www.matse.illinois.edu

Department of Materials Science and Engineering **News**

University of Illinois at Urbana-Champaign | Summer 2009

Coatings Self-Repair

Self-healing greatly extends the life of paints and coatings

From the Department Head

Dear Alumni,

I have now completed more than six years here, serving first as the interim Head and then as the Head of the department. It has been a great experience, but I came to the decision earlier in this semester that it was time for a change, both for me and for the department. I can think of no better time for a change—I was told it is best to step away when you are on top and I believe today that is where we are. Our student population has reached record numbers, and we continue to attract the best and brightest. I know you will be proud to welcome them to your ranks in the coming years. The faculty continues to excel, bringing new and exciting research programs that will pave the way to find technological solutions to many of the challenging issue our nation faces today. I continue to be impressed by the visionary and high quality research they and their students conduct. We, despite the challenging economic times, have hired a new faculty member, Lane Martin. Lane will be introduced to you in the Fall newsletter, and I am sure you will be impressed with his plans for the future. Shen Dillon will officially join the faculty ranks in the fall, too. Your generosity to and support of the department continues to grow, and it is hard to imagine a better and more loyal group of alumni. I could go on and list more achievements but … well, I am sure you get the idea. Our standing is perhaps best summed up in the words from a member of the external review committee who described the department as being what all materials science and engineering departments should aspire to be. Coming from a fellow department head at a peer institution, this is high praise indeed. All of us, faculty, staff, students and alumni, should be immensely proud of this achievement for we have all made important contributions.

Behind my success as Head of your department have been many people and I would like to take this opportunity to acknowledge the contribution of just a few of them. First and foremost, my wife Victoria and our son David, for without their love, understanding and support, none of this would have been possible; Kathy Dysart and Judy Brewer, my protectors; Jay Menacher for always finding the resources for all our projects; Angus Rockett and Phil Geil, my associate heads, for their advice and wise counsel and for keeping me from straying too far off path; and to all the other staff members: Cindy Brya, Debbie Kluge, Michelle Malloch, Bryan Kieft, John Bukowski and Dawn Sandone. They are incredibly dedicated to the department and are critical to its success.

Finally, I want to take this opportunity to thank you, the students, both past and present, for making us great. Our achievements would not have been possible without you. It has been an honor and privilege to have been given the opportunity to serve as the Head of this great department.

Thank you.

Ian M. Robertson

The Science of Hiking

The simple language that Joe Greene uses to explain the intricacies of nanoscience belie the complexity of interatomic interaction. It's a topic Greene spent more than 30 years investigating and one on which he has become an internationally recognized expert. The first in his family to attend college, Greene earned a doctorate degree in chemistry and physics before accepting a teaching position at the University of Illinois. "I ran out of degrees," he says wryly. "It pissed me off. I had to get a job."

In the following years, Greene and his wife Phyllis, an international flight attendant, traveled the globe as he juggled teaching responsibilities at Illinois and at Sweden's Linkoping University. He also spent time consulting, lecturing and teaching short courses in nanoscience in other foreign countries. But Greene shocked colleagues when, at the height of his career, he and Phyllis opted for semi-retirement and moved to Jackson, Wyoming. Co-workers predicted they would last five months before going "stark raving mad," he says. "But we've always been sort of weird that way. Scientists at a very high international level really don't do anything but science…But [Phyllis and I] have always had other interests."

A yoga class, taught by Jerry Fussel at the Senior Center of Jackson Hole, led Greene to his current position as a volunteer ranger in Grand Teton National Park. He never had been involved in volunteering, a foreign concept in the highly competitive world of research science, where he says, dollars are few and projects numerous and expensive. Fussel, a retired nuclear engineer involved in a variety of projects in the community, suggested to Greene that he apply to be a volunteer backcountry ranger—a post Fussel once held (he was one of the first in the valley to do so).

"The first year he suggested it, I thought he was nuts," Greene says. "But he kept working on me. [And] Phyllis thought it was a great idea." Greene credits his wife, honored locally as the Senior Citizen of the Year in 2007, as a shining example of one with the volunteer ethic. She gave him the necessary push to begin donating his own time to others.

In the summer of 2006, Greene donned his Park Service uniform and headed into the Tetons, charged with the tasks of helping visitors, monitoring human-wildlife interactions and assisting with pertinent backcountry tasks. Along with time alone in the backcountry, moments Greene describes as his own form of religion, volunteering has yielded other unexpected benefits. "I'm really an asocial physicist, a typical science geek who isn't comfortable at parties. This has helped me learn how to be more comfortable with groups of people."

And some of those groups are people he likely never would have interacted with. Greene recalls one evening spent on the Death Canyon Shelf, where he ran into 16 girls from the inner city of Chicago. The girls were "absolutely off the wall" when separated from their cigarettes and city surroundings, he explains. "But we stayed all night, just talking about life, physics, their problems, showing them black holes."

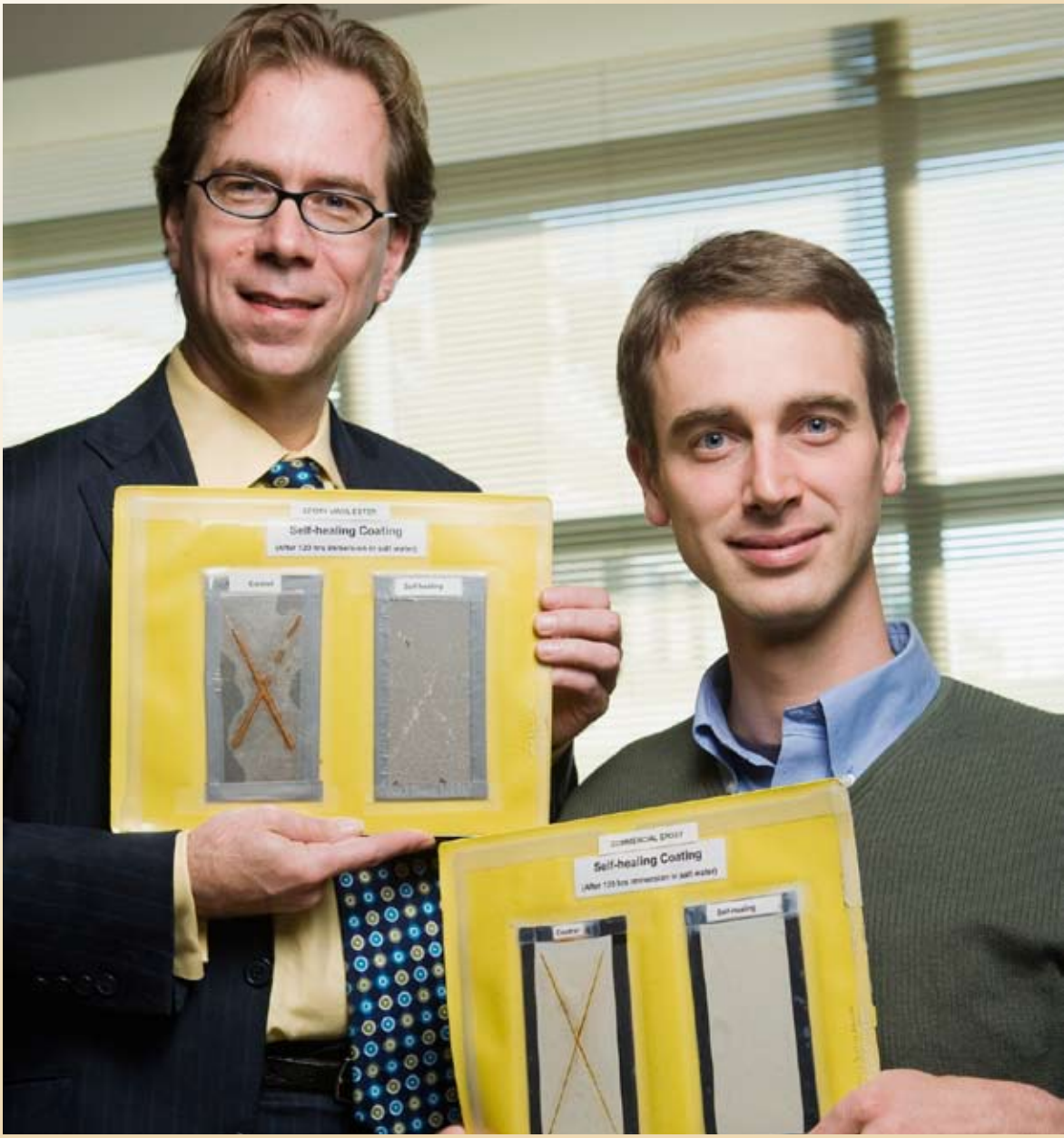
Greene's background not only qualifies him to talk about black holes with park visitors but also allows him to empathize with those new to the wilds of Wyoming. It's a perspective longtime residents sometimes forget. "The typical type [of tourist] I know very well," he says. "They know canyons, but it's a different kind of canyon—one running down the middle of Manhattan…They can be terrified. It's really reassuring to see someone in a uniform."

