MichiganEngineering
Materials Science and Engineering

University of Michigan
College of Engineering

MSE News

SPRING 2010

The Newsletter of the Department of Materials Science and Engineering

Special Microscope Helps Engineers Analyze Materials at a High Resolution

A 300NXT 300kV ultra-high-resolution scanning transmission electron microscope, now under construction in JEOL Ltd's factory in Akishima, Japan, will be installed at U-M in January of 2011. Funding for the instrument comes from the University of Michigan and the National Science Foundation's Major Research Instrumentation program under grant DMR-0723032 "MRI: Acquisition of a Monochromated, Aberration-Corrected, Ultra High Resolution Transmission Electron Microscope for the Univ. of Michigan's Electron Microbeam Analysis Laboratory," authored by Co-PIs Xiaoqing Pan, Lumin Wang, John Mansfield, Rodney Ewing, Roy Clarke, and more than 25 other faculty from across the University. After it is installed, this instrument, one of three in existence worldwide (the others are in Sheffield, England, and Tokyo, Japan), will be able to image and chemically analyze materials at sub-Ångstrom resolution.

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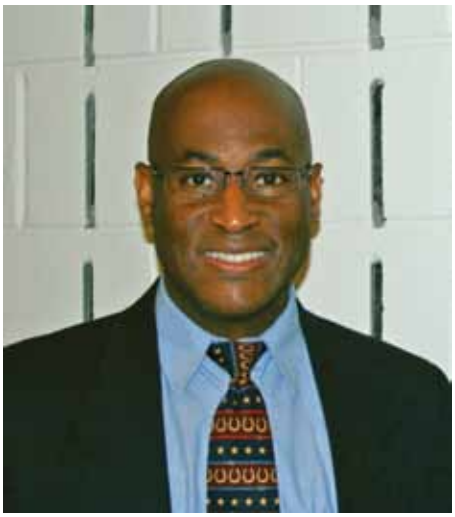
Letter to the Alumni



My last letter highlighted recent noteworthy achievements of our assistant professors, each of whom was recognized with a National Science Foundation (NSF) Early Career Faculty Development (CAREER) Award or, in one case, with a Presidential Early Career (PECASE) Award. I now report on very exciting new developments in three areas. First, three new people have joined the MSE faculty, and at least two more faculty are also slated to join on, or before, January 2011, reflecting the success of our faculty recruiting and hiring program. Secondly, we successfully competed for a $19.5 million Department of Energy (DOE) grant to launch an Energy Frontier Research Center (EFRC) for the research and development of new, complex materials for energy conversion. Finally, our student body is experiencing healthy growth: Our undergraduate program is the largest it has ever been, and we recently welcomed the single largest group of first-year students to our graduate program in the history of MSE at Michigan. Next, I expand on these exciting developments, as well as provide insight into the rationale behind our department's growth.

Two new assistant professors, Anish Tuteja and Akram Boukai, and a research professor, John Smith, joined our faculty in fall 2009. John Smith, formerly of GM and Delphi, is one of the pioneers in computational materials science. Tuteja, from MIT, and Boukai, from Caltech, have expertise in the areas of polymer nanocomposites and energy conversion, respectively, and were selected from nearly 300 outstanding applicants. Their publications have appeared in *Nature*, *Science*, and the *Proceedings of the National Academies*. Dr. Emmanuelle Marquis, from Oxford University, is scheduled to join our department on, or before, January of 2011. An expert in the area of metals, she has made significant contributions to the development and use of atom probe microscopy for materials analysis. We are searching for another assistant professor to augment our impact in the general area of energy storage.

Our undergraduate program is the largest it has ever been and we recently welcomed the single largest group of first-year students to our graduate program in the history of MSE at Michigan.

Last year we suffered two strategic losses; Dave Martin was recruited to become chair of the MSE department at the University of Delaware, and Tresa Pollock was recruited to the University of California, Santa Barbara. They both were major contributors to MSE and will be missed. Our plan is to hire a senior, high-profile metallurgist to replace Professor Pollock before the end of 2010, in order to maintain strength in the area of structural metals.

An effective MSE department should, in part, serve as a natural bridge among the sciences, medicine, and engineering design disciplines. Many societal problems, from energy and sustainability to national security and medicine, increasingly rely on the availability of new "hard" and "soft" materials of varying structures and "functionalities." For example, in regard to the issue of materials functionality, polymers are now used for diverse applications that include energy conversion, organic electronics, structural applications, and sensors; until 20 years ago they were largely used for packaging applications and toys. Applications of ceramic materials now include optics and computer memories. These developments, which are due largely to new and creative synthetic/processing strategies, point clearly to a paradigm shift. Indeed, the conventional manner in which programs in MSE departments are identified—with specializations in metals, polymers, ceramics, and semiconductors—is often not particularly constructive. A description based on materials "functionality" is often more useful. Our current challenge is to maintain a focus on recruiting researchers with expertise synergistic with other departments, in ways that enable us to compete for larger

multidisciplinary programs, with a strong materials emphasis. At the same time, it is critical to maintain expertise in core areas. If we maintain expertise in only one or two areas, we are destined to have limited impact on the institution and the field; this could be problematic for our future.

In order to compete for many large, multidisciplinary funding programs, it is essential for institutions to have outstanding expertise in key areas of the MSE discipline: computational materials science, new materials (organic and inorganic) synthesis, and measurement capabilities for the structure and properties of materials at the nanoscale. Our recent multimillion-dollar programs in the areas of prosthetics materials, negative index materials, and thermoelectrics, and the new $19.5 million EFRC on solar and thermal energy conversion, are all centered on materials functionality and not specific types of materials. In the EFRC, organic and inorganic materials play a critical role, since the goal of the Center is to discover and develop new materials and processes for high efficiency energy conversion using thermoelectric and photovoltaic devices. These challenges require an understanding of the properties of materials at the nanoscale. Expertise in functional materials synthesis; sophisticated tools, such as the new multi-million-dollar aberration corrected electron microscopes; and computational expertise are essential.

