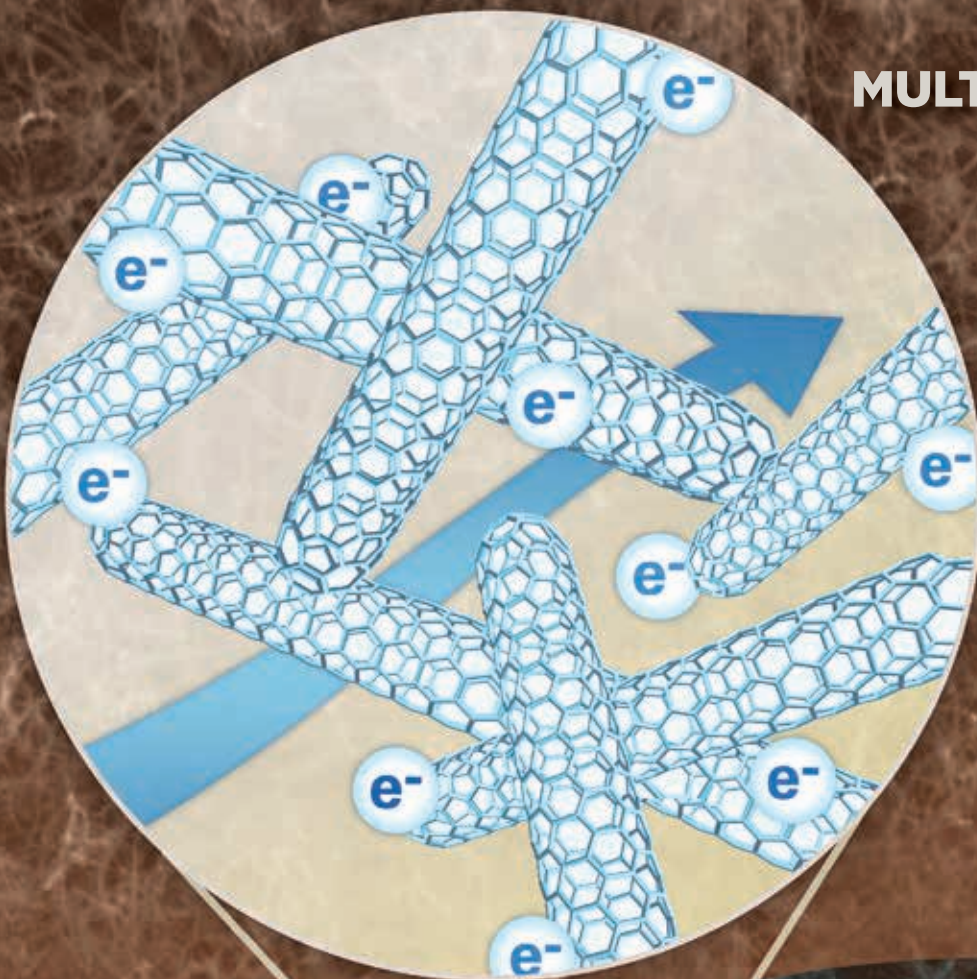




**MULTIFUNCTIONAL
CARBON
NANOTUBE
AEROGELS**

STORY ON PAGE 3





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Greetings to our MSE alumni! I am very happy to report that we have finally completed a \$4.5 million renovation of the MSE facilities in Doherty Hall. This process has taken many years. It was planned in 2007, approved in 2008, and then shelved later in 2008 because of the financial crisis. After a recommendation from the President's advisory board for MSE, the project was moved to priority status in mid-2011. The much-needed renovations were complete before the end of 2012.

The renovation includes an expanded laboratory facility for undergraduate education and research, office space for graduate students and researchers, an undergraduate student lounge, an expanded classroom, and office space for the masters degree program in Energy Science, Technology, and Policy.

Our new facilities are modern, bright, attractive, and LEED certified. In addition to being practical and user-friendly, the renovated space features a number of interesting elements. For example, there is a "show-case" lab for microscopy that is completely visible to passers-by in the main corridor through Doherty Hall. This eye-catching space is designed to raise awareness of our Department on campus and attract more students to the materials science and engineering field. This lab also features a stunning wall of large-grained titanium and support beams sheathed in titanium, all donated by Architectural Titanium. The microstructure of the material is visible to the naked eye, combining an educational example with a unique architectural feature. Please see our two-page story on pages 6 and 7 to learn more about the ambitious MSE renovation project.

A number of our alumni were able to see the nearly completed facilities when we hosted the 2012 Saltminers Dinner on campus during the annual Materials Science and Technology meeting. This October event was one of our largest gatherings, and it was a pleasure to catch up with old friends and meet some new ones. Please try to join us next year.