Greene hasn't entirely kissed the world of science good-bye. He still travels up to 200,000 miles by air each year, about half the number of miles he logged before semi-retiring. "I still have the intellectual satisfaction of doing very high-level science, consulting with foreign governments, presidents, ministers of science, but I can come home to Jackson and ski my butt off and volunteer in the park," he says. Greene tries to schedule the majority of his traveling in the winter and shoulder seasons, allowing him to work three days and two nights a week in the park in the summer. He spends an additional half-day accompanying Phyllis, who also volunteers in the park on patrols.

Greene is satisfied with the balance he has achieved in life. In winter, he ski tours up his favorite haunt, Mail Cabin Creek, any chance he gets. He hasn't let his "golden years" slow him down one bit. When asked his age, he fumbles for his wallet and does the math aloud. "Sixty-three years old. We don't celebrate birthdays or anniversaries. We celebrate every day we wake up healthy. That's a great day."

Reprinted with permission from the article "Golden Eagle – Retired baby boomers discover second careers in the national parks," *Jackson Hole Magazine* (Summer/Fall 2008)

New Polymer Coatings Prevent Corrosion, Even When Scratched



Illinois researchers Paul Braun (PhD MatSE '98), right, and Scott White have created self-healing coatings that automatically repair themselves and prevent corrosion of the underlying substrate.

Imagine tiny cracks in your patio table healing by themselves, or the first small scratch on your new car disappearing by itself. This and more may be possible with self-healing coatings being developed at the University of Illinois.

The new coatings are designed to better protect materials from the effects of environmental exposure. Applications range from automotive paints and marine varnishes to the thick, rubbery coatings on patio furniture and park benches.

"Starting from our earlier work on self-healing materials at the University, we have now created self-healing coatings that automatically repair themselves and prevent corrosion of the underlying substrate," said Paul Braun, a University Scholar and MatSE professor. Braun is corresponding author of a paper published in the journal *Advanced Materials*.

To make self-repairing coatings, the researchers first encapsulate a catalyst into spheres less than 100 microns in diameter (a micron is 1 millionth of a meter). They also encapsulate a healing agent into similarly sized microcapsules. The microcapsules are then dispersed within the desired coating material and applied to the substrate.

"By encapsulating both the catalyst and the healing agent, we have created a dual capsule system that can be added to virtually any liquid coating material," Braun said. When the coating is scratched, some of the capsules break open, spilling their contents into the damaged region. The catalyst and healing agent react, repairing the damage within minutes or hours, depending upon environmental conditions.

The performance of the self-healing coating system was evaluated through corrosion testing of damaged and healed coated steel samples compared to control samples that contained no healing agents in the coating.

Reproducible damage was induced by scratching through the 100-micron-thick polymer coating and into the steel substrate using a razor blade. The samples were then immersed in a salt solution and compared over time. The control samples corroded within 24 hours and exhibited extensive rust formation, most prevalently within the groove of the scratched regions, but also extending across the substrate surface, the researchers report. In dramatic contrast, the self-healing samples showed no visual evidence of corrosion even after 120 hours of exposure.

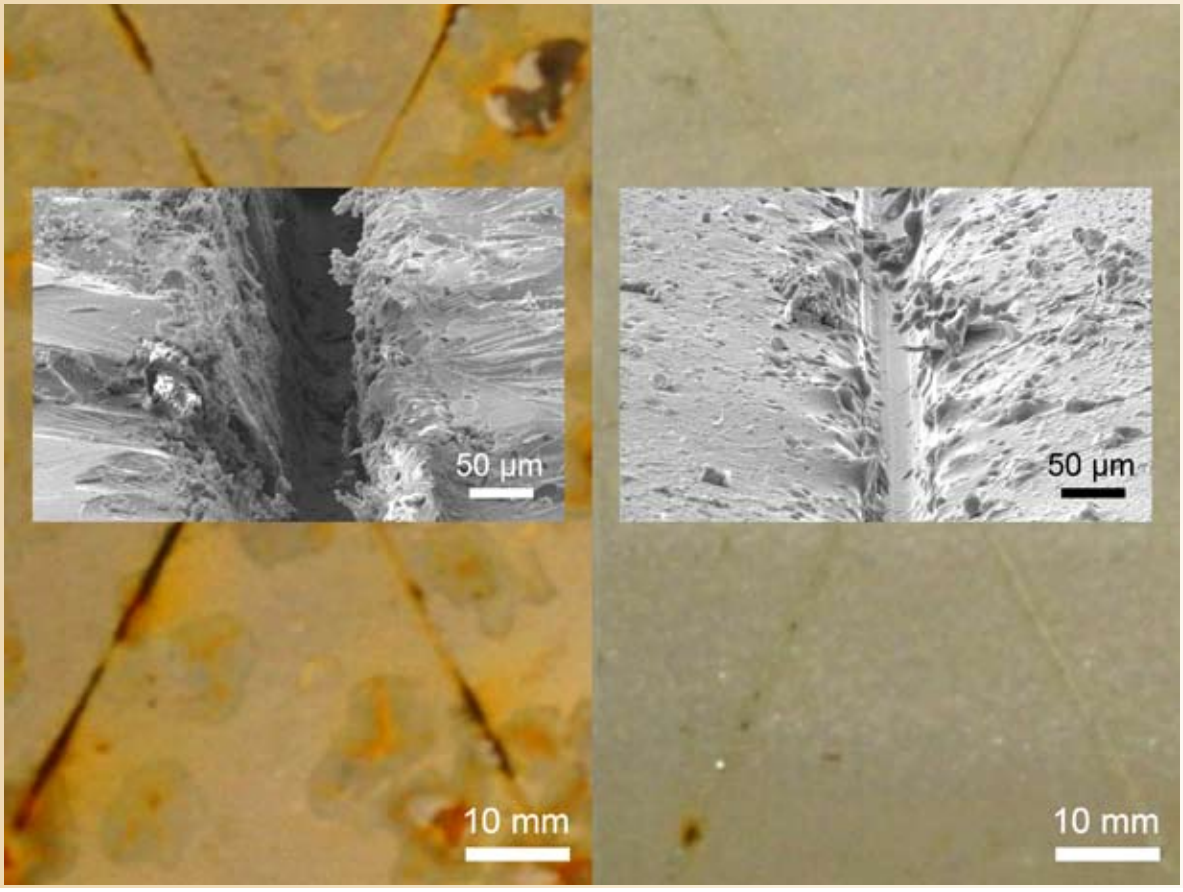
"Our dual capsule healing system offers a general approach to self-healing coatings that operates across a broad spectrum of coating chemistries," Braun said. "The microcapsule motif also provides a delivery mechanism for corrosion inhibitors, antimicrobial agents and other functional chemicals."

The new coatings would protect the finish on a park bench.

With Braun, the paper's co-authors are University of Illinois Aerospace Engineering professor Scott White, and former MatSE graduate student Soo Hyoun Cho. A company formed by Braun, White and other Illinois researchers is exploring commercialization of the self-healing coatings technology.

