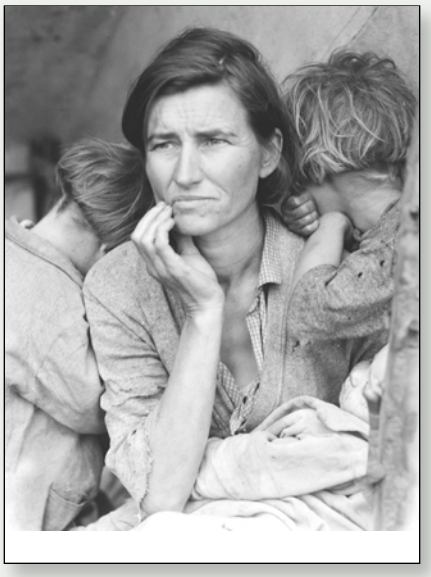
Fall 2008

WIMS WORLD

Director's Message

Each quarter as I sit down to write these columns, I grapple with what to write about. This time, there was no question. We have all seen an increasing tide of chaos in our financial markets during the last few months that threatens our very way of life. It is easily the most difficult time I have seen, although my parents, who married in 1930, saw much worse as they battled their way through the Great Depression. All of us are justifiably worried about how the crisis will affect us, our families, and our jobs. It resulted because our government failed to adequately regulate our financial institutions, in some cases rescinding laws already on the books. And it occurred because of unbridled greed on the part of the banks and Wall Street. I guess many of us knew that Wall Street was a first cousin to Las Vegas, but I was naive enough to think that bankers were careful conservative people. Many parallels have been drawn between our current situation and what happened in 1929, and indeed there are many similarities. Sometimes a picture is worth more than a thousand words, and I have always liked the picture of Florence Thompson and three of her seven children snapped by Dorothea Lange in 1936. It captures the hardship and despair of the Depression era, but there is also something resolute and noble in that face. It is a comfort to know that we got ourselves out of that mess, just as we will get ourselves out of this one.



Migrant Mother
Photo by Dorothea Lange, 1936.

Between 1925 and 1929, America discovered credit, and stocks came to be viewed not so much as a way to invest for the long term in good companies but as an avenue for short-term speculation. Millions of Americans began borrowing money to buy more and more stock. By September 1929, the Dow reached 381, having increased fivefold in five years. (It would not see that level again until 1954.) Brokers were lending small investors more than two-thirds the face value of the stocks they were buying. More money was out on loan than the entire amount of currency circulating in the country. Price-to-earnings ratios were above 30 (sound familiar?), and when prices began a sustained fall, investors found themselves holding stocks they couldn't pay for. The market lost 17% of its value in a month. Then on October 28, 1929, it lost another 13%, and the next day it dropped another 12%. The loss for the week now totaled $30B, ten times the annual budget of the Federal government. The bubble had burst, and the Great Depression was being ushered in. By late 1932, stock prices had plunged to about one-fifth of their pre-crash levels, and the output of American manufacturing plants had been cut nearly in half. There were massive layoffs, and when things hit rock bottom in March 1933, unemployment was over 25%. By that time, 5,000 banks had failed, the depositors losing their money. The Federal Reserve could not act because the law required partial gold backing of any credit, and there wasn't any more gold in the treasury. The U.S. would leave the gold standard in 1933.

In his inaugural address that year, Roosevelt declared "the only thing we have to fear is fear itself," and during the next 100 days, a blizzard of legislation was passed to lay the groundwork for the New Deal. Its legislation would include the Glass-Steagall Act (1933), creating the Federal Deposit Insurance Corporation (FDIC) and containing banking reforms to control speculation; the Civil Conservation Corps (1933); the Tennessee Valley Authority (1933); the Farm Relief Act (1933); the Social Security Act (1935); the Works Progress Administration (1935); and the Rural Electrification Act (1936). The Great Depression and the New Deal forever changed what Americans expect from their government: to care for the needy and regulate the economy to protect the public welfare.

