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MSE news

MATERIALS SCIENCE AND ENGINEERING

MSE Team Studies Magnetic Domain Walls and Anti-Phase Boundaries

See story on page 3

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“Thirty sophomores representing the class of 2009 entered the Department this fall; this is the largest class in more than a decade.”

A Note From the Department Head

Gregory S. Rohrer, W.W. Mullins Professor

Dear MSE Graduates:

I am happy to report that we begin a new academic year with record enrollment in the Materials Science and Engineering Department. Thirty sophomores representing the class of 2009 entered the Department this fall; this is the largest class in more than a decade. This follows several recent years with higher-than-average enrollments. More than 20 graduate students also joined the Department this year—and more than 70 full-time doctoral students are currently working on their Ph.D. dissertations.

These students will have the opportunity to experience a wider range of classes this year—including newly created courses in the areas of nanomaterials, polymer physics and morphology, and computational techniques in engineering.

Research by MSE faculty members continues to have a broad impact. MSE programs recently featured in the media include **Professor Tony Rollett's** use of three-dimensional computer models to aid in lifespan analysis of aircraft materials, **Professor Prashant Kumta's** new nanocrystalline materials for supercapacitors, and research by **Professors Mohammad Islam** and **Kris Noel Dahl** on the relationship between health and the mechanical properties of proteins within cells.

Three other MSE faculty members have recently received prestigious international awards. **Professor Bob Davis** won the *2006 International Prize* of the Japan Fine Ceramics Association, and **Professor Ted Massalski** won the *Jan Czochralski Award*, presented at the European Materials Research Society Meeting. In addition, **Professor Richard Fruehan** has been named an Honorary Member of AIME, the American Institute of Mining, Metallurgical, and Petroleum Engineers.

MSE students are also earning recognition—while gaining invaluable hands-on experience. **Nicole Hayward** made exciting contributions during her internship at Pittsburgh Corning, and **Abbie Bednar** traveled to Alabama this summer for an internship with Nucor Steel. They describe their experiences in their own words on pages 3 and 9.

In addition to recognizing these members of the MSE community, I'd like to take this opportunity to announce the appointment of **Professor Sridhar Seetharaman** to the *POSCO Development Professorship*. Seetharaman's appointment to this chair recognizes his research achievements in metals processing, as well as his role in the Center for Iron and Steelmaking Research (CISR). He follows in the strong tradition of **Professors Richard Fruehan** and **Alan Cramb**, the first and second recipients of the *POSCO Professorship*. The CISR recently celebrated its twentieth anniversary, and POSCO has been a steady supporter of this important initiative. We are grateful for this ongoing support.

Feedback on Our Program Educational Objectives

Our Undergraduate Program Assessment and Review Committee has recently revised our program educational objectives. In accordance with our curriculum assessment plan, we publish these objectives and solicit feedback from our alumni. We invite your comments on the objectives stated below. Please send any comments to **Professor Marc De Graef**, Chair of the Undergraduate Program Assessment and Review Committee, at degraef@cmu.edu or (412) 268-8527.

Our program will produce graduates who:

1) Are successful in a top graduate school and/or in materials engineering positions
2) Excel in professionalism and leadership in modern materials engineering practice, while accounting for the impact of their profession on an evolving society
3) Creatively advance our collective understanding of the principles of materials science and engineering and/or innovate the design of technological systems
4) Contribute effectively as an individual, team member, or leader to achieve group and institutional goals

COVER STORY

MSE Team Studies Magnetic Domain Walls and Anti-Phase Boundaries

This edition's cover shows details of magnetic domain walls and anti-phase boundaries within Ni_2MnGa alloys, produced through transmission electron microscopy—specifically, in the Lorentz imaging mode. **Professor Marc De Graef** and his research group study these alloys with financial support from the National Science Foundation.