The work was funded by Northrop Grumman Ship Systems, the U.S. Air Force Office of Scientific Research and the Beckman Institute.

-University of Illinois News Bureau



The background images show the dramatic reduction in corrosion of steel plates coated with a self-healing coating (right) as compared to a conventional coating (left) after they were scratched and subsequently immersed in 5% salt (NaCl) water for five days. The foreground pictures are scanning electron microscope images of the control (left) and healed (right) scratch showing the healing of the scratch in the self-healing coating.

Observing Atoms through the Corrective Lenses of Transmission Electron Microscopes

By Jian-Min Zuo

The magnifying power of a glass lens was recorded as early as the 8th century BC in ancient Egyptian hieroglyphs, which depict "simple glass meniscal lenses." Transforming glass lenses to microscopes with high magnifying powers, however, took a long time. There were many materials issues involved with making clear glasses that were slowly solved in Europe. Polishing the glass pieces into fine convex shapes for a magnifying lens also was a technique that only a few mastered until the time of the Dutchman, Antony van Leeuwenhoek (1632-1723). Leeuwenhoek was a tradesman from Delft, Holland. He had no family fortune and received no scientific training. What he had was the immense curiosity to see the small world that lives with us. With skill and diligence, Leeuwenhoek mastered the art of making minuscule glass lenses. He mounted the lens onto a tiny hole in a brass plate and attached a sharp needle on which he mounted his specimens. Using this, he discovered bacteria, sperm cells, blood cells and much more. His work brought an entire world of microscopic life to the awareness of scientists.

The optical microscopes we use today are much more sophisticated instruments than the primitive, single lens, microscopes Leeuwenhoek built. But they are all subjected to the resolution limit, first discovered by the Nobel laureate, Lord Rayleigh (1842-1919). He found that the best resolution an optical microscope can achieve is about 0.6 times the light wavelength divided by the numerical aperture of the lens. The wavelength of visible lights ranges from 390 to 780 nanometers (a billionth of a meter). With a numerical aperture on the order of one, the resolution of the optical microscope at best is around 300 nm using blue light.

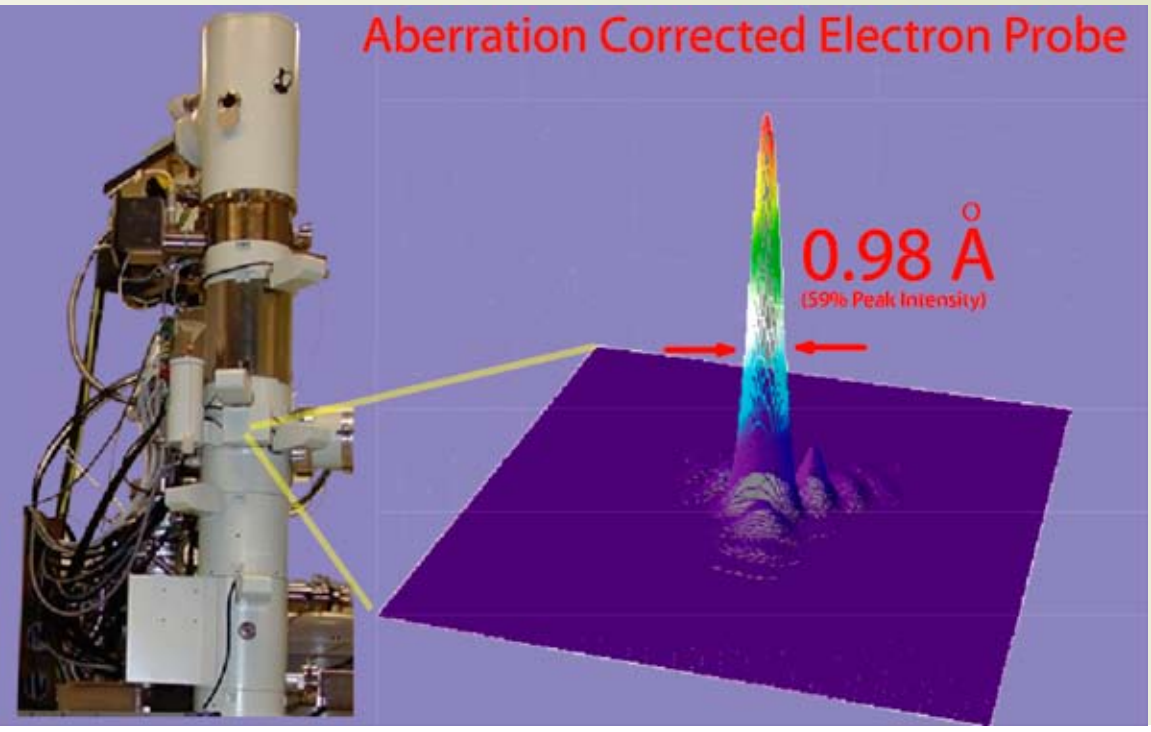
The first transmission electron microscope (TEM) was built in 1931 by Enrst Ruska together with Max Knoll. TEMs use high energy electrons of several hundred kilovolts traveling at speeds close to 2/3 of the speed of light for illumination. Magnetic lenses are used for focusing these electrons. Electrons behave similar to light thanks to the peculiar quantum mechanical effect of a particle having a wavelength of the Planck constant divided by the particle momentum. The electron wavelengths used in transmission electron microscopes ranges from 4 to 1 picometers (10^{-12} meter). The numerical aperture of electron microscopes is on the order of 10^{-1}. The theoretical resolution of

the electron microscopes, according to Lord Rayleigh, is less than an Ångstrom (100 picometers).

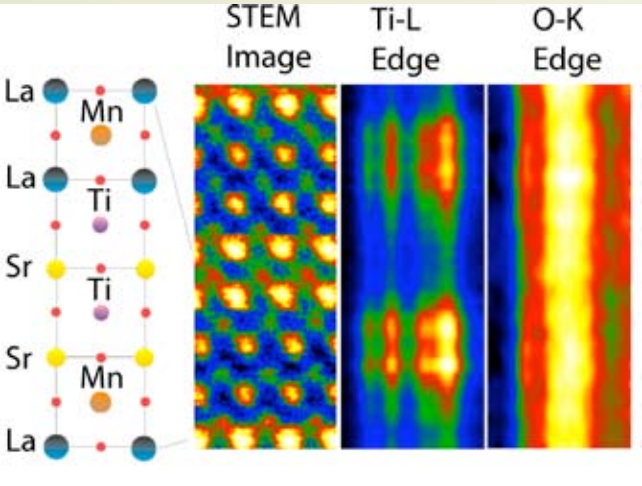
The transmission electron microscopes used by generations of materials scientists and engineers have had resolutions about 20 times worse than their theoretical limits. The poorer resolution was caused by the aberrations of the magnetic lens. The electron magnetic lens uses the fringe fields of a cylindrical shaped magnetic circuit (round lens) for focusing; the field is stronger away from the lens axis and consequently electrons traveling away from the axis are focused more than those traveling close to the axis. This effect is called spherical aberration. The spread in the focal distances caused by spherical aberration limits the resolution of the electron microscopes. The amount of focus spread is proportional to the spherical aberration coefficient C_s and the square of the off-axis distance divided by the lens focal length. Electron microscopes designed for high resolution imaging typically have a C_s of 0.5 to 1 mm. The C_s is positive corresponding to the over focus of off-axis electrons. For a 200 kilovolt electron microscope, the C_s limited resolution is about 2 Ångstroms.