One implication is that we must continue to give our students a strong foundation in materials, so that later they may specialize, depending on their job functions. Our students continue to learn the basics in materials science and engineering, taking specific courses in metals, polymers, ceramics, composites, and the electronic properties of materials (specifically, semiconductors). However, materials "functionality" is emphasized. Hence students learn about the uses and limitations of materials for a wide range of applications, some of which didn't exist two decades ago (e.g., iPods). Our undergraduate enrollment continues to increase. A significant fraction of our undergraduates, ~45%, attend graduate school. Many others find employment in the industrial sector. We constantly discuss changes that need to be made to our curriculum. Our undergraduate committee and the faculty continue to work hard to improve the educational process.

Students applying to universities are well aware of the evolution of the field, now involving new areas of materials. Students applying to our graduate program increasingly show interest in the functional aspects/applications of materials. It is noteworthy that fewer students identify metals, polymers, or ceramics as areas of interest than did even four years ago. Last year the single largest number of graduate students, 35, in MSE's history joined the department. One might argue that our poor economy accounted for this, but the number of applicants is much higher than it ever has been; moreover, this group of students is as academically strong as any group that previously entered MSE. This year the applicant pool is even more impressive and the interest expressed by students in areas of energy and applications involving functional materials is even greater.

My letter has perhaps been a bit long. However, I felt it was important to share my thoughts on U-M MSE and its future. We welcome any input or feedback from our alums or friends of the department on this or any related matters.

Go Blue!

Peter F. Green
Department Chair and
Vincent T. and Gloria M. Gorguze
Professor of Engineering

UNIVERSITY OF MICHIGAN

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Center for Solar and Thermal Energy Conversion Launches

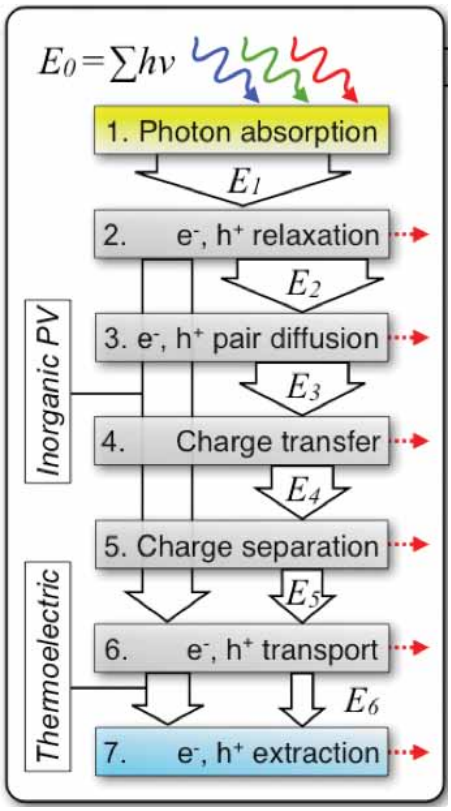
America's energy consumption is expected to rise significantly in the coming years. Currently, the country consumes nearly 25% of the world's energy (15 TW of power), with most of that consumption deriving from the combustion of fossil fuels. Though renewable sources promise to provide the most economical and environmentally friendly solution to the energy consumption/supply dilemma, they now account for less than 1% of the total U.S. consumption. An ample supply of solar energy exists, since the sun deposits approximately 1.2×10^5 TW of power on the earth's surface; however, very little U.S. power derives from solar energy.

To help meet the country's future energy needs while reducing its dependence on fossil fuels, the U.S. Department of Energy recently established 46 Energy Frontier Research Centers, after a nationwide competition involving academia and industry. One of these centers, established at U-M, will focus on advancing solar energy technology. "As global energy demand grows, there is an urgent need to reduce our dependence on imported oil and curtail greenhouse gas emissions," said Secretary of Energy Steven Chu in announcing the new centers. "Meeting the challenge to reduce our dependence on imported oil and curtail greenhouse gas emissions will require significant scientific advances. These Centers will mobilize the enormous talents and skills of our nation's scientific workforce in pursuit of the breakthroughs that are essential to make alternative and renewable energy truly viable as large-scale replacements for fossil fuels."

Launched in August of 2009, U-M's Center for Solar and Thermal Energy Conversion is dedicated to researching and developing new materials for the next generation of high-efficiency thermoelectric and photovoltaic devices involved in thermal energy and solar energy conversion, respectively. According to Peter Green, the MSE chair and director of the EFRC, "scientific advances in the areas of nanoscience and nanotechnology, which enable control of the structure and properties of materials at the nanoscale, as well as the discovery of new and creative strategies to synthesize new materials with unusual properties, has made it possible to articulate and to address scientific challenges that are necessary to create a new generation of materials for low-cost, high-efficiency energy conversion. Much of this was not possible even five years ago," said Green.

To this end, the Center has assembled a world-class team of 12 principal investigators and 16 senior investigators with expertise in theory, computation, materials growth and synthesis, ultrafast optical sciences, and materials characterization. Comprising faculty from the departments of Materials Science and Engineering, Chemistry, Physics, Chemical Engineering, Mechanical Engineering, and Electrical Engineering, the team will use a multidisciplinary approach to maximize the energy conversion efficiencies of photovoltaic (PV) and thermoelectric (TE) devices.

