

# PRELIMINARY PROGRAM



Sponsored by



The Executive Committee reserves the right to amend the program if necessary.

## Sunday, June 5

6:00 pm **Registration and Welcome Reception**  
- 9:00 pm

## Monday, June 6

7:00 am **Breakfast**

7:45 am **Welcome**  
Mark G. Allen, *University of Pennsylvania, USA*  
Tina Lamers, *Akustica, Bosch Group, USA*

### Plenary Presentation I

Session Chair: D. Horsley, *University of California, Davis, USA*

8:15 am **INNOVATIVE SWITCHING TECHNOLOGIES FOR FUTURE TUNABLE WIRELESS COMMUNICATIONS SYSTEMS**  
*Pierre Blondy, A. Mennai, K. Nadeau, and A. Crunteanu*  
*Universite de Limoges, XLIM, FRANCE*

### Session 1 - Oscillators and Resonators I

Session Chair: M. Rais-Zadeh, *University of Michigan, USA*

9:05 am **EXTREMELY WIDE TUNING RANGE OF MECHANICAL OSCILLATION OF A SILICON WAVEGUIDE DRIVEN BY OPTICAL GRADIENT FORCE**  
S. Tallur<sup>1,2</sup> and S.A. Bhav<sup>3</sup>  
<sup>1</sup>*Cornell University,* <sup>2</sup>*Analog Devices Inc., USA, and* <sup>3</sup>*Purdue University, USA*

9:25 am **ELECTRICAL AND OPTICAL TRANSDUCTION OF SINGLE-CRYSTAL 3C-SiC COMB-DRIVE RESONATORS IN A SiC-ON-INSULATOR (SiCOI) TECHNOLOGY**  
J.P. McCandless, J. Lee, H.-I. Kuo, V. Pashaei, M. Mehregany, C.A. Zorman, and P.X.-L. Feng  
*Case Western Reserve University, USA*

9:45 am **AUTONOMOUS OSCILLATIONS WITHOUT EXTERNAL POWER SUPPLY IN A MEMS OSCILLATOR THROUGH INTERNAL RESONANT MODE COUPLING**  
C. Chen<sup>1</sup>, D.H. Zanette<sup>2</sup>, D.A. Czaplewski<sup>1</sup>, and D. López<sup>1</sup>  
<sup>1</sup>*Argonne National Laboratory, USA and* <sup>2</sup>*Centro Atomico Bariloche, ARGENTINA*

10:05 am **Break and Table Top Exhibits**

**Session 2 - Cell Measurements and Interfaces**

Session Chair: A.E. Herr, *University of California, Berkeley, USA*

10:30 am **ARRAY OF MICROMECHANICAL MASS SENSORS ENABLES HIGH-THROUGHPUT SINGLE-CELL GROWTH-RATE MEASUREMENTS**

S. Olcum, N. Cermak, and S.R. Manalis  
*Massachusetts Institute of Technology, USA*

10:50 am **DESIGN AND OPTIMIZATION OF A SINGLE-CELL PROTEIN ASSAY FOR CLINICAL UTILITY**

J.J. Kim, E. Sinkala, and A.E. Herr  
*University of California, Berkeley, USA*

11:10 am **FABRICATION OF NEURAL MICROELECTRODE ARRAYS FROM EXTRACELLULAR MATRIX**

W. Shen, L. Struzyna, D.K. Cullen, and M.G. Allen  
*University of Pennsylvania, USA*

11:30 am **Poster Preview of Poster Session 1 Presentations**

Session Chairs: O. Brand, *Georgia Institute of Technology, USA* and  
C. Buie, *Massachusetts Institute of Technology, USA*

12:15 pm **Networking Lunch**

**Poster Session 1**

Session Chair: T. Lamers, *Aksutica, Bosch Group, USA*

1:45 pm - **Contributed and Late News**

4:15 pm See page 10 for listing of poster presentations

4:45 pm **End of Day**

## Tuesday, June 7

7:30 am **Breakfast**

### Plenary Presentation II

Session Chair: G. Piazza, *Carnegie Mellon University, USA*

8:15 am **FAST AUTONOMOUS FLIGHT WITH MICRO UNMANNED VEHICLES**

Y. Mulgaonkar, A. Makineni, K. Mohta, C.J. Taylor, and Vijay Kumar  
*University of Pennsylvania, USA*

### Session 3 - Sensors and Actuators

Session Chair: E. Briot, *Qorvo, USA*

10:05 am **ULTRATHIN LOUDSPEAKERS FROM ALD**

J.J. Brown, N.C. Moore, O.D. Supekar, and V.M. Bright  
*University of Colorado, USA*

9:05 am **ROBUST CATALYTIC GAS SENSING USING A SILICON CARBIDE MICROHEATER**

A. Harley-Trochimczyk, A. Rao, H. Long, C. Carraro, and R. Maboudian  
*University of California, Berkeley, USA*

9:25 am **SCANNING DIFFRACTIVE OPTIC ELEMENTS FOR UNTETHERED EYE-TRACKING MICROSYSTEMS**

N. Sarkar<sup>1,2</sup>, D. Strathearn<sup>1,2</sup>, G. Lee<sup>1,2</sup>, M. Olfat<sup>1,2</sup>, A. Rohani<sup>1,2</sup>,  
B. O'Hanlon<sup>1,2</sup>, R.R. Mansour<sup>1,2</sup>  
<sup>1</sup>*University of Waterloo, CANADA* and <sup>2</sup>*ICSPI Corp., CANADA*

9:45 am **TEXTILE-BASED ELECTROCHEMICAL SENSORS USING EMBROIDERED ELECTRODES**

X. Liu and P.B. Lillehoj  
*Michigan State University, USA*

10:25 am **Break and Table Top Exhibits**

### Session 4 - Micro Organisms and Environments

Session Chair: K. Cheung, *University of British Columbia, CANADA*

10:50 am **AN INTEGRATED LOW-COST RADIATION DOSIMETER UTILIZING MICROORGANISMS AS RADIATION-SENSITIVE MATERIAL**

C.K. Yoon, M. Ochoa, A. Kim, R. Rahimi, and B. Ziaie  
*Purdue University, USA*

- 11:10 am **MICROFLUIDIC MICROALGAL BIOREACTOR FOR HIGH-THROUGHPUT SCREENING OF CO<sub>2</sub> CONCENTRATION CONDITIONS ON MICROALGAE GROWTH**  
Z. Xu, Y. Wang, Y. Chen, M.H. Spalding, and L. Dong  
*Iowa State University, USA*
- 11:30 am **COMBINING SOFT LITHOGRAPHY AND PHOTO-POLYMERIZATION FOR ENGINEERED MICRO-ENVIRONMENT**  
Z. Ge and C.R. Buie  
*Massachusetts Institute of Technology, USA*

### **Session 5 - Late News I**

Session Chair: S. Bergbreiter, *University of Maryland, USA*

- 11:50 am **50 nm THICK ALUMINUM NITRIDE PIEZOELECTRIC NANO-PLATE RESONANT THERMAL DETECTORS**  
Z. Qian, S. Kang, V. Rajaram, and M. Rinaldi  
*Northeastern University, USA*
- 12:10 pm **HELMHOLTZ PMUT: DEMONSTRATING PASSIVE AMPLIFICATION IN MICROFABRICATED ACOUSTIC TRANSDUCERS**  
A.A. Shkel and E.S. Kim  
*University of Southern California, USA*
- 12:30 pm **SCALABLE LIQUID METAL THIN LINE PATTERNING FOR PASSIVE ELECTRONIC COMPONENTS USING SOFT LITHOGRAPHY**  
M. Kim, H. Alrowais, S. Pavlidis, and O. Brand  
*Georgia Institute of Technology, USA*

