

Hilton Head 2006

A Solid-State Sensors, Actuators, and Microsystems Workshop

FINAL PROGRAM

June 4 - 8, 2006
Hilton Head Island, South Carolina

Sponsored by



Educational Grants provided by
Defense Advanced Research Projects Agency - MTO/MEMS
The Transducer Research Foundation, Inc.

GENERAL INFORMATION

Information/Message Board

The Information/Message Board will be located near the Registration Desk. Messages will be posted in this area throughout the Workshop.

Meeting Room Logistics

Please contact the Workshop Registration Desk if you find the temperature in the room uncomfortable or you are unable to hear or see because of equipment difficulties.

Evaluation

There is a Workshop evaluation form in your packet. Your feedback is very important to the improvement and development of this Workshop. Please return the completed form to the Workshop Registration Desk.

Technical Digest and CD-ROM

An extended abstract of each paper presented at the Workshop has been published in a Technical Digest and on a CD-ROM. One copy of the Digest and the CD-ROM is included with your material. Additional copies may be purchased at the Workshop Registration Desk. Purchase price of the Technical Digest will increase after the Workshop. Be sure to order your additional copies in advance.

You will also find a printed collection of the MEMS Educational Posters with your material and on the CD. The printing of this booklet was supported by the National Science Foundation and National Aeronautics and Space Administration Goddard Space Flight Center.

Additional Technical Digests

Additional Technical Digests may be purchased at the Workshop Registration Desk for \$105.00 (\$140.00 plus shipping and handling after the Workshop). To take advantage of the Workshop price and to avoid shipping and handling fees, please purchase additional copies during the Workshop.

Smoking

All meeting rooms and seated functions are smoke free. Please regard the smoking policy of the Crowne Plaza Resort and use designated smoking areas only.

Job Market Board

Please visit the Job Market Board located in the lobby near the Workshop Registration Desk to see current job opportunities or to place your resume on the board.

Cellular Phones, Beepers, Watch Alarms, Cameras and Tape Recorders

Out of courtesy to our speakers and other attendees, please turn off any cellular phones, pagers and watch alarms during sessions. Cameras and tape recorders are strictly prohibited in the plenary and poster sessions.

Shipping Service

If you need to ship or mail any packages, please visit the Business Center located across from the Workshop Registration Desk. Shipping is to be at attendees' own expense. The Business Center is open 24 hours a day.

High Speed Internet Connection

All sleeping rooms at the Crowne Plaza are equipped with a wired Internet connection (\$9.95 plus tax for 24 hours). The public space of the hotel is equipped with wireless Internet (\$9.95 plus tax for 24 hours) and you will need to visit the Hotel front desk to receive a password. You may purchase a package (wired in room and wireless in the public space) for \$14.95 plus tax. Please inform the front desk of this request.

You may connect your laptop at the Business Center for no charge for the first 15 minutes of connectivity, but there will be a charge of \$8.00 plus tax for each additional 15 minutes.

MEMS EDUCATION ROUNDTABLE DISCUSSION

Please join us at the reserved tables during Monday's lunch to discuss a detailed acceptance criteria that might be used for selecting MEMS education abstracts at future Hilton Head meetings. The goal of this discussion would be to define a process for drafting a set of recommendation to the next Hilton Head Program Chair for how MEMS Education papers may be fully integrated into the meeting. Please sign up at the Workshop registration table if you would like to participate in this luncheon roundtable discussion.

WORKSHOP SOCIAL EVENTS**Welcome Reception**

The Welcome Reception will be held in the pavilion, Sunday evening, June 4th, 6:00 p.m. – 9:00 p.m.

Golf Tournament

The Tuesday afternoon Golf Tournament will be on June 6th at Golden Bear at Indigo Run Golf Course. Tee times start at 1:00 p.m. If you are interested in joining the Golf Tournament, please see Katharine at the Workshop Registration Desk.

Banquet

The banquet will be held in the Pavilion on Tuesday, June 6th, 7:00 p.m. - 9:00 p.m.

Guest Packages

Guest meal packages are available for purchase for guests of attendees. The package includes the Sunday Welcome Reception, Hospitality Room Breakfasts (Signals Lounge 8:30 a.m. – 10:00 a.m.), Lunches and the Banquet.

Adult guest packages may be purchased for \$100.00 at the Workshop Registration Desk. Child packages (7 – 12 years of age) are available for \$50.00 and children under 6 are free.

ORGANIZING COMMITTEE

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TRANSDUCER RESEARCH FOUNDATION

The Transducer Research Foundation (TRF) is a nonprofit organization whose mission is to stimulate research within the United States in science and engineering, with emphasis on technologies related to transducers, microsystems, and nanosystems, and to foster the exchange of ideas and information between academic, industrial, and government researchers.

The founders of TRF were also the founders of this biennial "Workshop on Solid-State Sensors, Actuators, and Microsystems," which began in 1984 under IEEE sponsorship. TRF took over the full sponsorship of the workshop in 1994. TRF also sponsors other topical workshops in the microsystems field and supports student development through travel grants that enable students to attend major microsystems conferences and workshops, worldwide.

If your organization would like to explore any of these options for TRF sponsorship or student grants, please contact someone at the Workshop registration desk, or a TRF officer/board member, or visit the web-site www.transducer-research-foundation.org for further information.

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COMMERCIAL SUPPORT

Special acknowledgements to the Transducer Research Foundation, Inc. and the Defense Advanced Research Projects Agency (DARPA) MTO/MEMS Program for their educational grant support of this workshop.