Speaking of alumni, I draw your attention to the list of doctoral dissertations on page 11. This list of 34 Ph.D.s—31 in the past year!—provides evidence of how hard our students and faculty are working. This represents the most productive year in recent memory.

You will find a variety of other positive trends in this issue of the *MSE News*. For example, *U.S. News & World Report* recently ranked our undergraduate program in the top 10 nationwide. Our faculty, students, and alumni continue to win awards and recognition. All of this makes it an exciting time to be part of the MSE community.

Gregory S. Rohrer

"MSE's new facilities are modern, bright, attractive, and LEED certified. In addition to being practical and user-friendly, the renovated space features a number of interesting elements."
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COVER STORY >

MULTIFUNCTIONAL CARBON NANOTUBE AEROGELS

Electrically and thermally conducting lightweight materials with large surface area are highly sought after, with broad applications as composite fillers, sieves, heat sinks, electrodes, and catalyst supports. Single-walled carbon nanotubes are anisotropic macromolecules with low density, ultrahigh surface area (theoretically $\sim 1315 \text{ m}^2/\text{g}$), high mechanical strength, and exceptional conductivities, both electrical and thermal. Consequently, nanotubes are optimal for shaping into foams for many of these applications.



Assistant Professor Mohammad F. Islam has been working with a team of researchers to explore fabrication methods for carbon nanotube aerogels that maximize their strength, thermal conductivity, and other performance characteristics. Doctoral student **Kyu Hun Kim**, masters student **Chloe Jeong**, and postdoctoral researchers **Youngseok Oh** and **Ilha Lee** have been performing critical research in Islam's lab at MSE.

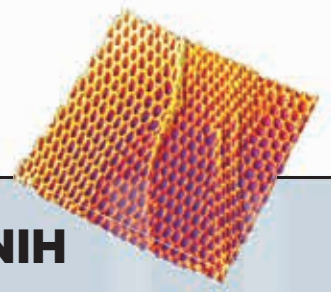
Kim and Oh have fabricated low-density ($\sim 7 \text{ mg/mL}$), freestanding aerogel monoliths from hydrogels of purified and isolated nanotubes. A tremendous strength of their new fabrication method is the tunability of shapes and sizes of the nanotube aerogels. The Young's moduli of these aerogels are larger than any other aerogels at comparable density. Even though the aerogels are mostly air, they can greatly enhance heat transfer by ~ 85 percent compared to air in the forced convective cooling method, likely because of their high porosity and surface area.

The aerogels retain many of the interesting intrinsic properties of nanotubes which make them suitable for a variety of applications. For example, due to their high electrical conductivity, aerogels can be shaped into flexible conductors that are suitable for use as electrodes in organic photovoltaics and flexible displays. The aerogels are also excellent fillers for composites and electrodes for fuel cells. Oh has found that composites of nanotube aerogels and thermoplastic polyurethanes are 360 times stronger than the polymer alone. Jeong and Lee have observed that direct ethanol fuel cells with electrodes made from composites of noble metal catalysts supported on nanotube aerogels have 10 times higher current density compared to commercial electrodes.

One weakness of these multifunctional aerogels is that they crumble when compressed by more than 10 percent. Recently, Kim and Oh have been able to overcome this weakness and transform these inelastic aerogels into superelastic, fatigue-resistant materials by coating them with between one and five layers of graphene. The graphene-coated nanotube aerogels exhibit no change in mechanical properties after more than 2000 cycles at 60 percent strain, or more than 106 compressive cycles with 2 percent strain. In addition, their original shapes can be recovered quickly after compression release.

Details can be found at the research group's Web site — <http://islamgroup.materials.cmu.edu> — as well as in these recently published papers:

- K.H. Kim, Y. Oh, and M.F. Islam, "Graphene Coating Makes Carbon Nanotube Aerogels Superelastic and Resistant to Fatigue," *Nature Nanotechnology* 7, 562 (2012).
- K.H. Kim, Y. Oh, and M.F. Islam, "Mechanical and Thermal Management Characteristics of Ultrahigh Surface Area Single-Walled Carbon Nanotube Aerogels," *Advanced Functional Materials* DOI: 10.1002/adfm.201201055 (2012).
- S.N. Schiffres, K.H. Kim, L. Hu, A.J.H. McGaughey, M.F. Islam, and J.A. Malen, "Thermal Transport and Gas Diffusion in Single-Walled Carbon Nanotube Aerogels," *Advanced Functional Materials* DOI: 10.1002/adfm.201201285 (2012).
- K.H. Kim, M. Vural, and M.F. Islam, "Single-Walled Carbon Nanotube Aerogel-Based Elastic Conductors," *Advanced Materials* 23, 2865 (2011).