Alloys of the type Ni_2MnGa are of interest because they exhibit a phenomenon known as "ferromagnetic shape memory," which means that they can change shape under an applied magnetic field. These alloys belong to the class of multiferroic materials, which can respond to multiple externally applied fields. Upon cooling from the melt, these alloys undergo two ordering transformations (disordered to B2 and B2 to $L2_1$, also known as Heusler ordering); a paramagnetic to ferromagnetic transition at around 380 K; and a martensitic transformation from cubic to tetragonal or orthorhombic, at a temperature that depends sensitively upon the alloy composition.

The cover image shows a magnetization map of an austenitic sample (at room temperature); the width of the image corresponds to a distance of about four microns. The colors indicate the direction of the local magnetization vector: red indicates a magnetization pointing from left to right, green from right to left, yellow from top to bottom, and blue from bottom to top. The curved boundaries between the colored regions correspond to anti-phase boundaries—i.e., defects in the lattice ordering of this alloy. The interactions between these anti-phase boundaries and the magnetic domain walls affect the magnetic coercivity of this alloy, and represent the subject of intense microstructural investigations.

A Block of Time I Call My Summer

By Nicole Hayward | MSE Class of 2007

You never know where employers look these days. I've heard rumors (from friends and *The Tartan)* of employers reading online profiles, such as Facebook and Myspace, for up-and-coming employees. The rumors were right.

One day this spring, as I was procrastinating in the MSE Undergrad Cluster, I checked my Myspace e-mail to find that Russell Fox of Pittsburgh Corning Corporation had e-mailed me. In his e-mail, Fox asked if I knew of a mortar that performs as a good thermal break. Surprised at the pithy question, as most questions on Myspace aren't, I replied to Fox.

Pittsburgh Corning Corporation (PCC) is a company that has made glass block since 1937. Its glass block is a distinctive industrial material that composes windows and walls all over the United States, providing useful performance features and a clean aesthetic. Pittsburgh Corning, Fox informed me, had been looking for an intern to bring new design ideas to the company. My materials background, he mentioned, would complement this position. But could I draw, could I design?

"Yes!" I told him. "I draw, paint, and use illustrating software." After interviewing with my artwork in hand, I began my new internship at Pittsburgh Corning in the Murrysville area. There, I began researching PCC competitors' current product aesthetics—until I was approached with a physics calculation on an impact test, a moment of inertia question, and a very urgent moisture vapor diffusion calculation, all in one day.

A week later, I was asked to present my calculations and considerations. Agreeing, I presented to a board of very important people in the company, an opportunity that gave me a strong voice in PCC's new product innovation. From then on, the summer became a whirl of innovation and opportunity.

PCC gave me the opportunity to visit its Port Allegheny facility, where I watched how gobs of molten glass become glass block. With this information and research, I helped to enable the production of a new block with a lower solar heat gain coefficient and U-value; I gave a presentation to PCC employees on nanotechnology and how it could aid in PCC products; I interpreted data about material performance, such as TiO_2 photocatalyst coatings; I innovated two new designer lines that I can't tell you about yet; I presented information on these products to PCC's very important people; and I drafted a patent and patent drawings for an up-and-coming product. (By the way, I aspire to be a patent attorney.)

That wasn't all I did with PCC this summer, but I won't divulge the details. I will say, however, that because PCC has given me wonderful opportunities and experience, I'm continuing to work part-time there this fall. So keep your eye out for new glass block designs. You'll know them when you see them—and, when you do, remember that they were designed with a good amount of material consideration.

FACULTY NEWS

Professor Prashant Kumta's paper in *Acta Biomaterialia*, entitled "Nanostructured Calcium Phosphates for Biomedical Applications: Novel Synthesis and Characterization," has been downloaded 827 times since publication. At this time, it is the most downloaded paper of the entire journal.

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Dr. Robert Heard has been named a *Wimmer Faculty Fellow*. This new fellowship, established by a grant from the Wimmer Family Foundation, is designed for junior faculty members interested in enhancing their teaching through concentrated work in designing or re-designing a course, innovating new materials, or exploring a new pedagogical approach. Fellows participated in a workshop series in May, then worked on developing materials for their own courses during the summer, in consultation with the Eberly Center for Teaching Excellence staff and colleagues.