The Transducer Research Foundation, Inc. would also like to thank the following companies for their support, encouragement, and involvement in the 2006 Solid State Sensors, Actuators and Microsystems Workshop.

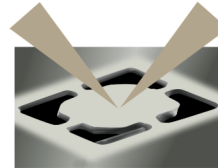
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***Tabletop Exhibits – the tabletops are located in the back of the plenary room.*

Monday, June 5

- 7:00 a.m. **Breakfast**
- 7:45 a.m. **Welcome and Introduction**
Thomas W. Kenny, *Stanford University* and
Leland “Chip” Spangler, *Aspen Technologies*
- Session 1 - Micromirrors and Displays**
Session Chair – Hal Jerman, *Coherent, Inc.*
- 8:15 a.m. **Invited Speaker**
TOWARD AN iMoD™ ECOSYSTEM
Mark W. Miles
Qualcomm MEMS Technologies, USA
- 9:00 a.m. MAGNETIC TWO-AXIS MICROMIRROR FOR 3D OCT ENDOSCOPY
J.J. Bernstein¹, T.W. Lee¹, F.J. Rogomentich¹, M.G. Bancu¹, K.H. Kim²,
G. Maguluri², B.E. Bouma², and J.F. DeBoer²
¹*Draper Laboratory* and ²*Massachusetts General Hospital*
- 9:25 a.m. MEMS SPATIAL LIGHT MODULATOR FOR OPTICAL MASKLESS
LITHOGRAPHY
V.A. Aksyuk, D. López, G.P. Watson, M.E. Simon, R.A. Cirelli, F. Pardo,
F. Klemens, A.R. Papazian, C. Bolle, J.E. Bower, E. Ferry, W.M. Mansfield,
J. Miner, T.W. Sorsch, and D. Tennant
Lucent Technologies
- 9:50 a.m. AN OPTICAL MICROSYSTEM FOR DISPLAYS
B. Winkler¹, D. Elkins¹, A. Tanner¹, R. Yeh², D. Bloom², V. Ramsey³,
R. Cuff³, and L. Spangler³
¹*Evans & Sutherland Corporation*, ²*Alces Technology*, and
³*Aspen Technologies*
- 10:15 a.m. **Break**
- Session 2 - Motors**
Session Chair – David Arnold, *University of Florida*
- 10:40 a.m. DYNAMIC CHARACTERIZATION OF A LINEAR VARIABLE-
CAPACITANCE MICROMOTOR
N. Ghalichechian¹, A. Modafe¹, A. Frey¹, J.H. Lang², and R. Ghodssi¹
¹*University of Maryland* and ²*Massachusetts Institute of Technology*
- 11:05 a.m. MODELING AND CONTROL OF A 3-DEGREE OF FREEDOM
WALKING MICROROBOT
Y.-M. Chen¹, J.W. Suh², G.T.A. Kovacs², R.B. Darling¹,
and K.F. Böhringer¹
¹*University of Washington* and ²*Stanford University*
- 11:30 a.m. **Poster/Oral Session Preview Presentations**
Session Chair – Gary K. Fedder, *Carnegie Mellon University*
- 12:30 p.m. **Lunch and MEMS Education Roundtable Discussion**

2:00 p.m. –
5:00 p.m.

Contributed Posters and Late News Posters

Session Chair – Svetlana Tatic-Lucic, *Lehigh University*

See page 13 for listing of Contributed Posters and page 20 for Late News Posters.

