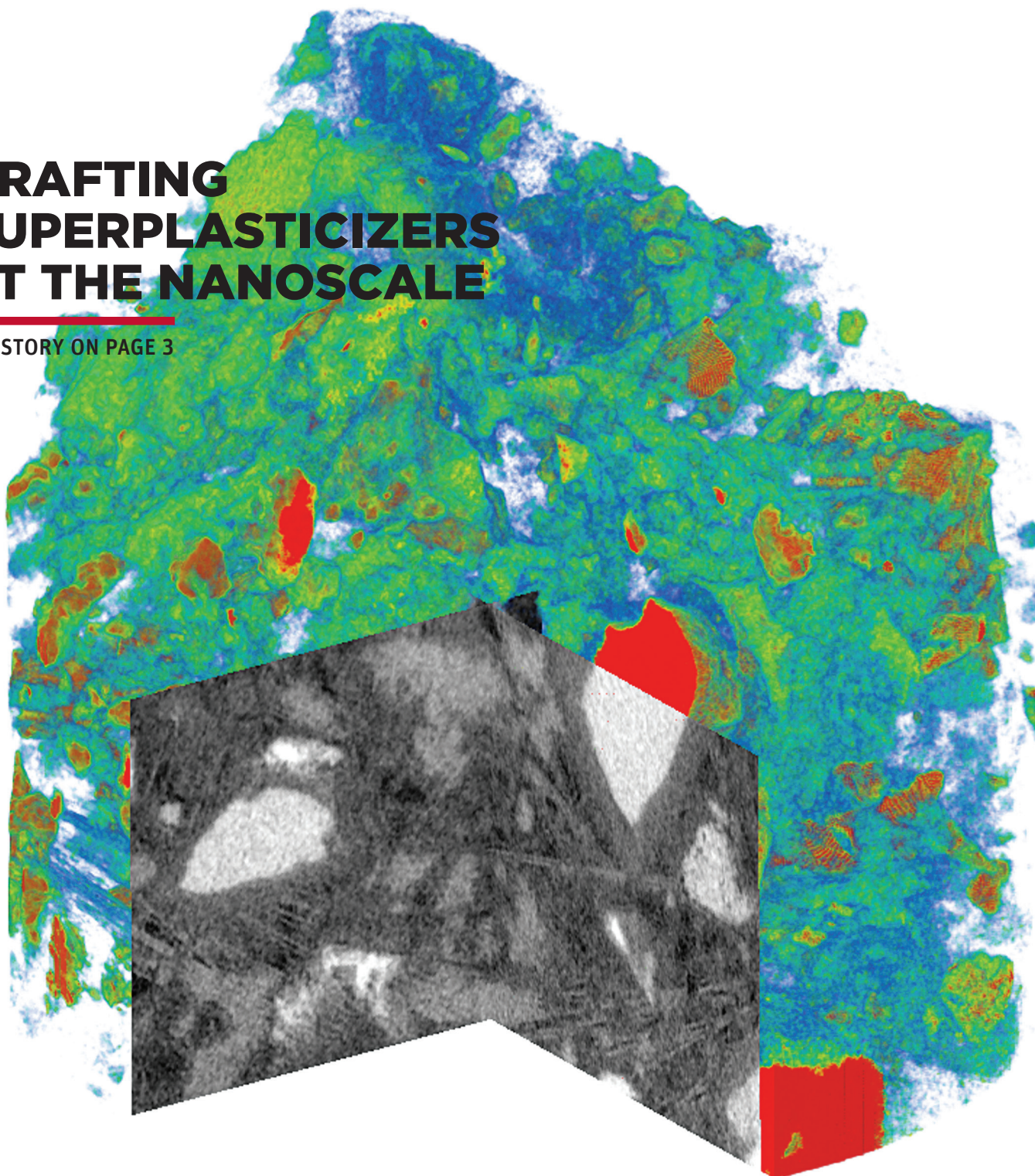


GRAFTING SUPERPLASTICIZERS AT THE NANOSCALE

SEE STORY ON PAGE 3





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Greetings to our MSE alumni! I am happy to report that the department continues to thrive. As always, you will find this issue of *MSE News* packed full of the successes of our students, faculty, and alumni.