12:50 pm - **Networking Lunch**  
2:20 pm

7:00 pm - **Tuesday Banquet**  
10:00 pm

## Wednesday, June 8

7:30 am **Breakfast**

### Plenary Presentation III

Session Chair: H. Jerman, *Coherent, USA*

8:15 am **TAILORING RADIO-WAVES, LIGHT AND SOUND WITH METAMATERIALS**

Andrea Alù

*University of Texas, Austin, USA*

### Session 6 - MEMS-Enhanced Surfaces

Session Chair: F. Herrault, *HRL Laboratories, USA*

9:05 am **EXTREME HOTSPOT HEAT FLUX THERMAL MANAGEMENT VIA THIN-FILM EVAPORATION FROM MICROSTRUCTURED SURFACES**

S. Adera<sup>1</sup>, D. Antao<sup>1</sup>, B. Barabadi<sup>1</sup>, R. Raj<sup>2</sup>, and E.N. Wang<sup>1</sup>

<sup>1</sup>*Massachusetts Institute of Technology, USA and*

<sup>2</sup>*Indian Institute of Technology, INDIA*

9:25 am **MULTILAYER ELECTRODEPOSITION FROM MICROMACHINED TEMPLATES: A CONTROLLABLE, SCALABLE ROUTE TO HIERARCHICAL SUPERHYDROPHOBIC SURFACES**

M. Kim<sup>1</sup>, J. Kim<sup>2</sup>, and M.G. Allen<sup>1</sup>

<sup>1</sup>*University of Pennsylvania, USA and* <sup>2</sup>*Georgia Institute of Technology, USA*

9:45 am **FACILE FABRICATION OF FLEXIBLE ELECTRONICS VIA DIRECT LASER WRITING OF CARBON-SILVER NANOCOMPOSITE**

R. Rahimi, M. Ochoa, T. Parupudi, W. Yu, and B. Ziaie

*Purdue University, USA*

10:25 am **Break and Table Top Exhibits**

### Session 7 - Oscillators and Resonators II

Session Chair: Q. Zou, *Avago Technologies, USA*

10:30 am **ALN PIEZOELECTRIC PARAMETRIC OSCILLATORS WITH LOW PHASE NOISE**

R. Lu, A. Gao, and S. Gong

*University of Illinois, Urbana-Champaign, USA*

10:50 am **SYNCHRONIZATION IN MICROMECHANICAL GYROSCOPES**

M. Defoort, P. Taheri-Tehrani, S. Nitzan, and D.A. Horsley

*University of California, Davis, USA*

11:10 am **VERTICAL ACOUSTIC CONFINEMENT FOR HIGH-Q FULLY-DIFFERENTIAL CMOS-RBTS**  
B. Bahr<sup>1</sup> and D. Weinstein<sup>2</sup>  
*<sup>1</sup>Massachusetts Institute of Technology, USA and <sup>2</sup>Purdue University, USA*

11:30 am **Poster Preview of Poster Session 2 Presentations**  
Session Chairs: M. Gaitan, *National Institute of Standards and Technology (NIST), USA* and M. Sheplak, *University of Florida, USA*

12:15 pm **Networking Lunch**

### **Poster Session 2**

Session Chair: B. Pruitt, *Stanford University, USA*

1:45 pm - **Contributed and Late News**  
4:15 pm See page 16 for listing of poster presentations

### **Poster Session 3**

Session Chair: M.G. Allen, *University of Pennsylvania, USA*

5:30 pm - **Commercial and Open Posters**  
7:00 pm See page 22 for listing of poster presentations

**MEMS & Sensors Industry Group Discussion Panel**  
Moderator: K. Lightman, *MEMS & Sensors Industry Group, USA*

7:00 pm - **INDUSTRY'S GUIDE TO TECHNOLOGY TRANSFER AND**  
8:00 pm **HOW TO COMMERCIALIZE YOUR MEMS/SENSORS PRODUCT**  
Panelists: Mary Ann Maher, *SoftMEMS, USA*  
Rob O'Reilly, *Analog Devices, Inc., USA*  
Eric Pabo, *EV Group, USA*  
Jason Tauscher, *Microvision, USA*

8:00 pm **Awards Ceremony**  
8:15 pm

8:15 pm - **MEMS Shark Pup Tank Entrepreneurship Competition**  
9:45 pm Judges: Janusz Bryzek, *eXo System, Inc., USA*  
Alissa Fitzgerald, *AMFitzgerald & Associates, LLC, USA*  
Nena Golubovic, *IP Group, Inc., USA*  
Kurt Petersen, *KP-MEMS, USA*



## Thursday, June 9

7:00 am **Breakfast**

### Diversity Event

Session Chair: A. Duwel, *Draper Laboratory, USA*

7:15 am - **DISCOVERY AND DIVERSITY ON THE FRONTIER OF PHYSICS:  
7:45 am MY FIFTY-YEAR JOURNEY IN CARBON SCIENCE**

M.S. Dresselhaus

*Massachusetts Institute of Technology, USA*

### Plenary Presentation IV

Session Chair: A. Duwel, *Draper Laboratory, USA*

8:15 am **FUTURE OPPORTUNITIES ARISING FROM IMPLICATIONS OF MOORE'S  
LAW**

Mildred S. Dresselhaus

*Massachusetts Institute of Technology, USA*

### Session 8 - AlN Devices

Session Chair: M. Maher, *softMEMS, USA*

9:05 am **UNPRECEDENTED FIGURE OF MERIT IN EXCESS OF 108 IN 920 MHZ  
ALUMINUM NITRIDE CROSS-SECTIONAL LAMÉ MODE RESONATORS  
SHOWING  $Kt^2$  IN EXCESS OF 6.2%**

C. Cassella, G. Chen, Z. Qian, G. Hummel, and M. Rinaldi

*Northeastern University, USA*

9:25 am **ALUMINUM NITRIDE VICINITY-BASED RESONANT CHARGING LINK**

E. Mehdizadeh and G. Piazza

*Carnegie Mellon University, USA*

9:45 am **DIFFRACTION BASED TRANSMIT-RECEIVE DELAY ELEMENT WITH  
ZERO TEMPERATURE COEFFICIENT**

M. Abdelmejeed, J. Kuo, and A. Lal

*Cornell University, USA*

10:25 am **Break and Table Top Exhibits**



## **Session 9 - Late News II**

Session Chair: S. Rajaraman, *MEMSCAP, Inc., USA*

- 10:30 am **ELECTROSPUN POLYCAPROLACTONE NANOFIBERS AND MICROBEADS LOADED WITH DEXAMETHASONE FOR EXTENDED OCULAR DRUG DELIVERY**  
S.-P. Fang, K.-H. Hsu, C.-L. Lin, A. Chauhan, and Y.-K. Yoon  
*University of Florida, USA*
- 10:50 am **FLEXIBLE SYSTEMS FOR WEARABLE PHYSIOLOGICAL MONITORING APPLICATIONS**  
S. Emaminejad<sup>1,2</sup>, W. Gao<sup>1</sup>, H.Y.Y. Nyein<sup>1</sup>, S. Challa<sup>2</sup>, R.W. Davis<sup>2</sup>, and A. Javey<sup>1</sup>  
<sup>1</sup>*University of California, Berkeley, USA* and <sup>2</sup>*Stanford School of Medicine, USA*
- 11:10 am **WEARABLE GRAPHENE SENSORS ON ADHESIVE TAPES**  
S. Oren, S. Tabassum, Y. Jiao, H. Ceylan, M.A. Ali, and L. Dong  
*Iowa State University, USA*
- 11:30 am - **Networking Lunch**
- 1:00 pm - **Workshop Adjourns**

**Poster Session 1**  
**Contributed and Late News**  
**Monday, June 6 1:45 pm – 4:15 pm**

**Actuators**

**P01 CAVITY OPTICAL TRANSDUCER PLATFORM WITH INTEGRATED ACTUATION FOR MULTIPLE SENSING APPLICATIONS**

T. Michels and V. Aksyuk

*National Institute of Standards and Technology (NIST), USA*

**P02 RESONANT PIEZOELECTRIC CANTILEVERS AS NANO-PRECISION DISPLACEMENT PROBES**

M. Mahdavi<sup>1</sup>, A. Abbasalipour<sup>1</sup>, A. Moses<sup>2</sup>, and S. Pourkamali<sup>1,2</sup>

*<sup>1</sup>University of Texas, Dallas, USA and <sup>2</sup>femtoScale Inc., USA*