So what happened to cause the current financial troubles? Well, we evidently decided the lessons of the past didn't apply to us. The banking industry tried for years to repeal the Glass-Steagall Act. They argued that they were losing market share to securities firms that were less strictly regulated. It would be all right, they said, if they regulated themselves. In 1999, Phil Gramm and James Leach introduced legislation to repeal Glass-Steagall. In the Senate, the vote was 53 Republicans and 1 Democrat for, and 44 Democrats against. When differences were resolved between the Senate and the House versions, it passed with a veto-proof majority. All this was of

(Continued on page 3)

Research Highlights

A Micromachined Perforated Plate Si/Glass Heat Exchanger With *In Situ* Temperature Sensing for Joule-Thomson Coolers

Weibin Zhu, Michael J. White, Gregory F. Nellis, Sanford A. Klein, and Yogesh B. Gianchandani

Micromachined Joule-Thomson (J-T) coolers have applications ranging from cryosurgery to cooling infrared detectors in space and portable applications. The counter-flow recuperative heat exchangers in the J-T coolers must maintain good stream-to-stream heat conductance while restricting stream-wise conduction in order to achieve a high effectiveness and allow a large enthalpy difference between the two streams. The WIMS ERC has developed a micromachined perforated plate Si/glass heat exchanger that uses numerous high-conductivity silicon plates, integrated with platinum resistance temperature detectors (Pt RTDs), to alternatively stack with low-conductivity glass spacers (see Figure 1). This heat exchanger demonstrated a high effectiveness of 0.912 in a temperature range of 237–252K and good robustness at high inlet gas pressures up to 1MPa. Furthermore, the temperature distribution along the heat exchanger was measured by the Pt RTDs that have sensitivities of 0.26–0.30%/K at a temperature range of 205–296K. A J-T system using this heat exchanger reached 76.1K below room temperature (approximately 218.7K) at steady state and 200.3K in a transient state, when using a 0.015-inch-diameter (0.1140mm^2) orifice for gas expansion (see Figure 2). The system provided 200mW cooling power at 228K and 1W at 239K with an estimated parasitic heat loss of 300–500mW. ■

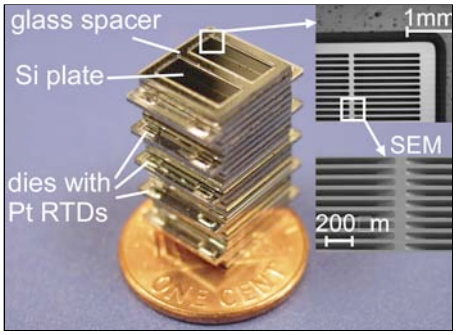


Figure 1 – Fabricated perforated plate Si/glass heat exchanger.

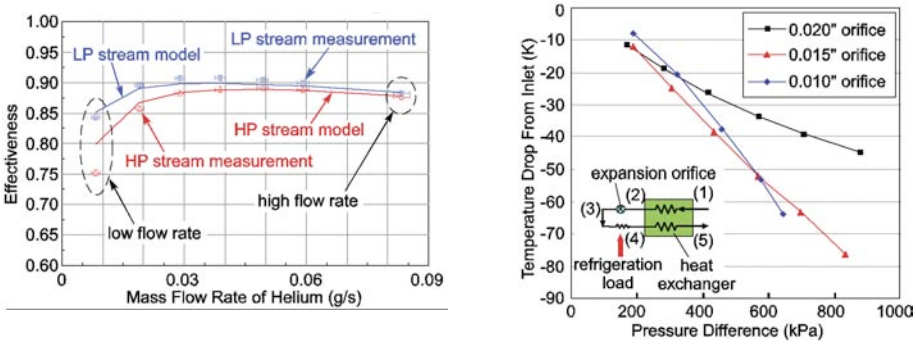


Figure 2 Left – Effectiveness measurement at a temperature range of 237–252K. Right – Cooling temperature measurement in a J-T self-cooling test with ethane as the work fluid.

A 150pW Program-and-Hold Timer for Ultra-Low Power Sensor Platforms

Yu-Shiang Lin, Dennis M. Sylvester, and David Blaauw

The average power consumption of sensor platforms, which are often low duty cycle, can be greatly reduced by applying strong power gating while idling. A key component in power gating is the timekeeping device while the system is in the idle mode. Since the timekeeping device, or timer, is always active, it is often the dominant source for energy loss and must oscillate at a low frequency (e.g., from sub-Hz to 10Hz). Crystal oscillators are too expensive and large for tiny sensor platforms, and typical watchdog timers consume uW of power, which is too high. We propose a program-and-hold timer with temperature self-compensation. The bias, hold, and oscillate stages are shown in Figure 1. During the programming mode, I_{ref} is used to bias transistor M_0 and store the bias voltage on the hold stage. In the active mode, I_{ref} is turned off to reduce power, and the oscillator is biased by the sampled voltage. With a 200:1 ratio between M_1 and M_0, the active power is greatly reduced. In most sensor applications, temperature varies slowly so that the programmed bias voltage remains valid the next refresh cycle. The proposed low-power timer consumes 150pW with a current starved oscillator frequency of 11Hz. A temperature insensitive current source is implemented by self-biasing of a resistor. The total area of the design is 0.019mm^2 in 0.13μm CMOS (see Figure 2). ■

