

2008 17th Biennial University/Government/Industry Micro-Nano Symposium

Proceedings

The Brown Hotel

Louisville, KY

July 13—July 16, 2008



UNIVERSITY OF
LOUISVILLE
It's Happening Here.

Table of Contents

Monday, July 14, 2008

Keynote Speaker

Facilitating Nanotechnology:
Collaboration, User Dreams and Limited Budgets 1
Abbie Gregg, Abbie Gregg, Inc., USA

Session 1 - Electrowetting: Novel Devices and Applications

I-V and Gain Characteristics of
Electrowetting-Based Liquid Field Effect Transistor 2
*Duk Young Kim, University of Cincinnati, USA; Stephen Herman, University of
Cincinnati, USA; Andrew J. Steckl, University of Cincinnati, USA*

A Capillary Microgripper Using Electrowetting..... 6
*Abhay Vasudev, University of Akron, USA;
Jiang Zhe, The University of Akron, USA*

Experimental Validation of >1 kHz Electrowetting Modulation 11
*N. R. Smith, University of Cincinnati, USA; L. Hou, University of Cincinnati, USA;
J. Zhang, University of Cincinnati, USA; J. Heikenfeld, University of
Cincinnati, USA*

Session 2 - Cleanroom Facilities and Infrastructure

Cornell's Nanomove:
Decontamination, Safety Reviews, and Various Lessons Learned..... 15
Daniel Woodie, Cornell University, USA; Lynn Rathbun, Cornell University, USA

Coral - Software to Help Operate and
Manage Advanced University Laboratories 20
*Bill Murray, Stanford University, USA; Mike Murray, Stanford University, USA;
John Shott, Stanford University, USA; Ike Lin, Massachusetts Institute of
Technology, USA*

Enterprise Dashboard Tools for
Management of Share-Use University Laboratory 24
*Eric Martin, Harvard University, USA;
Vincenzo Di Bernardo, Harvard University, USA*

Consolidation and Improvement of
Nanotechnology Research Facilities at the University of Kentucky 28
Charles E. May, University of Kentucky, USA

Flexible Display Center at Arizona State University:
A Unique Industry-Government-Academic Partnership for
Creating Revolutionary Information Display Technology 31
Gregory B. Raupp, Arizona State University, USA

Keynote Speaker

Challenges and Opportunities for Transformative Research at NSF 34
Rajinder P. Khosla, National Science Foundation, USA

Session 3 - Special Topics

Device Fabrication for Data Storage, Semiconductor and MEMS
Applications at the University of Alabama Microfabrication Facility 35
*S. Gupta, University of Alabama, USA; A. Highsmith, University of Alabama, USA;
Xiao Li, University of Alabama, USA; Z. R. Tadisina, University of Alabama, USA;
M. E. Brown, University of Alabama, USA; C. L. Guenther, University of Alabama,
USA; S. Burkett, University of Alabama, USA; S. Kotru, University of
Alabama, USA*

NanoBioMaterials - From BioLEDs to Tissue Engineering..... 41
Andrew J. Steckl, University of Cincinnati, USA

An Electronic Tongue System Design Using Ion Sensitive
Field Effect Transistors and their Interfacing Circuit Techniques..... 44
*Wen-Yaw Chung, Chung-Yuan Christian University, Taiwan, R.O.C.;
Kuo-Chung Chang, Chung-Yuan Christian University, Taiwan, R.O.C.;
Da-You Hong, Chung-Yuan Christian University, Taiwan, R.O.C.; Cheanyeh
Cheng, Chung-Yuan Christian University, Taiwan, R.O.C.; Febus Cruza, Chung-
Yuan Christian University, Taiwan, R.O.C.; Tai Sung Liu, Chung-Yuan Christian
University, Taiwan, R.O.C.; Chung Huang Yang, Vanung University of
Technology, Taiwan, R.O.C.; Jung-Lung Chiang, Chung-Chou Institute of
Technology, Taiwan, R.O.C.; Dorota G. Pijanowska, Polish Academy of Sciences,
Poland; Marek Dawgul, Polish Academy of Sciences, Poland; Wladyslaw Torbicz,
Polish Academy of Sciences, Poland; Pitor B. Grabiec, Institute of Electron
Technology, Poland; Bohdan Jarosewicz, Institute of
Electron Technology, Poland*