**Characterization, Fabrication and Materials**

**P03 A CONTACTLESS ELECTROCHEMICAL IMPEDANCE MEASUREMENT METHOD**

L. Yu, E. Pun, and E. Meng

*University of Southern California, USA*

**P04 A FLUSH-MOUNT SENSOR PACKAGE FOR A MEMS PIEZOELECTRIC MICROPHONE WITH THROUGH-SILICON-VIAS FOR AIRCRAFT FUSELAGE ARRAYS**

T. Reagan<sup>1</sup>, J.R. Underbrink<sup>2</sup>, J. Meloy<sup>2</sup>, and M. Sheplak<sup>1</sup>

*<sup>1</sup>University of Florida, USA and <sup>2</sup>Boeing, USA*

**P05 A NOVEL METHOD FOR MEASURING RING-DOWN IN A HIGH NOISE AND HIGH FREQUENCY SYSTEM USING LASER DOPPLER VIBROMETRY**

B. Gibson<sup>1</sup>, K. Qalandar<sup>1</sup>, G. Piazza<sup>2</sup>, and K.L. Turner<sup>1</sup>

*<sup>1</sup>University of California, Santa Barbara, USA and*

*<sup>2</sup>Carnegie Mellon University, USA*

**P06 ATOMIC LAYER DEPOSITED ETCH STOP LAYERS FOR HYDROFLUORIC ACID**

M.M. Winterkorn, A.L. Dadlani, Y. Kim, T.S. English, K.L. Harrison, J. Provine, and F.B. Prinz

*Stanford University, USA*

**P07 ATOMIC LAYER ETCHING OF SUSPENDED ULTRA-THIN STRUCTURES**

N.T. Eigenfeld<sup>1</sup>, J.C. Gertsch<sup>1</sup>, G.D. Skidmore<sup>2</sup>, S.M. George<sup>1</sup> and, V.M. Bright<sup>1</sup>

*<sup>1</sup>University of Colorado, USA and <sup>2</sup>DRS Technologies Inc., USA*

- P08 HIGH-ASPECT RATIO MICROSTRUCTURES IN BOROSILICATE GLASS BY MOLDING AND SACRIFICIAL SILICON ETCHING: CAPABILITIES AND LIMITS**  
A. Amnache and L.G. Fréchette  
*Université de Sherbrooke, CANADA*
- P09 DYNAMIC CHARACTERIZATION OF IN-PLANE BULK ACOUSTIC RESONATORS USING HIGH-SENSITIVITY OPTICAL REFLECTION MEASUREMENTS**  
V.J. Gokhale<sup>1,2</sup> and J.J. Gorman<sup>1</sup>  
<sup>1</sup>*National Institute of Standards and Technology (NIST), USA,*  
<sup>2</sup>*University of Michigan, USA*
- P10 ELECTROHYDRODYNAMIC JET PRINTING: A 3D PRINTING TECHNIQUE FOR SENSOR FABRICATION**  
C.P. Pannier<sup>1</sup>, Z. Wang<sup>2</sup>, D.J. Hoelzle<sup>2</sup>, and K.L. Barton<sup>1</sup>  
<sup>1</sup>*University of Michigan, USA and* <sup>2</sup>*University of Notre Dame, USA*
- P11 FABRICATION OF DOUBLE-SIDED MICROFLUIDIC STRUCTURES VIA 3D PRINTED TRANSFER MOLDING**  
C.C. Glick, M.T. Srimongkol, A. Schwartz, W. Zhuang, J. Lin, R. Warren, D. Tekell, P. Satimalee, J. Kim, C. Su, K. Kim, and L. Lin  
*University of California, Berkeley, USA*
- P12 LOCALIZED BIONANORECEPTOR 3D-ASSEMBLY VIA ELECTROWETTING: AN INTEGRATED MICRO/NANO/BIO FABRICATION TECHNOLOGY**  
S. Chu, F. Zang, A.D. Brown, J.N. Culver, and R. Ghodssi  
*University of Maryland, USA*
- P13 MILLED MICROMOLDS FOR LARGE AREA ALL-ELASTOMER "ROBOT SKIN" WITH 3-AXIS TACTILE SENSING VIA CONTACT RESISTANCE**  
A. Charalambides and S. Bergbreiter  
*University of Maryland, USA*
- P14 NON-PLANAR ELECTRODES MADE FROM BOND WIRES FOR IMPEDANCE SPECTROSCOPY OF 3D MICROTISSUES**  
A.B. Stettler, S.C. Bürgel, O. Frey, and A. Hierlemann  
*ETH Zurich, SWITZERLAND*
- P15 ORIGAMI FABRICATION OF THREE-DIMENSIONAL BIOFUEL CELLS WITH NOVEL ANODE MATERIALS**  
M. Mohammadifar, J. Zhang, O. Sadik, and S. Choi  
*State University of New York, Binghamton, USA*
- P16 PHOTOLITHOGRAPHY-FREE LASER-PATTERNED HF ACID-RESISTANT CHROMIUM-POLYIMIDE MASK FOR RAPID FABRICATION OF MICROFLUIDIC SYSTEMS IN GLASS**  
K.O. Zamuruyev, Y. Zrodnikov, and C.E. Davis  
*University of California, Davis, USA*

- P17 3-D PRINTED MICROFLUIDIC DEVICES FOR ELECTROHYDRODYNAMIC GENERATION OF CORE-SHELL MICROPARTICLES**  
D. Olvera-Trejo<sup>1,2</sup> and L.F. Velásquez-García<sup>2</sup>  
<sup>1</sup>*Tecnologico de Monterrey, MEXICO and*  
<sup>2</sup>*Massachusetts Institute of Technology, USA*
- P18 SOLID STATE ELECTROCHEMICAL ALKALI SOURCES FOR COLD ATOM SENSING**  
J.J. Bernstein<sup>1</sup>, A. Whale<sup>2</sup>, J. Brown<sup>1</sup>, C. Johnson<sup>1</sup>, E. Cook<sup>1</sup>, L. Calvez<sup>3</sup>,  
X. Zhang<sup>3</sup>, and S.W. Martin<sup>2</sup>  
<sup>1</sup>*Draper, USA,* <sup>2</sup>*Iowa State University, USA, and* <sup>3</sup>*University of Rennes, FRANCE*
- P19 STABILITY OF UV/OZONE TREATMENT OF PLASTICS FOR CAPILLARY-DRIVEN MICROFLUIDICS**  
T.-Y. Lin and P.B. Lillehoj  
*Michigan State University, USA*
- P20 STICTION AT HIGH TEMPERATURE (>250°C) IN ENCAPSULATED MEMS DEVICES FOR HARSH ENVIRONMENT APPLICATIONS**  
D.B. Heinz, V.A. Hong, C.-H. Ahn, Y. Yang, and T.W. Kenny  
*Stanford University, USA*
- P21 THE MEMS HAMMER, A TOOL TO STUDY MICROFRACTURE**  
J. Greenspun, T. Massey, and K.S.J. Pister  
*University of California, Berkeley, USA*
- P22 TIME-DEPENDENT GATING IN NANOFUIDIC CHANNELS FOR ACTIVE ELECTRIC DOUBLE LAYER MODULATION FOR ION TRANSPORT CONTROL**  
C. Boone, V. Lochab, M. Fuest, and S. Prakash  
*Ohio State University, USA*
- P23 TWO-LAYER PLATE MECHANICAL METAMATERIALS**  
J. Bryan, E. Lu, K. Davami, J. Cortes, C. Lin, D.E. Lilley, and I. Bargatin  
*University of Pennsylvania, USA*