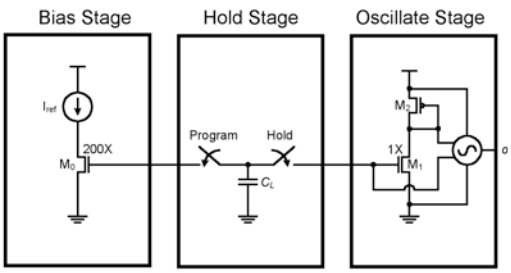


Figure 1 – Block diagram of the proposed timer design.

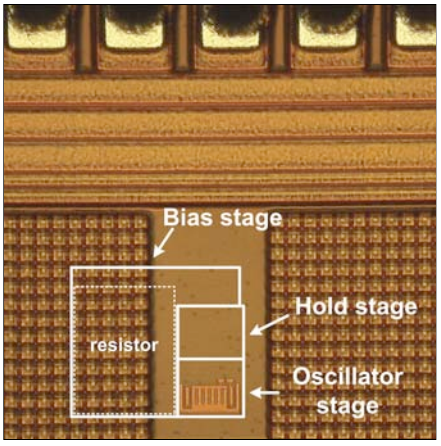
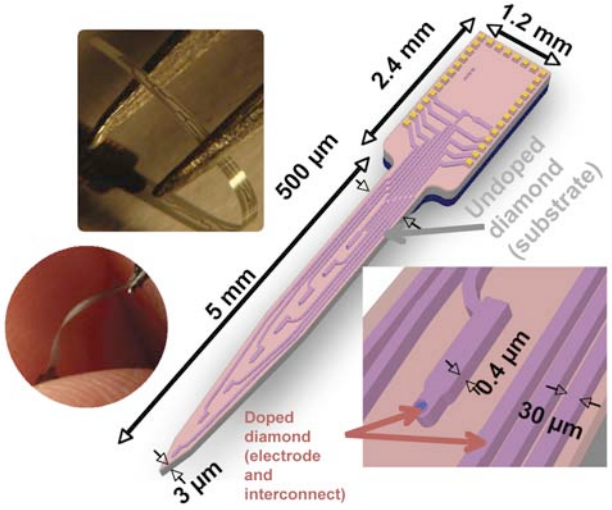


Figure 2 – Die photo of the test chip fabricated in 0.13μm CMOS technology.

All-Diamond Neural Probes for Neurochemical Detection and Neural Recording Applications

Ho-Yin Chan, Dean M. Aslam, and Kensall D. Wise

One of the key components in neural prosthetic systems is the microprobe, which is responsible for interfacing with neurons. This project aims to design and fabricate a novel all-diamond neural probe. Polycrystalline diamond is used as the material for the probe shank, interconnects/leads, and electrodes. Diamond is chosen because of its unique properties. It has one of the largest Young's moduli (~1011Pa) of all known materials. It has a large band gap (5.5eV), which is desirable for a substrate material. Diamond's optical transparency, furthermore, is useful for *in vitro* experiments as it allows electrodes on probes to be located easily under a microscope. In addition, boron-doped diamond's comparatively wide potential window in aqueous environments (-1V to 2V), low double layer capacitance (several $\mu F/cm^2$), chemical inertness and stability, resistance to fouling, and biocompatibility make it an excellent electrode material. For the first time, novel all-diamond neural probes have been successfully fabricated (see figure). Undoped diamond (resistivities of ~$10^5\Omega$cm) and highly boron-doped diamond (resistivities of ~$10^{-3}\Omega$cm) were used as the probe's shank material and electrode/interconnect material, respectively. The front portion of the probe is made solely from diamond. The probe has been successfully implanted in a guinea pig's brain, and *in vivo* neural activity has been recorded. In addition, with the integration of different electrodes (i.e., Pt counter and Ag/AgCl reference electrodes) on the probe's shank, it is capable of performing electrochemical detection. Currently, *in vitro* detection of neurotransmitters such as norepinephrine, dopamine, and serotonin has been performed with a detection limit on the order of a few nM ■



All-diamond neural probe.

Director's Message (Continued from page 1)

course largely unnoticed by the public. All we knew was that all of a sudden everyone was building castles in the country.

