

Tuesday, December 1, 2009

17:00 - **Registration at the Hilton Hotel – Assembly Room, Lobby Level**

19:00

17:00 - **Happy Hour Welcome Reception at McGinty’s Public House**

19:00

Wednesday, December 2, 2009

08:00 **Welcome and Introduction**

Reza Ghodssi, *University of Maryland, USA*

Carol Livermore, *Massachusetts Institute of Technology, USA*

David Arnold, *University of Florida, USA*

08:25 **Welcome from the Dean**

Dean Darryll Pines, *A. James Clark School of Engineering, University of Maryland, USA*

08:30 **Best Student Paper Award Presentation**

08:40 **Invited Presentation I**

Chair: C. Hebling, *Fraunhofer Institute for Solar Energy Systems (ISE), GERMANY*

**I-1 NEXT GENERATION MICRO-FUEL CELLS:
FUEL STORAGE, CONTROL, AND POWER GENERATION 1**

M.A. Shannon

University of Illinois, Urbana-Champaign, USA

Session O1A Fuel Cells Session Chairs: Y.-H. Cho, <i>Korea Advanced Institute of Science and Technology (KAIST), KOREA</i> P. Woias, <i>University of Freiburg - IMTEK, GERMANY</i>	Session O1B Energy Harvester Circuit Issues Session Chairs: F. Goldschmidtboeing, <i>University of Freiburg - IMTEK, GERMANY</i> E. Yeatman, <i>Imperial College London, UK</i>
Silver Theatre 1	Silver Theatre 2
09:25 - 09:45	
O1A-1 DEVELOPMENT AND CHARACTERIZATION OF A NOVEL AIR BREATHING MICRO DIRECT METHANOL FUEL CELL STACK 5 X. Liu, B. Zhang, Y. Zhang, J. Li, and Z. Yuan <i>Harbin Institute of Technology, CHINA</i>	O1B-1 CHARACTERIZATION OF A HYBRID AMBIENT LOW FREQUENCY, LOW INTENSITY VIBRATION ENERGY SCAVENGER SYSTEM 17 M. Khbeis, J. McGee, and R. Ghodssi <i>University of Maryland, USA</i>
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O1A-2 A FULLY-ENCLOSED MICRO PEM FUEL CELL WITH SELF-REGULATED FUEL DELIVERY AND SHUT-DOWN 9 N. Kroodsma ¹ , L. Zhu ² , J. Yeom ³ , M.A. Shannon ³ , and D.D. Meng ¹ ¹ <i>Michigan Technological University, USA,</i> ² <i>Indiana University-Purdue University, USA, and</i> ³ <i>University of Illinois, USA</i>	O1B-2 A MAGNETOELECTRIC ENERGY HARVESTER AND MANAGEMENT CIRCUIT 21 P. Li, Y. Wen, C. Jia, and X. Li <i>Chongqing University, CHINA</i>
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O1A-3 MINIATURE FUEL CELL WITH MONOLITHICALLY FABRICATED SI ELECTRODES - ADHESION BETWEEN ELECTRODES AND PEM 13 M. Hayase, K. Horikoshi, T. Fujii, and Y. Tajima <i>Tokyo University of Science, JAPAN</i>	O1B-3 A BRIDGE VOLTAGE DOUBLER AC/DC CONVERTER FOR LOW-VOLTAGE ENERGY HARVESTING APPLICATIONS 25 S. Cheng, Y. Jin, Y. Rao, and D.P. Arnold <i>University of Florida, USA</i>

* To assist you with finding the paper in the Technical Digest, we have provided the page number following each paper title.

Session O2A Reactors Session Chairs: S. Kwon, <i>Korea Advanced Institute of Science and Technology (KAIST), KOREA</i> M.A. Shannon, <i>University of Illinois, Urbana-Champaign, USA</i>	Session O2B Energy Harvester Systems Session Chairs: D. Arnold, <i>University of Florida, USA</i> J.W. Kwon, <i>University of Missouri, USA</i>
Silver Theatre 1	Silver Theatre 2
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O2A-1 FABRICATION AND EVALUATION OF A NABH₄ HYDROGEN MICROREACTOR ASSEMBLED BY TRIPLE STACK GLASS BONDING 29 K. Hoepfner ^{1,2} , R. Hahn ³ , H. Reichl ^{1,3} , M. Esashi ² , and S. Tanaka ² ¹ <i>Berlin University of Technology, JAPAN, and</i> ² <i>Tohoku University, JAPAN, and</i> ³ <i>Fraunhofer Institute for Reliability and Microintegration (IZM), GERMANY</i>	O2B-1 A PIEZOELECTRIC HARVESTER WITH AN INTEGRATED FREQUENCY-TUNING MECHANISM 45 C. Eichhorn, F. Goldschmidtboeing, Y. Porro, and P. Woias <i>University of Freiburg – IMTEK, GERMANY</i>
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12:05 **Lunch** (on own)