In addition, **Professor Heard** and Professor Deanna Matthews (Civil and Environmental Engineering) have received a *2006 Design Grant* from the "Ferrous Metallurgy Education Today"—or FeMET—initiative, sponsored by the American Iron and Steel Institute and the Association for Iron and Steel Technology Foundation. Heard and Matthews received an award of $47,500, to be used in addressing an industry technological problem or challenge, by working collaboratively to determine a solution. The FeMET initiative was created to attract top talent to the North American steel industry.

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Newell Washburn—Assistant Professor of Chemistry, Biomedical Engineering, and Materials Science and Engineering—has received a *3M Nontenured Faculty Award* to support his basic research on biointeractive polymers for wound healing. Washburn received one of 27 awards for basic research in the physical and/or biological sciences, selected by 3M researchers. The award provides unrestricted funds for his research.

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The Japan Fine Ceramics Association has awarded **Professor Robert F. Davis** its *2006 International Prize*. This prize is awarded to persons who have made significant and pioneering contributions to the fine ceramics industry through technological development, cooperative research, and international business development.

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A paper co-authored by **Professor Anthony Rollett** is the most highly cited of all articles published in 1997 issues of *Materials Science and Engineering A, B; Philosophical Mag. A,B; Scripta Mater.; Journal of Materials Science; Prog. Materials Science*; and other journals. The paper, entitled "Current Issues in Recrystallization," was co-authored by R.D. Doherty, D.A. Hughes, F.J Humphreys, J.J. Jonas, D.J. Jensen, M.E. Kassner, W.E. King, T.R. McNelley, and H.J. McQueen. It originally appeared in *Materials Science and Engineering A*.

Seetharaman Appointed to the POSCO Faculty Development Professorship

Professor Sridhar Seetharaman has been awarded the *POSCO Faculty Development Professorship* in Materials Science and Engineering, effective July 1, 2006.

Seetharaman received his Ph.D. from MIT in 1998 and then spent a year as a Research Associate at Imperial College in London. He first came to Carnegie Mellon as a Visiting Scholar in 1999 and was appointed an Assistant Professor in 2000. In 2005, he was appointed Associate Director of the Center for Iron and Steelmaking Research (CISR) at Carnegie Mellon.

His work has already received extensive recognition. The Iron and Steel Society has recognized him with the *Young Leader Award* in 2000 and the *Charles H. Herty Best Paper Award* in 2002. In 2002, Seetharaman also received the *Friedrich Wilhelm Bessel Research Prize* from the von Humboldt Foundation and the *Marcus A. Grossmann Young Author Award* from ASM International. In 2001, he received the *CAREER Award* from the National Science Foundation and the *Philbrook Award* from the MSE Department.

Seetharaman is the Principal Editor for *AIST Transactions* and has taken a leadership role in organizing a number of international conferences. He has published more than 100 papers, with 63 in archival journals.

Rollett Leads Effort to Ensure Aircraft Safety

MSE Professor Develops New Method to Track Plane Lifespans

As the US Navy's aircraft fleet ages—with many planes more than 30 years old—military officials are looking for more precise methods to assess the safety of individual planes. MSE's **Professor Anthony D. Rollett** is playing a critical role in this effort, by developing a new computational method that may help to track the lifespan of Navy aircraft.

"By creating new three-dimensional computer models of the materials used in aircraft, we can more effectively determine when an aircraft is ready for an overhaul—or when it should be retired," explains Rollett.

Rollett's computational models have been developed in partnership with Northrop Grumman Corporation, one of the nation's leading defense contractors. A $730,000 research grant—part of a larger program led by Northrop Grumman—is funded until 2007 by the US Defense Advanced Research Projects Agency (DARPA).

"By creating computer models, we can determine when an aircraft is ready for an overhaul—or retirement."

"Virtual" Materials Testing Helps to Predict Failure

Rollett and his research team use computer models to map the microstructure of aircraft materials, turning them into three-dimensional digital materials. Researchers can then use computational models to perform unlimited testing on these materials, in a risk-free "virtual" environment. This method is a refinement of a system that MSE researchers in the NSF-sponsored Materials Research Science and Engineering Center (MRSEC) had already developed, in collaboration with Pittsburgh-based Alcoa Corporation.