FEINBERG WINS INNOVATION AWARD FROM NIH

\$2.25 Million Grant Will Support Tissue Regeneration

Assistant Professor Adam Feinberg has won a five-year, \$2.25 million grant from the National Institutes of Health (NIH) to support his development of new techniques for cardiac tissue repair and regeneration.

The NIH created its *Director's New Innovator Award* to provide funding for "exceptionally creative new investigators who propose highly innovative projects that have the potential for unusually high impact." Feinberg is the first researcher at Carnegie Mellon to receive the prestigious award since it was introduced in 2007.

GETTING TO THE HEART OF THE MATTER

Feinberg's NIH proposal — titled "Human Myocardium Engineered Using Developmentally Inspired Protein Scaffolds" — focuses on new biomaterials and cardiac tissue engineering strategies to help repair the human heart following a heart attack or other injury.

"Those patients fortunate enough to survive a heart attack face a range of physical challenges, because myocardial infarction causes tissue damage and cell death," says Feinberg. "Moving forward, they have a chronic high risk of arrhythmia, stroke, and congestive heart failure. Repairing the heart is difficult because, unlike some other cells in the body, cardiac cells cannot proliferate in order to regenerate the damaged tissue."

Feinberg's lab, the Regenerative Biomaterials and Therapeutics Group, will address this problem by exploring heart-tissue regeneration processes that are inspired by biological processes such as human embryo growth and wound healing. By studying how complex tissue architectures are created in the natural world, Feinberg hopes to develop a "repair kit" for heart patients that includes lab-created protein scaffolds and genetically engineered tissues.

"We will be modeling how cells interact with the extracellular matrix in multiple tissue types, including cornea and cardiac muscle, to understand how they grow and regenerate," explains Feinberg.

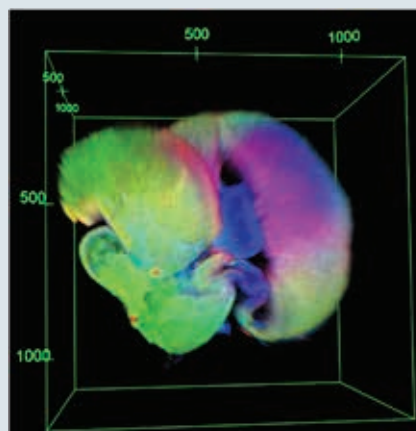
"The biomimetic principles we develop will have a range of future medical applications — from improved drug discovery and screening platforms to novel tools for biological investigation and engineered tissue grafts."

SPANNING DISCIPLINES TO SOLVE COMPLEX PROBLEMS

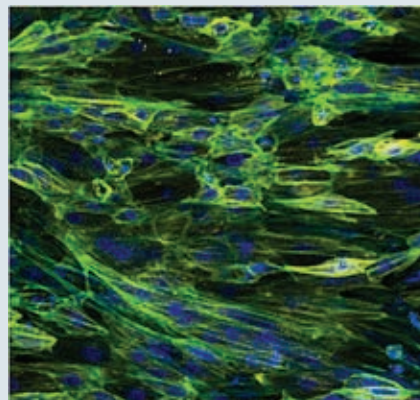
"I am extremely excited about the NIH *Director's New Innovator Award* because it will allow me to continue pursuing leading-edge, interdisciplinary research," Feinberg says. "We are bringing together developmental biology, advanced 3-D imaging, materials science, and cardiac tissue engineering. By combining such complementary and cutting-edge expertise, we are confident that our studies will yield new insights to actively move the field forward — ultimately enabling a synthetic developmental pathway to human tissue regeneration."

Feinberg joined the MSE faculty in 2010 and holds a joint appointment in Biomedical Engineering. He received his B.S. degree in Materials Science and Engineering from Cornell University in 1999, with co-operative experience at Abiomed, where he worked on artificial heart technologies. Feinberg obtained his Ph.D. degree in Biomedical Engineering in 2004 from the University of Florida.

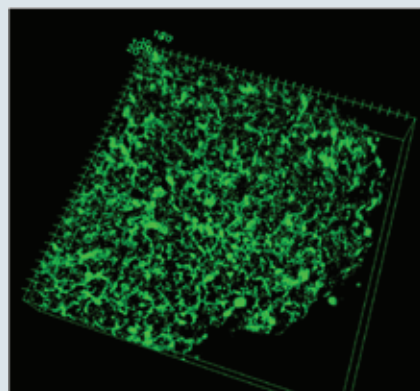
"Adam Feinberg's groundbreaking research is expanding the traditional boundaries of MSE — and placing our Department in the global spotlight," says MSE **Department Head Gregory Rohrer**. "His innovative work has the potential to improve the health and well being of millions of cardiac patients worldwide, while also impacting other areas of medicine which rely on tissue healing and regeneration. We applaud his vision and initiative in winning this highly competitive award."