## **Modeling**

- P24 A LOW-COST PAPER-BASED MODEL FOR ON-CHIP HUMAN RESPIRATORY SYSTEM STUDIES**  
R. Rahimi<sup>1</sup>, M. Ochoa<sup>1</sup>, S.S. Htwe<sup>2</sup>, A. Donaldson<sup>2</sup>, M. Zieger<sup>2</sup>, M.R. Dokmeci<sup>4</sup>,  
A. Khademhosseini<sup>4</sup>, R. Sood<sup>3</sup>, A. Ghaemmaghami<sup>2</sup>, and B. Ziaie<sup>1</sup>  
<sup>1</sup>*Purdue University, USA,* <sup>2</sup>*University of Nottingham, UK,* <sup>3</sup>*Indiana University School of Medicine, UK, and* <sup>4</sup>*Harvard-MIT Health Sciences and Technology, USA*

- P25      DISTRIBUTED AND THERMO-ACOUSTICALLY COUPLED MODELING FOR ACCURATE PREDICTION OF THERMAL NONLINEARITY IN PIEZOELECTRIC MEMS RESONATORS**  
R. Jhaveri<sup>1</sup>, R. Lu<sup>2</sup>, S. Gong<sup>2</sup>, and M. Kamon<sup>1</sup>  
*<sup>1</sup>Coventor, Inc., USA and <sup>2</sup>University of Illinois, Urbana-Champaign, USA*

## **Physical and Optical Sensors and Devices**

- P26      A COMB-DRIVE ACTUATOR ENABLED DYNAMICALLY TUNABLE TERAHERTZ METAMATERIAL**  
X. Zhao<sup>1</sup>, J. Zhang<sup>2</sup>, K. Fan<sup>1</sup>, G.R. Keiser<sup>1</sup>, G. Duan<sup>1</sup>, R.D. Averitt<sup>2</sup>, and X. Zhang<sup>1</sup>  
*<sup>1</sup>Boston University, USA and <sup>2</sup>University of California, San Diego, USA*
- P27      A HIGHLY SENSITIVE SMALL-FOOTPRINT VOX-BASED MICRO-PIRANI GAUGE FOR IN-SITU MONITORING OF VACUUM WAFER-LEVEL PACKAGED BOLOMETERS**  
P.J. Newby<sup>1</sup>, C. Spits<sup>1</sup>, O. Bernard<sup>1</sup>, R. Larger<sup>2</sup>, K. Kornelsen<sup>2</sup>, P.G. Charette<sup>1</sup>, and L.G. Fr chet te<sup>1</sup>  
*<sup>1</sup>Universit  de Sherbrooke, CANADA and <sup>2</sup>Teledyne DALSA Semiconductor Inc., CANADA*
- P28      ALL FLEXIBLE GRAPHENE STRAIN SENSORS WITH LIQUID METAL INTERCONNECTORS FOR EMBEDDED STRUCTURAL HEALTH MONITORING AND SKIN TACTILE SENSING**  
Y. Jiao, C. Young, S. Yang, C. Halil, and L. Dong  
*Iowa State University, USA*
- P29      AN ANISOTROPIC-WET-ETCHED PITCH OR ROLL MODE-MATCHED GYROSCOPE WITH SLANTED QUADRATURE-CANCELLATION ELECTRODES**  
H. Wen, S. Wisher, and F. Ayazi  
*Georgia Institute of Technology, USA*
- P30      ANALYSIS AND EXPERIMENTAL RESULTS OF UNTETHERED FLIGHT OF STEREOLITHOGRAPHICALLY PRINTED MEMS MICROFLIERS**  
S.A. Hussain, A. Klitzke, R. Majumdar, and I. Paprotny  
*University of Illinois, Chicago, USAUSA*
- P31      DEVELOPMENT OF A HYDRAULICALLY SMOOTH WALL SHEAR STRESS SENSOR UTILIZING THROUGH SILICON VIAS**  
C.A. Barnard, D. Mills, J. Meloy, and M. Sheplak  
*University of Florida, USA*
- P32      ELECTROMECHANICALLY ACTIVE FLAT OPTICAL DEVICES**  
T. Roy<sup>1,2</sup>, S. Zhang<sup>2</sup>, I.W. Jung<sup>1</sup>, F. Capasso<sup>2</sup>, and D. Lopez<sup>1</sup>  
*<sup>1</sup>Argonne National Laboratory, USA and <sup>2</sup>Harvard University, USA*

- P33 FLEXIBLE WIDE-BAND TWO-ARM SPIRAL ANTENNA FOR DIRECTIVITY OPTIMIZATION**  
P. Liu, S. Yang, Q. Wang, M. Yang, J. Song, and L. Dong  
*Iowa State University, USA*
- P34 HIGH-SPEED, LARGE SCAN AREA, DISTORTION-FREE OPERATION OF SINGLE-CHIP ATOMIC FORCE MICROSCOPES**  
G. Lee<sup>1,2</sup>, N. Sarkar<sup>1,2</sup>, D. Strathearn<sup>1,2</sup>, M. Olfat<sup>1,2</sup>, A. Bali<sup>1,2</sup>, and R.R. Mansour<sup>1,2</sup>  
<sup>1</sup>*University of Waterloo, CANADA and* <sup>2</sup>*ICSPI Corp., CANADA*
- P35 LITHOGRAPHY FREE SELF-RECONFIGURABLE POST-RELEASE STRESS ENGINEERING FOR FIELD-PROGRAMMABLE MICROSTRESSBOTS**  
R. Majumdar and I. Paprotny  
*University of Illinois, Chicago, USA*
- P36 NEAR-NAVIGATION GRADE QUAD MASS GYROSCOPE WITH Q-FACTOR LIMITED BY THERMO-ELASTIC DAMPING**  
S. Askari, M.H. Asadian, K. Kakavand, and A.M. Shkel  
*University of California, Irvine, USA*
- P37 PIEZOELECTRIC MEMS MICROPHONES NOISE SOURCES**  
R. Littrell and R. Gagnon  
*Vesper, USA*
- P38 OPTO-MECHANO-FLUIDIC MEMS FOR EXTREMELY HIGH-THROUGHPUT PHOTONIC SENSING OF FLOWING MICROPARTICLES**  
K. Han, J. Kim, and G. Bahl  
*University of Illinois, Urbana-Champaign, USA*
- P39 OPTOMECHANICAL TRANSDUCER-BASED SOFT AND HIGH FREQUENCY NANOSCALE CANTILEVER FOR ATOMIC FORCE MICROSCOPY**  
S. An<sup>1,2</sup>, J. Zou<sup>1,2</sup>, G. Holland<sup>1</sup>, J. Chae<sup>1,2</sup>, A. Centrone<sup>1</sup>, and V. Aksyuk<sup>1</sup>  
<sup>1</sup>*National Institute of Standard and Technology (NIST), USA and* <sup>2</sup>*University of Maryland, USA*
- P40 PIEZOELECTRIC PRESSURE ENERGY HARVESTERS USING CIRCULAR DIAPHRAGMS WITH CONCENTRIC RING-BOSS STRUCTURES**  
L. Beker<sup>1</sup>, B. Eovino<sup>1</sup>, A. Benet<sup>2</sup>, A.P. Pisano<sup>3</sup>, and L. Lin<sup>1</sup>  
<sup>1</sup>*University of California, Berkeley, USA,* <sup>2</sup>*University of California, San Francisco, USA, and* <sup>3</sup>*University of California, San Diego, USA*
- P41 STABILIZATION OF CORIOLIS VIBRATORY GYROSCOPES BY FREQUENCY LOCKING TO ULTRA STABLE CLOCKS**  
L.D. Sorenson, R. Perahia, R.J. Joyce, H.D. Nguyen, and D.T. Chang  
*HRL Laboratories, LLC, USA*

**P42 THIN FLEXIBLE AND STRETCHABLE TACTILE SENSOR BASED ON A DEFORMABLE MICROWAVE TRANSMISSION LINE**  
M.E. D'Asaro, D.B. Sheen, and J.H. Lang  
*Massachusetts Institute of Technology, USA*