"In our tests, we are looking for any kind of defect or fatigue exhibited by critical aircraft components," says Rollett. The tests recreate some of the stresses Navy aircraft are routinely subjected to—including repeated aircraft carrier landings, which some aviation experts call "controlled crashes."

According to Rollett, the novelty of the MSE team's approach lies in its ability to create many different examples of a given material in the virtual environment—so that researchers can understand the variability of that substance. This allows the team's results to be used in the statistically based systems that are used for tracking Navy aircraft lifespans.

Rollett's group is collaborating with the Alcoa Technical Center, as well as Cornell, Lehigh, Rensselaer, and Mississippi State Universities.

Massalski Lectures Around the World

In July **Ted Massalski**, Professor Emeritus, traveled to Asilomar, CA, to speak at an international conference on actinide metals and their importance and future in generating electrical power. Massalski chaired two plenary sessions, as well as presenting a paper—with Dr. Adam Schwartz of Lawrence Livermore National Laboratory—on the phase diagram of Pu-Ga alloys.

That same month, Massalski was invited to speak at the Congress of the Brazilian Institute of Materials in Rio de Janeiro. He presented an invited talk on "Phase Diagrams," as well as a plenary lecture entitled "The Magic World of Plutonium Science."

In September, Professor Massalski received the *Jan Czochralski Award* and medal at the European Materials Research Society Meeting in Warsaw, Poland. A special symposium was held in Massalski's honor, entitled "Phase Diagrams, Phase Stability: Theory on Applications." He also delivered a lecture, "Alloy Phase Diagrams: Opportunities, Problems, and Applications."

"This groundbreaking discovery could be used to power automobiles and industrial generators worldwide, as well as a broad spectrum of consumer electronics."

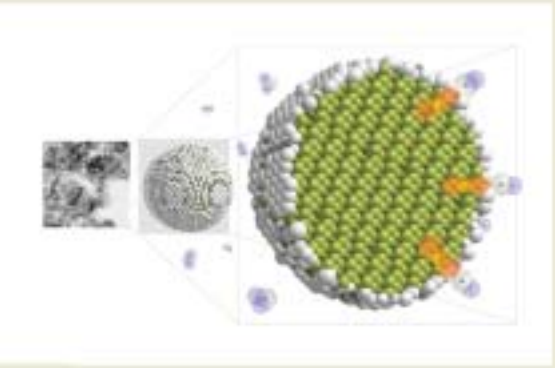
FACULTY NEWS *continued*

Kumta's Group Pioneers Next-Generation Nanocrystals

New Materials Could Revolutionize Energy Storage

A research team led by **Professor Prashant Kumta** has discovered a new nanocrystalline material that can significantly enhance energy storage capacity—while also cutting costs. The group's results were published this summer in *Advanced Materials Journal*, and featured on the publication's cover.

"The new nanocrystals were created by a low-temperature synthesis of nanostructured vanadium nitride, and controlled oxidation of the surface at the nano-scale," explains Kumta, who holds a joint appointment in MSE and Biomedical Engineering. "Not only is vanadium nitride less expensive than ruthenium oxide—which powers most supercapacitors today—but it can also store twice the amount of energy, for a longer period of time. When compared to activated carbon, the other material of choice, it can provide seven times more power for less than one-sixth the volume."



In fact, the new nanocrystalline material pioneered at MSE has the potential to cut materials costs ten-fold. While ruthenium oxide currently sells for $100 per gram, vanadium nitride costs less than $10 per gram.

MSE Innovation Expected to Have Global Impact

This groundbreaking discovery could be used to power automobiles and industrial generators worldwide, as well as a broad spectrum of consumer electronics—including cameras, camcorders, and cell phones. Kumta notes that, as these product categories grow—and consumers become more dependent on them—there is an ever-increasing demand for alternative energy sources.

"Today, people are using their cell phones to do more than just communicate," Kumta points out. "Consumers use portable phones to process family photos, watch movies, play games, and listen to music. They obviously need more power for such applications—and this new nanocrystalline material may offer a cost-effective way to prolong the life of existing battery technologies."