Our faculty and graduate students are being recognized not only for their scholarship, but also for the practical outcomes of their work. For example, we were all excited by the news that **Professor Jay Whitacre** received the *Lemelson-MIT Prize* in September. This award recognizes individuals who translate their ideas into inventions that improve the world — and this is an excellent description of what Whitacre has accomplished. He developed a rechargeable sodium-ion battery that uses an aqueous electrolyte, leading to the formation of a new company, Aquion Energy, that manufactures and markets the battery. Aquion's batteries are ideal for storing energy from renewable sources for later use, while avoiding many of the downsides and costs associated with lithium-ion batteries.

Over the summer, **Professor Newell Washburn** and doctoral student **Chetali Gupta** participated in NSF's I-Corps program, designed to help students and faculty translate their innovations to commercial products.

Washburn and Gupta have created a new cement additive, based on the biopolymer lignin, which has a controlled molecular architecture that improves the rheology of the cement and ultimately its strength. Using their I-Corps training, they are considering commercialization of their findings. Among the teams participating in I-Corps this spring, Gupta won the prize for *Top Entrepreneurial Lead*.

Our students also continue to achieve success at every level. Last spring, four MSE seniors were recognized by ASM in its undergraduate design competition: **Kate Groschner**, **Kellie Painter**, **Dylan Quintana**, and **Patrice Daniel**. Advised by **Professor Robert Heard** and in partnership with ATI, Inc., the team was recognized for its project on recycling byproducts from specialty metals plants.

In addition, this year three of our graduating doctoral students succeeded in winning NRC postdoctoral fellowships. Sponsored by these fellowships, **Brian Lin**, **Clare Mahoney**, and **Lily Nguyen** have taken up positions at NIST, Wright-Patterson AFB, and NRL, respectively.

Finally, as you enjoy this issue of *MSE News*, please note that we have a new editor, **Marygrace Antkowsky**. After editing the first 11 volumes of *MSE News*, **Suzanne Smith** has turned this publication over to Marygrace, who has done an excellent job on this first edition. We all thank Suzanne for creating an outstanding newsletter year after year — and we're certain that Marygrace will continue the tradition of excellence.

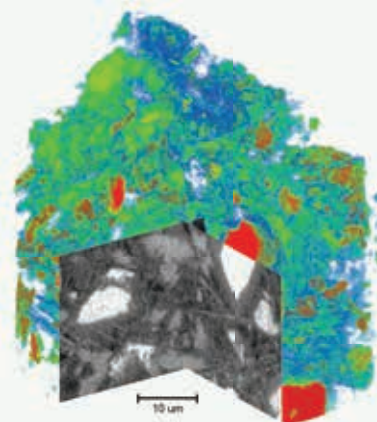
Gregory S. Rohrer

“Our faculty and graduate students are being recognized not only for their scholarship, but also for the practical outcomes of their work.”

ON THE COVER

GRAFTING SUPERPLASTICIZERS AT THE NANOSCALE

The cover of this edition of *MSE News* is a nanoscale computed tomography (nano-CT) image of Portland cement prepared using a polymer-grafted lignin nanoparticle (PGLN) superplasticizer. The image was generated by MSE Ph.D. student **Chetali Gupta**, working under the direction of **Dr. Newell Washburn**, an associate professor of Chemistry and Biomedical Engineering who holds a courtesy appointment in MSE.



To improve the dispersant and rheological properties of cement — making it more workable and improving its strength — a number of additives have been considered. The plant-derived biopolymer lignin, a byproduct of paper production, is commonly used as a low-cost/low-performance plasticizer. However, attempts to improve its effects on cement rheology through copolymerization with synthetic monomers have not led to significant improvements.

In the Washburn Lab, lignin-grafted polyacrylamide using controlled radical polymerization has been custom synthesized to address this issue. Because the lignin core is tunable, Washburn and Gupta can exploit different chemistries and molecular architectures to achieve the desired properties.

The team's research was published in the journal *Soft Matter* in February 2015. Research assistant Madeline Sverdløve, a junior majoring in Chemistry, is a co-author of the paper.

Last summer, Washburn and Gupta traveled to New York City to participate in the National Science Foundation Innovation Corps (NSF I-Corps) program. This initiative helps entrepreneurs develop a business model for commercializing their innovations. Gupta and Washburn discussed the potential of their lignopolymer dispersants during more than 50 interviews with researchers, salespeople, business development specialists, and corporate vice presidents from the construction industry, as well as chemical companies. As a result, the team is currently exploring commercialization via pilot-scale manufacturing and large-scale application testing.