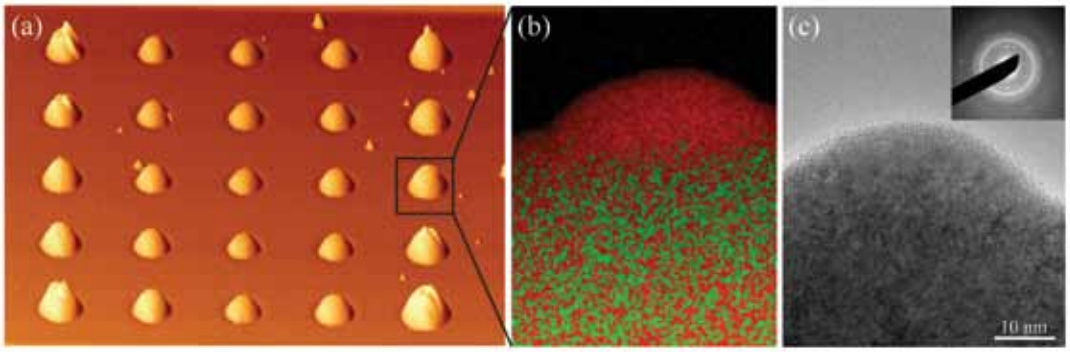
"We are working on challenging problems that can't be solved by just one person in a laboratory, but by an interdisciplinary team of world-class researchers from across the campus of the University of Michigan," Green remarked. "Our team includes researchers who study optical and electronic processes using very sophisticated tools, people who fabricate new materials and control structures at the nanoscale, people who can synthesize materials with unusual properties, and people who are experienced in designing and making devices."



An illustration of the multi-step, light-to-electricity conversion processes for organic PV, inorganic PV, and thermoelectrics. The loss mechanisms at each step are also described.

Nanoscale Patterning of Metallic Droplets by Dynamic Coalescence

Nanowire fabrication in three dimensions and the creation of metamaterials that can be used to construct perfect lenses can be enabled by the controlled nanoscale patterning of metallic droplets. In work published in *Applied Physics Letters* in October 2009, Professor Rachel Goldman and her research group discovered the mechanism underlying the formation of these metallic droplets. This mechanism, which is based on dynamic coalescence, can be used to control the formation of the droplets—preventing them when they're not wanted and patterning them when they are.



Figs: (a) AFM image of 2-dimensional FIB-fabricated Ga droplet array on GaAs; (b) XEDS cross-sectional map of Ga (red) and As (green) in the vicinity of a Ga droplet shows that the composition of this droplet is pure Ga; (c) cross-sectional TEM image and corresponding diffraction pattern in the vicinity of a Ga droplet indicate that the structure of the Ga droplet is amorphous and there is a polycrystalline GaAs layer underneath the droplet.

The discovery is based on experiments in which Professor Goldman and her group used focused gallium (Ga) ion beam (FIB) irradiation to make holes in a semiconducting gallium arsenide (GaAs) substrate. The original intent of the experiments was to grow patterns of quantum dots (QDs). The researchers found that Ga precipitated out from the substrate and formed drops on its surface.

"It was quite remarkable…. We were intending to make holes with FIB irradiation so we could grow the QDs, and we got droplets instead," explains Goldman. "We certainly weren't the first to see them, but we've been the first to provide an understanding of their formation."

Professor Goldman and her group discovered that dynamic coalescence —in effect, the movement and merging of droplets to form larger ones—is at work. The formation of droplets rather than films is due to differences in surface energies between Ga and GaAs. This is analogous to behavior observed in a more common materials combination, describes Professor Goldman: "When we put mercury on glass, it forms droplets. If we shake the glass, mercury droplets move towards each other and merge. This is analogous to the 'dynamic coalescence' that we observe upon continued irradiation of Ga droplets on GaAs surfaces."

Another unexpected experimental result was the observation that the droplets continued to grow even after irradiation with Ga ions stopped. Goldman continues the analogy: "If we add more mercury, the droplets grow larger." The supply of Ga provided by the FIB irradiation leads to a Ga-rich surface, which is analogous to the continued addition of mercury to the glass slide.

Ultimately, the mechanism of droplet formation implies that altering the binding energy of the substrate by using different materials can alter the type of nanostructure grown. "What's exciting is that our findings can be applied to other surfaces," Professor Goldman adds. "They offer a way to combine different intrinsic properties that can lead to new functionalities."

Reference:

J.H. Wu, W. Ye, B.L. Cardozo, D. Saltzman, K. Sun, H. Sun, J.F. Mansfield, and R.S. Goldman, "Formation and coarsening of Ga droplets on focused-ion-beam irradiated GaAs surfaces," Applied Physics Letters *95, 153107 (2009).*

Forty Years of Nanoscale Characterization at U-M—Celebrating the Electron Microbeam Analysis Laboratory's 40th Birthday

In the late 1960s, Professor Wil Bigelow of the then Department of Materials and Metallurgical Engineering, in collaboration with U-M's former Vice President for Research A. Geoffrey Norman, established a University-wide user facility for the chemical and structural analysis of materials at the sub-micron length scale. In 1968, an ARL EMX-SM electron microprobe was placed in the facility, and, in 1970, the first SEM was added. Soon after, the principles of operating the laboratory as a user facility were defined and U-M's Electron Microbeam Analysis Laboratory was born. Since then, the facility has frequently been updated, and today boasts two locations—one on Central Campus and one on North Campus and houses more than 20 instruments.