### **Late News**

**P43 THERMALLY ISOLATED MICROMACHINED QUARTZ RESONATOR ARRAY FOR DIFFERENTIAL MICRO-CALORIMETRIC MEASUREMENTS**  
D. Gaddes and S. Tadigadapa  
*Pennsylvania State University, USA*

**P44 MICROFLUIDIC LABEL-FREE IMMUNOCHIP FOR EARLY DIAGNOSTICS OF BREAST CANCER USING FUNCTIONALIZED POROUS GRAPHENE**  
M.A. Ali, S. Oren, Y. Jiao, Y. Wang, Z. Xu, and L. Dong  
*Iowa State University, USA*

**P45 TOWARDS PATHOGEN DETECTION VIA OPTICAL INTERROGATION OF MAGNETIC MICRODISCS**  
K.Y. Castillo-Torres, N. Garraud, E.S. McLamore, and D.P. Arnold  
*University of Florida, USA*

**P46 ULTRA LOW COST BLOOD DIAGNOSTIC CHIP FOR POINT-OF-CARE CLINICAL DETECTION**  
K.K. Lee and C.I. Hong  
*University of Cincinnati, USA*

### **Bio-Inspiration and Biomedical Devices**

**P47 A BIO-INSPIRED REFERENCE ELECTRODE: REGULATING THE RESPIRATION OF MICRO-ORGANISMS**  
H. Ren, C.I. Torres, and J. Chae  
*Arizona State University, USA*

**Poster Session 2**  
**Contributed and Late News**  
**Wednesday, June 8 1:45 pm – 4:15 pm**

**Bio-Inspiration and Biomedical Devices**

- P48 A HEXAGONAL MULTIPOINT PH AND TEMPERATURE SENSING NEEDLE FOR 3D PIG HEART MUSCLE PH MONITORING WITH TEMPERATURE COMPENSATION**  
Y.D. Lee<sup>1</sup>, J.C. Pan<sup>1</sup>, Y.T. Cheng<sup>1</sup>, and Y.S. Chen<sup>2</sup>  
*<sup>1</sup>National Chiao Tung University, TAIWAN and*  
*<sup>2</sup>National Taiwan University Hospital, TAIWAN*
- P49 A WIRELESS PASSIVE STIMULATOR OF CARDIOMYOCYTES**  
S. Liu, A. Navaei, M. Nikkhah, and J. Chae  
*Arizona State University, USA*
- P50 DEEP BRAIN TARGETING STRATEGY FOR BARE PARYLENE NEURAL PROBE ARRAYS**  
A. Weltman, H. Xu, K. Scholten, T.W. Berger, D. Song, and E. Meng  
*University of Southern California, USA*
- P51 INVESTIGATIONS OF BIO-INK RHEOLOGICAL PROPERTIES FOR DROP ON DEMAND PIEZOELECTRIC CELL PRINTING**  
Y. Li, E. Cheng, H. Yu, A. Ahmadi, and K.C. Cheung  
*University of British Columbia, CANADA*
- P52 PARYLENE ENCAPSULATED SUB-MICRON STRUCTURES FOR IMPLANTABLE BIOMEMS**  
K. Scholten and E. Meng  
*University of Southern California, USA*
- P53 ULTRA-DIELECTROPHORETIC FORCE SPECTROSCOPY ARRAY FOR PROBING INTERMOLECULAR AFFINITIES**  
S. Emaminejad<sup>1,2,3</sup>, S. Talebi<sup>2,3</sup>, A. Javey<sup>1</sup>, R.W. Davis<sup>2,3</sup>, and M. Javanmard<sup>4</sup>  
*<sup>1</sup>University of California, Berkeley, USA, <sup>2</sup>Stanford School of Medicine, USA,*  
*<sup>3</sup>Stanford University, USA, and <sup>4</sup>Rutgers University, USA*

**Biological Diagnostics, Systems, and Analysis**

- P54 A DEP-BASED LAB-ON-A-CHIP SYSTEM FOR THE DETECTION OF MULTIDRUG RESISTANCE IN K562 LEUKEMIA CELLS**  
Y. Demircan Yalçın<sup>1,2</sup>, G. Özkayar<sup>1,2</sup>, E. Özgür<sup>2</sup>, U. Gündüz<sup>1</sup>, and H. Külah<sup>1,2</sup>  
*<sup>1</sup>Middle East Technical University (METU), TURKEY and*  
*<sup>2</sup>Mikro Biyosistemler Inc., TURKEY*



- P55 A FLEXIBLE, LARGE-SCALE DIAMOND-POLYMER CHEMICAL SENSOR FOR NEUROTRANSMITTER DETECTION**  
 B. Fan<sup>1</sup>, Y. Zhu<sup>1</sup>, R. Rechenberg<sup>2</sup>, M.F. Becker<sup>2</sup>, and W. Li<sup>1</sup>  
<sup>1</sup>Michigan State University, USA and <sup>2</sup>Fraunhofer USA, Inc., USA
- P56 A PARYLENE PERIPHERAL NERVE CUFF ELECTRODE WITH INTEGRATED MICROFLUIDICS**  
 A. Cobo<sup>1</sup>, K. Scholten<sup>1</sup>, J. Yoo<sup>1</sup>, C. Larson<sup>1</sup>, T. Hudson<sup>1</sup>, V. Pikov<sup>2</sup>, and E. Meng<sup>1</sup>  
<sup>1</sup>University of Southern California, USA and <sup>2</sup>GlaxoSmithKline, UK
- P57 BIODEGRADABLE ELECTRICAL INTERCONNECTS FOR TRANSIENT IMPLANTABLE SYSTEMS**  
 T. Zhang<sup>1</sup>, M. Tsang<sup>2</sup>, and M.G. Allen<sup>1</sup>  
<sup>1</sup>University of Pennsylvania, USA and <sup>2</sup>Georgia Institute of Technology, USA
- P58 LOW-POWER ELECTRICALLY CONTROLLED THERMOELASTIC MICROFLUIDIC VALVE ARRAY FOR MULTIPLEXED IMMUNOASSAY**  
 C.-W. Wang, S. Augustine, T. Nishida, and Z.H. Fan  
 University of Florida, USA
- P59 MEMS AIR-MICROFLUIDIC LAB-ON-A-CHIP SENSOR FOR PERSONAL MONITORING OF AIRBORNE PARTICULATE MATTER**  
 D. Fahimi<sup>1</sup>, O. Mahdavi<sup>1</sup>, T. Cados<sup>2</sup>, T. Kirchstetter<sup>2</sup>, P. Solomon<sup>3</sup>, L. Gundel<sup>2</sup>, R.M. White<sup>4</sup>, N. Fukushima<sup>5</sup>, H. Nagai<sup>5</sup>, M. Saitoh<sup>5</sup>, and I. Paprotny<sup>1</sup>  
<sup>1</sup>University of Illinois, Chicago, USA, <sup>2</sup>Lawrence Berkeley National Laboratory, USA, <sup>3</sup>U.S. Environmental Protection Agency, USA, <sup>4</sup>University of California, Berkeley, USA, and <sup>5</sup>Kanomax Inc., JAPAN
- P60 MICROELECTRODE ARRAYS IN THIN-LAYER CELLS FOR RAPID, SENSITIVE, AND CALIBRATION-LESS DETERMINATION OF ARSENIC IN  $\mu\text{L}$  VOLUMES BY ANODIC STRIPPING COULOMETRY**  
 M.M. Marei, T.J. Roussel, M.M. Crain, R.P. Baldwin, and R.S. Keynton  
 University of Louisville, USA
- P61 CAPILLARY MICROFLUIDICS-INTEGRATED IMPEDANCE SENSOR FOR RAPID LABEL-FREE ANTIBODY SENSING**  
 F. Zang, S. Chu, K. Gerasopoulos, J.N. Culver, and R. Ghodssi  
 University of Maryland, USA
- P62 REDUCED GRAPHENE OXIDE SENSOR FOR QUANTIFICATION OF METABOLITES IN EXHALED BREATH CONDENSATE**  
 A. Gholizadeh, D. Voiry, C. Wiesel, A. Gow, R. Laumbach, H. Kipen, M. Chhowalla, and M. Javanmard  
 Rutgers University, USA