Session 4 - Semiconductor Devices

Inversion-Type Enhancement-Mode InP Mosfets with
ALD High-K Al₂O₃ and HFO₂ as Gate Dielectrics..... 49
*Y. Q. Wu, Purdue University, USA; M. Xu, Purdue University, USA;
Y. Xuan, Purdue University, USA; P. D. Ye, Purdue University, USA;
J. Li, AmberWave, USA; Z. Cheng, AmberWave, USA;
A. Lochtefeld, AmberWave, USA*

A New Fabrication Procedure for Reproducibly Observing Leakage Current
Reduction of SiO₂ due to Enhanced Phonon-Energy Coupling 53
*Pang-Leen Ong, University of Kentucky, USA;
Zhi Chen, University of Kentucky, USA*

Compact Models of the Quantized Sub-Band Energy Levels for
MOSFET Device Application..... 58
*H. Abebe, USC/ISI, USA; E. Cumberbatch, CGU, USA;
H. Morris, CGU, USA; V. Tyree, USC/ISI, USA*

Microfabrication Process and Characteristic Testing of
a MEMS-Based Preconcentrator..... 61
*Julia Aebersold, University of Louisville, USA; Michael Martin, University of
Louisville, USA; Thomas J. Roussel, University of Louisville, USA;
Robert S. Keynton, University of Louisville, USA; Kevin M. Walsh, University of
Louisville, USA*

Design of a 32nm Independently-Double-Gated FlexFET SOI Transistor..... 64
*K. Modzelewski, Tennessee Tech University, USA; R. Chintala, Tennessee Tech
University, USA; H. Moolamalla, Tennessee Tech University, USA; Stephen Parke,
Tennessee Tech University, USA; D. Hackler, American Semiconductor, Inc., USA*

Tuesday, July 15, 2008

Keynote Speaker

Nanoparticles: A Route to Post-Shrink Information Systems..... 68
S. A Campbell, University of Minnesota, USA

Session 5 - University Micro-Nano Curriculum Development

MEMS Fabrication Course for Pressure Sensors,
Flow Sensors, Fluidic Channels and Micro-Pumps 70
*Robert E. Pearson, RIT, USA; Lynn F. Fuller, Rochester Institute of Technology,
USA; Ivan Puchades, Rochester Institute of Technology, USA*

A Course for Designing Transistors for High Gain Analog Applications 75
David W. Parent, SJSU, USA; Eric J. Basham, UCSC, USA

A New Test Chip for CMOS Manufacturing Laboratory Courses at RIT..... 79
*Burak Baylav, Rochester Institute of Technology, USA ; Lynn F. Fuller, Rochester
Institute of Technology, USA; Dhireesha Kudithipudi, Rochester Institute of
Technology, USA*

MEMS Courses for Undergraduates 85
*Azad Siahmakoun, Rose-Hulman Institute of Technology, USA;
Aaron Miller, Rose-Hulman Institute of Technology, USA*

Session 6 - MEMS Sensors and Actuators

Development of Ultra-Miniaturized Piezoresistive
Pressure Sensors for Biomedical Applications 89
*Usha Gowrishetty, University of Louisville, USA; Kevin M. Walsh, University of
Louisville, USA ; Julia Aebersold, University of Louisville, USA; Douglas Jackson,
University of Louisville, USA; Huntly Millar Instruments Inc., USA;
Tommy Roussel, University of Louisville, USA*

Design and Evaluation of a MEMS Bimetallic
Thermal Actuator for Viscosity Measurements 93
*Ivan Puchades, Rochester Institute of Technology, USA;
Lynn F. Fuller, Rochester Institute of Technology, USA*

A High Gauge Factor Capacitive Strain Sensor and its Telemetry Application in Biomechanics 98
Ji-Tzuoh Lin, University of Louisville, USA; Douglas Jackson, University of Louisville, USA; Julia Aebersold, University of Louisville, USA; Kevin M. Walsh, University of Louisville, USA; John Naber, University of Louisville, USA; William Hnat, University of Louisville, USA

Vacuum Cold Cathode Emitter Electronic Devices Comprised of Diamond or other Carbons 102
J. L. Davidson, Vanderbilt University, USA; W. P. Kang, Vanderbilt University, USA; K. Subramanian, Vanderbilt University, USA; Y. M. Wong, Vanderbilt University, USA

Theoretical Efficiency of a Microfabricated Knudsen Pump 107
Davor Copic, University of Louisville, USA; Ellen Brehob, University of Louisville, USA; Shamus McNamara, University of Louisville, USA

Keynote Speaker

Nanotechnology and Cyberinfrastructure: The nanoHUB Experience 111
Mark Lundstrom, Purdue University, USA