Other project researchers include **Adjunct Professor George Blomgren** and Research Associate **Daiwon Choi.** The team's work is supported by Carnegie Mellon seed funding, as well as a grant from the National Science Foundation.

Fruehan Becomes AIME Honory Member

Professor Richard J. Fruehan, U.S. Steel and University Professor, has been selected by the Board of Directors of the Association for Iron and Steel Technology (AIST), and ratified by the AIME Board of Trustees, as an Honorary Member of AIME.

This appointment is in recognition of his life-long commitment to the iron and steel industry through distinguished service to AIME, ISS, and AIST, as well as his exceptional contributions to the fundamental knowledge of iron and steelmaking, and to the development of new steelmaking technologies.

AIME Honorary Membership is one of the highest honors that the Institute can bestow on an individual. It is awarded in appreciation of outstanding service to the Institute, or in recognition of distinguished scientific or engineering achievement in the fields embracing the activities of AIME and its member societies. Candidates for Honorary Membership are generally (1) members of the AIME member societies who are outstanding in their respective fields and/or who have performed unusual service to the Institute; (2) United States citizens, whether AIME member society members or not, who are particularly outstanding; or (3) citizens of foreign countries who are outstanding in their work, combined with some official position of service to the profession.

This honor is given to only one-tenth of one percent (0.1%) of the members of member societies of AIME, which include the Society for Mining, Metallurgy, and Exploration; the Minerals, Metals, and Materials Society; the Association for Iron and Steel Technology; and the Society of Petroleum Engineers.

A ceremonial medallion and certificate of honorary membership will be awarded to Professor Fruehan in May 2007, at the Annual AIST Meeting in Indianapolis.

Researchers Probe Mysterious Childhood Disease

Cooperative Team Focuses on Causes at the Cellular Level

Hutchinson-Gilford Progeria Syndrome (HGPS) is an extremely rare childhood disease that accelerates the aging process to about seven times the normal rate—causing a child of 10 to have respiratory, cardiovascular, and arthritic conditions similar to a 70-year-old. Children afflicted with HGPS rarely survive their teens.

But a multidisciplinary research team at Carnegie Mellon—including **Professor Kris Noel Dahl** and **Professor Mohammad F. Islam**—may offer new hope to HGPS patients. The group's findings, which were published in July in *Proceedings of the National Academy of Sciences Journal*, may shed new light on the cause of this terminal disorder.

Other experts involved in this groundbreaking research include Paola Scaffidi and Tom Misteli of the National Cancer Institute, Katherine Wilson of Johns Hopkins University, and Arjun Yodh of the University of Pennsylvania.

A Microscopic Difference—With Huge Implications

Dahl, an Assistant Professor of Chemical and Biomedical Engineering with a courtesy appointment in MSE, explains that HGPS begins at the cellular level. "The nucleus in all three trillion cells of the human body contains the DNA genome, which is wrapped in a protein shell called the nuclear lamina," says Dahl. "Children with HGPS have a mutation in one of the proteins of the lamina shell. For years, experts have thought this mutation made their nuclei much softer, and more likely to be ruptured under stress."

But the work of the cooperative research team revealed that the lamina shell in HGPS patients is, in fact, stiffer than normal. The stiffer HGPS lamina is much more brittle—and more susceptible to fracture. "The mutant HGPS lamina is like an eggshell that cracks under excessive pressure or force," Dahl explains, "while a normal nuclear lamina resembles the rubbery outer shell of a racquetball—retaining its original shape even after hard impacts."

How does this fragile lamina contribute to an accelerated aging process? The researchers believe that the stiffer lamina in HGPS patients may be unable to communicate the proper biological signals to the DNA inside the nucleus—which inhibits normal cell growth.