WHITACRE WINS \$500,000 LEMELSON-MIT PRIZE

Professor Jay Whitacre has received the 2015 Lemelson-MIT Prize for his invention of the Aqueous Hybrid Ion (AHI™) battery — a reliable, environmentally benign, and cost-efficient energy storage system. This first-of-its-kind battery, often used in combination with solar and wind energy systems, stores significant amounts of energy at a low cost per joule and allows for around-the-clock consumption.

Accompanied by a cash award of \$500,000, the Lemelson-MIT Prize honors outstanding mid-career inventors improving the world through technological invention and demonstrating a commitment to mentorship in science, technology, engineering,

and mathematics (STEM). Whitacre plans to contribute a significant portion of the cash award to create a fellowship to support graduate students and nurture interest in innovative energy solutions.

Jerome H. Lemelson, one of U.S. history's most prolific inventors, and his wife Dorothy founded the Lemelson-MIT Program at the

Massachusetts Institute of Technology in 1994. It is funded by The Lemelson Foundation and administered by the School of Engineering at MIT.

"We are proud to recognize Jay Whitacre as this year's Lemelson-MIT Prize winner," said Joshua Schuler, executive director of the Lemelson-MIT Program. "Jay is passionate about sharing his experiences with young people, and is intent on inspiring them to cultivate an interest in STEM and invention. He personifies the mission of Lemelson-MIT through his commitment to mentorship, his desire to solve some of our world's greatest problems, and his ability to commercialize his technologies."

As the 2015 Lemelson-MIT Prize winner, Whitacre will speak at EmTech MIT, the annual conference on emerging technologies hosted by *MIT Technology Review* at the MIT Media Lab on November 2.



The Aqueous Hybrid Ion (AHI™) battery



Professor Jay Whitacre and CMU President Subra Suresh

FACULTY NEWS BRIEFS



Assistant Professor Bryan Webler has been named a 2015-2016 Wimmer Faculty Fellow. These fellowships, funded through the Wimmer Family Foun-

ation, are designed for junior faculty members pursuing teaching innovation through designing or re-designing a course, creating new materials, or exploring a new pedagogical approach. Webler was recognized for his innovative class, "Structure of Materials." In this core course taken by all MSE students, Webler maximizes students' opportunities to practice using computational methods, a curriculum-level priority across second- and third-year courses. Specifically, he aims to implement learning modules that incorporate various software programs and visualization tools to improve students' understanding of crystal structure via application of computational methods.

By measuring student performance and soliciting student feedback, Webler plans to evaluate the impact of these modules on students' learning, as well as their confidence in employing computational methods. This data will inform the future teaching of computational methods across courses.

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Professor Emeritus Ted Massalski recently returned from a two-week invited lecture tour in China. He delivered the 67th Dachi (Wisdom) lecture at Shanghai Jiao Tong University, where he received the *Lee Hsun Award* for his significant impact and great contributions to the

field of materials science and engineering. He also gave a memorial lecture at the Institute of Metal Research in Shenyang and another lecture at Tsinghua University in Beijing. Massalski discussed several topics, including phase diagrams, compilations of data, international cooperation, phase stability measurements and theories, laws of thermodynamics, practical use of phase diagrams, and the very fast computer calculations that will shape the future of the field. In addition to lecturing, he met with faculty members and students at each university.



PROFESSOR GREGORY S. ROHRER has agreed to serve another term as department head of MSE. He was originally appointed in 2005 and reappointed in 2010. Under Rohrer's leadership, the department has remained in strong financial health, enhanced the quality of its physical space, and improved in national and global rankings.

In addition, Rohrer has been elected to the Board of Directors of the American Ceramic Society (ACerS) for a three-year term. The membership of ACerS includes more than 9,500 scientists, engineers, researchers, manufacturers, plant personnel, educators, students, and marketing and sales professionals from more than 70 countries. Rohrer is also an associate editor of the *Journal of the American Ceramic Society* and was chair of the ACerS University Materials Council in 2011. He has been honored with five awards from ACerS and was elected a fellow of ACerS in 2003 for his contributions to research and education.

Rohrer joined the MSE faculty in 1990 after completing his Ph.D. degree and post-doctoral work at the University of Pennsylvania. His research objective is developing structure/property relationships for polycrystalline materials used in structural, electrical, and catalytic applications. He has authored or co-authored more than 240 papers, as well as a textbook on structure and bonding in crystalline materials.