Tuesday, June 6

7:30 a.m. **Breakfast**

Session 3 - Mechanical Structures

Session Chair – David Arch, *Honeywell International*

8:15 a.m. **Invited Speaker**

SiSonic™ – THE FIRST COMMERCIALIZED MEMS MICROPHONE

Peter V. Loeppert and S.B. Lee

Knowles Electronics, LLC

9:00 a.m. A MICROMACHINED PIEZOELECTRIC MICROPHONE FOR
AEROACOUSTICS APPLICATIONS

S. Horowitz, T. Nishida, L. Cattafesta, and M. Sheplak

University of Florida

9:25 a.m. FLEXIBLE WIRELESS PASSIVE PRESSURE SENSORS FOR
BIOMEDICAL APPLICATIONS

M.A. Fonseca¹, M.G. Allen¹, J. Kroh², and J. White²

¹*Georgia Institute of Technology* and ²*CardioMEMS, Inc.*

9:50 a.m. A HIERARCHICAL GECKO-INSPIRED SWITCHABLE ADHESIVE

M.T. Northen¹, K.L. Turner¹, C. Greiner², and E. Arzt²

¹*University of California at Santa Barbara* and

²*Max Planck Institute for Metals Research, GERMANY*

10:15 a.m. **Break**

Session 4 - Processes

Session Chair – Aaron Knobloch, *General Electric/Global Research*

10:40 a.m. SOI MEMS PROCESS INSENSITIVE TO SACRIFICIAL OXIDE ETCH
INDUCED SUBSTRATE ANCHOR PERIMETER VARIATION

G.J. O'Brien¹, D.J. Monk² and K. Najafi³

¹*Arizona State University*, ²*Freescale Semiconductor* and

³*University of Michigan*

11:05 a.m. A PLANAR GLASS/SI MICROMACHINING PROCESS FOR THE
HEAT EXCHANGER IN A J-T CRYOSURGICAL PROBE

W. Zhu¹, D.W. Hoch², G.F. Nellis², S.A. Klein², and Y.B. Gianchandani¹

¹*University of Michigan* and ²*University of Wisconsin*

11:30 a.m. LIGHT-ACTUATED AC ELECTROOSMOSIS FOR OPTICAL
MANIPULATION OF NANOSCALE PARTICLES

P.-Y. Chiou, A.T. Ohta, A. Jamshidi, H.-Y. Hsu, J.B. Chou, and M.C. Wu

University of California at Berkeley

Late News Oral Papers

- 11:55 a.m. 800 MHZ LOW MOTIONAL RESISTANCE CONTOUR-EXTENSIONAL ALUMINUM NITRIDE MICROMECHANICAL RESONATORS
P.J. Stephanou and A.P. Pisano
University of California at Berkeley
- 12:10 p.m. COMPOSITE FLEXURAL MODE RESONATOR WITH REDUCED TEMPERATURE COEFFICIENT OF FREQUENCY
R. Melamud, B. Kim, M.A. Hopcroft, S. Chandorkar, M. Agarwal, C. Jha, S. Bhat, K.K. Park, and T.W. Kenny
Stanford University
- 12:25 p.m. –
1:30 p.m. **Lunch**
- 7:00 p.m. –
9:00 p.m. **Banquet**

Wednesday, June 7

- 7:30 a.m. **Breakfast**
- Session 5 - Actuators**
Session Chair – Michael Putty, *Delphi Research Labs*
- 8:15 a.m. **Invited Speaker**
SUB-NANOMETER POSITION CONTROL USING A SECOND STAGE ACTUATOR IN HARD DISC DRIVES
Dallas W. Meyer, N.F. Gunderson, K.J. Schulz, T.A. Bordson, R.A. Budde, M.A. Huha, M. Jiang, D.A. Sluzewski, J.S. Wright, and L.J. Berg
Seagate Technology
- 9:00 a.m. AUTOMATED OPTICAL FIBER ALIGNMENT IN 2-AXES USING 3D SHAPED ACTUATORS
B. Morgan and R. Ghodssi
University of Maryland
- 9:25 a.m. HALF-MILLIMETER-RANGE VERTICALLY SCANNING MICROLENSES FOR MICROSCOPIC FOCUSING APPLICATIONS
A. Jain and H. Xie
University of Florida
- 9:50 a.m. BILLION-CYCLE ULV ELECTROSTATIC RF MEMS SWITCH
T.-K.A. Chou, H. Bar, J. Heck, Q. Ma, J.B. Melki, Q. Tran, S. Tubul, B. Weinfeld, and N. Ziharev
Intel Corporation
- 10:15 a.m. **Break**

Session 6 - Resonators

Session Chair – William P. Taylor, *Alegro Microsystems, Inc.*

- 10:40 a.m. COUPLED TORSIONAL CANTILEVERS FOR LABEL-FREE SINGLE MOLECULAR LEVEL BIO-DETECTION AND NANOMATERIALS CHARACTERIZATION
O. Sahin¹, H.H.J. Persson², C.F. Quate², and O. Solgaard²
¹*Harvard University* and ²*Stanford University*
- 11:05 a.m. DISSIPATION IN SINGLE-CRYSTAL 3C-SIC ULTRA-HIGH FREQUENCY NANOMECHANICAL RESONATORS
X.L. Feng¹, C.A. Zorman², M. Mehregany², and M.L. Roukes¹
¹*California Institute of Technology* and ²*Case Western Reserve University*
- 11:30 a.m. AMPLITUDE NOISE INDUCED PHASE NOISE IN ELECTROSTATIC MEMS RESONATORS
M. Agarwal, K.K. Park, B. Kim, M.A. Hopcroft, S.A. Chandorkar, R.N. Candler, C.M. Jha, R. Melamud, T.W. Kenny, and B. Murmann
Stanford University
- 11:55 a.m. **Lunch**
- Late News Oral Papers**
Session Chair – Kimberly L. Turner, *University of California at Santa Barbara*
- 1:15 p.m. FAST, MEMS-BASED, PHASE-SHIFTING INTERFEROMETER
H. Choo¹, R. Kant², D. Garmire¹, J. Demmel¹, and R.S. Muller¹
¹*University of California at Berkeley* and ²*Stanford University*
- 1:30 p.m. ADVANCED MEMS SPATIAL LIGHT MODULATOR FOR COMMUNICATIONS, IMAGING, AND TARGETING
F. Pardo, M.E. Simon, V.A. Aksyuk, W.Y.-C. Lai, C.S. Pai, F.P. Klemens, J.F. Miner, R.A. Cirelli, E.J. Ferry, J.E. Bower, W.M. Mansfield, A. Kornblit, T.W. Sorsch, J.A. Taylor, M.R. Baker, R. Fullowan, H. Dyson, A. Gasparyan, and S. Arney
Lucent Technologies
- 1:45 p.m. PROXIMITY MODE INCLINED UV LITHOGRAPHY
Y.-K. Yoon and M.G. Allen
Georgia Institute of Technology
- 2:00 p.m. SILICON-ON-SILICON (SOS): A NEW CMOS COMPATIBLE LOW TEMPERATURE MEMS PROCESS USING PLASMA ACTIVATED FUSION BONDING
T. Galchev, W.C. Welch, III, and K. Najafi
University of Michigan
- 2:15 p.m. A MICROFABRICATED IMPEDANCE SENSOR FOR IONIC TRANSPORT IN NANOPORES
S. Prakash, J. Yeom, and M.A. Shannon
University of Illinois at Urbana-Champaign