The team is still exploring the root causes for the different lamina shell found in those afflicted with HGPS. Islam, who holds a joint appointment in MSE and Chemical Engineering, says that the increased stiffness may be caused by mutant proteins self-organizing within the HGPS lamina. "This could make the lamina stiffer and cause fractures in the nucleus," he notes, "while a healthy lamina remains disordered, and therefore less rigid. Once we understand what causes the HGPS lamina to stiffen, we can try to reverse or stop this process."

ALUMNI UPDATES

Kai-Chieh (Eric) Chang *(M.S. '98, Ph.D. '03)* is in the media group at Seagate Research, Pittsburgh, where his main job is thin film growth, using different techniques and characterization of films made.

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Melik C. Demiril *(M.S. '01, Ph.D. '02)* is the Pearce Assistant Professor in the Department of Engineering Science and Mechanics, College of Engineering, at the Pennsylvania State University. Demiril was recently invited to a Young Investigator Research Workshop at the National Institute of Materials.

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Dr. Norman A. Gjostein *(Ph.D. '58)* will be remembered in MSE as one of our most successful alumni. He made outstanding contributions to the scientific underpinnings of materials science, rose to high positions in industry, gave generously of his time and resources in support of the University, and was recognized by the engineering community at large. It is with great sorrow that we learned of his untimely death this past spring.

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Warren H. Hunt Jr. *(M.S. '82, Ph.D. '92)* received a unanimous vote to lead the Minerals, Metals, and Materials Society (TMS)—headquartered in Warrendale, PA—as Executive Director.

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Wilbur C. Thomas *(B.S. '44)* will receive the Carnegie Mellon Alumni Achievement Award during Homecoming on October 13th. The Award is made in recognition of his innovative work in both the steel and car manufacturing industries.

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We love hearing from our graduates!
If you would like to be included in the next issue of MSE News, simply send your update to ***sb3n@andrew.cmu.edu****, or mail it directly to the Department c/o Alumni Updates.*

STUDENT NEWS

Jui-Hung Chien

MSE student **Jui-Hung (Harry) Chien** won the poster competition of the Light Metals Division at the TMS Meeting in San Antonio, TX, with his poster "The Effect of Manganese Oxide and Iron Oxide on Radiative Heat Transfer in Continuous Casting."

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James Rogers

The 2006 Krivobok-Brooks Metallography Award is presented each year to an undergraduate student and a graduate student who have displayed the greatest evidence of excellence in the art of metallography. The entries were all exceptionally good, and it was necessary to split the awards. The team of **James Rogers** and **Eric Vanderson**, and the team of **Esther Yu** and **Eric Vanderson**, received the undergraduate award. The graduate award was split between **Tamara Baum** and **Nan Boonyachut**.

Tamara Baum

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The Lloyd E. Sutch and Dan A. Sutch Scholarship was established in 1998 by Dan A. Sutch. Students must demonstrate financial need, with awards made to a sophomore student enrolled in MSE who was in the top 50% of the freshman class. **Todd Hoffman** of Sheridan, WY, was the recipient of the 2005-2006 scholarship.

David J. Soltesz

Senior **David J. Soltesz** has been awarded an *AIME Lewis E. and Elizabeth W. Young Scholarship*. These $1,000 grants are awarded to mining, metallurgical, petroleum engineering, or materials science undergraduates in Western Pennsylvania, West Virginia, or Virginia. Recipients must also have graduated from a high school in one of these areas. Scholarship sponsor Dr. Lewis Emanuel Young was an outstanding mining consultant, with special interest in the development, operation, and management of copper, coal, limestone, and potash mines in the US and Canada. Elizabeth W. Young was a long-time active member of the Woman's Auxiliary of AIME.

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MSE students were recognized at the 16th ASM International Young Members Night (Pittsburgh Golden Triangle Chapter). Junior **Scott Roberts** and sophomore **Nicholas Jones** were awarded *Past Chairperson's Education Assistance Awards*, while senior

MSE student Abbie Bednar logged the fastest time in the annual buggy races during Spring Carnival. Bednar, who drives for the fraternity Pi Kappa Alpha, crossed the finish line with a time of 2:07:31 around the .83-mile course.