Session 7 - Wireless MEMS/NEMS

Development of Piezoelectric RF MEMS Switch and Phase Shifter 112
Tracy D. Hudson, U. S. Army RDECOM AMRDEC, USA

Penta-Band Planar Inverted F-Antenna (PIFA) Integrated by RF-NEMS Switches 116
Bedri A. Cetiner, Utah State University, USA; Necmi Biyikli, Utah State University, USA

Interfacing Microfabricated and Nanomaterial-Based Sensors with a Modular Environmental Monitoring System 120
Cindy Harnett, University of Louisville, USA

Session 8 - Optical Devices

Fabrication and Preliminary Characterization of a Parabolic Coupler for Photonic Crystal Waveguides 123
Scott A. Masturzo, University of Cincinnati, USA; Joseph T. Boyd, University of Cincinnati, USA; Jan M. Yarrison-Rice, Miami University, USA; Howard E. Jackson, University of Cincinnati, USA

Compact Thermally Tunable Silicon Wavelength Switch 126
X. Wang, Florida International University, USA ; J. A. Martinez, Florida International University, USA; M. S. Nawrocka, Florida International University, USA; R. R. Panepucci, Florida International University, USA

Investigation of the Interaction of Surface Plasmons (SP) with
an Electro Optic Polymer and Development of SP Optical Devices..... 128
*Milan C. Buncick, AEGIS Technologies, USA; Paul R. Ashley, US Army AMRDEC,
USA; M. Scalora, US Army AMRDEC, USA; Neset Akozbek, US Army AMRDEC,
USA; Maria Antonietta Vincenti, University of Rome, Italy; Marco Centini,
University of Rome, Italy; Jason D. Fowlkes, ORNL, USA;
Iliia N. Ivanov, ORNL, USA*

Waveguide Microgripper with Optical Feedback for Microassembly 132
*R. R. Panepucci, Florida International University, USA
J. A. Martinez, Florida International University, USA*

Session 9 – Posters

Placed after Session 11

Wednesday, July 16, 2008

Session 10 - Processing and Materials for Micro-Nano Technology

Bottom Up Microsystem Construction Strategies Built Upon
3D Directed Self-Assembly of Metallic and Polymeric Nanostructures 134
Robert W. Cohn, University of Louisville, USA

Electrospun Biopolymer-Based Micro/Nanofibers 139
*Nick Bedford, University of Cincinnati, USA; Daewoo Han, University of
Cincinnati, USA; Andrew J. Steckl, University of Cincinnati, USA*

A Novel Class of High-T_C Ferromagnetic Semiconductors:
Novel Ferromagnetic Semiconductors..... 142
*L. V. Shlyk, University of Kentucky, USA; S. A. Kryukov, University of Kentucky,
USA; L. E. De Long, University of Kentucky, USA; B. Schüepf-Niewa, T. U.
Muenich, Germany; R. Niewa, T. U. Muenich, Germany; J. W. Lynn, NIST
Gaithersburg, USA; Qing Huang, NIST Gaithersburg, USA; E. Arenholz, Lawrence
Berkeley Nat. Lab., USA; C. Piamonteze, Lawrence Berkeley Nat. Lab., USA*

Process Model Verification for
Dopant Segregation and Oxidation Enhanced Diffusion 148
*Robert E. Pearson, Rochester Institute of Technology, USA; Karl D. Hirschman,
Rochester Institute of Technology, USA; Robert Manley, Rochester Institute of
Technology, USA*

Sorbent Coatings and Processing Techniques for
Trace Analysis of Hazardous Materials in Micro/Nano Sensors..... 153
R. S. Pai, U.S. Naval Research Laboratory, USA; R. A. McGill, U.S. Naval Research Laboratory, USA; D. L. Simonson, U.S. Naval Research Laboratory, USA; B. A. Higgins, U.S. Naval Research Laboratory, USA; E. J. Houser, U.S. Naval Research Laboratory, USA; M. R. Papantonakis, U.S. Naval Research Laboratory, USA; V. Nguyen, U.S. Naval Research Laboratory, USA; S. V. Stepnowski, U.S. Naval Research Laboratory, USA; T. H. Stievater, U.S. Naval Research Laboratory, USA; W. S. Rabinovitch, U.S. Naval Research Laboratory, USA; N. A. Papanicolau, U.S. Naval Research Laboratory, USA; R. Bass, U.S. Naval Research Laboratory, USA; J. L. Stepnowski, Nova Research, Inc., USA; M. T. Rake, Nova Research, Inc., USA;

Synthesis of Single-Wall Carbon Nanotubes by
Atmospheric Thermal CVD 157
Jyh-Hua Ting, National Nano Device Laboratories, Taiwan, R.O.C.; Jhih-Yuan Lyu, National Central University, Taiwan, R.O.C.; Fuang-Yuan Huang, National Central University, Taiwan, R.O.C.; Tsung-Lung Li, National Chia-Yi University, Taiwan, R.O.C.; Cho-Lun Hsu, National Nano Device Laboratories, Taiwan, R.O.C.; Chien-Wei Liu, National Nano Device Laboratories, Taiwan, R.O.C.