- P63 THE BIOSENTINEL BIOANALYTICAL MICROSYSTEM: CHARACTERIZING DNA RADIATION DAMAGE IN LIVING ORGANISMS BEYOND EARTH ORBIT**  
A.J. Ricco<sup>1</sup>, R. Hanel<sup>1</sup>, S. Bhattacharya<sup>1</sup>, T. Boone<sup>1</sup>, M. Tan<sup>1</sup>, A. Mousavi<sup>1</sup>, M. Padgen<sup>1</sup>, D. Gentry<sup>1</sup>, A. Rademacher<sup>1</sup>, A. Schooley<sup>1</sup>, B. Klamm<sup>1</sup>, J. Benton<sup>1</sup>, C. Friedericks<sup>1</sup>, G. Defouw<sup>1</sup>, M. Parra<sup>1</sup>, S. Santa Maria<sup>1</sup>, D. Marina<sup>1</sup>, B. Lewis<sup>1</sup>, H. Sanchez<sup>1</sup>, J. Chartres<sup>1</sup>, D. McIntosh<sup>1</sup>, T. Lusby<sup>1</sup>, S. Gavalas<sup>2</sup>, S. Wheeler<sup>2</sup>, and Johnson Space Center Radworks Group<sup>2</sup>  
<sup>1</sup>NASA Ames Research Center, USA and <sup>2</sup>NASA Johnson Space Center, USA

## Chemical and Gas Sensors

- P64 2DEG-HEATED AlGaIn/GaN MICRO-HOTPLATES FOR HIGH-TEMPERATURE CHEMICAL SENSING MICROSYSTEMS**  
M. Hou, A.J. Suria, A.S. Yalamarthy, H. So, and D.G. Senesky  
*Stanford University, USA*
- P65 DEVELOPMENT OF A MEMS PRECONCENTRATOR (PC) - GAS CHROMATOGRAPH (GC) FOR THE SPACECRAFT ATMOSPHERE MONITOR FOR ISS AND ORION**  
B. Bae, W.G. Rellergert, J. Simcic, J.J. Gill, M.L. Homer, E.L. Neidholdt, D. Nikolic, R.D. Kidd, S.M. Madzunkov, and M.R. Darrach  
*California Institute of Technology, USA*
- P66 MICRO-SCALE ELECTROCHEMICAL GAS SENSOR FOR SELECTIVE DETECTION OF VOLATILE POLLUTANTS**  
P.-A. Gross<sup>1,3</sup>, T. Larsen<sup>1,2</sup>, F. Loizeau<sup>1</sup>, T. Jaramillo<sup>1</sup>, D. Spitzer<sup>3</sup>, and B.L. Pruitt<sup>1</sup>  
<sup>1</sup>Stanford University, USA, <sup>2</sup>Ecole Polytechnique Fédérale de Lausanne, SWITZERLAND and <sup>3</sup>ISL/CNRS/UNISTRA, FRANCE
- P67 MICROFABRICATED THERMAL PRE-CONCENTRATOR WITH INTEGRATED CANTILEVER-BASED RESONANT SENSORS**  
C. Carron<sup>1,2</sup>, P. Getz<sup>1</sup>, M. Navaei<sup>1</sup>, G. McMurray<sup>1</sup>, and O. Brand<sup>1</sup>  
<sup>1</sup>Georgia Institute of Technology, USA and <sup>2</sup>Harris Corporation, USA

## Microfluidics

- P68 A LOW-VOLTAGE MICROFLUIDIC VALVE BASED UPON A REVERSIBLE HYDROPHOBICITY EFFECT**  
R. Wang, W. Yu, M.N. Kozicki, and J. Chae  
*Arizona State University, USA*
- P69 A SCALABLE ELECTRONIC SENSOR FOR MULTIPLEXED DETECTION OF CELLS IN DIFFERENT MICROFLUIDIC CHANNELS**  
R. Liu, N. Wang, W. Waheed, and A.F. Sarioglu  
*Georgia Institute of Technology, USA*

- P70 HIGH HEAT FLUX EVAPORATIVE NANOPOROUS SILICON MEMBRANE DEVICE FOR ADVANCED THERMAL MANAGEMENT**  
 D.F. Hanks<sup>1</sup>, J. Sircar<sup>1</sup>, Z. Lu<sup>1</sup>, D.S. Antao<sup>1</sup>, K.R. Bagnall<sup>1</sup>, B. Barabadi<sup>1</sup>, T.R. Salamon<sup>2</sup>, and E.N. Wang<sup>1</sup>  
<sup>1</sup>Massachusetts Institute of Technology, USA and <sup>2</sup>Alcatel Lucent, USA
- P71 MICROFLUIDIC FLOW-THROUGH MICROBIAL FUEL CELLS**  
 H. Jiang, M.A. Ali, Z. Xu, L.J. Halverson, and L. Dong  
 Iowa State University, USA
- P72 RECONFIGURABLE ION SELECTIVE SENSOR ARRAY ENABLED BY DIGITAL MICROFLUIDICS**  
 A. Farzbod and H. Moon  
 University of Texas, Arlington, USA

### Power Generation and Management

- P73 A BIOLOGICAL FUEL CELL MICROFABRICATED WITHIN A SINGLE SHEET OF PAPER**  
 Y. Gao and S. Choi  
 State University of New York, Binghamton, USA
- P74 A HIGH POWER-DENSITY, SELF-SUSTAINED HYBRID BIO-SOLAR CELL WITH CO-CULTURE OF HETEROTROPHIC AND PHOTOSYNTHETIC BACTERIA**  
 X. Wei, W. Yang, and S. Choi  
 State University of New York, Binghamton, USA
- P75 A PVDF-BASED FLEXIBLE AND SHAPEABLE ACOUSTIC POWER SOURCE FOR IMPLANTABLE BIOMEDICAL DEVICES**  
 J. Zhou, R. Rahimi, A. Kim, M. Ochoa, and B. Ziaie  
 Purdue University, USA
- P76 VIBRATION ENERGY HARVESTER BASED ON FLOATING MAGNET FOR GENERATING POWER FROM HUMAN MOVEMENT**  
 Y. Wang, L. Zhao, A. Shkel, Y. Tang, and E.S. Kim  
 University of Southern California, USA

### Resonant Devices

- P77 130 SECOND RING-DOWN TIME AND 3.98 MILLION QUALITY FACTOR IN 10 KHZ FUSED SILICA MICRO BIRDBATH SHELL RESONATOR**  
 T. Nagourney, J.Y. Cho, A. Darvishian, B. Shiari, and K. Najafi  
 University of Michigan, USA