MSE ADDS NEW STAFF MEMBERS

The Department of Materials Science & Engineering is a dynamic environment, with ever-evolving staffing needs. Following is a look at four employees who have joined the MSE family recently. We offer a warm welcome to each of them!



Dave Crockett joined MSE as IT Support Consultant in April 2014. With 25 years of experience in the information technology field, he has become indispensable

in maximizing MSE's IT investments. Dave has redesigned the department's web page and set up a new 1024-core computing cluster to handle computationally large equations. Even before joining MSE, Dave had a close connection to the department — he is married to **Professor Elizabeth Holm**. The couple moved from New Mexico in 2012 and now reside in Regent Square. They have four grown children — Cassandra, Jason, Jessica, and Maggie — along with five grandchildren. A self-confessed daredevil, Dave has been both a licensed skydiver and a scuba instructor; he also enjoys kayaking, paragliding, and caving. "If it's dangerous and expensive, I've probably done it," he says with a laugh.

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MSE's newest employee, **Brett Riale**, was hired in July 2015 as Facilities Coordinator. In this newly created position, Brett maintains the department's equipment and

physical facilities — and also ensures that

MSE complies with all environmental health and safety regulations. Brett was drawn to the department because of his undergraduate degree in Earth Science & Geology, though he has worked in facilities management for 10 years. Brett lives with his wife Kim and son Toren (age 6) in Shaler. In his free time, he enjoys sabre fencing — and is training for tournament competition. "Fencing is a vigorous physical sport, but I enjoy the mental aspect of it, too," says Brett. "You need to get inside your opponent's brain and anticipate what's going to happen next."

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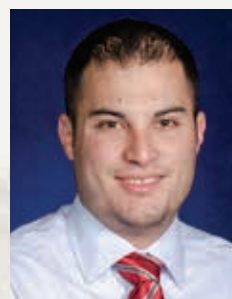
Receptionist **Kelly Rockenstein** is the friendly face and voice of MSE to all visitors. She was hired in April 2015, soon after finishing an associate's degree in Business

Management. Previously, Kelly spent 13 years in office and transaction management for a local manufacturer. "I wanted to work at a university and expand my horizons beyond the business world," says Kelly. "At MSE, I feel like I'm learning something new every day!" In addition to managing the phones and front desk, Kelly coordinates MSE's Friday afternoon seminar series, purchases supplies, and schedules conference rooms. She and husband Craig live in Moon Township, and they have three daughters: Marybeth (age 23), Casey



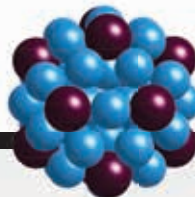
(19), and Hannah (16). During football season, Kelly can be found under the "Friday night lights," volunteering at the concession stand to support the Moon High School Marching Band. Daughter Hannah is a proud member of the Moon color guard.

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Anthony Talotta joined MSE as Business Manager in April 2015, with responsibility for managing the financial operations of the department. He also helps

oversee the financial aspects of faculty research projects and grants. Anthony was previously a senior accountant in CMU's International Finance Department, a position he held since 2008. "MSE is growing, and that makes it an exciting place to work," he notes. "In addition, the College of Engineering is undergoing some landmark renovations and other changes that will keep CMU at the forefront globally." Anthony is no stranger to renovation. He and his wife Hayley spent over a year gutting and modernizing their 40-year-old house in Allison Park. When not focused on home improvement, Anthony enjoys coaching and playing in a recreational softball league, as well as watching and attending Pittsburgh Pirates games.



ALUMNI NEWS BRIEFS

SCHULTZ LEVERAGES EXPERIENCE IN NEW ROLE



Andrew M. Schultz (*M.S. 2010, Ph.D. 2012*) has accepted a position as a senior associate in materials and corrosion engineering at Exponent Engineering & Scientific Consulting in Menlo Park, California.

Schultz has deep research experience in fabrication, processing, and characterization of functional oxide films. He has expertise in electroceramic materials, high-temperature electronic oxides, and optoelectronic devices. Schultz also has extensive experience in thin film and bulk characterization methods, including scanning probe microscopy, scanning electron microscopy, electron backscatter diffraction, optical microscopy, x-ray diffraction, and UV/Vis/NIR spectroscopy. His thin film synthesis capabilities include pulsed laser deposition, magnetron sputtering, and sol-gel spin coating.