In optical microscopes, a glass lens with positive C_s can be corrected by using a glass lens with a negative C_s. However, in magnetic lenses, Otto Scherzer, a German electron optician, pointed out that all cylindrical magnetic lenses have positive C_s. In order to correct the aberration in magnetic lenses, a non-cylindrical magnetic lens with a negative C_s must be used. One lens that meets this requirement is a thick magnetic hexapole lens made of three magnetic dipoles. However, the hexapole lens, like any other multipole lenses, has strong lower order aberrations (the C_s is a third order aberration), which if not removed will place a greater limit on the resolution than the C_s. The first successful corrector for a TEM was built by a German team led by Max Haider using the two magnetic hexapole design of Harold Rose. The two magnetic hexapoles are symmetric and they are arranged with the help of two additional round lenses to cancel each other's lower order aberrations. Ondrej Krivanek of NION corporation, Seattle, built the first electron probe corrector using a combination of magnetic quadrupoles. The aberration correction improves the resolution of a 200 kilovolts electron microscope from above 2 Ångstroms to below 1 Ångstrom.

At the University of Illinois, the Center for Microanalysis of Materials (CMM) at the Frederick Seitz Materials Research Laboratory has successfully installed an aberration corrected high resolution transmission electron microscope made by JEOL (JEOL USA Inc. Peabody, MA). The microscope is equipped with a high brightness field emission gun and can operate between 80 and 200 kilovolts. The aberration corrector is installed above the specimen. The corrector is used to form sub-Ångstrom electron probes (see Figure 1). The sub-Ångstrom electron probe is used to scan across the sample. As it scans, the electron probe is scattered by atoms in the sample. Electrons scattered into an annular detector placed after the sample are collected and used to form a raster image. This form of imaging is called annular dark-field (ADF) scanning transmission electron microscopy (STEM). In ADF-STEM



University of Illinois aberration corrected transmission electron microscope and the one-Angstrom electron probe.



Atomic resolved electron energy loss spectra from along a line across the superlattice for the Ti L-edge due to excitation of 2p electrons and the O k-edge from the excitation of 1s electrons.

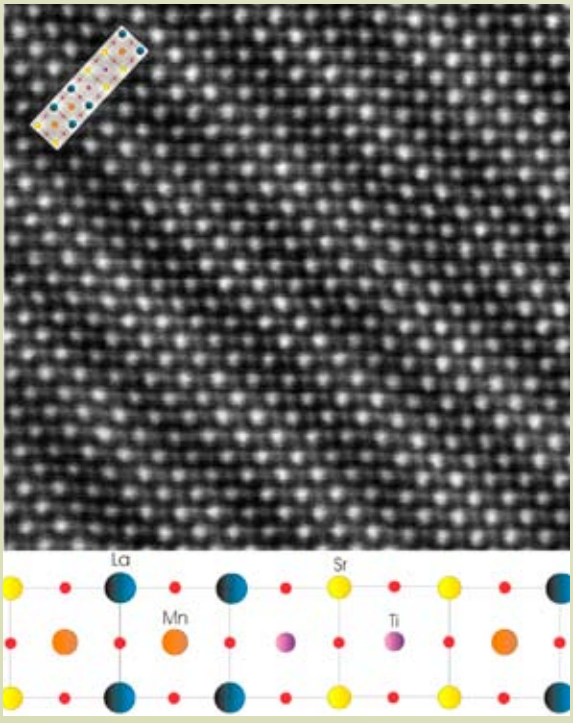
when a large inner cutoff angle is used for the ADF detector, the electron image contrast is approximately proportional to the square of the atomic number, which is called Z-contrast. The figure below, at left, shows an example of a Z-contrast image of an oxide superlattice grown by Professor Eckstein's group in Physics, University of Illinois, using the atomic layer-by-layer molecular beam epitaxy deposition technique. The superlattice consists of unit cells of a conductive oxide, $LaMnO_3$, and an insulating oxide, $SrTiO_3$. The heavy La atoms appear as the brightest dots in the image, Sr stoms which have a smaller Z than La appear as less bright dots. Mn and Ti atoms have similar Z; they appear as the weakest dots in the image. The oxygen has the lowest Z; their scattering is too weak to be seen.

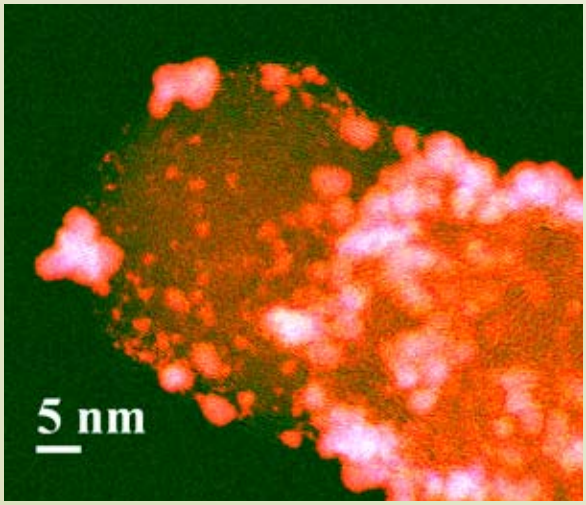
The sub-Ångstrom electron probe achievable using an aberration corrector is also useful for the study of chemical and electronic structure of materials. Inside the microscope, when a probe electron excites a crystal electron to the conduction band, the probe electron suffers an energy loss. The amount of energy loss and the number electrons losing the specific energy tell us about the atom and its electronic structure. This technique is called electron energy loss spectroscopy (EELS). In ADF-STEM, part of electrons in the sub-Ångstrom probe that transmit through the sample can be collected and analyzed for their energy. The power of an aberration corrected electron probe for EELS is demonstrated for oxygen K edge of oxygen atoms in the superlattice of the figure at left. The modulations of the intensity arise from the electron probe that scanned on and off columns of atoms. In the case of oxide superlattices, this technique allows us to investigate the electrons at the interface and their energy states.

What is the impact of the aberration corrected TEM for science and technology? The immediate impact is in energy science and nanotechnology. Nanotechnology relies on nanometer scaled structures with the number of atoms ranging anywhere from hundreds to tens of thousands. The development of truly successful nanotechnology has been hampered by our ability to see all these atoms. Imagine a builder who is unable to visualize the structure he or she has built. In energy science, metal nanoparticles of few nanometers in sizes are used to promote chemical reactions for the refinement of gasoline or in the catalytic converters of automobiles for environment protection. The figure below, at right, is an example of an ADF-STEM image of a catalyst made of platinum atoms supported on carbon black. The ability to see these atoms may finally allow a correlation of the structure of catalyst and their chemical reactivity.

(right) Atomic clusters of Pt supported on carbon black. The material is used as catalyst in fuel cells.

(left) Atomic resolution image of oxide superlattice with the structural model. The small red circles are oxygen atoms. Oxygen atoms on top of Ti and Mn are not shown.





Department News

Zeba Farheen Abdul Samad

Zeba Farheen Abdul Samad, Ph.D. student in Jim Economy's research group, has received the 2009 Bostik Award for her paper, "Advanced Aerospace Composites Using an Aromatic Thermosetting Copolyester Matrix Improved Thermal Fatigue." The award, worth $1,000, will be presented to her during the Society of Plastics Engineers ANTEC 2009 in June.

Christopher Hansen, Ph.D. student in Jennifer Lewis' research group, and **Bo Wang,** Ph.D. student in Steve Granick's research group, have been selected to receive the 2010 Mavis Memorial Fund Scholarship Awards, worth $5,000, from the College of Engineering.

Zlatomir Apostolov, Ph.D. student in Trudy Kriven's group, has been awarded a scholarship under the Science, Mathematics and Research for Transformation Program (SMART). The SMART Scholarship for Service Program was established by the Department of Defense (DoD) to support undergraduate and graduate students pursuing degrees in Science, Technology, Engineering and Mathematics disciplines. The program aims to increase the number of civilian scientists and engineers working at DoD laboratories. From a competitive field of more than 1,500 applicants, approximately 200 to 300 awards are made each year.

Dallas Trinkle

Paul Braun has been named a recipient of one of the 2009 Xerox Awards for Faculty Research.

Dallas Trinkle has received a Faculty Early Career Development (CAREER) Award from the National Science Foundation (NSF). This is the NSF's most prestigious award for young faculty members who have shown exceptional promise in teaching and research.