Scott Roberts

Tim Miller

Yuranan Hanlumyuang

Diana Chan

Selina Brownridge

Yuranan Hanlumyuang was presented the *Outstanding College Senior Award*. In the graduate student poster competition, doctoral student **Samuel Lim** was awarded first place, and doctoral student **Chris Roberts** was awarded second place. In the undergraduate student poster competition, the team of juniors **Scott Roberts**, **Tim Miller**, **Nicole Cates**, and **Hannes Eggenschweiler** won first place, while the team of seniors **Selina Brownridge**, **Diana Chan**, **Harry Chien**, and **Yuranan Hanlumyuang** won second place. MSE junior **Esther Yu** received the third-place prize.

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MSE doctoral student **Christopher Roberts** has been named the *2006 International Symposium on Superalloys Scholar* by TMS. This honor, which carries a $2,000 cash award, is available to undergraduate and graduate students majoring in metallurgical

and/or materials science and engineering—with an emphasis on all aspects of the high-temperature, high-performance materials used in the gas turbine industry and all other applications.

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Nicole Cates

Senior **Nicole Cates** has been awarded the TMS *Electronic, Magnetic, and Photonic Materials Division Gilbert Chin Scholarship*. The $2,000 cash award is available to an undergraduate student studying subjects related to synthesis and processing, structure, properties, and performance of electronic, photonic, magnetic, and superconducting materials—as well as materials used in packaging and interconnecting such materials in device structures.

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Senior **Esther Yu** spent this summer in London, working on a unique project that combined components of experimental and computational bio-materials science. Yu carried out research under a project entitled "Optimization of Bioactive Scaffolds for Bone Tissue Engineering." Her work was supervised by Dr. Julian R. Jones and Professor Peter D. Lee, both with the Department of Materials at Imperial College of Science, Technology, and Medicine. Yu—who was nominated by **Professor Sridhar Seetharaman**—was awarded a $3000 travel grant through the Zdrojkowski Fund, which supports students traveling abroad to work on innovative projects.

What I Did on My Summer Internship

By Abbie Bednar | MSE Class of 2007

After finishing my junior year in chilly Pittsburgh, I enjoyed my summer internship as a Hot Mill Metallurgist at Nucor Steel in Decatur, Alabama, very much. I enjoyed it so much, in fact, that I didn't want to leave—and it wasn't just because of the beautiful, hot, and sunny weather!

At Nucor, I was fortunate to work on a variety of projects that allowed me to apply my coursework at MSE. My first project involved examining defective steel products that had been reported by customers. I performed microscopy on these samples, and also analyzed all the data that was available on specific defective strips. From there, I used problem-solving techniques to identify why each defect had occurred.

My next project entailed cataloging the different grades of steel produced by Nucor, based on strengthening additives, as well as the corresponding grain sizes of the grades. While this may not sound interesting, it was a good opportunity to learn about Nucor's product range, as well as the steel manufacturing process.

Next, with the help of my mentor at Nucor, I looked at models of Nucor's run-out table—or cooling table—with the goal of varying the steel's grain size by using different laminar cooling patterns, and effectively strengthening the steel.

Although I had specific projects to work on while at Nucor, I was given the opportunity to experience any aspect of the mill that I wanted to—from using a blow torch for fun to chatting with the administrative staff. Being in an actual steel mill each day was an experience that was rewarding in so many ways; it's difficult to express in writing.

One of the best aspects of working at Nucor was the people I met there. Throughout the entire summer, I never met a single person who did not enjoy their job, and love the company. Everyone was eager to welcome me, and went out of their way to help me—making me feel like part of the team, instead of a student intern.

I'll admit, that even after a chilly winter in Pittsburgh, I was a little hesitant about spending a summer in Alabama. But the people of Nucor, and the hands-on experience in the field, made it an internship that I would highly recommend to other MSE students.

We Need Your Help!

Every academic year, MSE has 20 or more openings in our doctoral program for which we seek the best and the brightest. Please encourage undergraduates at your university or workplace—or your coworkers who are thinking of returning to graduate school—to apply to our program.

Additional information about the graduate program, as well as application information, can be found on our Departmental Web page at www.materials.cmu.edu. We accept applications for entry into the program in both September and January.