To celebrate EMAL's 40th birthday and to support U-M's nanoscale characterization needs, a two-day symposium was held on October 20th and 21st in conjunction with the 2009 Van Vlack Lectures (delivered at the end of each day). U-M faculty and students, EMAL alumni, emeritus EMAL faculty and staff, and local industry and sister educational institutions attended the event. Wil Bigelow, now a professor emeritus, gave the opening talk. He described the events leading to the establishment of EMAL and the lab's development over the first 20 years of operation. Next, the associate director of the North Campus branch, John Mansfield, detailed the second 20 years of EMAL's history. EMAL alum presenters then discussed how their EMAL experiences shaped their current endeavors, illustrating both the breadth of research

that EMAL supports and the lifelong skills students learn working there.

On the first day, Larry Allard, of Oak Ridge National Laboratory, outlined his experiences with an *in-situ* environmental electron microscopy; John Mardinly described how he had used knowledge gained working in EMAL during his 17-year tenure at Intel Corporation; Christine Orme, of Lawrence Livermore National Laboratory, discussed her current research—how molecular processes at interfaces modify the way that materials assemble and disassemble; Christian Kübel, of the Karlsruhe Insitute of Nanotechnology, explored the development of the electron microscopy of polymers, from classical high resolution imaging to modern electron tomography; Elaine DiMasi, of Brookhaven National Laboratory, discussed her nanoscale study of the biomineralization of extracellular matrix proteins by synchrotron and electron microscopy. The day was brought to a close with the first Van Vlack Lecture, "Knowledge of Structure is the Pathway to Enlightenment," delivered by Professor Edwin (Ned) Thomas of MIT. A reception and dinner followed.

The second day began with a fascinating presentation by Tricia Wilson Nguyen, of Fabric Works, LLC, and Thistle Threads, LLC. Nguyen detailed the process she developed to identify the individual seamstresses responsible for sewing appliqués on a range of 17th-century garments. Amit Misra, of Los Alamos National Laboratory, discussed his nanostructural analysis of nanolayered composites. Brendan Foran, of the Aerospace Corporation, discussed his group's analysis of InGaAs/AlGaAs strained quantum-well infrared laser diodes by scanning transmission electron microscopy and focused in beam techniques. Xiaojun Weng, a research scientist at Penn State, presented the results of his research in III-V semiconductors, which involves examining the effects of silicon doping on the evolution and growth of threading dislocations in AlGaN films. In his talk "Finding Excuses Not to Do TEM—Nanoscale Structural Analysis Inside a SEM," Yoosuf Picard, a research scientist at Carnegie Mellon University,

illustrated how powerful a tool the SEM has become. Lawrence Drummy of Wright-Patterson Air Force Base then described the morphological characterization of polymer nanocomposites with both high resolution transmission electron microscopy and electron tomography. In the second Van Vlack Lecture, Ned Thomas spoke on the development of polymer-based nanomaterials for photonics and phononics.

To view the presentations in Flash format, go to www.emal.engin.umich.edu/education_materials/emal40th.html

The University of Michigan Electron Micorbeam Analysis Laboratory would like to thank the FEI Company, Inc.; EDAX, Inc.; and JEOL USA, Inc., for their generous sponsorship of this event.

Discovering 3-D Communication in Silica Nano-Cages

For 15 years, Professor Richard Laine has been synthesizing polyhedral silsesquioxanes (SQs), or nano-cages of silica. These molecules, and materials based on them, are fast becoming a "hot" topic judging from recent spikes in related journal articles and patents. The SQs have a lot to offer: They're relatively easy to make and purify, and their functionalities can be altered for a wide range of applications, including low-k dielectrics for semiconductor chip insulation and for photonic materials used in organic light-emitting diodes. The ability to add organic functional groups to the vertices of the SQ core structure also opens the door to new star, branched, and hyper-branched molecules.

About 5 years ago, Laine's research group made a key observation: The functional organic groups attached at the vertices appeared to communicate electronically in the excited state through the center of the all-silica cage. This is surprising because silica is well known for its insulating properties, and so scientists had long assumed such communication was nil. However, given the nanoscale size and properties of the cages, a number of research groups, including one led by MSE Professor John Kieffer, determined there was a theoretical possibility of 3-D conjugation in SQs in the excited state (e.g., after absorbing a photon). Perhaps, in this state, the silicon-based molecules act less like insulators and more like semiconductors.

Laine's team subsequently spent 5 years conducting experiments on SQs to determine if there is indeed 3-D conjugation in the excited state. Recently, working with a group in Italy, the group made additional model compound studies looking at the photophysical properties of single corners of cages and half cages and comparing their properties with full cages. In work with the Theodore Goodson group in U-M's Chemistry department, Laine's team looked at the ultraviolet-visible absorption and emission behavior and at two photoabsorption cross sections. In work with the Stephen Rand group in the Applied Physics department, they also looked at cathodoluminescent behavior.

What the team found has tremendous potential: The cage-like molecules indeed appear to possess the unique property of 3-D conjugation in the excited state. "If that's the case and SQs have semiconducting properties, then they also have band gaps," Laine explains. "So now we have a molecule we can make easily that seems to behave like a 3-D semiconductor. If that's correct, one could attach source, drain, and gate leads and expect that it would act like a transistor. And the idea of a single molecule transistor is very exciting."

The work, a collaboration among researchers at the U-M as well as U.Va. and the University of Milan, was recently published in the *Journal of the American Chemical Society*.

Further research by Laine's group supports the earlier findings. They now have also shown that oligomers containing cages joined by conjugated groups show similar 3-D interactions, not only within but also between cages, as well as between cages of different sizes and compositions.