Now we are reaping the benefits of the Gramm-Leach-Bliley Act and have learned some unpleasant things about our financial institutions and the people who run them. We have also learned some unpleasant things about some of our companies and the people who run them. It has long been my belief that companies exist to produce products that improve the quality of life and to provide jobs for their employees. I used to think that companies were all about the people who work in them, but clearly it's not the people who work in them that are important today. It's the people on Wall Street. Now I understand that sometimes, in situations of great economic stress, it may be necessary to lay off people to preserve the company. But that should be a last resort. I would like someone to explain to me the rationale for laying off people when you are still making a profit. Who is running these companies and where do they get their ideas? Is it a reflection of our business schools and the notion that only MBAs can successfully run companies? Engineers who understood their products and the applications for them ran the best companies I have known. Any high-tech company that would lay off engineers in these difficult times when they are making a profit must have forgotten that the engineers are the reason they have a company. This Center has worked very hard to spread the word that engineering is an exciting profession that produces things that matter. It is mankind's best hope of meeting the difficult challenges that lie before us. Getting more of our young people to opt for careers in science and engineering has also been a priority for the National Science Foundation. But then we hear about some of our "best" electronics companies laying off their engineers so they can show even greater short-term profit. These companies do great harm, reinforcing the public perception that engineering is a collection of journeymen at the mercy of forces far beyond their control, to be hired and fired as needed. Never mind the families that are affected or the lives that are ruined. But engineers are the people in our society that create things that help people. They are the ones who solve problems and improve the quality of life. Something's badly out of whack here, and it's time to fix it. ■

Ken Wise

Director, Engineering Research Center for
Wireless Integrated MicroSystems

Recent Events

Industrial Advisory Board Meeting Brings Industry, Faculty, and Students Together

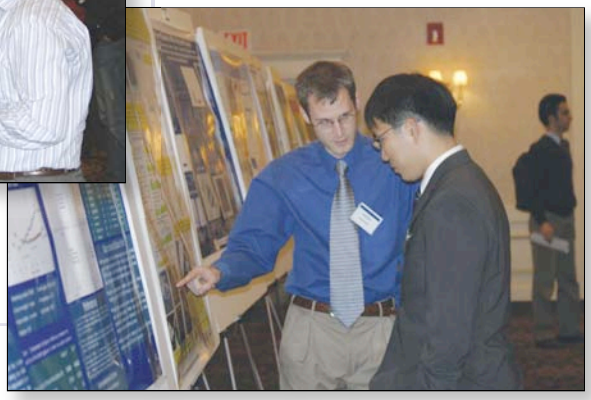
On October 21–22, WIMS hosted its Industrial Advisory Board meeting at the Four Points Sheraton in Ann Arbor. Once again, members of industry had the opportunity to talk with WIMS students about their projects during the poster sessions. In addition to meeting the research faculty and students, the IAB had the opportunity to meet with U-M faculty serving administrative roles. During the Round Table, there was discussion of the structure the WIMS ERC will take after graduation from the NSF. The factors of most importance include membership, value proposition, and IP model. At the IAB banquet, Daryl C. Weinert, Executive Director of U-M's Business Engagement Center, addressed the challenges and opportunities involved in industry/academic collaboration. Another highlight of the evening was the presentation of the WIMS Student Leadership Council's (SLC) Outstanding Leadership Award, which was given to Jae Yoong Cho, by current SLC President, Tzeno Galchev. ■

Demonstration of the micro gas chromatograph applications.

Banquet Speaker Daryl C. Weinert

Jae Yoong Cho (left) receives award from 2008 SLC President Tzeno Galchev.

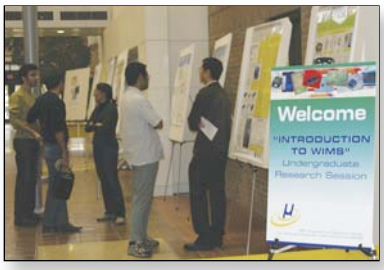
Industrial Advisory Board members interact with WIMS graduate students during poster session.