3-D Whole Heart



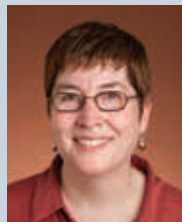
2-D Engineering Myocardium



3-D Ventricular Fibronectin Matrix

FACULTY NEWS UPDATES

ELIZABETH HOLM JOINS MSE



MSE welcomes its newest faculty member, **Professor Elizabeth Holm**. She joins the Department from Sandia National Laboratories, where she has held various positions since 1992. Most recently, Holm was a Distinguished Member of the Technical Staff, performing fundamental and applied

research in the theory and modeling of microstructural evolution in complex polycrystals. She also studied the physical and mechanical response of microstructures, as well as the wetting and spreading of liquid metals.

Holm holds a bachelors in Materials Science and Engineering from the University of Michigan (1987), a masters in Ceramics from the Massachusetts Institute of Technology (1989), and a dual Ph.D. degree in Materials Science and Engineering and Scientific Computing from the University of Michigan (1992). She served as a Visiting Professor at the University of Michigan in 2004.

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HECKEL HONORED WITH NEW SCHOLARSHIP



Former MSE Professor and Department Head **Richard Heckel** is being honored with a new undergraduate scholarship. Heckel, who died in May 2010, was the first MSE alumnus to serve as Department Head, from 1971 to 1976. He earned three degrees in the Department: a B.S. in 1955, an M.S. in 1958, and a Ph.D. in 1959. He is remembered by students as a very enthusiastic and dedicated teacher.

Heckel led a number of important curriculum changes required when Carnegie Mellon separated the CIT and MIS organizations. He also played a critical role in MSE's involvement in developing the NSF-sponsored Processing Research Institute and the Center for Joining Materials.

The *Richard W. Heckel Memorial Scholarship* was established by an anonymous alumnus and friend of Dick Heckel. Each year, a \$2500 award will be made to an undergraduate student who qualifies for financial aid. In order to build up the scholarship, other former students, alumni, and faculty are encouraged to make a gift to this fund. If you have fond memories of Dick Heckel and would like to make a gift, please e-mail **Suzanne Smith** at sb3n@andrew.cmu.edu.

BETTINGER AWARDED \$1.6 MILLION GRANT



Assistant Professor Christopher Bettinger is the co-investigator for a research project that recently won a four-year, \$1.6 million grant from the U.S. Army to develop next-generation prosthetics. Bettinger, Chemistry Professor Krzysztof Matyjaszewski, and Kacey Marra at the University of Pittsburgh will work to create devices that can trans-

late the neural activity of a patient into instructions to move robotic limbs or other prosthetic devices. The researchers aim to engineer autologous tissues using mechanically compliant, electrically conducting polymeric materials.

The project will help America's wounded warriors by providing amputees with better control of prosthetic limbs. American soldiers and Marines walking combat patrols in Afghanistan have suffered a surge of gruesome injuries, losing one or both legs. Military statistics report more amputee injuries are possible, as attacks by improvised explosive devices skyrocketed from five in April 2009 to more than 300 in April 2012.

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KITCHIN WINS EARLY CAREER AWARD



Associate Professor John Kitchen has been recognized with the *Presidential Early Career Award for Scientists and Engineers* (PECASE), the highest honor bestowed by the U.S. government on science and engineering professionals in the early stages of their careers. Only 96 award recipients were announced for 2012. Kitchen is a

faculty member in the Department of Chemical Engineering with a courtesy appointment in MSE. Kitchen was nominated for his research in collaboration with the National Energy Technology Lab's Regional University Alliance. Kitchen's team developed an electrochemical method for separating oxygen from air at ambient pressure and temperature.

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MSE RANKS #10

In its 2012 nationwide survey of universities, *U.S. News and World Report* has ranked Carnegie Mellon number 10 in its list of the best undergraduate schools for materials engineering. Congratulations to our outstanding faculty members, who play such a significant role in our ability to offer an exceptional education at all student levels!