13:35 **Invited Presentation II**
 Chair: L. Frechette, *University of Sherbrooke, CANADA*

I-2 FUNDAMENTALS OF THIN FILM PIEZOELECTRIC MATERIALS AND PROCESSING DESIGN FOR A BETTER ENERGY HARVESTING MEMS 61
K. Wasa, I. Kanno, and H. Kotera
Kyoto University, JAPAN

Session O3A Piezoelectric Energy Harvestors Session Chairs: M. Hopcroft, <i>University of California, Berkeley, USA</i> R. Richards, <i>Washington State University, USA</i>	Session O3B Bearing Technologies Session Chairs: M. McCarthy, <i>Massachusetts Institute of Technology, USA</i> J. Peirs, <i>Katholieke Universiteit Leuven, BELGIUM</i>
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O3A-1 VACUUM PACKAGED MEMS PIEZOELECTRIC VIBRATION ENERGY HARVESTERS 67 R. Elfrink, M. Renaud, T.M. Kamel, C. de Nooijer, M. Jambunathan, M. Goedbloed, D. Hohlfeld, S. Matova, and R. van Schaijk <i>IMEC, THE NETHERLANDS</i>	O3B-1 ULTRA-HIGH-SPEED TAPE-TYPE RADIAL FOIL BEARING FOR MICRO TURBOMACHINERY 79 K. Hikichi ¹ , S. Togo ² , K. Isomura ³ , N. Saji ³ , M. Esashi ¹ , and S. Tanaka ¹ ¹ <i>Tohoku University, JAPAN,</i> ² <i>Tohoku-Gakuin University, JAPAN, and</i> ³ <i>IHI Corporation, JAPAN</i>
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15:00 - 15:20	
O3A-3 INCREASED POWER OUTPUT FROM PIEZOELECTRIC ENERGY HARVESTERS BY PRE-BIASING 75 J. Dicken, P.D. Mitcheson, I. Stoianov, and E.M. Yeatman <i>Imperial College London, UK</i>	O3B-3 CONTACTLESS MAGNETIC MICRO-BEARING BASED ON 3D SOLENOIDAL MICRO-COILS FOR ADVANCED POWERMEMS COMPONENTS 87 V. Badilita, M. Pauls, K. Kratt, and U. Wallrabe <i>University of Freiburg - IMTEK, GERMANY</i>

15:30 - **Poster Session** (See page 8 for listing of Contributed Posters)
 18:00