John Rogers has been selected as a 2009 National Security Science and Engineering Faculty Fellow (NSSEFF) by the Department of Defense (DoD). NSSEFF provides grants—$3 million over five years—to top-tier researchers from U.S. universities to conduct long-term, unclassified, basic research involving the most challenging technical issues facing the DoD. This basic research is crucial to enabling future applications in sensors, functional materials, surveillance, near shore navigation, communications and information security, energy independence and force protection. Rogers' research includes fundamental and applied aspects of nano and molecular scale fabrication as well as materials and patterning techniques for unusual format electronics and photonic systems.

Bryan Kieft

Bryan Kieft joined the department last month as an Office Support Associate. He is responsible for first contact with the department via phone, e-mail or walk-in. He handles the mail distribution, colloquium speaker's schedule and visit arrangements, and undergraduate records. Kieft arrived in Champaign from his hometown of Kewanee, Illinois, for college in 1996. He started out as a Computer Science major, then switched to rhetoric and graduated with that degree in 2000. Since then he worked in shipping and receiving, retail and massage therapy, before returning to the University.

Pascal Bellon

Bellon Receives Pierce Award

Pascal Bellon was named the recipient of the 2009 Stanley H. Pierce Award from the College of Engineering. The Pierce Award recognizes faculty who foster cooperation and positive relationships between faculty and students. As professor and chief advisor for the MatSE Department, Bellon works to develop rapport with his students through advising, mentoring, interacting with student societies and participating in student fundraising events such as the student-faculty basketball game. He is consistently recognized by his students as one of the top instructors in the department and is regularly listed on the "Incomplete List of Instructors Ranked as Excellent by Their Students." He is developing a mentoring and support program for underrepresented groups to ensure that such students receive extra encouragement. He has done a great deal to improve the advising process, including development of the department's undergraduate advisory board. Bellon also serves as faculty advisor for the student chapter of the Undergraduate Materials Organization/Material Advantage.

Betty Coulman

Coulman Receives Alumni Award from College

Betty Coulman received the Alumni Award for Distinguished Service from the College of Engineering at the University of Illinois. She received the award for her contributions to the field of printing technology and her efforts to advance women in science and engineering. Her career in research and development began at Philips, where she worked on a range of semiconductor device design and processing projects. She continued her work in microelectronics at Wacker, 1992-1994, where she led the procurement and qualification of processing equipment for a new wafer fab. Coulman joined HP in 1995 as a lead product engineer in integrated circuits testing. She moved into inkjet printing the following year, where she managed significant improvements in quality, yield, performance and cost for the highest volume, most profitable HP pen. As R&D Program Manager for HP, Coulman led the identification, analysis and development of new inkjet printing markets. She managed a cross-divisional project which developed the product architecture for future high performance desktop printers.

An advocate for women in science and engineering, Coulman served as a mentor to HP women new to management and created more network opportunities for women in the company. She served on the Materials Science and Engineering Alumni Board at the University of Illinois and participated in numerous career panels for MatSE students. Coulman has more than 20 materials science publications and nine Web-based publications on digital photography and printing. She has three patents pending. Coulman also is deeply committed to volunteer service. In the aftermath of Hurricane Katrina, she gave her time to restore heirloom photos for hurricane survivors.

Lisa Mazzocco

Undergrad Recognized for Contributions to College

Lisa Mazzocco, junior in MatSE, received the Engineering Council Outstanding Student Contribution Scholarship. A native of Champaign, Mazzocco has made it a goal to add value to the University of Illinois as well as the community through her student activities. She is a member of the Office for Technical Consulting Resources, the college's student-run consulting firm. The group specializes in technology strategy, business development and new product launches to aid the growth and efficiency of local businesses. Mazzocco also co-leads the content and curriculum team for the college's iFoundry program, working with staff on a curriculum for a new freshmen-level course designed to allow students to pursue their own interests while incorporating more design, team work and exploration. She enjoys helping younger students learn about science and coached the Campus Middle School team to a third-place regional finish in the Science Olympiad.

Lemelson Prize Finalists

Two MatSE graduate students were among the eight finalists for the $30,000 Lemelson-Illinois Student Prize. Finalists were chosen by a panel of faculty members from across the Urbana campus. The Lemelson-Illinois Student Prize is an extension of the $30,000 Lemelson-MIT Student Prize, which has recognized outstanding student inventors at MIT since 1995.

Jang-Ung Park and Professor **John Rogers** have invented techniques for an electrohydrodynamic jet (e-jet) printing process that can produce patterns and functional devices that establish new resolution benchmarks for liquid printing which significantly exceed those of conventional inkjet technologies. This technology could potentially lead to the printing of various electronic devices, such as flexible computer screens, cell phones and credit cards at home.

Robert Shepherd is currently working on creating a standard, less complicated, more flexible micro electrical-mechanical systems (MEMS) fabrication route which can generate these parts at rates of 100's per second using low cost material feed stock. The market for MEMS is emergent and large; with devices encompassing microphones, implantable drug delivery systems, accelerometers and lenses. These systems are currently used in products such as the iPhone, Nintendo Wii and vehicle air bags.

Lemelson ILLINOIS STUDENT PRIZE Finalist 2009

Jang-Ung Park

Robert Shepherd

Save the Date: Engineering Homecoming

Saturday, October 10, 2009

Cheer on the Fighting Illini as they take on Michigan State for Homecoming 2009! Enjoy a pre-game brunch with Engineering at Illinois Alumni at the campus Activities and Recreation Center, conveniently located next to the stadium and nearby parking. Brunch will begin two hours before game time. Tickets for brunch only: $15 for adults/ $10 for children under 10. Football tickets and brunch: $50 for adults/$45 for children under 10.

Online registration will be available July 15 on the Engineering at Illinois Alumni Web page engineering.illinois.edu.

Placement Services Available to Alumni

The MatSE Department would like to remind alumni that the placement services available to students are available to alumni, too. Post your job opening or search through resumes to find a good fit for a position at your company. If you're going through a career change, post your resume on the Web site and network with other alumni. The placement Web site is powered by AfterCollege.

Go to **www.matse.illinois.edu/jobs** to get started.

The Making of the Materials Show

by Robert Smith, MatSE senior

Robert Smith dresses in a lion suit to promote a film for the 2009 Materials Show.

Conception

Rich and I (Robert Smith, author of this article) first came up with the idea to do the 2009 Materials Show as a parody of L. Frank Baum's *The Wizard of Oz* toward the end of the Spring 2008 semester. We spent a 24-hour period studying for Cahill's 405 final exam, but instead mostly discussed the movie in our delirious, sleep-deprived state. We both agreed to work on it during the summer, but neither of us did. We did, however, work on the movie for the freshmen Engineering 100 class, which could be considered a precursor to the Materials Show 2009.

First Draft

After the Fall 2008 semester, we again agreed to work on the movie during the winter break, but in classic procrastinator fashion, we applied for jobs instead of writing the movie. We started discussing plot possibilities the week that we returned from break, and the script writing happened the following week. It was fun, and there were many revisions, but it was definitely an arduous process. With two people working on the same thing, it can be a little tough to make a linear, coherent plot. All in all, it probably took the two of us about 20 combined hours (not all 100% dedicated to actual work, of course).

Production

In February, we began filming. We were fortunate enough to have one of the freshman we taught in Engineering 100 lend us a nice video camera. The one mistake we made with our plot was involving too many characters in most of the scenes. With everyone's busy schedules and midterms creeping up, it was hard to work out times in which everyone would be available. By the end of February we finished filming.

Post-Production

From there, we were again fortunate to have a good friend in the College of Media, who lent us her skills and time to edit the film on professional computers and software. Overall, we had two and a half hours of video, which we ended up shortening into 30 minutes. The editing process took about eight hours.

Red-carpet Screening and Engineering Open House

The editing was finished a couple of days before Engineering Open House (EOH), and to show our appreciation to all who helped, Rich and I threw a red-carpet screening party, carpet included! Rich made delicious hors d'oeuvres. Everyone was pleased with the overall product. During the EOH weekend the film was a good draw. Rich even talked me into parading around in the silly (and small) lion suit to advertise for the film. We'd like to thank everyone who helped us with the movie.