During his postdoctoral fellowship at the National Energy Technology Laboratory, Schultz developed advanced gas sensor materials for extreme environment fossil energy applications. His doctoral work at MSE focused on the growth and characterization of electronic oxide films for applications in solar water photolysis. While at MSE, he served as a teaching assistant for multiple materials science and engineering courses.



Lily Nguyen has accepted an offer as a post-doctoral NRC research associate and will work at the Naval Research Laboratory (NRL) in Wash-

ington, D.C. She will conduct research in advanced characterization of 3D material microstructures. NRL is the corporate research laboratory for the Navy and Marine Corps and conducts a broad program of scientific research, technology, and advanced development. Nguyen studied quantification of microstructural evolution using moment invariants and has been advised by **Professor Marc De Graef**.

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THREE GRADS WIN NRC FELLOWSHIPS

Three 2015 Ph.D. graduates from MSE — **Brian Lin**, **Clare Mahoney**, and **Lily Nguyen** — have been awarded fellowships through the National Research Council (NRC) Research Associateship Program (RAP).

The mission of the NRC-RAP is to promote excellence in scientific and technological research conducted by the U.S. government via graduate, postdoctoral, and senior-level research opportunities at federal laboratories and affiliated institutions. The National Academies of Sciences, Engineering, and Medicine Fellowships Office manages the NRC Research Associateship Program, in cooperation with sponsoring federal laboratories and other research organizations.



Brian Lin will be a post-doctoral associate at the Center for Automotive Lightweighting (NCAL) at the National Institute of Standards and

Technology (NIST) in Gaithersburg, Maryland. He will pursue his interest in microstructure characterization and evolution in the field of advanced high-strength steels and aluminum alloys for automotive parts. Co-advised by **Professor Gregory S. Rohrer** and **Professor Anthony D. Rollett**, Lin has been studying the mechanisms responsible for the

formation of annealing twins in face-centered cubic nickel.

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Clare Mahoney will pursue research at the Air Force Research Laboratory in Wright-Patterson AFB, Ohio, working in the field of optical engineering of poly-

mer nanocomposites in the laboratories of Richard Vaia. Mahoney completed her Ph.D. under the supervision of **Professor Michael Bockstaller**. Her research focused on elucidating the governing parameters that dictate thermal transport in polymer nano composites.

MSE Friends and Family Meet in Portland, Oregon

In August, a group of MSE “friends and family” met at the Microscopy & Microanalysis 2015 Meeting in Portland, Oregon. Shown from left to right are: former research scholar **Rumyana Petrova**; former MSE professor **Katayun Barmak**; **Tom Nuhfer**, MSE Director of Electron Microscopy and Materials Characterization; **Amanda Petford-Long** of Argonne National Laboratory; **Begum Gulsoy Phatak** (*M.S. 2007, Ph.D. 2010*) of Northwestern University, with Arya; and **Charudatta Phatak** (*Ph.D. 2009*) of Argonne National Laboratory.



KEVIN J. HANDERHAN | *High Achiever*



Dr. Kevin J. Handerhan (B.S. 1980, M.S. 1986, Ph.D. 1988) will bring positive recognition to MSE when he receives Carnegie Mellon's *Alumni Achievement Award* at the university's commencement ceremony next May. This prestigious award was created to recognize both accomplishment

and leadership in the field which brings honor to Carnegie Mellon University.

Dr. Handerhan manages his own consulting company, 525 Flynn Consulting, which helps manufacturers improve their financial performance, with an emphasis on companies involved in specialty metals processing. Prior to becoming an entrepreneur, Dr. Handerhan spent 33 years with Ellwood Group, a specialty metals producer headquartered in Ellwood City, Pennsylvania. He was hired as a superintendent of quality assurance and retired as chief operating officer.

A native of Carnegie, near Pittsburgh, Dr. Handerhan was always a hard worker and high achiever. Though he was the

youngest of 11 children in a working-class family, he was able to earn three degrees at MSE—two while working full-time at Ellwood Group.

Dr. Handerhan looks back fondly on his many years in the department. "I enjoyed the academic challenges of materials science and metallurgy, as well as the friendships I formed with both fellow students and faculty," he recalls. "We were a tight-knit group, and everyone was willing to help one another. I still use the problem-solving skills and technical knowledge I learned from my teachers and advisors, including **Professor Warren Garrison**, who nominated me for the Alumni Achievement Award."

"I enjoyed the academic challenges of materials science and metallurgy, as well as the friendships I formed with both fellow students and faculty."