20:15 - **PowerMEMS at the Movies** - Fantastic Voyage
 21:55

Thursday, December 3, 2009

08:15 **Workshop Announcements**

08:20 **Invited Presentation III**

Chair: C. Livermore, *Massachusetts Institute of Technology, USA*

**I-3 ENGINEERING ORGANISMS AS BUILDING BLOCK MATERIALS
FOR ENERGY AND ELECTRONICS 91**

A. Belcher

Massachusetts Institute of Technology, USA

Session O4A Heat Engines and Micro Combustion Session Chairs: C. Cadou, <i>University of Maryland, USA</i> R. Peterson, <i>Oregon State University, USA</i>	Session O4B Fuel Cell Membranes/Thermal Management Session Chairs: M. Hayase, <i>Tokyo University of Science, JAPAN</i> N. Mueller, <i>Michigan State University, USA</i>
Silver Theatre 1	Silver Theatre 2
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<p style="text-align: center;">O4A-1</p> <p>EXPERIMENTAL VERIFICATION OF COMPRESSOR PERFORMANCE FOR AN ULTRA-MICROGASTURBINE 92</p> <p>J. Peirs¹, T. Waumans¹, K. Liu¹, E. Ferraris¹, T. Verstraete², R. Van den Braembussche², and D. Reynaerts¹</p> <p>¹<i>Katholieke Universiteit Leuven, BELGIUM</i> and ²<i>von Karman Institute for Fluid Dynamics, BELGIUM</i></p>	<p style="text-align: center;">O4B-1</p> <p>NOVEL NANOTUBE BUCKYPAPER AS ELECTRODE MATERIAL FOR FUEL CELL APPLICATIONS 112</p> <p>L. Hussein¹, K. Jensen², S. Alia², C. Contreras², Y. Yan², G. Urban¹, and M. Krüger¹</p> <p>¹<i>University of Freiburg, GERMANY</i> and ²<i>University of California, Riverside, USA</i></p>
09:25 - 09:45	
<p style="text-align: center;">O4A-2</p> <p>DESIGN AND ANALYSIS OF A NOVEL MEMS-HEAT ENGINE FOR POWER GENERATION 96</p> <p>T. Huesgen and P. Woias</p> <p><i>University of Freiburg – IMTEK, GERMANY</i></p>	<p style="text-align: center;">O4B-2</p> <p>NANOSTRUCTURED SILICON-BASED PROTON EXCHANGE MEMBRANE FOR MICRO FUEL CELLS 116</p> <p>S. Moghaddam, E. Pengwang, R.I. Masel, and M.A. Shannon</p> <p><i>University of Illinois, Urbana-Champaign, USA</i></p>
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<p style="text-align: center;">O4A-3</p> <p>MULTIPLYED ELECTROSPRAY SCALING FOR LIQUID FUEL INJECTION 100</p> <p>C.M. Waits, D. Behrens, and I. Lee</p> <p><i>US Army Research Laboratory, USA</i></p>	<p style="text-align: center;">O4B-3</p> <p>A CAPILLARY-PUMPED LOOP HEAT PIPE WITH MULTI-LAYER MICRO-STRUCTURED WICKS 119</p> <p>H.A. Kariya, C. Koveal, J. Allison, M. Kelley, M. McCarthy, J.G. Brisson, and E.N. Wang</p> <p><i>Massachusetts Institute of Technology, USA</i></p>
10:05 - 10:25	
<p style="text-align: center;">O4A-4</p> <p>A STUDY OF THE INFLUENCE OF A SWIRLED INJECTION ON MICRO-SCALE NON-PREMIXED COMBUSTION 104</p> <p>F.X. Nicoul, S. Bouvet, and J. Guidez</p> <p><i>ONERA, FRANCE</i></p>	<p style="text-align: center;">O4B-4</p> <p>FABRICATION AND CHARACTERIZATION OF SUPERHYDROPHILIC CU MICRO-POSTS FOR MICRO HEAT PIPES 123</p> <p>Y. Nam and Y.S. Ju</p> <p><i>University of California, Los Angeles, USA</i></p>
10:25 - 10:45	
<p style="text-align: center;">O4A-5</p> <p>PYROMEMS IGNITER BASED ON A TEMPERATURE GRADIENT: CONCEPT, FABRICATION AND CHARACTERIZATION 108</p> <p>D.A. de Koninck¹, U. Bley², V. Gass³, D. Briand¹, and N.F. de Rooij¹</p> <p>¹<i>Ecole Polytechnique Fédérale de Lausanne (EPFL), SWITZERLAND,</i> ²<i>RUAG Ammotec GmbH, SWITZERLAND,</i> and ³<i>RUAG Aerospace, SWITZERLAND</i></p>	<p style="text-align: center;">O4B-5</p> <p>A SILICON-BASED GALINSTAN MAGNETOHYDRODYNAMIC PUMP 127</p> <p>W. Irshad and D. Peroulis</p> <p><i>Purdue University, USA</i></p>

10:45	Break	
11:05	Workshop Announcements	
11:10	Plenary Invited Presentation Introduction Chair: N. Kasagi, <i>University of Tokyo, JAPAN</i>	
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12:00	Lunch & Guided Tour <i>Energy Research Center and Maryland NanoCenter at the University of Maryland</i>	
14:30 - 22:00	Banquet at Mount Vernon	

Friday, December 4, 2009

08:15 **Workshop Announcements**

08:20 **Invited Presentation IV**

Chair: M. Allen, *Georgia Institute of Technology, USA*

I-4 **FROM NANOTUBES TO HETEROGENEOUS NANOWIRES:
FAST ELECTROCHEMISTRY FOR HIGH POWER AND
HIGH ENERGY STORAGE DEVICES 131**

S.B. Lee

University of Maryland, USA and Korea Advanced Institute of Science and Technology (KAIST), KOREA

