinet, Eric	42, 83	Hui-Min, Yu	138, 206
Collard, Dominique	244	Iannacci, Jacopo	25
Couderc, Vincent	233	Ichiki, Masaaki	142
Courtois, Bernard	322	Ikehara, Tsuyoshi	116
Crunteanu, Aurelian	233	Iker, F.	31
Darrasse, Luc	239	Ionescu, Adrian Mihai	168, 179, 185
De Rooij, N.	195, 270	Jian, Zhu	266
De Vincenzo, P.	31	Jiao, Jiwei	127
Delaire, Jacques	260	Juillard, Jerome	42, 83
Deng, Leilei	69	Jullien, Marie Caroline	260
Desportes, Serge	260	Jung, Erik	9
Dhum, Ch.	316	Jung, Seung-Boo	131, 148
Dijkstra, M.	14	Kabanemi, K. K.	380
Doelle, Michael	77	Karam, Jean Michel	8
Dominguez, Manuel	42, 83	Kaschlun, Karin	9

Klapka, I.	31, 217	Paquay, S.	31
Kobayashi, T.	116, 142, 159	Pardoen, Thomas	189
Kokawa, Hiroyuki	63	Paul, Oliver	77
Koo, Ja-Myeong	131, 148	Pereira-Ramos, J. P.	365
Koukharenko, E.	286	Pérez-Rodriguez, A.	292
Kronmüller, Silvia	310	Peter, Yves-Alain	211
Kubalinska, Dorota	73	Petit, Lionel	338
Kuo, Chiung-Ting	298	Phommahaxay, Alain	58
Laur, Rainer	73	Pichonat, Tristan	354
Lee, Chia-Yen	255	Pieri, Francesco	223
Lee, Chung-Tze	250	Pisani, Marcelo Bento	168, 179
Lefevre, Elie	338	Plissonnier, Marc	349, 369
Lefevre, Jean Pierre	260	Poirier-Quinot, Marie	239
Legrand, Bernard	244	Polian, Ilia	77
Leinenbach, Christina	310	Polosky, Marc A.	1
Leroy, Christine	168	Pons, Joan	42, 83
Lhermite, Jerome	233	Pothier, Arnaud	88
Li, Jing	69	Poulichet, Patrick	260
Lim, S. P.	270	Puech, Michel	168
Lin, Gwo-Sen	20, 105	Puer, R.	328
Lin, Ming-Tzer	99	Raskin, J. P.	31, 189
Lin, Tsung-Hung	52	Raudzis, Carsten	310
Lin, Yi-Chin	20, 105	Raynaud, Jean-Sébastien	239
Ling, C. H.	92	Reinert, Wolfgang	304
Lissorgues, Gaëlle	58	Rencz, Marta	154, 322
Liu, Xiaowei	360	Ricart, Jordi	42, 83
Louis, C.	31, 217	Richard, Claude	338
Lu, Jian	116	Robert, Philippe	239
Lu, Xuebin	360	Roberts, S.	286
Maeda, R.	63, 116, 142, 159, 173, 375	Rochus, V.	31, 217
Magagni, Luca	9		
Malhaire, Christophe	47	Rollier, Anne-Sophie	244
Margesin, Benno	305	Roth, Roland	77
Martin, S.	349	Rousseau, Lionel	58, 260
Martincic, Emile	239	Roy, S.	286
Martins, Paolo	47	Ruther, Patrick	77
Marty, Frédéric	274	Sabourdy, David	233
Mazza, Marco	185	Saha, C.	279
Mehdaoui, Alexander	179	Salot, R.	349, 365
Mendez, Carlos	31, 217	Salvelli, G.	349
Metivet, Sandrine	47	Salvi, C.	349, 369
Mihara, Takashi	116	Saumer, Monika	316
Mitcheson, P.D.	332	Savelli, Guillaume	369
Mohammed, Hazem	92	Schmitt, M.	316
Molfese, Antonio	223	Schmitz, Stefan	9
Montserrat, J.	292	Seitz, Karl	77
Morante, J.R.	292	Serre, C.	292
Morikawa, Yasushi	142	Shan, X.C.	173, 375
Moulin, Johan	227	Shyu, Ruey Fang	110
Müller-Fiedler, Roland	310	Sinaga, Saoer	25
Nakada, Takeshi	142	Spinner, Stefan	77
Nannini, Andrea	223	Sterken, T.	328
Narayanan, Nithin	165	Stojanovic, Olivier	47
Nemeth, Balazs	322	Sun, Y. F.	173, 375
Nicole, Pierre	58	Suo, Chunguang	360
Noell, W.	270	Svetovoy, V. B.	14
Nonaka, Kazuhiro	142	Szabo, Peter	322
Oukassi, S.	365	Szekely, Vladimir	154
O'Donnell, T.	279, 286	Takahashi, M.	159
		Tian, Jason	25

Tjeung, R. T.	195
Tong, Chi-Jia	99
Torah, R. N.	286
Tsai, Jhy-Cherng	110
Tsai, Wen-Ren	110
Tsamados, D.	179
Tudor, M. J.	279, 286
Van Honschoten, Joost	14
Van Hoof, Chris	121
Veijola, Timo	36
Verjus, Fabrice	274
Vudathu, Shyam Praveen	73
Wang, Gou-Jen	20, 105
Wang, Yuelin	127
Wang, Z. F.	195, 270, 375
Wang, Zhanjie	63
Wen, Chih-Yung	255
Wiegerink, R. J.	14
Witvrouw, Ann	121
Worgull, Matthias	380
Woytasik, Marion	227, 239
Wu, M.	375
Wu, Suntao	69
Xing, Jia Shi	266
Yang, Hsiharn	52, 110, 250
Yeatman, E.M.	332
Yntema, D. R.	14
Yong, Zhang	266
Yoon, Jeong-Won	148
Youn, Sung Won	159
Yuanwei, Yu	266
Zhang, Haifeng	360
Zhang, Qide	173
Zhang, Yufeng	360
Zhi Peng, Chen	201
Zhou, Lei	165
Zhū, Guchuan	211
Zickar, M.	270