- P78 920 MHz ALUMINUM NITRIDE CROSS-SECTIONAL LAMÉ MODE PIEZOELECTRIC MEMS TRANSFORMER WITH HIGH OPEN-CIRCUIT VOLTAGE GAIN IN EXCESS OF 39**  
C. Cassella, G. Chen, Z. Qian, G. Hummel, and M. Rinaldi  
*Northeastern University, USA*
- P79 MULTIMODE BLACK PHOSPHORUS NANOMECHANICAL RESONATORS WITH INTRINSIC MECHANICAL ANISOTROPY AND ELECTRICAL TUNABILITY**  
H. Jia, Z. Wang, and P.X.-L. Feng  
*Case Western Reserve University, USA*
- P80 FERROMAGNETIC RESONANCE IN BULK-ACOUSTIC WAVE MULTIFERROIC DEVICES**  
S. Tiwari<sup>1</sup>, P. Nordeen<sup>1</sup>, Q. Xu<sup>1</sup>, Z. Yao<sup>1</sup>, Y.E. Wang<sup>1</sup>, G.P. Carman<sup>1</sup>, and R.N. Candler<sup>1,2</sup>  
<sup>1</sup>*University of California, Los Angeles, USA and*  
<sup>2</sup>*California NanoSystems Institute, USA*
- P81 HIGH SENSITIVITY BIDIRECTIONAL PRESSURE SENSOR BASED ON FORCE FREQUENCY EFFECT IN MICROMACHINED AT-CUT QUARTZ RESONATORS**  
N. Goel<sup>1</sup>, S. Bart<sup>2</sup>, and S. Tadigadapa<sup>1</sup>  
<sup>1</sup>*Pennsylvania State University, USA and* <sup>2</sup>*MKS Instruments, Inc., USA*
- P82 MODE- AND DIRECTION-DEPENDENT AKHIEZER DAMPING IN SINGLE-CRYSTAL SILICON RESONATORS**  
S.S. Iyer<sup>1</sup> and R.N. Candler<sup>1,2</sup>  
<sup>1</sup>*University of California, Los Angeles, USA and*  
<sup>2</sup>*California NanoSystems Institute, USA*
- P83 RING-SHAPED PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS (PMUT) WITH INCREASED PRESSURE GENERATION**  
B.E. Eovino, S. Akhbari, and L. Lin  
*University of California, Berkeley, USA*
- P84 SCANDIUM DOPED ALUMINUM NITRIDE BASED PIEZOELECTRIC MICROMACHINED ULTRASOUND TRANSDUCERS**  
Q. Wang<sup>1</sup>, Y. Lu<sup>1</sup>, S. Fung<sup>1</sup>, X. Jiang<sup>2</sup>, S. Mishin<sup>3</sup>, Y. Oshmyansky<sup>3</sup>, and D.A. Horsley<sup>1</sup>  
<sup>1</sup>*University of California, Davis, USA,* <sup>2</sup>*University of California, Berkeley, USA, and*  
<sup>3</sup>*Advanced Modular System, Inc., USA*
- P85 SINGLE-CRYSTAL DIAMOND NEMS DEVICES FOR THE STUDY OF COLOR CENTERS**  
Y.-I. Sohn, S. Meesala, M.J. Burek, H.A. Atikian, and M. Lončar  
*Harvard University, USA*

- P86      SYSTEMATIC DESIGN OF MEMS RESONATORS FOR OPTIMAL  
NONLINEAR DYNAMIC RESPONSE**  
L.L. Li<sup>1</sup>, P.M. Polunin<sup>2</sup>, S. Dou<sup>3</sup>, O. Shoshani<sup>4</sup>, B.S. Strachan<sup>2,5</sup>, J.S. Jensen<sup>3</sup>,  
S.W. Shaw<sup>2,4</sup>, and K.L. Turner<sup>1</sup>  
<sup>1</sup>University of California, Santa Barbara, USA, <sup>2</sup>Michigan State University, USA,  
<sup>3</sup>Technical University of Denmark, DENMARK, <sup>4</sup>Florida Institute of Technology,  
USA, and <sup>5</sup>SiTime Corporation, USA
- P87      THE EFFECT OF CRYSTALLINE ORIENTATION ON VIBRATION SENSITIVITY  
OF SILICON MICRO-RESONATORS**  
B. Khazaeili and R. Abdolvand  
University of Central Florida, USA

## Late News

- P88      3D SELF-ASSEMBLED MICROSCALE RESONATOR AS ULTRA SENSITIVE  
ISOTROPIC SENSOR**  
K. Agarwal, C. Liu, D. Joung, and J.-H. Cho  
University of Minnesota, USA
- P89      A PRELIMINARY STUDY OF AN ELECTROSTATIC CURVED BEAM  
ACTUATOR FOR A BIO-MEMS FORCE SENSOR**  
B.S. Preetham, M.A. Lake, and D.J. Hoelzle  
University of Notre Dame, USA
- P90      GALLIUM NITRIDE HIGH-ORDER MODE LAMB-WAVE RESONATORS AND  
DELAY-LINES**  
A. Ansari, H. Zhu, and M. Rais-Zadeh  
University of Michigan, USA
- P91      SHOCK MITIGATED MICRO-ELECTROMECHANICAL SYSTEMS STRUCTURE**  
A. Chen, S. Nam, Y.C. Lai, and J. Chae  
Arizona State University, USA
- P92      REDUCED RADIUS OF CURVATURE AND OPTICAL ACTUATION OF  
NITINOL SHAPE MEMORY ALLOY MEMS ACTUATORS**  
C.R. Knick, M.D. Srour, and C.J. Morris  
US Army Research Laboratory, USA
- P93      TEMPERATURE SENSITIVITY OF SOLID-WAVE GYROSCOPES**  
E. Yilmaz and D. Bindel  
Cornell University, USA
- P94      A MEMS BASED METHOD TO FABRICATE A MICRO PRESSURE SWIRL  
ATOMIZER AND ITS PERFORMANCE**  
D. Kumaran<sup>1</sup>, D. Gaddes<sup>2</sup>, E. Freeman<sup>2</sup>, S. Tadigadapa<sup>2</sup>,  
and M.V. Panchagnula<sup>1</sup>  
<sup>1</sup>Indian Institute of Technology, Madras, INDIA and  
<sup>2</sup>Pennsylvania State University, USA

**Poster Session 3**  
**Commercial and Open Posters**  
**Wednesday, June 8 5:30 pm - 7:00 pm**

**Commercial**

- C01 3-D VIBRATION AND MOTION TESTING OF DEVICES AND MICROSYSTEMS WITH PICOMETER RESOLUTION USING A NEW LASER DOPPLER VIBROMETRY APPROACH**  
D. Oliver  
*Polytec, Inc., USA*
- C02 A NATURE JOURNAL: MICROSYSTEMS & NANOENGINEERING**  
T. Cui<sup>1</sup>, T. Liu<sup>2</sup>, C. Zhang<sup>3</sup>, and X. Bai<sup>4</sup>  
<sup>1</sup>*University of Minnesota, USA,* <sup>2</sup>*Chinese Academy of Sciences, CHINA,*  
<sup>3</sup>*Nature Publishing Group, UK, and*  
<sup>4</sup>*Editorial Office of Microsystems & Nanoengineering, CHINA*
- C03 A SCANNING MEMS MIRROR FOR LASER PROJECTORS**  
D. Bordelon<sup>1</sup>, M. Naftali<sup>2</sup>, and A. Baram<sup>2</sup>  
<sup>1</sup>*MEMSCAP Inc., USA and* <sup>2</sup>*Maradin Ltd., ISRAEL*
- C04 CAD TOOLS INCORPORATING MANUFACTURING VARIATIONS**  
M.A. Maher<sup>1</sup> and S. Cases<sup>2</sup>  
<sup>1</sup>*SoftMEMS LLC, USA and* <sup>2</sup>*SoftMEMS EURL, FRANCE*
- C05 CONFIGURABLE MEMS IP BLOCKS ARE COMING!**  
S. Breit and S. Truax  
*Coventor, Inc., USA*
- C06 DIRECT WRITE LITHOGRAPHY FOR THE INTERNET OF THINGS**  
J. Sasserath  
*Advanced Micro Patterning, a Division of Rave NP, USA*
- C07 ELECTROFORMED MAGNETIC MICROPORE FILTERS FOR HIGH THROUGHPUT IMMUNOMAGNETIC SORTING**  
J. Ko, V. Yelleswarapu, A. Singh, and D. Issadore  
*University of Pennsylvania, USA*
- C08 GREATLY IMPROVING XENON DIFLUORIDE ETCHING SELECTIVITY OF SILICON TO SILICON NITRIDE**  
J. Neumann, K. Leboutitz, and D. Springer  
*SPTS Technologies, USA*