<p>Session O5A Energy Storage Session Chairs: B. Morgan, <i>U.S. Army Research Laboratory, USA</i> L. Zhu, <i>Indiana University Purdue University, USA</i></p>	<p>Session O5B Thermal Systems Session Chairs: Y. Suzuki, <i>University of Tokyo, JAPAN</i> C.M. Waits, <i>U.S. Army Research Laboratory, USA</i></p>
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09:05 - 09:25	
<p style="text-align: center;">O5A-1</p> <p>ELECTROSTATIC NANO-SUPERCAPACITORS FOR ENERGY STORAGE 133 L.C. Haspert, P. Banerjee, I. Perez, S.B. Lee, and G.W. Rubloff <i>University of Maryland, USA and Korea Advanced Institute of Science and Technology (KAIST), KOREA</i></p>	<p style="text-align: center;">O5B-1</p> <p>THERMIONIC EMISSION FROM MICROFABRICATED SILICON-CARBIDE FILAMENTS 149 J.-H. Lee¹, I. Bargatin¹, J. Provine¹, W.A. Clay¹, J.W. Schwede¹, F. Liu², R. Maboudian², N.A. Melosh¹, Z.-X. Shen¹, and R.T. Howe¹ ¹<i>Stanford University, USA and</i> ²<i>University of California, Berkeley, USA</i></p>
09:25 - 09:45	
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<p style="text-align: center;">O5A-3</p> <p>DIRECT WRITE DISPENSER PRINTING OF ZINC MICROBATTERIES 141 C.C. Ho, J.W. Evans, and P.K. Wright <i>University of California, Berkeley, USA</i></p>	<p style="text-align: center;">O5B-3</p> <p>MICROMACHINED THERMOELECTRIC ENERGY HARVESTER FABRICATION ON 6-INCH WAFER AND CHARACTERIZATION 157 J. Su¹, M. Goedbloed¹, Y. van Andel¹, V. Leonov², Z. Wang^{2,3}, and R.J.M. Vullers¹ ¹<i>IMEC, THE NETHERLANDS;</i> ²<i>IMEC, BELGIUM,</i> ³<i>Katholieke Universiteit Leuven, BELGIUM</i></p>
10:05 - 10:25	
<p style="text-align: center;">O5A-4</p> <p>TOBACCO MOSAIC VIRUS-SUPPORTED SILICON ANODE FOR LITHIUM-ION BATTERIES 145 X. Chen, K. Gerasopoulos, J. Guo, R. Ghodssi, J.N. Culver, and C. Wang <i>University of Maryland, USA</i></p>	<p style="text-align: center;">O5B-4</p> <p>EMISSION SPECTRAL CONTROL USING METAL-COATED SILICON MICROCAVITY FOR THERMOPHOTOVOLTAIC 161 D. Kirikae, Y. Suzuki, and N. Kasagi <i>University of Tokyo, JAPAN</i></p>

10:25 **Break**

Session O6A Capacitive and Electret Energy Harvesters Session Chairs: P. Mitcheson, <i>Imperial College London, UK</i> A. Seshia, <i>University of Cambridge, UK</i>	Session O6B Mechanical Energy Storage/ Nuclear Energy Sources Session Chairs: S. Beeby, <i>University of Southampton, UK</i> C. Rossi, <i>LAAS-CNRS, FRANCE</i>
Silver Theatre 1	Silver Theatre 2
10:45 - 11:05	
O6A-1 A MICRO CAPACITIVE VIBRATION ENERGY HARVESTER FOR LOW POWER ELECTRONICS 165 H. Kloub ¹ , D. Hoffmann ² , B. Folkmer ² , and Y. Manoli ^{1,2} <i>¹University of Freiburg – IMTEK, GERMANY and ²Institute for Micromachining and Information Technology (HSG-IMT), GERMANY</i>	O6B-1 HIGH POWER MICROMECHANICAL THRUSTERS WITH EMBEDDED ELASTOMER 181 A.P. Gerratt, I. Penskiy, and S. Bergbreiter <i>University of Maryland, USA</i>
11:05 - 11:25	
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12:05 **Conference Adjourns**

Poster Session

Energy Scavenging for Remote Sensors and Microsystems

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Université de Toulouse, FRANCE
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University of Southampton, UK
- P-003 A WIRELESS RF AND DC INTERFACE FOR A MEMS-BASED IDENTIFICATION SYSTEM** 205
 J.D. Cross¹, J.L. Schneider¹, G.A. Leiby², S. McCarter², J. Smith², and T.P. Budka²
¹*Cerberex Technologies, Inc. (dba Veratag), USA* and ²*RF Diagnostics, LLC, USA*
- P-004 AN ENERGY-AUTONOMOUS WIRELESS TEMPERATURE MONITORING SYSTEM POWERED BY PIEZOELECTRIC ENERGY HARVESTING** 209
 P. Woias, M. Wischke, C. Eichhorn, and B. Fuchs
University of Freiburg – IMTEK, GERMANY
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¹*University of South Florida, USA* and ²*Polytechnic University of Turin, ITALY*
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 D. Maurath¹ and Y. Manoli^{1,2}
¹*University of Freiburg – IMTEK, GERMANY* and
²*Institute for Micromachining and Information Technology (HSG-IMIT), GERMANY*
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¹*Korea Institute of Machinery and Materials, KOREA* and
²*Korea Advanced Institute of Science and Technology (KAIST), KOREA*
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¹*University of Barcelona, SPAIN*, ²*Catalonia Institute for Energy Research, SPAIN*, and
³*Microelectronics Institute of Barcelona, SPAIN*
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Université de Savoie, FRANCE

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	E. Romero ^{1,2} , M.R. Neuman ² , and R.O. Warrington ^{2,3} ¹ <i>University of Turabo, USA</i> , ² <i>Michigan Technological University, USA</i> , and ³ <i>University of Michigan, USA</i>	
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