- 2:30 p.m. PASSIVE MICROFLOW REGULATION USING THERMALLY RESPONSIVE POLYMERS
B. Stoeber¹, D. Liepmann², and S.J. Muller²
¹*University of British Columbia, CANADA and*
²*University of California at Berkeley*
- 2:45 p.m. CONTROLLED DROPLET COALESCENCE IN AIR AND ITS APPLICATION TO MICROMIXING
C.-Y. Lee, H. Yu, and E.S. Kim
University of Southern California
- 6:00 p.m. –
8:00 p.m. **MEMS Educational Posters and Open Posters**
Session Chair – James M. Bustillo, *Lawrence Berkeley National Laboratory*
See page 21 for listing of MEMS Educational Posters and page 22 for Open Posters.
- 8:00 p.m. –
10:00 p.m. **Rump Session**
Session Chair – Jack Judy, *University of California at Los Angeles*

Thursday, June 8

- 7:30 a.m. **Breakfast**
- Session 7 - Micro Devices**
Session Chair – Stephen Casalnuovo, *Sandia National Laboratory*
- 8:15 a.m. **Invited Speaker**
CHIP-SCALE ATOMIC DEVICES
John Kitching¹, S. Knappe¹, P.D.D. Schwindt¹, Y.-J. Wang¹, H. Robinson¹,
L. Hollberg¹, L.-A. Liew¹, J. Moreland¹, A. Brannon², J. Breitbarth²,
B. Lindseth², Z. Popovic², V. Shah², V. Gerginov³, and M. Eardley⁴
¹*National Institute of Standards and Technology*, ²*University of Colorado*,
³*University of Notre Dame*, and ⁴*State University of New York*
- 9:00 a.m. A MEMS SINGLET OXYGEN GENERATOR
T.F. Hill¹, L.F. Velásquez-García¹, B.A. Wilhite², K.F. Jensen¹,
A.H. Epstein¹, and C. Livermore¹
¹*Massachusetts Institute of Technology and* ²*University of Connecticut*
- 9:25 a.m. A MICRO DIRECT METHANOL FUEL CELL WITH SELF-PUMPING OF LIQUID FUEL
D.D. Meng and C.-J. Kim
University of California at Los Angeles
- 9:50 a.m. AN IMPROVED SILICON DIRECT FORMIC ACID FUEL CELL FOR PORTABLE POWER GENERATION
K.-L. Chu, R.I. Masel, and M.A. Shannon
University of Illinois at Urbana-Champaign
- 10:15 a.m. **Break**

Session 8 - Chemical Devices
Session Chair – Storrs Hoen, *Agilent Labs*

- 10:40 a.m. CHANNEL-TO-DROPLET EXTRACTIONS FOR ON-CHIP SAMPLE PREPARATION
U.-C. Yi, W. Liu, P.-P. de Guzman, and C.-J. Kim
Core Microsolutions, Inc.
- 11:05 a.m. ENGINEERING SURFACE MICRO-STRUCTURE TO CONTROL FOULING AND HYSTERESIS IN DROPLET BASED MICROFLUIDIC BIOANALYTICAL SYSTEMS
A. Shastry, S. Goyal, A. Epilepsia, M.J. Case, S. Abbasi, B. Ratner, and K.F. Böhringer
University of Washington
- 11:30 a.m. A NOVEL BENZOCYCLOBUTENE-BASED DEVICE FOR STUDYING THE PHYSICS OF THE EBULLITION PROCESS
S. Moghaddam, K.T. Kiger, A. Modafe, and R. Ghodssi
University of Maryland
- 11:55 a.m. STREAMLINE BASED DESIGN OF A MEMS DEVICE FOR CONTINUOUS BLOOD CELL SEPARATION
S. Zheng and Y.-C. Tai
California Institute of Technology
- 12:20 p.m. **Closing Remarks**
Thomas W. Kenny and Leland “Chip” Spangler
- 12:25 p.m. –
2:00 p.m. **Lunch**

Contributed Posters

CHEMICAL

- P1** A LOW-POWER PRESSURE- AND TEMPERATURE-PROGRAMMABLE μ GC COLUMN
J.A. Potkay, G.R. Lambertus, R.D. Sacks, and K.D. Wise
University of Michigan
- P2** A NANO INTERDIGITATED ELECTRODES ARRAY ON POLYMER FOR DISPOSABLE IMPEDIMETRIC BIOSENSORS
Z. Zou, J. Kai, M.J. Rust, and C.H. Ahn
University of Cincinnati
- P3** A MICROMACHINED INKING CHIP FOR SCANNING PROBE NANOLITHOGRAPHY USING LOCAL THERMAL VAPOR INKING METHOD
S. Li, K.A. Shaikh, S. Szegedi, E. Goluch, and C. Liu
University of Illinois at Urbana-Champaign