Education Highlights

WIMS Undergraduate Research (WUGR) Program Rolls Out New Recruiting Event

For the fifth consecutive year, the Center hosted a session to introduce undergraduate students to WIMS research programs and staff, as well as to invite undergraduates to apply for research positions Winter Term 2009. The session was held November 19, 2008, with a significantly different format of an afternoon poster session (rather than the former evening presentations session). WIMS faculty and graduate students contributed by hosting posters for the session. Another new aspect was to highlight the research projects under the direction of faculty new to the WIMS Center, with the aim to attract increased participation in WIMS with important contemporary applications, such as energy generation and management, health care, environmental monitoring and quality, and homeland security. As in past years, undergraduate students who become valuable contributors to the research team during Winter Term will be invited to continue in full-time paid positions for the following four months spanning the Spring-Summer Term. ■



Student Retreat Explores Entrepreneurship

This year the WIMS Student Leadership Council (SLC) was given the honor of heading the NSF ERC student retreat in Bethesda, Maryland. They selected an especially timely and meaningful theme for the retreat: "Bridging the Great Divide: Successfully Transforming University Innovations into Marketable Products." Founders Dr. Larry Schmitt of Inovo Technologies, Mrs. Shirley Collier of Optemax, and Dr. John Santini of MicroChips each gave talks on starting a company from university-created technology. Dr. Schmitt's talk focused on identifying the marketable innovation in a new technology and turning it into a profitable product. Mrs. Collier and Dr. Santini both outlined the process of creating a complete company around an innovative product. They discussed best practices for starting a new company and acquiring financial backing. Mrs. Collier highlighted the benefits of seeking investors outside the venture capital (VC) markets, while Dr. Santini discussed the cases where receiving VC funding is both a necessity and an advantage. All three speakers were dynamic and greatly enjoyed by the attendees, as they imparted a message of advancing university innovations through the development of new companies. ■

Pre-College Students Enjoy MEMS and More

Last fall's WIMS Detroit Area Pre-College Engineering Program (DAPCEP) was heavily focused on teaching the students about MEMS and nanotechnology. The middle school students received lessons from WIMS faculty on the major areas of research in MEMS. Lessons were both on the applications of MEMS technology and on the general engineering concepts and theory behind it. To reinforce the lessons learned in class, the students built a LEGO Robot to respond to an LED representation of a microelectrode array, as well as digital control circuitry for the array itself. In addition to learning how MEMS devices work, the students also had an opportunity to learn how they are made. The five-week program ended with the students receiving a tour of the Lurie Nanofabrication Facility (LNF) and participating in hands-on activities where they processed their own wafers, explored the insides of a desktop computer, and tested a number of commercial products developed out of nanotechnology. Overall, the students were truly engaged in the hands-on MEMS-based activities, and the program increased their enthusiasm for science and engineering. ■

Personnel Focus

Wei Lu received the B.S. degree in Physics from Tsinghua University, Beijing, China, in 1996, and the M.A. and Ph.D. in Physics from Rice University, Houston, Texas, in 1999 and 2003, respectively. From 2003 to 2005, he worked as a postdoctoral research fellow at Harvard University, Cambridge, Massachusetts, on the synthesis and device applications of semiconductor nanowires. In 2005, he joined the faculty of the Electrical Engineering and Computer Science Department at the University of Michigan as an assistant professor.

Professor Lu and his students work on the application and fundamental understanding of nanostructures and nanodevices. Projects relevant to the WIMS Center include semiconductor nanowire-based chemical sensors that offer high sensitivity and fast response, flexible and transparent nanowire thin-film electronics that operate in the radio frequency range, and very-high frequency nanoelectromechanical resonators. In addition, his group is exploring novel memory and logic devices based on two-terminal resistive switches (so-called "memristors") and hybrid nano/CMOS systems that can potentially lead to density scaling beyond that which can be achieved by conventional transistor systems alone.

Professor Lu is a member of the IEEE, as well as APS and MRS. He is also a board member of the AVS Michigan Chapter, and he has served on the program committee of several international conferences. He is an active reviewer for over 20 scientific journals and is currently on the editorial board of *Micro and Nanosystems Journal*. He has been invited numerous times to give presentations at international conferences, as well as academic and industrial seminars. He has published over 30 journal and conference papers that have been cited over 1200 times to date, and has five patent applications in fields related to his research areas. ■

Presentations and Publications

Conferences Presentations/Papers

International Conference on Miniaturized Chemical and Biochemical Analysis Systems (μTAS), San Diego, California, October 2008

J. Chung, Y. J. Kim, I. J. Cho, and E. S. Yoon, "Highly Efficient Single Cell Capturing in Microwell Array Using Hydrodynamic Guiding Structures," pp. 477–479

Y. J. Kim, H. K. Lee, J. Chung, I. J. Cho, and E. S. Yoon, "Sequentially Addressable Two-Dimensional Microwell Array for High-Throughput Single Cell-Based Assay," pp. 483–485

IEEE International Conference on Sensors, Lecce, Italy, October 2008

C. Yang and A. Mason, "Membrane Protein Biosensor With Multi-Channel CMOS Impedance Extractor and Digitizer," pp. 642–645