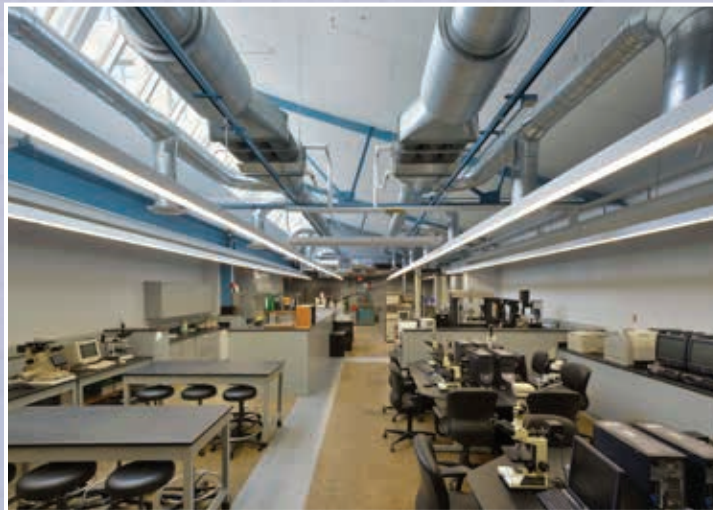


AN EXTREME MAKEOVER

MSE Finishes Its Much-Needed Renovations

The Department of Materials Science and Engineering recently completed renovations of its physical space on the A and C levels of Doherty Hall. While MSE has grown and changed dramatically over the years, these facilities had remained essentially unchanged since the 1950s. About two years ago, former CIT Dean Pradeep Khosla and MSE **Department Head Gregory Rohrer** agreed to fund much-needed renovations to ensure that MSE remains a global leader in engineering education.

On the A level, the most visible change is that the structural arches along the main corridor have been opened up, revealing a new state-of-the-art MSE undergraduate materials characterization facility that includes optical microscopes, scanning electron microscopes, and atomic force microscopes. This change provides new visibility into the innovative undergraduate research happening in MSE every day.

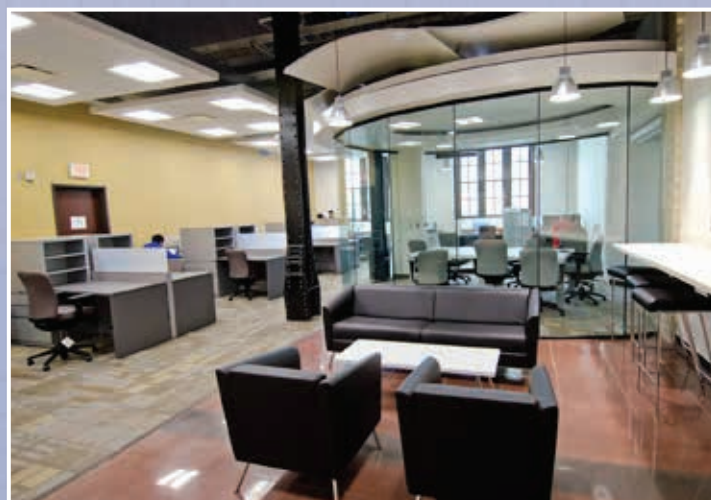


This formerly dark, fragmented space is now bright and filled with natural light, and highlights the structural aspects of Doherty Hall.

The A level also features a new multipurpose lab that focuses on biomedical and other specialty research. In addition, a new classroom at the top of the hallway can accommodate about 130 students, making it one of the largest classrooms on the Carnegie Mellon campus. The latest media

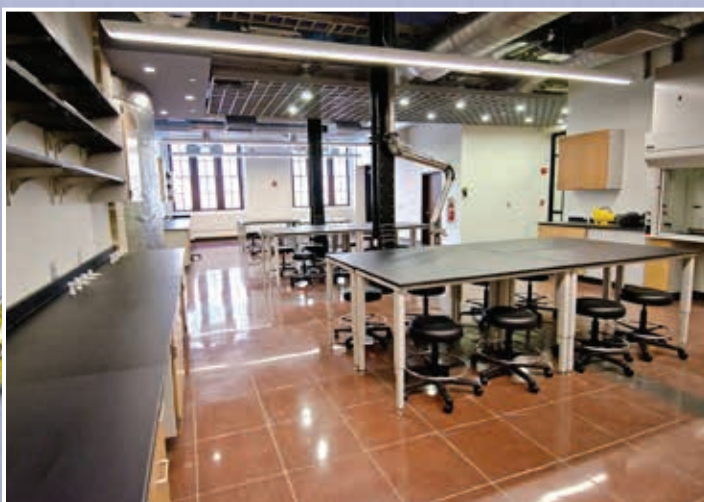
resources make this room perfect for interactive lectures. This level also includes shared office space for 24 graduate students. The new Energy Science, Technology, and Policy (ESTP) masters degree program is also headquartered on the A level.

On the C level of Dougherty Hall, the old MSE machine shop has been completely gutted and renovated to house heavy-duty equipment such as rolling mills, tensile frames, polishing units, and high-temperature furnaces. It is used by



all MSE undergraduates, including freshmen in their “Engineering the Materials of the Future” introductory course. Skylights flood this bright, attractive space with light and air.