- P4** A PNEUMATICALLY-ACTUATED MICROVALVE FOR SPATIALLY-SELECTIVE CHEMICAL DELIVERY
K. Baek, Y. Li, M. Gulari, and K.D. Wise
University of Michigan
- P5** CHARACTERIZATION AND DESIGN OF DIGITIZING PROCESSES FOR UNIFORM AND CONTROLLABLE DROPLET VOLUME IN EWOD DIGITAL MICROFLUIDICS
J. Gong and C.J. Kim
University of California at Los Angeles
- P6** DEVELOPMENT OF A WATER MONITORING SYSTEM BASED ON INTEGRATED POLYMER MICROFLUIDICS
L. Zhu¹, D. Meier², Z. Boger^{2,3}, C. Montgomery², S. Semancik², and D.L. DeVoe¹
¹University of Maryland, ²National Institute of Standards and Technology, and ³OPTIMAL – Industrial Neural Systems Ltd., ISRAEL
- P7** EXPERIMENTAL CHARACTERIZATION OF FREQUENCY DEPENDENT ELECTROSTATIC ACTUATOR FOR AQUEOUS MEDIA
V. Mukundan and B.L. Pruitt
Stanford University
- P8** LAB-ON-A-CARD ASSAY FOR ENTERIC PATHOGENS
B.H. Weigl¹, J. Gerdes², P. Tarr⁴, P. Yager³, L. Dillman¹, J. Gerlach¹, M. Steele¹, R. Peck¹, S. Ramachandran³, M. Lemba³, D. Hoekstra², M. Kokoris², M. Nabavi², F. Battrell², D.M. Denno³, and E.J. Klein³
¹Program for Appropriate Technology in Health, ²Micronics, Inc., ³University of Washington at Seattle, and ⁴Washington University at St. Louis
- P9** IMPEDANCE BASED BIOSENSOR WITH DIELECTROPHORESIS CONCENTRATION FOR CARDIAC MYOCYTE HYPERTROPHY SENSING
M. Yang¹, C.C. Lim¹, R. Liao², and X. Zhang¹
¹Boston University and ²Harvard Medical School
- P10** IN-DROPLET PARTICLE SEPARATION BY TRAVELLING WAVE DIELECTROPHORESIS (twDEP) AND EWOD
Y. Zhao¹, U.-C. Yi², and S.K. Cho¹
¹University of Pittsburgh and ²Coremicrosolutions Inc.
- P11** METAL-CORED CARBON MICROPOSTS FOR THREE-DIMENSIONAL LI⁺ MICROBATTERY
F. Chamran, U.-C. Yi, and C.-J. Kim
University of California at Los Angeles
- P12** MICRO-MRI VELOCIMETRY IN MICROCHANNEL NETWORKS
L.G. Raguin, D.C. Karampinos, S. Honecker, and J.G. Georgiadis
University of Illinois at Urbana-Champaign

- P13** MICROFLUIDIC MIXERS FOR THE INVESTIGATION OF PROTEIN FOLDING USING SYNCHROTRON RADIATION CIRCULAR DICHROISM SPECTROSCOPY
A.S. Kane^{1,2}, D. Hertzog¹, P. Baumgartel³, J. Lengefeld³, D. Horsley², B. Schuler⁴, and O. Bakajin¹
¹Lawrence Livermore National Laboratory, ²University of California at Davis, ³University of Potsdam, GERMANY, and ⁴University of Zurich, SWITZERLAND
- P14** MULTILAYERED POLYMER MICROFLUIDIC CHIP WITH NANOFLUIDIC INTERCONNECTS FOR MOLECULAR MANIPULATION
B.R. Flachsbarth, K. Wong, J.M. Iannacone, E.N. Abante, R.L. Vlach, P.A. Rauchfuss, P.W. Bohn, J.V. Sweedler, and M.A. Shannon
University of Illinois at Urbana-Champaign
- P15** NANO SELF-ASSEMBLED ION-SENSITIVE FIELD-EFFECT TRANSISTORS FOR ACETYLCHOLINE BIOSENSING
Y. Liu, A.G. Erdman, and T. Cui
University of Minnesota
- P16** SURFACE-MICROMACHINED IN-CHANNEL PARYLENE DUAL VALVES FOR UNPOWERED MICROFLOW REGULATION
P.-J. Chen¹, D.C. Rodger^{1,2}, E. Meng², M.S. Humayun², and Y.-C. Tai¹
¹California Institute of Technology and ²University of Southern California
- P17** SURGICALLY IMPLANTED MICRO-PLATFORMS IN MANDUCA-SEXTA MOTHS
A. Paul, A. Bozkurt, J. Ewer, B. Blossy, and A. Lal
Cornell University
- P18** WIRELESS CHEMICAL SENSORS FOR HIGH TEMPERATURE ENVIRONMENTS
E. Birdsell and M.G. Allen
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- P19** ARRAYS OF COUPLED NANOMECHANICAL RESONATORS
M.K. Zalalutdinov¹, J.W. Baldwin², M.H. Marcus², B.H. Houston², R.B. Reichenbach³, and J.M. Parpia³
¹SFA, Inc., ²Naval Research Laboratory, and ³Cornell University
- P20** A 2-AXIS QUASI-PASSIVE PLATFORM FOR NANOSCALE PHOTONIC ASSEMBLY
B. Li, M. Pietrusky, and A. Sharon
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- P21** A MONOLITHIC CMOS-MEMS 3-AXIS ACCELEROMETER WITH A LOW-NOISE, LOW- POWER DUAL-CHOPPER AMPLIFIER
H. Qu, D. Fang, and H. Xie
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- P22** A COMBUSTIBLE/ELECTRONEGATIVE GAS DETECTOR UTILIZING URANIUM DOPED CAST CERAMIC MICROCHANNELS
J.D. Olivier and C.G. Wilson
Louisiana Technical University