D. Rairigh, G. Warnell, A. Mason, C. Xu, M. P. Rowe, E. T. Zellers, E. Covington, and C. Kurdak, "Nanoparticle Coated Chemiresistor With CMOS Baseline Tracking and Cancellation," pp. 196–199

E. Covington, R. Turner, M. P. Rowe, C. Xu, E. T. Zellers, and C. Kurdak, "Electrical Noise in Gold Nanoparticle Chemical Sensors," pp. 240–242

N. Ghafouri, H. Kim, M. Z. Atashbar, and K. Najafi, "A Micro Thermoelectric Energy Scavenger for a Hybrid Insect," pp. 1249–1252

ASEE Frontiers in Education Conference, Saratoga Springs, New York, October 2008

D. M. Aslam and A. Shao, "Innovative Nanotechnology Learning Modules Using Programmable LEGO Robotic VD Graaf Generators"

D. M. Aslam, Z. Cao, and C. Rostamzadeh, "Innovative Microsystems Education Using Cluster Van de Graaff Generators"

International Wireless Internet Conference, Maui, Hawaii, November 2008

D. Kim and M. Liu, "Optimal Stochastic Routing Strategies in Low Duty-Cycled Wireless Sensor Networks"

IEEE SEM Fall Conference on Green Energy in Great Lakes, Dearborn, Michigan, November 2008

S. Hatch, B. Chaudhry, C. Rostamzadeh, and D. M. Aslam, "Energy Scavenging from Static Charges"

Z. Cao and D. M. Aslam, "MEMS Packaging With Built-In Energy Scavenging Devices"

Sir Mark Oliphant Inaugural Conference on Medical Bionics, Lorne, Australia, November 2008

K. D. Wise, "Chronic Microelectrode Arrays and Integrated Wireless Technology for Advanced Neural Prostheses," p. 24

Army Science Conference, Orlando, Florida, December 2008

M. Acharya, D. D. Cheam, P. S. Karre, and P. L. Bergstrom, "Threshold Voltage Improvement and Gate Leakage Current Reduction in a Multi-Dot Room Temperature Operating Single Electron Transistor (RT-SET)," paper #MP-05

K. A. Walczak, M. Acharya, D. Lucking, P. L. Bergstrom, and C. R. Friedrich, "Integration of the Bionanomaterial Bacteriorhodopsin and Single Electron Transistors," paper #MP-06

P. S. Karre and P. L. Bergstrom, "Detection of Ion Absorption Using Room Temperature Operating Single Electron Transistor," paper #MP-07

D. D. Cheam, P. S. Karre, and P. L. Bergstrom, "Optimization of Focus Ion Beam Patterning and Reactive Ion Etching Process of Quartz Template for Ultra Violet Nano Imprint Lithography," paper #MP-21

Industrial Liaison's Report

Industrial Advisory Board Meeting May 19–20, 2009

This fall we had our October Industrial Advisory Board (IAB) meeting in Ann Arbor, Michigan, and the December Annual Meeting of ERCs in Washington, D.C. Both meetings devoted much time to addressing how ERCs can assist industry. At the IAB meeting, we discussed how we could enhance our value proposition for our partners. One of the outcomes was the suggestion that each member's financial contribution be directed into focused research areas that address the specific applications of interest to that member. At the NSF Annual Meeting the consensus among the industrial liaison officers was that structures need to be put in place that build successful partnerships toward innovation pathways. An innovation pathway is a method that takes an idea or invention and develops this into a product that people will buy. This requires that the product meet both the functional and cost requirements of the application. Participants at both meetings came to the realization that to be successful there must be a close collaboration between the partner companies and the ERCs. To truly innovate, all parties need to focus efficiently on their strengths and apply their resources to a mutually beneficial goal. In this way, both groups can succeed.

The WIMS ERC is well-positioned to help our partners succeed in these challenging times. We have both the new ideas and the physical resources to collaborate with industry in effectively meeting the challenges of the marketplace. The Lurie Nanofabrication Facility (LNF) has the physical resources capable of supporting the commercial development of the WIMS inventions and ideas generated by academia and industry. Our spin-offs, as well as our partners' successes in the marketplace, are proof that ERCs and industry can collaborate to be successful in the marketplace. WIMS continues to provide viable solutions for a wide variety of application challenges, encompassing biomedicine, security, infrastructure management, and environmental monitoring. I encourage our partners to bring new challenges to WIMS, so that together we can bring technology to the marketplace.