Reference:

R.M. Laine, S. Sulaiman, C. Brick, M. Roll, R. Tamaki, M.Z. Asuncion, M. Neurock, J-S. Filhol, C-Y. Lee, J. Zhang, T. Goodson III, M. Ronchi and M. Pizzotti, S.C. Rand, and Y. Li, "Synthesis and photophysical properties of stilbeneoctasilsesquioxanes: Emission behavior coupled with theoretical modeling studies suggest a 3-D excited state involving the silica core," J. Am. Chem. Soc. 2010, *132 3708–3722.*

Meet New MSE Faculty Members Akram Boukai, John Smith, and Anish Tuteja

Akram Boukai has joined MSE as an assistant professor.

Boukai graduated from UCLA, where he double majored in electrical engineering and chemistry. While pursuing a PhD in chemistry at Caltech, he focused on the thermoelectric properties of bismuth and silicon nanowires. He completed his postdoctoral work on solar cells at UC Berkeley.

At Caltech, Boukai discovered that silicon nanowires have a 100-fold improvement in thermoelectric efficiency over bulk silicon. Research results demonstrated the possibility of using heat and temperature differences to generate electricity, a significant discovery given silicon's abundance in the Earth's crust.

Boukai's research also showed that the quality of a material's surface and the way it is processed have a significant impact on the efficiencies of thermoelectrics and solar cells. At U-M, he plans to further investigate renewable energy sources to power both thermoelectrics and solar cells and to strive to increase their efficiencies. He will also explore questions related to heat flow that arise at the nanoscale.

Boukai is looking forward to working with some of the brightest engineers in the U.S. "I am most excited about interacting with my new colleagues and exploring my ideas further in the world-class MSE facilities."

John R. Smith has joined MSE as a research professor.

Smith earned his PhD in physics from Ohio State and completed postdoctoral research in physics at UC San Diego, with chemistry Nobel Laureate Walter Kohn. For nearly 28 years, he worked for GM Research Laboratories as a research scientist. For 7 of them, he also taught in U-M's Physics department. At GM, Smith led the Surface Physics and Solid State Physics groups and the Engineered Surfaces Program. He focused on developing new materials and on the theory and simulation of material properties. He also built upon his research with Kohn by developing and applying density functional methods.

Smith's work centers on the computer simulation and theory of solid surfaces and interfaces, particularly adhesion and chemisorption. He has extensively researched the development of coatings, including thermal barrier coatings for jet engine rotor blades for the U.S. Navy and Air Force. As part of this research, Smith collaborated with Professors Tresa Pollock and David Srolovitz, both formerly with MSE.

Recently, Smith has focused on developing a new water splitting process to convert solar energy into hydrogen fuel. Because of the intermittent nature of solar radiation, storing solar energy as a fuel is highly desirable. The process entails using a nanopowder catalyst in the presence of sunlight to split water into hydrogen and oxygen gases. The hydrogen can be stored as a fuel and then recombined with oxygen to release energy as needed. The only combustion product is water; no greenhouse gases are released, and no hydrocarbon fuels are involved.

In MSE, Smith will continue to refine his thermal photocatalytic water splitting process. He is looking forward to working with MSE faculty. "I've come to know a number of U-M faculty over the years, and I'm most excited to have the opportunity to collaborate with members of this fine department."

Anish Tuteja has joined MSE as an assistant professor.

Tuteja earned a BS in chemical engineering from Panjab University and a PhD in chemical engineering from Michigan State. He completed postdoctoral research in the area of surface and interfacial science at MIT. While at MIT, he helped develop the first-ever "superoleophobic" surfaces, which resist wetting by extremely low

surface tension liquids such as various oils and alcohols. These surfaces are expected to have widespread commercial applications, such as in the development of stain-resistant textiles and fingerprint-resistant surfaces. This work was named one of the top 5 breakthroughs of 2007 in nanotechnology by *Technology Review* and one of 5 new discoveries that will change the world by *Chosun Daily*.

At U-M, Tuteja plans to build a research program focused on understanding and engineering functional nanoparticle-polymeric systems. Materials developed will address some of the key challenges of renewable energy. He will also build upon his MIT work on understanding the synergistic effects of surface texture and chemistry on surface wettability. If successful, Tuteja anticipates his research approach will considerably broaden the commercial appeal of bioethanol and encourage its large-scale use.

Tuteja is excited about mentoring a new generation of materials scientists at U-M. "I believe materials scientists will have a defining role in both discovering and commercializing materials for efficient energy conversion."

Faculty News

KUDOS

National, regional, and local awards and honors continue to recognize the outstanding quality of our faculty.

FACULTY AWARDS AND HONORS

Rodney Ewing
Royal Society of Canada–Earth, Ocean & Atmospheric Division (Foreign Fellow, 2009)

Ronald Gibala (Emeritus Faculty)
ASM International Albert Sauveur Achievement Award

Rachel Goldman
2010 MSE Outstanding Achievement Award

J. Wayne Jones
ASM International Albert Easton White Distinguished Teacher Award

Nicholas Kotov
R&D Magazine 100 Award

Joanna Millunchick
2010 College of Engineering Education Excellence Award

Ann Marie Sastry
CNNMoney.com's Innovators in Detroit List

Max Shtein
2009 MSE Outstanding Achievement Award

Michael Thouless
Awarded University of Cambridge ScD degree

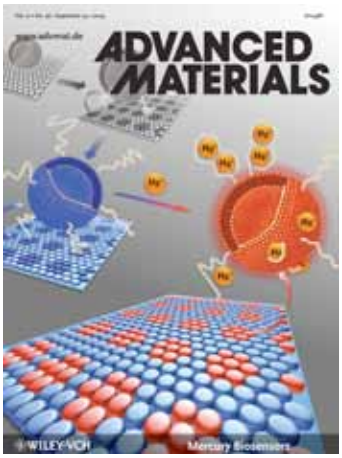
PROFESSIONAL SERVICE

Stephen Forrest
Elected Board Chairman of Ann Arbor SPARK

Ronald Gibala (Emeritus Faculty)
ABET evaluator for Materials, Metallurgical and similar programs and member of TMS and MRS accreditation committees. Most recent visit: Middle East Technical University, Ankara, Turkey.