- P23** A DIGITAL MEMS OPTICAL SWITCH
R.C. Gutierrez¹, T.K. Tang¹, R. Calvet¹, D. Harrington¹, S. Vargo¹,
and I. Chakraborty²
¹*Siimpel Corporation and* ²*Bain & Company, Inc.*
- P24** A MAGNETICALLY ENHANCED WIRELESS MICRO-GEIGER COUNTER
C.K. Eun¹, R. Gharpurey², and Y.B. Gianchandani¹
¹*University of Michigan and* ²*University of Texas at Austin*
- P25** A MICROASSEMBLED LARGE-DEFLECTION TIP/TILT MICROMIRROR
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M.E. Last, V. Subramaniam, and K.S.J. Pister
University of California at Berkeley
- P26** A NANOMECHANICAL PROTEIN CONCENTRATION DETECTOR USING A
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W.C. Lee^{1,2}, Y.-H. Cho¹, and A.P. Pisano²
¹*Korea Advanced Institute of Science and Technology, KOREA and*
²*University of California at Berkeley*
- P27** A PIEZOELECTRICALLY ACTUATED CERAMIC-SI-GLASS MICROVALVE
FOR DISTRIBUTED COOLING SYSTEMS
J.M. Park¹, R.P. Taylor², A.T. Evans¹, T.R. Brosten², G.F. Nellis², S.A. Klein²,
J.R. Feller³, L. Salerno³, and Y.B. Gianchandani¹
¹*University of Michigan,* ²*University of Wisconsin, and*
³*NASA Ames Research Center*
- P28** A RESONANT SISO SENSOR BASED ON A COUPLED ARRAY OF
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B.E. DeMartini¹, J.F. Rhoads², S.W. Shaw², and K.L. Turner¹
¹*University of California at Santa Barbara and* ²*Michigan State University*
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- P30** ABSORPTION FILTERS FOR WAVELENGTH TUNING AND FINESSE
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W.S. Smith, P.G. Hartwell, and R.G. Walmsley
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C.-C. Lo and G.K. Fedder
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- P33** DESIGN & CHARACTERIZATION OF A MEMS THERMAL SWITCH
J.H. Cho¹, C.D. Richards¹, J. Jiao², D.F. Bahr¹, and R.F. Richards¹
¹Washington State University and ²Portland State University
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C. Lee¹, M. Liamini², and L.G. Fréchet^{1,2}
¹Columbia University and ²Université of Sherbrooke, CANADA
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S. Pourkamali and F. Ayazi
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A.J. Knobloch¹, C.E. Seeley¹, A. Mulay², and R.J. Saia¹
*¹General Electric Global Research Center and
²John F. Welch Technology Centre, INDIA*
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¹University of Michigan and ²New Mexico Institute of Mining and Technology
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M. Nasir¹, M. Dickinson², and D. Liepmann¹
¹University of California at Berkeley and ²California Institute of Technology
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- P43** MICROMECHANICAL TIME DELAY MECHANISMS FOR ORDNANCE FUSING
J. Liu¹, D.L. DeVoe¹, and L. Fan²
¹University of Maryland and ²Naval Surface Warfare Center
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- P45** PRESSURE ENHANCED AIR DAMPING IN ENCLOSED LATERALLY OSCILLATING MICROSTRUCTURES
K.Y. Yasumura¹ and H. Jerman²
¹FormFactor Inc. and ²Coherent Inc.
- P46** SELF-POWERED HUMIDITY SENSOR POWERED BY NICKEL-63 RADIOISOTOPE
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- P47** SINGLE-WALLED CARBON NANOTUBE MICROPATTERNS AND CANTILEVER ARRAY FABRICATED WITH ELECTROSTATIC LAYER-BY-LAYER NANO SELF-ASSEMBLY AND LITHOGRAPHY
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J. Lee, T. Beecham, K. Park, Z. Zhang, S. Graham, and W.P. King
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- P50** WIDE DYNAMIC RANGE MICROELECTROMECHANICAL VISCOSITY SENSOR
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J. Mitchell, G.R. Lahiji, and K. Najafi
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- P60** MEMS CANTILEVER BEAM ELECTROSTATIC PULL-IN MODEL
G.J. O'Brien¹, D.J. Monk², and L. Lin³
¹Arizona State University, ²Freescale Semiconductor, and
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- P61** MICROMACHINED PMN-PT SINGLE CRYSTAL FOR ADVANCED
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W. Hackenberger¹, J. Catchmark³, J. McIntosh³, and X. Geng⁴
¹TRS Technologies, Inc., ²Boston Scientific Corporation,
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- P62** MICROMANIPULATOR CONTROLLED FABRICATION OF MICRO- AND NANOSCALE POLYMER FIBERS AND APPLICATION AS SACRIFICIAL STRUCTURES IN THE PRODUCTION OF MICROCHANNELS
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- P66** WIRELESS SENSING OF DISCHARGE CHARACTERISTICS FOR QUALITY CONTROL IN BATCH MODE MICRO-ELECTRO-DISCHARGE MACHINING
M.T. Richardson¹, R. Gharpurey², and Y.B. Gianchandani¹
¹*University of Michigan* and ²*University of Texas at Austin*

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D.J. Laser, C.T. Hardham, and J. Kim
Wave 80 Biosciences, Inc.
- P68** DIRECTIONAL REASSEMBLY OF MYOFIBRILS IN CULTURED CARDIAC MYOCYTES USING A THREE-DIMENSIONAL POLYMERIC SUBSTRATE
Y. Zhao and X. Zhang
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- P69** AN ELASTIC MEMS DEVICE FOR CELLULAR FORCE MEASUREMENT
Y. Sun, X. Liu, W. Wang, and B.M. Lansdorp
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- P70** ENVIRONMENT-ADAPTIVE VARIABLE-FOCUS LIQUID MICROLENSES
L. Dong, A.K. Agarwal, D.J. Beebe, and H. Jiang
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- P71** TEMPERATURE REGULATED NONLINEAR MICROVALVES FOR SELF-ADAPTIVE MEMS COOLING
M. McCarthy¹, N. Tiliakos^{1,3}, V. Modi¹, and L.G. Fréchette^{1,2}
¹*Columbia University*, ²*Université de Sherbrooke, CANADA*, and ³*ATK – GASL*