You're a Loyal Bunch!

Once again, the generosity of our alumni and friends has been outstanding. In fiscal year 2006, the following donors contributed $57,000 directly to the Department. Your generosity is most appreciated.

Mr. Robert L. Albert
Dr. John E. Allison
Mr. Thomas B. Andersen
Mr. Joseph D. Batson
Mr. W. H. Clay Beringer, Jr.
Mr. Donald Berman
Mr. Dennis F. Bickford
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Mr. and Mrs. David J. Kirkpatrick
Mr. and Mrs. Fred Kocks
Mr. George Konoval
Mrs. P. Joyce Konoval
Ms. Kathy R. Lachenauer
Mr. Edgar Landerman
Dr. Perry H. Leo
Mr. Moses A. Levinstein
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Dr. Carl F. Lutz
Dr. Christopher L. Magee
Dr. Thomas F. Marinis, Jr.
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Mr. Robert C. Mills
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Hub Aaronson Remembered

On May 15th, family, friends, colleagues, and former students gathered at Carnegie Mellon to remember the late **Hubert I. Aaronson**, R.F. Mehl Professor Emeritus. Attendees traveled from as far as Japan and the United Kingdom to share stories and anecdotes about "Hub." The audience was provided much insight into the man who was a friend and mentor to so many over the years.

To date, the Hub Aaronson Memorial Fund has grown to more than $4,000—and the first award was given at the MSE diploma ceremony on May 21st (see page 11).

If you would like to participate in this ongoing tribute to Hub Aaronson, please send your contributions to:

The Hub Aaronson Memorial Fund
Materials Science and Engineering Department
3323 Wean Hall, Carnegie Mellon University
Pittsburgh, PA 15213-3890

Commencement | Class of 2006

The Paxton Award for the Best Doctoral Dissertation in Materials Science and Engineering—which was made possible by the generosity of **Ann and Harry Paxton** (U.S. Steel University Professor Emeritus)—is intended to promote excellence in doctoral scholarship by recognizing the best Ph.D. dissertation of the year. During the May MSE diploma ceremony, the award was given to **Andrew J. Francis** for his thesis "Heteroepitaxial Growth of Metal Thin Films on Chiral and Achiral Ceramic Substrates." Francis, who was advised by **Professor Paul Salvador**, is currently working as a Materials Scientist Consultant at the GE Global Research Center in Niskayuna, NY.

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Selina Brownridge was given the *Mullins Award*, which is presented to a graduating senior in the MSE Department who best exemplifies the qualities associated with **Professor Bill Mullins**.

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The recently established *Hubert I. Aaronson Undergraduate Award* was presented to graduating senior **Jacqueline Milhans**. The award, in memory of **Professor Hub Aaronson**, is given to a deserving undergraduate metallurgy student who is planning to attend graduate school. Milhans plans to pursue graduate studies involving computational materials science.

Pranay Choudhary

Selena Brownridge

Matthew Simone

Pallav Kaushik (left) and Prof. Gregory Rohrer

Prof. Lisa Porter and Dan Ewing

Graham Doorley was awarded the *William T. Lankford Jr. Memorial Scholarship*, which is presented each year to a student in the Department who, in the judgment of the selection committee, exemplifies the attributes associated with Bill Lankford—true scholarship, high standards, great potential, and the willingness to help others unselfishly.

The James W. Kirkpatrick and Jean Keelan Kirkpatrick Scholarship is awarded to a graduating senior in the MSE Department who best exemplifies the qualities as described in the scholarship bequest—"a graduating senior who has best supplemented his/her intellectual abilities with effort and work ethic." This year's award recipient was **Noel Walker**.

Noel Walker (left) and Aurora Zinck

Left to right: Andy Francis, Professor Paul Salvador, and Bala Kavaipatti

MSE news

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X-Ray Tech Jason Wolf—MSE's own *Science Guy*—gives his "Materials at Extreme Temperatures" presentation as part of Carnegie Mellon's "Take Our Daughters and Sons to Work Day" in April.