If you haven’t visited the Department for a while, you will probably be surprised by the many changes that have taken place. We invite you to visit soon to see firsthand the results of our extreme facilities makeover!



COMBINING EDUCATION WITH AESTHETICS

One of the first thing visitors notice when they enter the new MSE materials characterization facility are the walls and beams sheathed in glittering titanium. These stunning materials were donated and installed by Kansas-based Architectural Titanium-



Architectural Titanium’s Dave Hawley, Project Manager (left), and Gary Nemchook, President (right), join MSE’s Gregory Rohrer for the unveiling of the new titanium walls.

um, a long-time partner with MSE. The titanium utilized has a special finish developed by Architectural Titanium called “crystal titanium.” The crystals are grown in a vacuum chamber at elevated temperature.

The company’s president, Gary Nemchook, first consulted with Department Head Gregory Rohrer when Nemchook was working on the revolutionary Guggenheim Museum in Bilbao, Spain — the world’s most famous titanium-clad building.

Over the years, Rohrer and MSE graduate student researchers have collaborated with Architectural Titanium to achieve a better understanding of the self-cleaning, photocatalytic properties of this unique material.

“I have enjoyed all my years of working in partnership with the Department of Materials Science and Engineering, and I am happy that we were able to contribute a stunning architectural feature to MSE’s newly renovated space,” says Nemchook. “My hope is that future generations of MSE students will not only enjoy the opportunity to study the exposed material characteristics, but also enjoy the sheer beauty of the spectacular walls and beams.”

Alumni Profile

A DISTINGUISHED FAMILY MEMBER



At Carnegie Mellon's recent Cèilidh Weekend, **Ken Russell** (*Ph.D. 1964*) was one of only five grads to receive an *Alumni Achievement Award*, honoring their accomplishments in their field.

Russell has been a faculty member at the Massachusetts Institute of Technology (MIT)

for 48 years, beginning as an Assistant Professor and Post-Doctoral Fellow in 1964 and rising to Professor in 1978. Today, he holds the title of Professor Emeritus of Metallurgy and Nuclear Engineering. An American Society for Materials Fellow, Russell is best known for his research on nucleation. He has authored two books, co-edited two books, and authored or co-authored more than 140 scientific publications.

Russell grew up on his family's farm in northeastern Colorado, then attended the Colorado School of Mines to study metallurgy. A job offer from the Westinghouse Materials Lab brought him to Pittsburgh in 1960. Russell visited MSE and

was greatly impressed. "At Westinghouse, I saw that the engineers with Ph.D. degrees got all the interesting jobs — and I was eager to join that club quickly," says Russell.

While studying in the Carnegie Mellon library, Russell met his future wife Charlotte, who worked there. The couple went on to have two sons, David and Doyle. Today, the Russell family also includes daughters-in-law Teresa and Kica, as well as two-year-old grandson Miles.

While Russell left Pittsburgh for Boston nearly 50 years ago, he remains one of MSE's most ardent and enthusiastic supporters.

"There is a spirit of collegiality at MSE that I have never found anywhere else," says Russell. "The Department is characterized by a feeling of 'we're all in this together, let's help one another.' That feeling has never left me. I was on a first-name basis with all my professors — which was unusual in the 1960s — and they helped me gain my first position at MIT. Wherever I go, I will always be a member of the MSE family."

ENGINEERING WITH A SOUTHERN ACCENT

At the University of Southern Mississippi (USM), three MSE alums are working to define materials innovations that could change the future of competitive sports. **Dave Krzeminski** (*B.S. 2007*), **Nadine Lippa** (*B.S. 2008*), and **Morgan Heskett** (*B.S. 2012*) are doctoral students in USM's unique Sports and High-Performance Materials research program.

All three alums, who were student-athletes at Carnegie Mellon, were drawn to USM based on their interest in using innovative materials to solve pressing challenges in athletic equipment. **Professor Michael McHenry** of MSE assisted Krzeminski's acceptance into the program, and has since referred Lippa and Heskett. The USM program, founded in 2005, is the only one of its kind worldwide.

The MSE alums are mentored and advised at USM by Carnegie Mellon alums Professor Robert Lohead (*Fulbright Scholar, Chemistry, 1973-75*) and Assistant Professor Daniel Savin (*M.S., Polymer Science, 1997; Ph.D., Chemistry, 2002*).

Krzeminski is exploring new materials for headgear that could help reduce concussions, and Lippa is studying materials degradation in athletic

footgear. While Heskett just began her studies, she is interested in track and field footwear.

"Too often, there's a disconnect between materials designers and athletic product manufacturers, because they're speaking two different languages," notes Lippa. "We're trying to bridge these fields."