MEMS Educational Posters

- EP1** A MEMS/MICROSYSTEM CURRICULUM WITH INTERNATIONAL DISSEMINATION
L.C. McAfee¹, K. Najafi¹, Y.B. Gianchandani¹, K.D. Wise¹, M.M. Maharbiz¹,
D.M. Aslam², P.L. Bergstrom³, and C.R. Friedrich³
¹University of Michigan, ²Michigan State University, and
³Michigan Technological University
- EP2** ADAPTING INTERDISCIPLINARY MEMS TEACHING AND TRAINING IN A
“SMALL” FACULTY ENVIRONMENT
S. Bhansali
University of South Florida
- EP3** AN INTERDISCIPLINARY LABORATORY COURSE IN MICROSYSTEM
DEVELOPMENT
K.D. Wise, K.T. Beach, T.F. Briggs, R.J. Gordenker, and M.N. Gulari
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- EP4** BENCHTOP POLYMER MEMS AS A LOW-COST EDUCATIONAL TOOL
M. Urdaneta, R. Delille, and E. Smela
University of Maryland
- EP5** EVOLUTION OF THE HILTON HEAD WORKSHOP RESEARCH
COMMUNITY
A.D. Troy, G.-Q. Zhang, and M. Mehregany
Case Western Reserve University
- EP6** HANDS-ON MEMS: BUILDING COMPETENCE THROUGH PRACTICAL
LEARNING EXPERIENCES
L.G. Fréchet^{1,2}, C.W. Wong², K. Chin³, K.F. Farmer⁴, G. Georgiou³, F. Miller⁵,
and V. Modi²
¹Université de Sherbrooke, CANADA, ²Columbia University,
³New Jersey Institute of Technology, ⁴TSI Incorporated, and ⁵Lehigh University
- EP7** INTRODUCTORY MICROMACHINING AND MEMS COURSE FOR
GRADUATE AND UNDERGRADUATE STUDENTS
J.W. Judy¹ and P.S. Motta²
¹University of California at Los Angeles and ²Innovative Micro Technology
- EP8** MEMS CURRICULUM AT AUBURN UNIVERSITY’S MICROELECTRONICS
CENTER
R. Ramadoss
Auburn University
- EP9** COMPREHENSIVE MEMS CURRICULUM AT UCLA
J.W. Judy, G.P. Carmen, F.M.-C. Chang, Y. Chen, H.H. Fetterman, N.N. Ghoniem,
W.S. Grudfest, V. Gupta, C.-M. Ho, Y.S. Ju, W.J. Kaiser, P. Kavehbour, C.-J. Kim,
R.T. M’Closky, C.D. Montemagno, L. Pilon, J.J. Schmidt, E. Yablonovitch,
and X. Zhong
University of California at Los Angeles

- EP10** MICRO AND NANOSCALE EDUCATION AT STANFORD UNIVERSITY
A.A. Barlian, R.T. Howe, G.T.A. Kovacs, and B.L. Pruitt
Stanford University
- EP11** NSF/NASA-GSFC MEMS EDUCATION WORKSHOP OUTCOMES
B.L. Pruitt¹, M.T.A. Saif², R. Ghodssi³, K.L. Turner⁴, J.W. Judy⁵,
and M.A. Schmidt⁶
¹*Stanford University*, ²*University of Illinois at Urbana-Champaign*,
³*University of Maryland*, ⁴*University of California at Santa Barbara*,
⁵*University of California at Los Angeles*, and
⁶*Massachusetts Institute of Technology*
- EP12** SELF-ASSEMBLY OF A BIOMEMS SYLLABUS: TEACHING BIOMEMS
THROUGH THE DEVELOPING ORGANISM
M.M. Maharbiz
University of Michigan
- EP13** THE 18mm² CLASSROOM
T. Dallas, R. Gale, and J. Berg
Texas Tech University
- EP14** WHAT SHOULD A FIRST COLLEGE COURSE ON MEMS BE?
K. Najafi and M. Maharbiz
University of Michigan

Open Posters

CHEMICAL

- OP1** CHITOSAN FOR BIOFUNCTIONALIZATION OF MEMS
S.T. Koev, V. Badilita, M.A. Powers, H. Yi, W.E. Bentley, G.F. Payne,
G.W. Rubloff, and R. Ghodssi
University of Maryland
- OP2** DESIGN AND CHARACTERIZATION OF A POLYMER-BASED
MICROFLUIDIC SYSTEM FOR ELECTROPHYSIOLOGICAL STUDIES
E.D. Moss, N. Reddy, and A.B. Frazier
Georgia Institute of Technology
- OP3** FORCE-SENSING PILLARS FOR THE STUDY OF LOCOMOTION IN THE
NEMATODE C. ELEGANS
S.M. Coulthard¹, S.-J. Park¹, S. Lockery², M.B. Goodman¹, and B.L. Pruitt¹
¹*Stanford University* and ²*University of Oregon*
- OP4** INP OPTICAL MEMS FOR INTEGRATED SENSING AND PHOTONICS
APPLICATIONS
N. Siwak, J. McGee, and R. Ghodssi
University of Maryland
- OP5** INTEGRATED SYSTEM TO ANALYZE THE GENTIC EFFECTS OF THE
SPACE ENVIRONMENT ON LIVING CELLS IN CULTURE: GENESAT
A.J. Ricco¹, E. Agasid², V. Barker², T. Fahlen², M. Henschke², J.W. Hines²,
L. Levine³, R. Mancinelli², D. Oswell¹, R. Ricks², K. Ronzano², D. Squires²,
C. Storment¹, G. Swaiss², L. Timucin², J. Tucker², U. Udoh², and B. Yost²
¹*Stanford University*, ²*NASA Ames Research Center*, and ³*ALine, Inc.*