Session 11 - Lab-on-a-Chip Devices and Systems

Electrical Control of Debye Screening in
Liquid Microchannels for Ionic Separations..... 161
M. Dhindsa, University of Cincinnati, USA; J. Heikenfeld, University of Cincinnati, USA; S. Kwon, University of Tennessee, USA; J. Park, University of Tennessee, USA; P. D. Rack, University of Tennessee, USA

Carbon Nanotube Meshes for Separating Proteins Electrophoretically 165
Rathishh Dorairaj, University of Louisville, USA; Thomas J. Roussel, University of Louisville, USA; Gamini Sumanasekera, University of Louisville, USA; Palaniappan Sethu, University of Louisville, USA; Carolyn M. Klinge, University of Louisville, USA; Robert S. Keynton, University of Louisville, USA

On-Chip Fluorescence Detection Using
Organic Thin Film Devices for a Disposable Lab-on-a-Chip 169
Yun Shuai, University of Cincinnati, USA; Ansuman Banerjee, University of Cincinnati, USA; David Klotzkin, University of Cincinnati, USA; Ian Papautsky, University of Cincinnati, USA

A High Throughput Multiplexed Micro
Coulter Counter Using Amplitude Modulation 173
Ashish V. Jagtiani, The University of Akron, USA; Joan Carletta, The University of Akron, USA; Jun Hu, The University of Akron, USA; Jiang Zhe, The University of Akron, USA

High-Sensitivity MEMS Based On-Chip Fluorescence Detection System:
Measurement and Analysis of Ultimate Sensitivity Limits 177
*Ansuman Banerjee, University of Cincinnati, USA; Yun Shuai, University of
Cincinnati, USA; David Klotzkin, University of Cincinnati, USA; Ian Papautsky,
University of Cincinnati, USA*

PhotoPDMS: Photodefinable PDMS for Rapid Prototyping 183
*Preetha Jothimuthu, University of Cincinnati, USA; Ali Asgar S. Bhagat,
University of Cincinnati, USA; Ian Papautsky, University of Cincinnati, USA*

Session 9 - Posters

Electrowetting: Novel Devices and Applications

Composite Dielectrics and Surfactants for
Low Voltage Electrowetting Devices 187
*B. Raj, University of Cincinnati, USA; N. R. Smith, University of Cincinnati,
USA; L. Christy, University of Cincinnati, USA; M. Dhindsa, University of
Cincinnati, USA; J. Heikenfeld, University of Cincinnati, USA*

Cleanroom Facilities and Infrastructure

Cleanroom Utilities Overview: University of Louisville 191
Don Yeager, University of Louisville, USA

An Interuniversity Research, Development, and Training Center in Nano:
National Nano Device Laboratories, Taiwan, Republic of China 194
Jyh-Hua Ting, National Nano Device Laboratories, Taiwan, R.O.C.

University Micro-Nano Curriculum Development

Your Cleanroom as an Outreach Vehicle 197
*Joseph H. Lake, University of Louisville, USA; Ana S. Kieswetter,
University of Louisville, USA; Mark M. Crain, University of Louisville, USA;
B. W. Alphenaar, University of Louisville, USA; Robert S. Keynton,
University of Louisville, USA; Mickey R. Wilhelm, University of Louisville,
USA; Kevin M. Walsh, University of Louisville, USA*

MEMS Design Course Solutions to the Tennessee Trash Problem 200
*Paul Luttrell, Tennessee Tech University, USA; Matt Drummonds,
Tennessee Tech University, USA; Matt Ervin, Tennessee Tech University,
USA; Jacob Sluder, Tennessee Tech University, USA; Evan Weeks,
Tennessee Tech University, USA; Joseph Biernacki, Tennessee Tech
University, USA; Satish Mahajan, Tennessee Tech University, USA;
Stephen Parke, Tennessee Tech University, USA; Chris Wilson, Tennessee
Tech University, USA*