Katsuyo Thornton
Inaugural Chair, TMS Integrated Computational Materials Engineering (ICME) Technical Committee

Michael Thouless
Chair of U-M's Senate Advisory Committee on University Affairs (SACUA), 2009–2010



September issue of *Advanced Materials*: Jiseok Lee, Hayeon Jun, Jinsang Kim. "Polydiacetylene Liposome Microarrays for Selective and Sensitive Mercury (II) Detection." *Adv. Mater.*, 2009, 21, 3674. (Inside Cover)

Alumni Society Merit Award Winner

From left: Paul A. Bauerschmidt, Dean David Munson, Larry Miller, and Peter Green at the 2009 Alumni Society Awards Dinner, held on September 25, 2009. Photo courtesy of Dwight Cendrowski.

Larry Miller has enjoyed a distinguished career in the plastics industry for more than four decades. Now retired, he was a founding partner of Molmec, Inc., a pioneer in the mass production of close-tolerance, injection-molded plastic parts. Headquartered in Walled Lake, Michigan, Molmec was a major supplier of molded plastic components (e.g., door handles, interior trim, and fans and shrouds) and carburetors to the automotive industry. The company was one of the first to use robots in the injection-molding manufacturing process, and it introduced the first toilet designed to conserve water by using only a gallon and a half of water per flush.

Prior to co-founding Molmec, Inc., Miller worked in research and sales for the DuPont Corporation. He earned his bachelor's in materials science and his master's in high polymer chemistry, both from U-M, and an executive business degree from Harvard University. As a U-M student, he belonged to the Sigma Nu and Tau Beta Pi honor societies, and he received the Oreon E. Scott Award for Distinguished Scholarship in Science.

Over the years, Miller has given generously of his time, talent, and resources to both the College and University. As a member of the College's Class of '55E Emeritus Committee, he helped organize the 50-year class reunion and led fundraising efforts for the class gift. He also served as the '55E alumni class representative at the College's 2005 graduation ceremony. In addition, Miller gave a significant gift to U-M's Kellogg Eye Center, which enabled the purchase of two high-resolution research microscopes.

Miller has been active in the plastics industry, serving on the board of the Detroit chapter of the Society of Plastics Engineers and participating in advisory committees at Eastern Michigan and Ferris State universities. He currently lives in Williamsburg, Virginia, and Orchard Lake Village, where he once held the positions of mayor and member of the Village Planning Commission.

Thomas Gives Van Vlack Lecture

Professor Edwin L. Thomas of the Massachusetts Institute of Technology (MIT) delivered the 2009 Van Vlack Lectures, a major annual event in MSE that honors an outstanding materials scientist and educator. The annual lectureship was established by the Van Vlack family in memory of Professor Larry Van Vlack and his outstanding educational and research contributions to MSE at Michigan. We are pleased that the Van Vlack family continues to participate in this event with an annual visit to campus.

Edwin L. (Ned) Thomas is the department head of Materials Science and Engineering, the founding director of the Institute for Soldier Nanotechnologies, and the Morris Cohen Professor of Materials Science and Engineering at MIT. A member of the National Academy of Engineering, he earned a BS in mechanical engineering from the University of Massachusetts (1969) and a PhD in materials science and engineering from Cornell University (1974). During his two-day visit on October 19 and 20, Professor Thomas presented two lectures entitled "Knowledge of Structure is the Pathway to Enlightenment" and "Polymer Based NanoMaterials for phoXonics (x = t + n)." This year's lectureship was held in conjunction with the 40th anniversary of the Electron Microbeam Analysis Laboratory, featuring alumni of the laboratory who are active in materials science research (see related article p. 6).

Alumni Notes

Dr. Larry Allard (BSE '67, MSE '69, PhD '81) was recently elected director (for a 3-year term) of Physical Sciences in the Microscopy Society of America. He was also selected to be a fellow in the Society, in only the second year of its fellows program. Larry is a distinguished research staff member at Oak Ridge National Laboratory (ORNL), and a task leader for the Materials Analysis group at ORNL's High Temperature Materials Laboratory. Professor Emeritus Wilbur Bigelow mentored Larry as he pursued his several degrees in MSE, and continues to collaborate with him in developing and implementing new technologies at ORNL since his retirement in 1993.

James Yurko (BSE '97) is one of ten young professionals selected to receive the 2010 TMS Young Leader Professional Development Award. James is the co-founder, process development manager, and chief engineer of Electrolytic Research Corporation LLC, in Sudbury, Massachusetts.

Mike Tolinski (BSE, '90), an independent researcher and writer for the plastics industry, has published his first book. Entitled *Additives for Polyolefins: Getting the Most out of Polypropylene, Polyethylene and TPO*, the book was published by Elsevier in the summer of 2009 (www.additivesforpolyolefins.com). After a career as an engineer, Mike became convinced that he was at least as much of a writer as he was an engineer, and moved into the profession of transmitting manufacturing and engineered materials issues and information to industry readers. His current research focus is on sustainability issues in regard to plastics and bioplastics.

Myung-Su Kim (PhD '09) accepted a research scientist position with the Solar Cell Division, Samsung Electronics in South Korea.