If you, or one of your colleagues, is interested in giving a seminar, please contact me to schedule a date at (734) 615-3096 or giachino@eecs.umich.edu.

As always, please visit the Center when in the Ann Arbor area, so we can share our latest technical developments and have you tour our Lurie Nanofabrication Facility. ■

Joseph M. Giachino
Associate Director, Industry

Presentations and Publications (con't)

Journal Articles

J. Wang and K. D. Wise, "A Hybrid Electrode Array With Built-In Position Sensors for an Implantable MEMS-Based Cochlear Prosthesis," *IEEE/ASME Journal of Microelectromechanical Systems (JMEMS)*, vol. 17 (5), pp. 1187–1194, October 2008.

C. Jin and E. T. Zellers, "Limits of Recognition for Binary and Ternary Vapor Mixtures Determined With Multi-Transducer Arrays," *Analytical Chemistry*, 80, pp. 7283–7293, October 2008.

N. K. Gupta and Y. B. Gianchandani, "Thermal Transpiration in Zeolites: A Mechanism for Motionless Gas Pumps," *Applied Physics Letters*, vol. 93, issue 19, paper #193511, October 2008.

W. F. Weitzel, C. L. Cotant, Z. Wen, R. Biswas, P. Patel, H. Panduranga, Y. B. Gianchandani, and J. M. Rubin, "Analysis of Novel Geometry-Independent Method for Dialysis Access Pressure-Flow Monitoring," *Theoretical Biology and Medical Modelling*, no. 1270590582218425, October 2008.

A. Basu and Y. B. Gianchandani, "Virtual Microfluidic Traps, Filters, Channels, and Pumps Using Marangoni Flows," *Journal of Micromechanics and Microengineering*, vol. 18, paper #115031, October 2008.

M. Ferriss and M. P. Flynn, "A 14mW Fractional-N PLL Modulator With a Digital Phase Detector and Frequency Switching Scheme," *IEEE Journal of Solid-State Circuits*, 43, pp. 2464–2471, November 2008.

N. Chang and M. Liu, "Constrained Sequential Resource Allocation and Guessing Games," *IEEE Transactions on Information Theory*, vol. 54, no. 11, pp. 4946–4965, November 2008.

Patent Issued

Y. B. Gianchandani, K. Takahata, K. D. Wise, and A. W. DeHennis, "Antenna Stent Device for Wireless Intraluminal Monitoring," U.S. Patent No. 7,452,334, issued November 18, 2008.

Doctoral Dissertations

Kyusuk Baek, "Integrated Microvalves for Cortical Drug Delivery at the Cellular Level"
University of Michigan, 2008
Postgraduate Position: Senior Research Scientist, Hospira, Inc., Lake Forest, IL
Advisor: Professor Kensall D. Wise

Nupur Basak, "Fabrication and Characterization of 3C-Silicon Carbide Microsensor for Wireless Blood Pressure Measurements"
Howard University, 2008
Postgraduate Position: Dell Computer Corporation, Austin, TX
Advisor: Professor Gary L. Harris

Ho-Yin Chan, "Polycrystalline CVD Diamond Probes for Use in *In Vivo* and *In Vitro* Neural Studies"
Michigan State University, 2008
Postgraduate Position: Postdoctoral Research Fellow, Michigan State University
Advisor: Professor Dean A. Aslam

Meng-Ping Chang, "Electrostatic Elastomer Devices for Reconfigurable High-Density Microfluidics"
University of Michigan, 2008
Postgraduate Position: Research Process Engineer, NanoSelect, Inc., Ann Arbor, MI
Advisor: Professors Michel M. Maharbiz and Yogesh B. Gianchandani

Scott M. Hanson, "Low Voltage Circuit Design Techniques for Cubic-Millimeter Computing"
University of Michigan, 2008
Postgraduate Position: Postdoctoral Research Fellow, University of Michigan
Advisor: Professor Dennis M. Sylvester

Joshua Jaeyoung Kang, "Techniques for High Resolution and Low Power Operation of SAR ADCs"
University of Michigan, 2008
Postgraduate Position: Senior Analog Design Engineer, Data Communication Department, Marvell Semiconductor, Santa Clara, CA
Advisor: Professor Michael P. Flynn

Dongsook Kim, "Low Duty-Cycled Wireless Sensor Networks: Connectivity and Opportunistic Routing"
University of Michigan, 2008
Postgraduate Position: Samsung Electronics Co., Ltd., Seoul, Korea
Advisor: Professor Mingyan Liu