- OP6** OPTICAL CARBON MONOXIDE SENSING WITH NANO-COMPOSITE THIN FILMS OF NiO/Au IN SiO₂
M.L. Post¹, A. Martucci², D. Buso², and M. Guglielmi²
¹National Research Council of Canada and ²University of Padova, ITALY
- OP7** ORIENTED AND VECTORIAL PATTERNING OF CARDIOMYOCYTES USING A MICROFLUIDIC DIELECTROPHORESIS CHIP - TOWARDS ENGINEERED CARDIAC TISSUE WITH CONTROLLED MACROSCOPIC ANISOTROPY
M. Yang and X. Zhang
Boston University
- OP8** A MICROFLUIDIC BASED HIGH THROUGHPUT RESISTIVE-PULSE SENSOR FOR BIOPARTICLE DETECTION AND COUNTING
J. Zhe, A. Jagtiani, and J. Hu
University of Akron

EDUCATION

- OP9** A NANOGRAM MICROROBOT DEMONSTRATION COMPETITION FOR ROBOCUPSOCER
C. McGray¹, F. Arai², A. Jacoff¹, S. Tadokoro², and M. Gaitan¹
¹National Institute of Standards and Technology and ²Tohoku University, JAPAN

PHYSICAL

- OP10** A SILICON-ON-INSULATOR INERTIAL MEMS MULTISENSOR
M. Kranz¹, J. McKee¹, M. Whitley¹, T. Hudson², and S. Holt²
¹Morgan, A Stanley Company and ²U.S. Army AMRDEC
- OP11** MODELING OF CMOS COMPATIBLE MEMS ACTUATORS FOR WIRELESS COMMUNICATIONS
R.Kotha and A.A. Ayon
University of Texas
- OP12** TEMPERATURE-STABILIZED MICROMECHANICAL RESONATORS
M.A. Hopcroft¹, B. Kim¹, S.A. Chandorkar¹, M. Agarwal¹, R. Melamud¹, C.M. Jha¹, R.N. Candler², G. Yama², and T.W. Kenny¹
¹Stanford University and ²Robert Bosch Corporation
- OP13** THE PHAZIR™: A PORTABLE MEMS-BASED NEAR-INFRARED SPECTROMETER
S.D. Senturia, M. Butler, E. Deutsch, D. Day, M. Smith, A. McAllister, K. Zafiriou, K. Bober, J. Booth, E. Jahn, and F. Haibach
Polychromix, Inc.

TECHNICAL

- OP14** APPLICATION OF A MODIFIED QUALITY FUNCTION DEPLOYMENT METHOD FOR MEMS
T. Lamers, R. Flynn, P. Chiang, Y.R. Rau, B. Pruitt, and K. Ishii
Stanford University
- OP15** FULLY DRY MICROASSEMBLY AND PARALLEL PART TRANSFER USING ADHESION FORCE AT THE SOLID/SOLID INTERFACE
K. Wang¹, R. Baskaran², and K.F. Böhringer¹
¹University of Washington and ²Intel

- OP16** IN-PLANE STRAIN DETERMINATION IN NANOSCALE CANTILEVERS
USING SCANNING MOIRÉ INTERFEROMETRY
Y. Zhao and X. Zhang
Boston University
- OP17** LENGTH-SCALE EFFECT ON NANOINDENTATION CREEP IN PLASMA-
ENHANCED CHEMICAL VAPOR DEPOSITED SILICON OXIDE FILMS
Z. Cao and X. Zhang
Boston University
- OP18** LEVERAGING STANDARD IC PACKAGING FOR MEMS OSCILLATORS
P. Gupta, E. Radza, W. Chen, R. Sheridan, R. Sheridan, R. Melamud, M. Lutz,
A. Partridge, and K. Petersen
SiTime Corporation
- OP19** PARAMETERIZED METHOD FOR MEMS GEAR DESIGN
E.S. Kolesar and C.A. Edwards
Texas Christian University
- OP20** SIMULTANEOUS MEASUREMENT OF TEMPERATURE AND STRESS IN
MEMS DEVICES USING RAMAN SPECTROSCOPY
T. Beechem and S. Graham
Georgia Institute of Technology
- OP21** SMART CERAMIC PACKAGING
C. Sippola and C. Ahn
University of Cincinnati
- OP22** THEORY AND EXPERIMENTS FOR GRADIENT RESIDUAL STRESS IN
MEMS-BASED INFRARED DETECTOR STRUCTURES
S. Huang and X. Zhang
Boston University
- OP23** THERMALLY DRIVEN MICRO/NANO GAS FLOWS: NUMERICAL
TECHNIQUES AND PHYSICAL PHENOMENA
N. Masters and W. Ye
Georgia Institute of Technology

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