New Material Advantage chapter at Illinois

by Pam Wojtulewicz, MatSE senior and Material Advantage chapter president

The Undergraduate Materials Organization has become an official chapter of Material Advantage, a professional materials society for undergraduates in Materials Science and Engineering. It serves as an umbrella organization and grants undergraduates membership in TMS, ASM, AIST and ACerS.

Becoming a part of our now nationally recognized society has several advantages for our MatSE students. We can attend conferences at a reduced cost and access professional networking resources. This means job opportunities and grad school connections for our students outside of Illinois. Material Advantage members also are offered exclusive access to many scholarships that can greatly reduce the cost of education.

As a chapter of Material Advantage, we hope to improve the college experiences of undergraduates in our department. We plan to boost our edge by winning intercollegiate competitions and keeping the University of Illinois at the top of the list for years to come.

Engineering Open House 2009

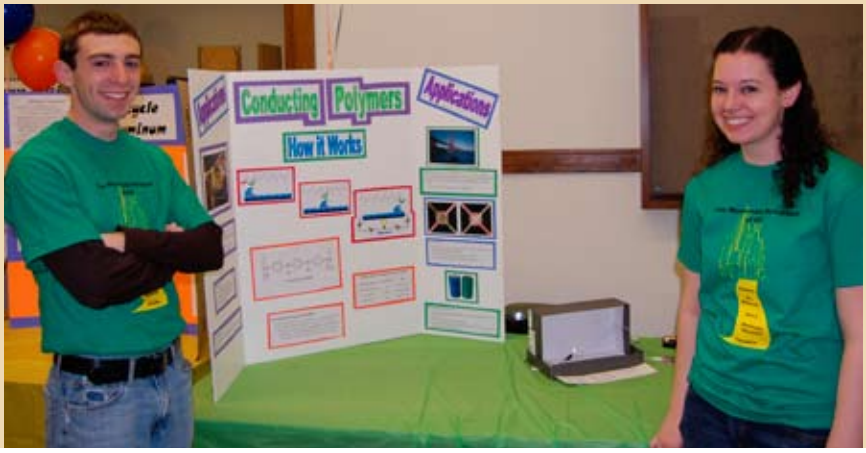
The freshmen EOH project, "Piezoelectrics" won first place in the category "Class Projects."

Pictured: Amanda Reader, Andy Mannix, Sam Martin

Materials Challenge won third place in the category "Just for the Fun of It: Hands-on Learning."

Pictured: David Duterte, Caitlin Tribout, Mike Scarpelli, and Alyssa Harder

MatSE freshmen Michael Campion and Tim Bates get dirty in their EOH project, "Non-Newtonian Fluids."



Stephen Menke and Alissa Cote greet visitors at the exhibit "Conducting Polymers."

Students See Metallurgy in Action

Professor Pascal Bellon's metals processing students took a field trip to the Nucor Steel Mini-Mill in Crawfordsville, Indiana, on April 23. The trip was part of Bellon's course "Metals Processing" (MSE 441), the intro course to the Metals area. Out of the 24 students enrolled in the class, 17 attended. During the trip, students saw an electric arc furnace, a continuous caster, hot-rolling and cold- rolling mill and a galvanizing line. The host for the field trip was Eric Gallo. Nucor Steel has been extremely gracious during the past four years, organizing visits and providing the class with a free lunch at the mill.

Readey Joins MatSE Department

Dennis Readey joined the MatSE Department at Illinois as Adjunct Professor at the start of the last academic year. He taught MSE 422–Electrical Ceramics in fall 2008 and MSE 402/501–Kinetic Processes in Materials in spring 2009.

Readey is University Emeritus Professor of Metallurgical and Materials Engineering at the Colorado School of Mines where he was the Herman F. Coors Distinguished Professor of Ceramic Engineering and head of the Colorado Center for Advanced Ceramics. He was selected to present the CSM Faculty Distinguished Lecture in 2007.

He holds a B.S. in Metallurgical Engineering from Notre Dame and a Sc.D. in Ceramic Engineering from MIT. His prior experience includes: chairman of the Ceramic Engineering Department, Ohio State University; program manager, U.S. Energy Research and Development Administration (DOE); principal scientist and materials laboratory manager, Raytheon Company; group leader, Argonne National Laboratory; and captain, U.S. Army, Harry Diamond Laboratories.

His research includes: high temperature gas and aqueous corrosion of ceramics; reactive atmospheres and sintering; materials with controlled porosities; magnetic, dielectric and transport properties of ceramics; preparation and properties of metal-ceramic composites; and compound thin films for solar cells, batteries, and other devices.

He has advised 24 Ph.D. and 41 M.S. students. He has taught both graduate and undergraduate courses on: kinetics, introduction to ceramics, introduction to materials, integrated circuit processing, electrical properties, thermal properties, point defect chemistry and transport, and ceramics processing.

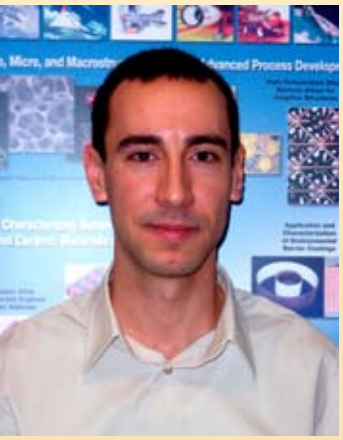
Readey has been active in the American Ceramic Society for many years and served as Society Treasurer, Vice President and President. He received the Society's Jeppson, Purdy and Educator of the Year awards and was its Sosman Lecturer in 2002. He is a fellow and a Distinguished Life Member. He is a fellow of ASM International and served on the Board of Directors of TMS. He is also a member of ASEE, AAAS, MRS and Sigma Xi.

He was an Accreditation Board for Engineering and Technology (ABET) evaluator for more than 20 years for both ceramics and materials programs, represented TMS on the Engineering Accreditation Commission, served as their ABET trainer and currently represents TMS on the ABET Board. He has served on the National Materials Advisory Board, the Space Studies Board and the NIST Materials Research Advisory Committee of the National Academy of Sciences. He was a member of the Universities Space Research Association Materials Working Group, Materials Advisory Committee for NSF, Engineering Review Group for the Office of Nuclear Waste Isolation, Industrial Advisory Board of the Edison Welding Institute, Lehigh Materials Science and Engineering Visiting Committee and a Trustee of the Edward Orton Jr. Ceramic Foundation.

Class Notes

Sanak Mishra

David Van Aken



Alp Sehirlioglu

Bob Setlak (BS Met '64) is now retired from his position as Senior Manager of Materials Science at Crown Cork and Seal. However, he remains active in ASTM International; chairing the subcommittee on Tin Mill Products and serving as one of the Vice-Chairmen of Committee A01 on Steel, Stainless Steel and Related Alloys.

John Sturgul (PhD Mining '68) is a Senior Lecturer in mining engineering at the University of Adelaide in Australia.

Sanak Mishra (MS Met '70, PhD Met '73) has received the Distinguished Alumni Award from the Council of the Indian Institute of Sciences and the Alumni Association of the Indian Institute of Sciences at Bangalore. The award was presented during the council's centenary year celebrations for Mishra's pioneering contribution to engineering, technology and industry. Presently the Chief Executive Officer of the Arcelor Mittal—the world's largest steel producer—for its India Greenfield Projects, Mishra is best remembered for the reforms he made as the Managing Director of the Rourkela Steel Plant.

Carolyn M. Primus (BS Cer '74) is a medical device consultant. She and her husband, Gino, live in Bradenton, Florida.

Nestor Zaluzec (PhD Met '79) has been elected a Fellow of the Microscopy Society of America. Zaluzec is being recognized for his tireless service to the society and his range of research activities and contributions to the field of electron microscopy and microanalysis. The award will be conferred during the plenary session of the Microscopy & Microanalysis 2009 Meeting to be held in Richmond, Virginia, in July. This is the first year the award of Fellow is being presented. Zaluzec is a senior scientist and principle investigator in the Electron Microscopy Center at Argonne National Laboratory as well as a Fellow of both Oak Ridge National Laboratory and the Computational Institute of the University of Chicago.