Krzeminski notes that the interdisciplinary nature of MSE prepared these alums for success. "By working across disciplines at Carnegie Mellon, we gained both outstanding project management skills and the ability to translate our results across different academic departments. The capstone course and other experiences at MSE exposed us to complex real-world challenges like the ones we're tackling now," he says.

"There's a certain kind of initiative and follow-through that's gained at MSE," adds Lippa. "The MSE culture encourages innovation, hard work, and the ability to speak multiple engineering languages. Those traits are serving all of us well at USM."



Left to right: Nadine Lippa, Dave Krzeminski, and Morgan Heskett

ALUMNI NEWS UPDATES

Todd Gross (B.S. 1975) is Professor and Chair of the Mechanical Engineering Department at the University of New Hampshire. Gross received his Ph.D. in Materials Science from Northwestern University in 1981. His research interests are in the mechanical behavior of materials, the behavior of material systems, scanning probe microscopy, nanoindentation, and sensors for machining.

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Matthew Williard (B.S. 1995, M.S. 1997, Ph.D. 2000) has taken a position as an Associate Professor of Materials Science and Engineering at Case Western Reserve University in Ohio. In addition, Williard presented an invited talk at the National Academy of Engineering's Frontiers of Engineering conference in October. His talk — titled "Stronger, Lighter, and More Energy Efficient: Challenges of Magnetic Material Development for Vehicle Electrification" — was given as part of the Vehicle Electrification session.

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Amul Tevar (M.S. 2009, Ph.D. 2011) and his wife Amy recently welcomed their first son, Aarav Tevar. He was born on July 6 and weighed 6 pounds, 4 ounces.



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Sukbin Lee (M.S. 2003, M.I.S.M. 2003, Ph.D. 2008) has been named Assistant Professor in the School of Mechanical and Advanced Materials Engineering at Ulsan National Institute of Science and Technology in South Korea. His research focuses on multi-scale 2D and 3D generation/reconstruction of digital microstructures from simulations, microstructural evolution, phase transformation, characterization of microstructures, 3D materials properties, visualization of 3D microstructural data, and parallel computing simulations for grain growth and coarsening in both single-phase and two-phase materials.

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Jaewon Lee (M.S. 2003, Ph.D. 2008) began law school this fall at the University of California Davis.

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Pallava Kaushik (M.S. 2003, Ph.D. 2006) has won the 2012 *Richard J. Fruehan Award for Best Paper* from the Association of Iron & Steel Technology (AIST). Named for **Professor Richard J. Fruehan** of MSE, this annual award is presented to the author of a process metallurgy technical paper judged to be the best of class by the AIST Metallurgy — Processing, Products and Applications Technology Committee. Kaushik co-authored the paper, "How to Evaluate a Process for Clean Steelmaking and Quality Control."

IN MEMORIAM

Leo Janol (B.S. 1957) passed away on January 9, 2012, at the age of 77. Following graduation, he worked at Combustion Engineering in Monongahela, and then for American Chain and Cable Company in Monessen. Janol retired from the Allenport plant of Wheeling-Pittsburgh Steel, where he was a supervisor in quality control. He is survived by his wife of 53 years, Sophia; a sister, Shirley; two brothers-in-law; and numerous nieces and nephews. MSE extends its sympathies to his family.

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Leroy "Lee" Lynam (B.S. 1962) died on April 16 at the age of 85. He retired as an engineer from Bettis and was an Army Air Force veteran of World War II. Lynam was predeceased by his wife Verna. He is survived by his daughters Karen, Donna, and Valerie, as well as five grandchildren and two great-grandchildren. The Department offers sincere condolences to the Lynam family.

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Larry Alan Nesbit (M.S. 1976, Ph.D. 1978) passed away on September 19. He spent his entire career at IBM and was also a master inventor. Nesbit is survived by his wife Victoria and three children — Rebekah, Sarah, and Christopher. He also had five grandchildren. Everyone at MSE sends their deepest sympathies to his family.

SALTMINERS DINNER

Nearly 40 MSE alums and their guests gathered on Monday, October 8, for the annual Saltminers Dinner. The event, held in the Singleton Room in Roberts Engineering Hall, was preceded by a tour of the Department's newly renovated lab space in Doherty Hall (see related story on pages 6-7).



STUDENT NEWS

STUDENT NEWS UPDATES

Doctoral student **Stephanie Bojarski** won the *Graduate Excellence in Materials Science (GEMS) "Sapphire" Award* from the American Ceramic Society, based on her presentation at the 2012 Materials Science and Technology (MS&T) Conference and Exhibition, held in Pittsburgh in October. Finalists for this prestigious award are selected based on their scientific and academic accomplishments, the quality of the research they present at the annual MS&T meeting, and the quality of their oral presentation. Bojarski's doctoral research is advised by **Professor Gregory Rohrer**.