Left: Professor Hosford and MMS President Andrew Koltonow ponder burgers at the 2009 MMS fall picnic. Right: Former MMS President Dave Trumble and Vice President Jeff Wongstrom staff the grills in Professor Hosford's yard (from the MMS archive, circa 1985).

An Eye on Tradition and Hamburgers

We often hear a great deal about the importance of tradition at U-M, but don't give much thought to its significance. However, as technology advances at an ever-quickening pace, and as materials scientists and engineers continue to enhance and redefine the industries underpinning our world, we must ask: What is tradition, and what is its value?

A hallowed tradition that started in the 1960s provides some answers. At that time, students in the Michigan Metals Society approached their advisor, Professor Hosford, about hosting a picnic for students and professors in the MSE department. Since then, the Hosford estate has provided a social venue for the families of the MSE department biannually. Perhaps these two photographs can help illustrate the value of tradition in our department. Tradition can be connected to friendships that survive through the years, and to memories that persist because an event reoccurs over time. One thing seems certain: Hamburgers never go out of style.

MSE Photo Contest

In conjunction with the Electron Microbeam Analysis Laboratory (EMAL), MSE sponsors a yearly contest in which students submit their best digital images from research, class work, or other projects. A panel of judges is selected to review the anonymous submissions and to select two grand prize winners and numerous category awards. Sixty individuals submitted 75 submissions for the 2009 Imaging Microstructure Contest, which represents a significant growth in participation from the inaugural contest in 2008. Alejandro Perez-Bergquist (Scientific Merit) and Laura Ligeski (Artistic Merit) were the grand prize winners; the category winners are listed below. All winning entries can be seen at: www.mse.engin.umich.edu/internal/imaging-microstructure-contest-2009/winners. The 2010 contest is underway, and expectations are high for an ever-increasing number of high-quality entries.

Category Winners

Category I Optical and Scanning Electron Microscopy

Damien Stonick
Richard R. Lunt
Qiaona Hu

Category II TEM, X-ray Imaging, and Surface Probe Techniques

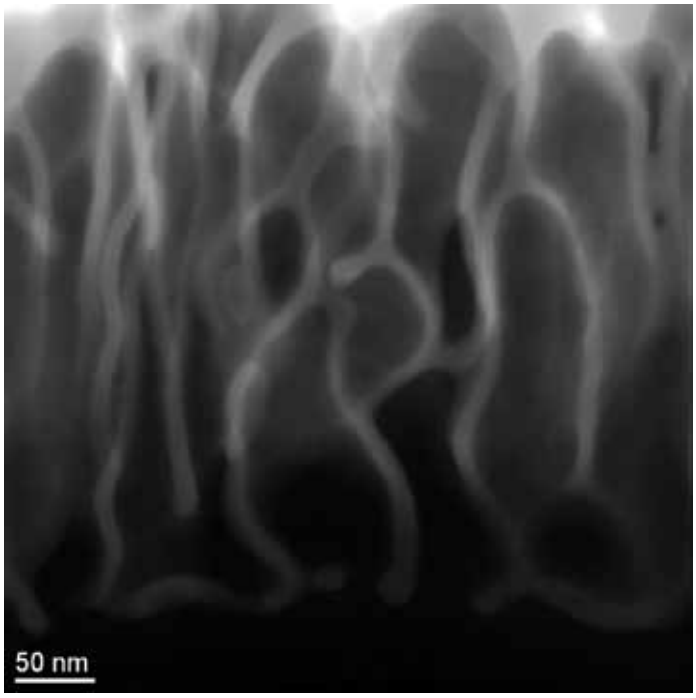
Christopher Nelson
Lee Sears
Michael Katz

Category III Simulated Microstructures as Products of Computational Materials Science

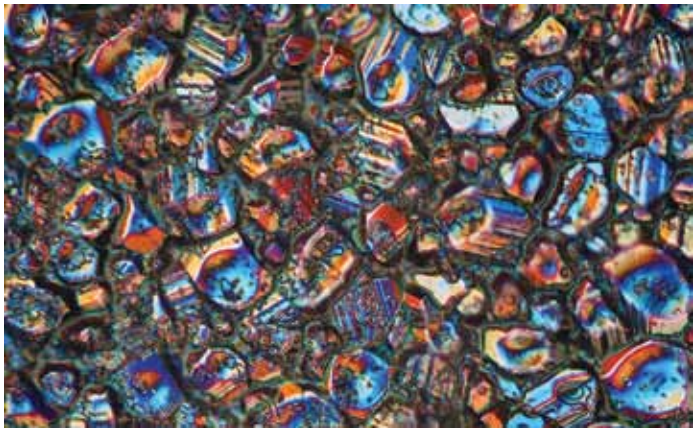
Victor Chan
Nick Patterson
Chloe Funkhouser

Category IV Digitally Enhanced or Colorized Images of Microstructures

Jungwoo Lee
Kevin Grossklaus
(tie) Alex Perez-Bergquist and
Laura Ligeski



Alejandro Perez-Bergquist, "Germanium Nanofibers or Jellyfish Tentacles?"



Laura Ligeski, "Secondary Grains of Sintered Barium Titanate"

Undergraduate Program Update

The undergraduate program continues to evolve with 133 students now distributed across the three upper classes. Among recent highlights are the key changes that are transforming the laboratory and capstone design sequences to offer a more imaginative and open-ended educational experience. First, in the third year laboratory sequence, we are using National Instruments (NI) Labview VI software, in alliance with NI, to build auxiliary instrumentation for distributed materials characterization. This is being used to track strain, temperature, and other physical sensory attributes in several different examples over the course of the term.