David Van Aken (BS Met '78, PhD Met '86) has been named Curators' Teaching Professor of Materials Science and Engineering at the Missouri University of Science and Technology. He joined the S&T faculty in 1993. Previously, he taught at the University of Michigan and worked for Caterpillar. He has won numerous university awards for teaching excellence. Van Aken's research interests include the physical metallurgy of ferrous alloys and the mechanical behavior of structural metals.

Ken Cadien (PhD Met '81), professor in the Department of Chemical and Materials Engineering at the University of Alberta, has been selected as an Alberta Ingenuity Scholar. Alberta Ingenuity selected Cadien, whose cutting-edge work in nanofabrication has applications in areas ranging from fuel cells and oil refining to drug discovery and micro-electrical systems, to receive $1.2 million in funding during the next five years. Cadien was recently named an IEEE Fellow.

John Lancaster (BS Met '84) is a metallurgical engineer who heads the General Motors aluminum foundry in Bedford, Indiana. He has worked in GM foundries in five states over the years.

Jeff Moore (PhD Met '89) was inducted into the American Academy of Arts and Sciences in October 2008. Moore is the William H. and Janet G. Lycan Professor of Chemistry at the University of Illinois.

Fengyi (Fred) Huang (PhD MatSE '94) left his position as a senior engineer for IBM in order to set up a small start-up business in Shanghai and Los Angeles. He has been appointed as an invited Full Professor by Southeast University.

Deirdre Olynick (PhD MatSE '97) is a Staff Scientist at the Molecular Foundry at LBNL working in nanofabrication.

Suneel Kodambaka (PhD MatSE '02) is an assistant professor in Materials Science and Engineering at the University of California, Los Angeles.

Alp Sehirlioglu (PhD MatSE '05) will receive the Charles F. Lucks Award at the 30th International Thermal Conductivity Conference and 18th International Thermal Expansion Symposium in late August in Pittsburgh. The Lucks Award is given for outstanding contributions in the field of thermophysics. Sehirlioglu will give the plenary lecture, "Crystal physics and macroscopic symmetry revealed by thermal expansion measurements." Sehirlioglu is a Research Scientist from Case Western Reserve University and NASA Glenn Research Center.

Jennifer Gregg (BS MatSE '06) married Andrew James Cummins on May 6 at St. John Lutheran Church in Champaign. The couple are engineers at Caterpillar in Peoria.

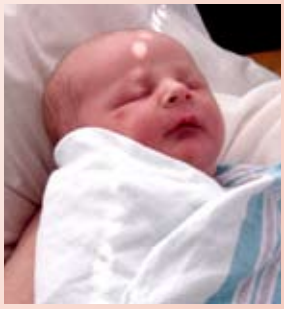
New Additions

Ariana Saige Harmon, daughter of **Joe Harmon** (BS MatSE '00) and **Casey (Motter) Harmon** (BS MatSE '00), was born on Easter Sunday, April 12, at 4:59 p.m. She weighed 8 lbs. 9 oz. and was 20.5 inches long.

Matt Janet (BS Cer '97, MS MatSE '00) welcomed daughter **Lyla** on March 20. She weighed 8 lbs. 12 oz.

Stephanie (Pruzinsky) Rinne (PhD MatSE '06) and **James Rinne** celebrated the birth of their son **Owen Thomas** on January 15. Owen weighed 8 lb. 11 oz. and was 22 inches long. Stephanie is a postdoctoral fellow at Beckman, and James is finishing his Ph.D. in MatSE.

Chris Carroll (BS MatSE '00) and his wife, **Monica,** celebrated the birth of their daughter, **Elaine Joann,** on April 27. The family resides in Edwardsville, Illinois.



Marge Kaunas (BS Cer '97) welcomed a new son, **Joshua Andrew,** on May 18. Joshua weighed 9 lbs. 2 oz. and was 21 inches long. Joshua joins brother, James, and sister, Sara.

Illini Reception in Pittsburgh

MatSE is coming to Pittsburgh this fall. Join us for the University of Illinois Alumni Reception on **Monday, October 26, from 5:30-7 p.m.** Complimentary hors d'oeuvres and beverages will be provided. Come for the evening and visit with Illinois alumni attending the Materials Science & Technology Conference and Exhibition (MS&T '09). For more details and to register, go to **www.matse.illinois.edu/alumni/Pittsburgh.html.**

MS&T'09®

Support the Future of MatSE and the University of Illinois

Brilliant Futures, the Campaign for the University of Illinois, is an ambitious undertaking to raise $1.5 billion. The resources generated through the Campaign will ensure that Illinois continues to create a better world through our teaching, research and public engagement. Gifts to the campaign will provide more scholarships and fellowships, endow more faculty positions, improve programs and research and update facilities across the campus.

Brilliant Futures are what happens when you give someone a chance. When you make a gift, of any size, to the University of Illinois you create an endless ripple effect—one life brightening another, then another, and on for generations. Your gift can become something that is larger and more powerful than all of us. The campaign priorities include:

brilliant futures

THE CAMPAIGN FOR THE UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Leadership for the 21st Century

Leadership is learned through excellent programs and experiences both inside and outside of the classroom. The campus is focused on enhancing students' intercultural, research, creative and experiential learning opportunities. The success of these programs will build on a great Illinois tradition of fostering innovative leadership.

Enhance Academic Excellence

Attracting and retaining diverse, exceptional faculty drives our academic excellence, as do educational programs that attract excellent, ambitious, diverse students. We must also ensure the wise use of financial and other resources to gain the greatest impact.

Pursue Knowledge and Breakthrough Innovation

Creating knowledge and innovative uses of existing knowledge are essential to the research mission of the institution. The campus must enable discoveries to occur in new and different ways.

Foster a Transformative Learning Environment

A vibrant university fosters a vibrant, dynamic learning environment. Essential to this environment are world-class facilities, a culture of conservation and sustainability, the development of living/learning communities that augment the traditional classroom and a culture that embraces diversity across the campus.

Ensure Greater Access to the Illinois Experience

We seek to improve access to the Illinois experience by increasing the diversity of the student population, providing additional merit- and need-based aid, and increasing the use of online learning alternatives.

To learn more about the Brilliant Futures campaign, visit **brilliantfutures.illinois.edu**

Department of Materials Science & Engineering Fund

Yes, I want to support MatSE with my gift of: ❒ $1,000 ❒ $500 ❒ $250 ❒ $100 ❒ Other:_____

❒ I have enclosed my check in the above amount made payable to: UIF/MatSE Dept. Please direct my gift to:

❒ MatSE general fund [7-77904]
❒ Charlie Wert Scholarship Fund [7-73848]
❒ Earl Eckel Scholarship Fund [7-72479]
❒ Clifton Bergeron Scholarship Fund [7-72728]
❒ Howard Birnbaum Lecture Series Fund [7-70282]
❒ Other: _____
❒ Bob Bohl Scholarship Fund [7-71507]
❒ Ceramic Engineering [7-75740]
❒ Jim Nelson Scholarship Fund [7-72833]
❒ Phil Geil Scholarship Fund [7-75866]
❒ Marvin Wayman Memorial Fund [7-73939]

❒ I authorize the U of I Foundation to collect my gift in the amount above through the credit card checked:

❒ Visa ❒ Discover ❒ MasterCard ❒ American Express

Card no.: _____ Expiration date: _____ Signature:_____

❒ My company, _____, will match my gift with $_____

I am enclosing my employer's Matching Gift form.

5M 5GE

Name_____

Home address_____

City_____ State_____ Zip_____

I understand that this gift is tax deductible as allowed by law.