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Ph.D. candidate **Shen Shen** has received a travel grant to attend the 12th Joint MMM/Intermag Conference, which will be held in Chicago in January. Last summer, Shen attended the IEEE Magnetics Society Summer School in July. The IEEE Magnetics Society covered all expenses for this trip, including travel to Chennai, India, for approximately 100 students from around the world, based on a

competitive application process. Last spring, Shen won a travel grant from the Minerals, Metals & Materials Society (TMS) to attend the 141st TMS Annual Meeting and Exhibition in Orlando, Florida. In this year's Graduate Student Symposium, Shen won second place in the category of "Oral Presentations." Shen's research is advised by **Professor Michael E. McHenry**.

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MSE seniors **Daniel Cardenas Rivero** and **Katherine Smith** are among the most recent recipients of the prestigious *Boeing Scholarship*. These scholarships are awarded annually to students from across the U.S. who are interested in a career in the aerospace industry, and include a grant of \$5000 to support winners' studies in a related field, such as engineering. This grant program was created to help the aerospace leader build relationships with the nation's top engineering programs, as well as with especially promising students who may seek internships or entry-level positions with Boeing in the future.

MSE STUDENTS MAKE A SPLASH

First-year MSE students **Patricia Xu** and **Julia Yang** are members of the Carnegie Mellon Solar Splash team, which just won a \$40,000 grant from Constellation Energy to help develop a competitive solar-powered 18-foot-long racing boat.

The University's Solar Splash team competes in intercollegiate regattas that promote energy conservation, while giving students hands-on engineering experience in a competitive setting. More than 30 students from CIT — as well as the School of Design, the School of Architecture, and the Tepper School of Business — collaborate and compete at the annual Solar Splash competition, which involves various sprint and endurance races for fiberglass and carbon fiber boats.

The team was one of 10 programs selected nationwide to receive the *E2 Energy to Educate* grant, which comes from the Constellation Energy family of retail electricity and natural gas suppliers. Constellation is a subsidiary of Exelon Corp., which is one of the nation's leading energy



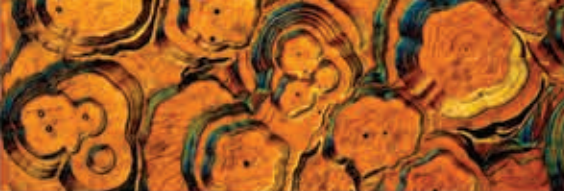
providers. The grant is designed to "enhance student understanding of the science and technology needed to address energy issues, and reach and inspire students to think differently about energy."

The Carnegie Mellon team will use this funding to prepare a racing boat for the 2013 national Solar Splash competition, scheduled for June 12-16 in Cedar Falls, Iowa. Team members

also have a long-range plan to compete in the DONG Solar Challenge in the Netherlands in 2014, one of the premier solar boat races in the world. You can follow the Carnegie Mellon team's progress at <http://www.cmusolar.org/>.

"We're very proud to sponsor research and education programs that will help prepare a new generation for energy opportunities and challenges that lie ahead," said Kenneth Cornew, President and CEO of Constellation Energy.

For more information about the Constellation Energy education program, see <http://www.constellation.com/community/pages/community-overview.aspx>.



RECENT PH.D. DISSERTATIONS

Ronen Berechman

"Characterization of Extended Defects and Their Influence on the Performance of 4H-SiC Devices"

Advisor: Marek Skowronski

Abhijeet Budruk

"Microstructural Investigations of Defects and Domains in Magnetic Shape Memory Alloys"

Advisor: Marc De Graef

Patrick Callahan

"Quantitative Characterization and Comparison of Precipitate and Grain Shape in Ni-Based Superalloys Using Moment Invariants"

Advisor: Marc De Graef

Robin Hsin-Kuo Chao

"Improving Solid Oxide Fuel Cell Cathode Performance by Infiltrating Mesoporous Perovskite Coatings"

Advisors: Paul Salvador and John Kitchin

Kelvin Cheung

"The Effect of Mold Flux on Reheat Scale Austenitic Stainless Steel Slabs"

Advisor: Chris Pistorius

Harry Chien

"The Effects of Microstructure and Thermal Stresses on the Hardness of CVD Deposited Al_2O_3 and TiC_xN_{1-x} Coatings"

Advisor: Gregory Rohrer

Doocho Choi

"Tungsten as a Next-Generation Interconnect Metal in Semiconductor Devices"

Advisor: Katayun Barnak

Jihoon Choi

"Particle Brush Systems: Mechanical Properties and Equilibrium Structure in Particle Brush Assemblies"

Advisor: Michael Bockstaller

Sangeun Chun

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