MEMS Actuators and Sensors

Modeling a Monolithic Comb Drive for
Large-Deflection Multi-DOF Microtransduction 203
J. V. Clark, Purdue University, USA

Piezoresistive Geometry for Maximizing Microcantilever Array Sensitivity	208
<i>Patrick C. Fletcher, University of Louisville, USA; Y. Xu, University of Louisville, USA; P. Gopinath, University of Louisville, USA; J. Williams, University of Louisville, USA; B. W. Alphenaar, University of Louisville, USA; R. D. Bradshaw, University of Louisville, USA; Robert S. Keynton, University of Louisville, USA</i>	
Ultrasonic Nanostructured Thin Film Transducers for Flooded Member Detection	212
<i>Matthew Hartmann, Louisiana Tech University, USA; Ville Kaajakari, Louisiana Tech University, USA</i>	
Microelectronic Development with MEMS Capable Caseless Projectiles	215
<i>Blake Hosli, Louisiana Tech University, USA Chester Wilson, Louisiana Tech University, USA</i>	
Measurement of Intraocular Pressure from the Extra-Ocular Space of the Eye Using a MEMS Pressure Sensor.....	217
<i>Matthew Turner, University of Louisville, USA; John Naber, University of Louisville, USA; Kevin M. Walsh, University of Louisville, USA</i>	
Wireless MEMS/NEMS	
Strain-Induced Three-Dimensional Microfabrication for Advanced Antenna Architectures	220
<i>Y. M. Senousy, University of Louisville, Louisville, USA; Evgeniya Moiseeva, University of Louisville, USA; Cindy Harnett, University of Louisville, USA</i>	
A Wireless Microsystem for MEMS Capacitive Sensor Using Bluetooth	223
<i>Jirachai Getpreecharsawas, Rochester Institute of Technology, USA; Lynn F. Fuller, Rochester Institute of Technology, USA</i>	
Optical Devices	
Sub-Micron Integrated Grating Couplers for Single-Mode Planar Optical Waveguides.....	227
<i>Colin M. Hayes, University of Louisville, USA; Marcelo B. Pereira, University of Louisville, USA; Baylor C. Brangers, University of Louisville, USA; Mustafa M. Aslan, University of Louisville, USA; Rodrigo Sergio Wiederkehr, University of Louisville, USA; Sergio B. Mendes, University of Louisville, USA; Joseph H. Lake, University of Louisville, USA</i>	
Fast Estimation of Total Quality Factor of Photonic Crystal Slab Cavities	233
<i>T. Liu, Florida International University, USA; R. R. Panepucci, Florida International University, USA</i>	

Processing and Materials for Micro-Nano Technology

High-Temperature Microreactors for In-Situ Nanomaterial Deposition.....	236
<i>Evgeniya Moiseeva, University of Louisville, USA;</i> <i>Cindy Harnett, University of Louisville, USA</i>	
Shape Memory Alloys and Their Use in MEMS Capable Deployable Sensors	239
<i>Daniel Scoggin, Louisiana Tech University, USA;</i> <i>Chester Wilson, Louisiana Tech University, USA</i>	
Direct Write Fabrication of Polymer Fibers for Microscale Applications	242
<i>Scott M. Berry, University of Louisville, USA; Scott D. Cambron, University of Louisville, USA; Sean P. Warren, University of Louisville, USA; Santosh Pabba, University of Louisville, USA; Robert W. Cohn, University of Louisville, USA; Robert S. Keynton, University of Louisville, USA</i>	
Surface Plasmon Resonance (SPR) Effect in Nanoscale Nichrome Alloy Films	245
<i>Maarij Syed, Rose-Hulman Institute of Technology, USA; Chris Leibs, Rose- Hulman Institute of Technology, USA; Azad Siahmakoun, Rose-Hulman Institute of Technology, USA</i>	
Lab-on-a-Chip Devices and Systems	
Design and Fabrication of a PDMS Micropump with Moving Membranes	249
<i>Charles P. Cartin, Virginia Commonwealth University, USA; Ramana M. Pidaparti, Virginia Commonwealth University, USA; Gary M. Atkinson, Virginia Commonwealth University, USA</i>	
Numerical Study of a Piezoelectric Microvalve Using Continuum Methods	254
<i>Rodrigo Sergio Wiederkehr, University of Louisville, USA; Maria Cecilia Salvadori, University of Sao Paulo, Brazil; Fernando Massa Fernandes, University of Sao Paulo, Brazil; Mauro Cattani, University of Sao Paulo, Brazil</i>	
Author Index	follows page 258