Sang-Hyun Lee, "Wafer-Level Packaging for Environment-Resistant Microinstruments"
University of Michigan, 2008
Postgraduate Position: Postdoctoral Research Fellow, University of Michigan
Advisor: Professor Khalil Najafi

Kenneth J. Loh, "Development of Multifunctional Carbon Nanotube Nanocomposite Sensors for Structural Health Monitoring"
University of Michigan, 2008
Postgraduate Position: Assistant Professor, University of California - Davis
Advisor: Professor Jerome P. Lynch

Jong M. Park, "A Piezoelectrically Actuated Cryogenic Microvalve With Integrated Sensors"
University of Michigan, 2008
Postgraduate Position: Research and Development Scientist, Honeywell Automation and Control Solutions Division, Sensors and Wireless Lab, Plymouth, MN
Advisor: Professor Yogesh B. Gianchandani

Shaelah M. Reidy, "High-Performance Microfabricated Gas Chromatography Columns for Complex Mixture Analysis"
University of Michigan, 2008
Postgraduate Position: Postdoctoral Research Fellow, University of Michigan
Advisors: Professors Richard D. Sacks, Franklin L. Dorman, and Mark E. Meyerhoff

William Rose, "Investigation of Aluminum Oxynitride as Replacement Dielectric for SIC Devices"
Howard University, 2008
Postgraduate Position: Postdoctoral Research Fellow, Howard University
Advisor: Professor Gary L. Harris

Huseyin Serif Savci, "Low-Power CMOS Receiver for Medical Implant Communication Services"
Syracuse University, 2008
Postgraduate Position: Skyworks Solutions, Inc., Cedar Rapids, IA
Advisor: Professors Ercument Arvas and Numan S. Dogan

Rebecca A. Veeneman, "Design and Characterization of a Multi-Vapor Preconcentrator for a Micro-Scale Gas Chromatograph"
University of Michigan, 2008
Postgraduate Position: Agilent Technologies, Wilmington, DE
Advisor: Professor Edward T. Zellers

Scott A. Wright, "Microdischarge-Based Pressure Controlling Devices and Their Applications to Chemical Sensing in Harsh Environments"
University of Michigan, 2008
Postgraduate Position: Postdoctoral Research Fellow, University of Michigan
Advisor: Professor Yogesh B. Gianchandani

Ping Yin, "A Low-Power Radio Transmitter Design for Medical Implant Communication Services:
North Carolina A&T State University
Postgraduate Position: Entropic Communications, San Diego, CA
Advisor: Professor Numan S. Dogan

Sang Won Yoon, "Vibration Isolation and Shock Protection for MEMS"
University of Michigan, 2008
Postgraduate Position: TR Department, Toyota Technical Center, Ann Arbor, MI
Advisor: Professors Khalil Najafi and Noel C. Perkins

Weibin Zhu, "Lithographically Micromachined SI/Glass Heat Exchangers for Joule-Thomson Coolers"
University of Michigan, 2008
Postgraduate Position: Research Engineer, PicoCal, Inc., Ann Arbor, MI
Advisor: Professor Yogesh B. Gianchandani

Inset Left – MTU Chair: **Lakshman Kumar Vanga**

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***October 23, 2008**
Cory S. Fix
Graduate Student, University of Michigan
Intern at Sandia National Laboratories
"Modulator Development for Comprehensive Two-Dimensional Gas Chromatography (GCxGC)"

***October 29, 2008**
Michael De Volder, Ph.D.
Visiting Research Fellow, University of Michigan
"Pneumatic and Hydraulic Microactuators: A New Approach for Achieving High-Force Densities at Microscale"

***November 6, 2008**
David Ewing
Synapse Wireless
"Developing WSN Applications in a SNAP With Embedded Python Virtual Machine (VM) and RPC-Based Mesh Network Technology"

***November 12, 2008**
Professor Wei Lu
EECS Department, University of Michigan
"What Wonderful Things Small (Nano) Wires Can Do For You: From High-Density Memories to Transparent Electronics"

***November 19, 2008**
Professor Euisik Yoon
EECS Department, University of Michigan
"Polymer MEMS for Flexible Tactile Imaging and Microfluidics"

***December 3, 2008**
Professor Brian Otis
Department of Electrical Engineering, University of Washington
"IC Design for Low-Power Wireless Sensing"

***December 10, 2008**
Professor Ben Calhoun
Assistant Professor, ECE Department, University of Virginia
"Leveraging Sub-Threshold Digital Circuits to Minimize System-Level Power"

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