Coupled with this new emphasis on equipping our students with advanced engineering tools, we have expanded and evolved the capstone design sequence. Students working on innovative projects in the fall semester in MSE 489 will have an opportunity to develop prototypes in the winter semester on a limited basis. Already in fall of 2009, Professor Max Shtein (who teaches the MSE 489 design course) accepted 8 engineering students into his Smart Surfaces course (www.smartsurfaces.net/fall2009) to give them a broader design studio experience. This hands-on design course was co-taught with faculty from the College of Architecture and Urban Planning (Karl Daubmann) and the School of Art & Design (John Marshall), and exposed students to multidisciplinary design teams, digital design, fabrication, and programming. We anticipate that these innovative design experiences will greatly broaden our students' horizons and transform them into more effective engineers. For the past 5 years, Professor Shtein's design course (MSE 489) has focused on renewable energy harvesting and efficient utilization, with tremendous student response. The excellence of the design courses is evidenced by one student group ("Project Zephyr" led by Kelsey Poineau) reaching the semifinals of the $100,000 DTE Energy Prize competition. Poineau is in the process of prototyping the technology her group proposed for mitigating ice accumulation on offshore wind turbines and forming a start-up company. In fall 2010, Shtein wants to institute a competition for the senior design course, so that student teams can vie for monetary awards that will help them defend intellectual property and create physical prototypes of their inventions. (If you would like to participate as a sponsor and/or judge, please contact Max at mshtein@umich.edu.)

2010 North Campus Martin Luther King, Jr. Spirit Award recipients announced

On Tuesday, February 9, Casady Wyckoff (shown fourth from the left in the photo) was one of five students chosen to receive the 2010 University of Michigan North Campus Martin Luther King, Jr. Spirit Awards. These students were selected as award recipients based on their leadership, promotion of diversity, and exemplification of the vision of Dr. King. An award luncheon was held in their honor at the Slusser Gallery in the School of Art & Design on North Campus. Casady Wyckoff, a current MSE senior, received the award for her efforts promoting LGBTQ awareness throughout the College of Engineering. Wyckoff—who helped found the Student Alliance of Gay Engineers in 2008—has worked to bring many of the LGBTQ resources Central Campus provides up to North Campus, including Ally Training, the Day of Silence, and many other efforts. In addition to Casady Wyckoff, this year's Spirit Award recipients were undergraduates Jasmine Way and Vikas Hiremath and graduate students Michael Alexander and Kush Patel.

2009 ASM Summer Teacher's Camp

The ASM Teacher's Camp celebrated its eighth year last summer. During this one-week workshop, teacher participants learn the basics of materials science technology as it is taught at the high-school level. Camp instructors encourage students to learn science concepts by completing small hands-on projects and by attending lectures that explain the basic material principles. Teachers can then use this information as a basis for teaching their own materials science technology courses, or incorporate the concepts into an existing science curriculum. We look forward to hosting this exciting program once again on North Campus from July 12–16, 2010.

Scholarships and Awards

Graduate

Department Awards

MSE Graduate Service Award for Recruiting
Michael Aldridge, Anna Belak, Andrea Dangelewicz, Susan Gentry, Denis Nothern, Jonathan Wei

Best Overall Teaching Assistant
Jessica Ter-Bush

Best Overall GPA
Jonathan Wei

Best Overall Written Exam Score
Aaron Tan

EMAL 40th Anniversary Symposium Poster Contest—1st Place
Myungkoo Kang

College/University Awards

2010–2011 Rackham Predoctoral Fellowship
Changgua Zhen

CoE Distinguished Achievement Award
Obiefune Ezekoye

CoE Distinguished Leadership Award
Obiefune Ezekoye, Jessica Ter-Bush

Undergraduate

Department Awards

Richard A. Flinn Scholarship
Joel Ondersma

Fontana-Leslie Scholarship Fund
Jiwon Kim, Stephanie Prado, Mit Shah, Damien Stonick, Janice Weaver

James W. Freeman Memorial Scholarship
Yuming Jiang, Tatsuya Kamiya

John Grennan Scholarship
Victoria Miller

Jack J. Heller Memorial Engineering Scholarship Fund
Diana Goulding

William F. Hosford Scholarship
Michael Mathieu, Greger Pioszak, Lisa Shaw

Schwartzwalder Memorial Scholarship
Theresa Benedeti, Chien Chen, Cory Dubrish, Bethany Glesner, Kyle Luck, Chipo Mulaisho, Kelsey Poineau, Christopher Sketch, Denar Van Drasek, Tianhao Wu

Clarence A. Siebert Memorial Scholarship
Tamir Arbel, Mark Hendryx, Katharina Maisel

Alfred H. White Memorial Scholarship
Roger Jia, Steven Madsen

Brian D. Worth Prize (awarded Spring 2009)
Caroline Dove

MMS Anvil Award (awarded Spring 2009)
Conlin Hsu

College/University Awards

Distinguished Leadership Award
Casady Wyckoff

Distinguished Achievement Award
Garrett Huff

Tau Beta Pi Frst Year Student Award
Victoria Miller

2010 North Campus MLK Spirit Award
Casady Wyckoff

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Thank you for your generous gifts to our department or to the College of Engineering for the benefit of the department. If we have missed someone, please accept our sincere apology, and let us know so that we can correct our records.

Materials Science and Engineering Fellowship Challenge Fund

With your generous donations we have established a fellowship fund to support first-year graduate students. Although President Coleman's one-to-one match has ended, we are continuing to accept donations for this important initiative. Donations can be made using the enclosed return envelope.

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Thanks to MSE staff members Kevin Worth (and alum, BSE '96) and Justin Scanlon, friends of MSE can keep informed of the department's programs and activities through a MSE Facebook page http://facebook.com/UMMSE.