- C09 HOLOGRAPHIC MEMS ANALYZER**  
*LyncéeTec, SWITZERLAND*
- C10 INTELLECTUAL PROPERTY PROTECTION -COMMON MISCONCEPTIONS AND REALITIES**  
J. Walker and W. Breyer  
*Kaplan Breyer Schwarz & Ottesen, LLP, USA*
- C11 MASKLESS ALIGNERS AND APPLICATIONS**  
G. Moore and N. Wijnaendts van Resandt  
*Heidelberg Instruments, Inc., USA*
- C12 NNCI: THE NEXT GENERATION OF SHARED NANOTECHNOLOGY RESOURCES**  
D. Gottfried  
*Georgia Institute of Technology, USA*
- C13 PLASMA ETCH AND DEPOSITION PROCESSES FOR SENSORS AND ACTUATORS**  
M. Steel<sup>1</sup>, H. Knoops<sup>1,2</sup>, and R. Sundaram<sup>1</sup>  
<sup>1</sup>*Oxford Instruments, UK and*  
<sup>2</sup>*Technical University of Eindhoven, THE NETHERLANDS*
- C14 R&D PROCESSING SOLUTIONS TO MEET IOT CHALLENGES**  
T. O'Hara and D. Drysdale  
*memsstar Limited, UK*
- C15 RECENT MEMS SIMULATION INNOVATIONS: DRIE SIMULATOR CALIBRATION, NON-LINEAR DEVICE SIMULATION, ROBUST PROCESS MODEL MESHING**  
T. Hall and Y. He  
*IntelliSense Software Corp., USA*
- C16 REMOVAL OF ORGANIC SACRIFICIAL LAYERS IN MEMS DEVICE MANUFACTURING**  
Y. Xu<sup>1</sup>, V. Tarasov<sup>1</sup>, W. Chen<sup>1</sup>, and K. Suu<sup>2</sup>  
<sup>1</sup>*ULVAC, Inc., USA and* <sup>2</sup>*ULVAC, Inc., JAPAN*
- C17 TECHNOLOGY ENABLERS THAT ENHANCE FAB PRODUCTIVITY AND CAPITAL EFFICIENCY WITH INNOVATIVE SOLUTIONS FOR THE MEMS DEVICES**  
M. Bourke, J. Minami, L. Hoang, P. Nowakowski, and T. Pandhumsoporn  
*Lam Research Corporation, USA*

## Open Posters

**OP01 A MEMS SENSOR PLATFORM FOR IN SITU CHARACTERIZATION OF LI-ION BATTERY ELECTRODES**

H. Jung<sup>1</sup>, K. Gerasopoulos<sup>2</sup>, A.A. Talin<sup>3</sup>, and R. Ghodssi<sup>1</sup>

<sup>1</sup>University of Maryland, College Park, USA, <sup>2</sup>Johns Hopkins University Applied Physics Laboratory, USA, and <sup>3</sup>Sandia National Laboratories, USA

**OP02 A SINGLE SEMESTER PROBLEM-ORIENTED MEMS COURSE USING A QUASI-SURFACE MICROMACHINING FABRICATION PROCESS (UIC SOI)**

I. Paprotny, R. Majumdar, M. Humayun, A. DiVenere, S. An, S. Rajoria, R. Mohan, N. Farajpour, R. Jain, and M. Sheth

University of Illinois, Chicago, USA

**OP03 AMPLITUDE AND FREQUENCY SATURATION FROM MODE COUPLING IN MEMS RESONATORS**

O. Shoshani<sup>1</sup>, B.S. Strachan<sup>2,3</sup>, P.M. Polunin<sup>3</sup>, S.W. Shaw<sup>1,2</sup>, M.I. Dykman<sup>3</sup>, C. Chen<sup>4</sup>, D.A. Czaplewski<sup>4</sup>, and D. Lopez<sup>4</sup>

<sup>1</sup>Florida Institute of Technology, USA, <sup>2</sup>SiTime Corporation, USA,

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**OP04 DESIGN AND FABRICATION OF A HIGHLY TUNABLE GRAPHENE-BASED NANO-ELECTROMECHANICAL RESONATOR SYSTEM**

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**OP05 ENGINEERED SURFACES FOR CONTROLLING SECONDARY ELECTRON EMISSION TO SUPPRESS MULTIFACTOR**

J.M. Sattler, R.A. Coutu, and T. Laurvick

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**OP06 LOW-COST, HIGH-THROUGHPUT MICROFLUIDIC DROPLET INCUBATORS CAPABLE OF GENERATING STABLE THERMAL GRADIENT**

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Iowa State University, USA

**OP07 MATERIALS TO ENABLE LOW-POWER NEM-BASED COMPUTATION**

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**OP08 MEMS ARE BECOMING 3D AND ATOMICALLY PRECISE**

A.M. Shkel, A. Efimovskaya, S. Askari, M.H. Asadian, Y. Wang, Y. Lin, R. Mohammednoor, and B. Seifi

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- OP09 MICRO ASSEMBLY PRINTER**  
E.M. Chow, J.P. Lu, J.A. Bert, S. Raychourdhuri, G.L. Whiting, I. Matei, P. Maeda, G. Burton, S. Nelaturi, L. Crawford, D.K. Biegelsen, and Y. Wang  
*Palo Alto Research Center, USA*
- OP10 MIND: MICROSYSTEMS DEVELOPMENT FOR NEUROPSYCHIATRIC DISORDERS**  
T.E. Winkler<sup>1</sup>, G.E. Banis<sup>1</sup>, S.E. Chocron<sup>1</sup>, E. Kim<sup>1</sup>, H. Ben-Yoav<sup>2</sup>, G.F. Payne<sup>1</sup>, D.L. Kelly<sup>3</sup>, and R. Ghodssi<sup>1</sup>  
<sup>1</sup>*University of Maryland, College Park, USA*, <sup>2</sup>*Ben-Gurion University of the Negev, ISRAEL*, and <sup>3</sup>*University of Maryland, Baltimore, USA*
- OP11 PHASE NOISE REDUCTION IN A MEMS OSCILLATOR USING A NONLINEARITY ENHANCED SYNCHRONIZATION DOMAIN**  
O. Shoshani<sup>1</sup>, D. Heywood<sup>2</sup>, Y. Yang<sup>2</sup>, T.W. Kenny<sup>2</sup>, and S.W. Shaw<sup>1</sup>  
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- OP12 REMOTE-CONTROLLED MICRO-SCALE THREE-DIMENSIONAL SELF-ASSEMBLY USING MICROWAVE ENERGY**  
C. Liu, D. Joung, J. Schauff, and J.H. Cho  
*University of Minnesota, USA*
- OP13 REVEALING AND CHARACTERIZING NOISE SOURCES IN MEMS RESONATORS**  
P.M. Polunin<sup>1</sup>, Y. Yang<sup>1</sup>, S.W. Shaw<sup>1,3</sup>, T.W. Kenny<sup>2</sup>, and M.I. Dykman<sup>1</sup>  
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- OP14 SELF-POWERING WIRELESS TEMPERATURE SENSOR NODE**  
P. Wang, X.-Q. Zheng, Z. Wang, and P.X.-L. Feng  
*Case Western Reserve University, USA*
- OP15 TOWARDS BROADBAND ELECTRO-OPTO-MECHANICAL MODULATION AT 780NM**  
D.B. Sohn and G. Bahl  
*University of Illinois, Urbana-Champaign, USA*
- OP16 ULTRAFast GATING OF X-RAY PULSES FROM SYNCHROTRONS FOR TIME-RESOLVED SCIENCE**  
I.W. Jung, Z. Li, Y. Gao, D.A. Walko, J. Wang, G.K. Shenoy, and D. Lopez  
*Argonne National Laboratory, USA*
- OP17  $\mu$ BIODAT: MICROSYSTEMS FOR BIOFILM OBSERVATION, DETECTION AND TREATMENT**  
S. Subramanian<sup>1</sup>, R.C. Huiszoon<sup>1</sup>, H.O. Sintim<sup>2</sup>, W.E. Bentley<sup>1</sup>, and R. Ghodssi<sup>1</sup>  
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