Return this form
and your check to:
University of Illinois Foundation
P.O. Box 3429
Champaign, IL 61826-9916

Make your gift online:
www.matse.illinois.edu

In Memoriam

John Edward (Jack) Cunningham (BS Met '44) died March 9, 2009, at his home in Knoxville, Tennessee. After graduating from the University of Illinois and before undertaking a military commitment with the Army Corps of Engineers in World War II, he worked at Thompson Products in Cleveland, Ohio, as an automotive and engine parts maker and was granted U.S. and foreign patents for the development of sodium cooled, hollowed stem valves for heavy duty service in truck engines. While on assignment with the Corps of Engineers, he oversaw and served in a liaison capacity between the Kellex Corp. and J. A. Jones Company on the Gaseous Diffusion Plant. He was actively involved thereafter in the preoperational testing of the cascade enrichment test process. His longest and most productive tenure of professional service, however, came while employed at Oak Ridge National Laboratory, where he held the following positions of ascending responsibility in the Metals and Ceramics Division: Supervisor of the Melting and Fabrication Facility, 1948-58; Assistant Director, 1958-68; and Associate Director, 1968-85. He was named a U.S. delegate in the 1955 Geneva Conference on the Peaceful Uses of Atomic Energy and was a member of the technical team that designed, built and operated the display reactor in Geneva, Switzerland. Major achievements made by him during his career in the nuclear field are design and manufacture of alclad enriched uranium fuel and associated control components for the start up operation of the LITH, BSR, MTR, CP-3, CP-5, ORR, HFIR, OWR, NRL and other follow on research and test reactors, the initial core loadings for the APRR and SM Power Package Reactors which were the first to demonstrate the merits of UO2 and U308 as suitable nuclear fuels for generation of electrical power and the manufacture of plutonium-bearing fuels for the production of research quantities of Americium, Berkelium and Californium. Cunningham was a Fellow of the American Nuclear Society (ANS) and the American Society for Metals (ASM) and held elective office in several professional societies. He is the holder of several patents, honorific awards and had 40 professional articles in journals and open-literature publications. He was a loving and devoted husband of 62 years to the late Dolores Geneva Cunningham and father of five children.

James Fox (BS Met '48) died May 13, 2009, at his home in Mt. Vernon, IL. He spent his working career in the coal mining industry, first with Freeman Coal Mining Corporation and then as a manufacturer's representative dealing in Process equipment used in coal cleaning. He was a member of the Southern Illinois Society of Coal Preparation Engineers, the Illinois Mining Institute, and was a Legion of Honor member of the American Institute of Mining Engineers. He was a veteran of World War II, a member of the Mt. Vernon Moose Lodge and the Mt. Vernon AMVETS. He is survived by his wife of 49 years, Margaret, and two daughters.

Walter S. "Wally" Lucas (BS Met '54), 76, passed away November 1, 2008. After graduating from the University of Illinois, he entered U.S. military service as a commissioned officer with the U.S. Army Combat Engineers and was stationed in Germany. After serving two years of military service, Lucas was employed by Sahara Coal Company in southern Illinois as a coal preparation engineer. He rapidly rose in the company, becoming vice president in charge of all mining operations. He remained in charge of Sahara Coal mining operations for more than 20 years and until the company ceased mining operations. After his employment with Sahara, he established his own registered professional engineer consulting business with offices in Harrisburg, Illinois. He maintained his office until his death. Lucas was a member of the Illinois Mining Institute and is a past president. He was an avid outdoorsman and established, with his brother, the Honker Hill Hunting Club in 1981, which was officially recognized as one of the best in the state by the General Assembly of the State of Illinois. He is survived by his wife, Toni; daughter Staci Warren and grandson, Jacob Warren of Marion.

Walter Rose passed away on January 19, 2009. He received his B.S. in chemistry from the University of Chicago in 1944. He worked at major oil company laboratories, lectured for a year at the University of Texas at Austin, was editor of the Gulf Coast section of the Oil & Gas Journal, before joining the faculty of the Metallurgy and Mining Department at the University of Illinois in 1955. He announced his resignation from the University on November 22, 1967, to a group of 300 students at the Illini Union. This was in response to the expulsion of seven undergraduates who participated at a sit-in protesting the Dow Chemical Co. Rose continued his teaching and consulting career around the world from 1968 through 2004. During this time, he was also heavily involved in developing and leading petrophysical laboratories both for private industry as well as for government research agencies. He was inducted into the "Legion of Honor" by the Society of Petroleum Engineers, and received a Lifetime Achievement Award from the Alberta Petroleum Research Council. Rose authored hundreds of papers in peer reviewed journals, as well as a chapter on relative permeability in the Second Edition of the Petroleum Engineering Handbook. He holds several patents for laboratory test equipment. He is survived by his wife Edith, his sister Dolly, six children, 10 grandchildren and nine great-grandchildren.

George McTaggart (BS Cer '50, MS Cer '54, PhD Cer '56), 81, died November 17, 2008. He served in the Navy during World War II as Seaman First Class and also served in the Army during the Korean conflict, achieving the rank of Captain. After graduating from the University of Illinois with his Ph.D., he was employed by Corning Glass Works as a research manager and was awarded seven patents. He served as vice president and member of the Board of Directors of Zedmark Incorporated and retired from Findlay Refractories Company as technical director. He was a member of the Presbyterian Church.

Ervin Schuetze (BS Cer '51) died March 13, 2009. Following high school, he served in the U.S. Navy. He then continued his education at the University of Illinois, graduating with a degree in ceramic engineering. During his career, he was employed by A.P. Green, U.S. Steel, and Martin Marietta Materials. He is survived by his wife Peggy, three children and eight grandchildren.

Spring Lectures Honor MatSE Department

This spring the MatSE Department at the University of Illinois held two named lectures. On April 8, Dawn Bonnell, Trustee Professor of Materials Science and Engineering at the University of Pennsylvania, gave the talk "Molecular Interactions on Ferroelectric Materials: Exploiting Fundamental Properties to Design Hybrid Nanodevices" as the first Racheff Future of Materials Science Lecture. The Racheff Lecture is a special lecture that the department intends to hold annually. The lecture series is designed to promote the future of materials science and engineering, to encourage more MatSE undergraduates to go to graduate school, and for more MatSE graduate students and post docs to go on and become faculty members. While she was on campus, Dawn Bonnell had a lunch seminar with female students in the department and met with students in the Women in Engineering program.

On April 28, George Crabtree, Distinguished Fellow and Director of the Materials Science Division at Argonne National Laboratory, gave the Howard K. Birnbaum Memorial Lecture, "Materials Challenges for Sustainable Energy." The Birnbaum Lecture Series was established to pay tribute to Howard Birnabum, professor emeritus and former director of the Materials Research Laboratory, who passed away in 2005. Howard's contribution to science and engineering extended well beyond the scientific papers he published. He was a mentor, teacher and role model for his many graduate students, post-doctoral fellows, and faculty colleagues. The Birnbaum Lecturers are scientists and engineers who are influencing and directing our field, and who are able to deliver a visionary talk about critical areas in science and engineering. Our intention is to endow this lecture series so that it continues indefinitely. To achieve this goal requires the lecture series be endowed at a level of $100,000. Through your support and generosity we have come a long way in reaching our target, and with commitments, are less than $30,000 from our target. If you believe this is an endeavor that will enrich the experience of tomorrow's students or you would like to honor a colleague, please consider making a contribution toward the Birnbaum Memorial Lecture Series Fund. Details on how to do so can be found on page 15.

If you were a Ceramics student in the 1970s, you could probably name these professors without looking at their T-shirts.

Photo courtesy of Richard Friedberg (Art Friedberg's son).

For more Ceramics memories, including a copy of a 1941 The Illini Ceramist, go to www.matse.illinois.edu/alumni/memories.html

We want to hear from you!

Send comments and letters to the editor to MatSE News, Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign, 201B MSEB, 1304 W. Green Street, Urbana, IL 61801 or email brya@illinois.edu

University of Illinois at Urbana-Champaign
Department of Materials Science and Engineering
1304 West Green Street
Urbana, IL 61801

Non-Profit Organization
U.S. Postage Paid
Champaign, IL 61820
Permit No. 75