Dr. Handerhan's personal life was also impacted by his years at Carnegie Mellon. He met his wife Katheen Knestrick (B.S. 1979, *Civil Engineering*) in an undergraduate computer science class. Today, the couple lives in Cranberry Township, Pennsylvania, and they are the proud parents of three sons: Ryan (M.S. 2008, *Information Systems Management*), Jason, and Tyler.

LAUREN JELLISON | *Forging Her Own Success*



Lauren Jellison (M.S. 2014) has had a clear vision of her career path since she first toured a steel mill as an undergrad at Virginia Tech. "I was a Chemistry major, but I knew I didn't want to work in a research lab. Visiting a steel mill changed my perspective on the industry," she says. "There was something about the large scale of the manufacturing processes, and the associated reactions, that just fascinated me."

Three internships with Nucor Steel only solidified Jellison's vision. She determined that she wanted to focus on the "hot" side of the business, working in molten metal processing.

When she decided to pursue her master's degree, Carnegie Mellon MSE was an easy choice. The Center for Iron and Steel-making Research (CISR), a National Science Foundation initiated research center within MSE, factored heavily in her decision.

"The CISR is a prominent research program for the steel industry in North America, and it's an incredible resource for anyone interested in a career in metals," explains Jellison. "The opportunity to focus so sharply on steelmaking, and to work with world-renowned faculty like **Professor Chris Pistorius**, offered the best possible training."



After completing her master's research project, entitled "Effect of Increased Carbon Levels in Direct Reduced Iron on Electric Steelmaking," Jellison was recruited by Nucor in April 2014 to work as a process engineer. Today, Jellison works on projects involving process improvements and yield optimization at Nucor's direct reduced iron (DRI) facility in St. James Parish, Louisiana.

"I love my work because Nucor's team environment focuses on continual improvement. As a teammate, I'm solving real problems, in a hands-on manner, every day—and the problems are always different," Jellison notes. "I'm applying the practical principles I learned in classes like 'Kinetics of Steelmaking' to make a true impact. That's really gratifying."

STUDENT NEWS BRIEFS



Graduate student **Jorge Gibson** won first place in the Graduate Student Poster Contest at the AISTech 2015 Conference, held in Cleveland, Ohio,

in May. Sponsored by the Association for Iron & Steel Technology (AIST) and attended by approximately 8,000 professionals, this annual event showcases technologies from all over the world that help steel producers compete more effectively in today's global market. The graduate student poster contest provides students with the opportunity to present their research in a forum for all conference attendees to enjoy—with poster subjects relating to the iron and steel industry, properties, or applications. Gibson won a cash prize of \$1,500.

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Graduate student **Rachel Ferebee** was chosen to make an oral presentation at the Chemical and Biological Defense Science and Tech-

nology (CBD S&T) Conference, held in May in St. Louis, Missouri. Titled "Characterization and Modeling of Polymer-Conjugated Enzyme and Membrane Systems," Ferebee's presentation also earned her a student scholarship award—which covered the registration fee, transportation, lodging, and meals. "Oral presentations at CBD S&T are highly competitive," says **Professor Michael Bockstaller**. "There are no regular 'contributed talks.' Instead, there are 'platform presentations' where Department of Defense agencies select one representative of each ongoing funding program to showcase research that is being done within the program. Rachel actually submitted a poster, but was chosen by the program manager to give a platform

presentation. That's a great honor and reflects very well on MSE."

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Doctoral student **Michael Kurniawan** was one of approximately 100 students accepted to attend the 2015 IEEE Magnetics Society Summer

School, held in June at the University of Minnesota in Minneapolis. He won the *Silver Poster Award* for his poster

presented there. Titled "Low-Cost Soft Magnetic Alloys for Sensing Applications at High Temperature," Kurniawan's research focuses on the development of soft magnets for giant magnetoimpedance-based field sensors and synthesis routes to achieve an alloy cost reduction greater than 60 percent. The IEEE Magnetics Society Summer School, held annually during the northern-hemisphere summer holiday, is designed for graduate students studying magnetism and related areas.

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MSE UNDERGRADS HONORED BY AMERICAN SOCIETY FOR METALS (ASM)

Each year, the ASM Materials Education Foundation sponsors an annual Undergraduate Design Competition. Undergraduate engineering students are invited to submit design-focused project reports, describing work that was performed as part of a capstone course or as a team project.

In the 2015 competition, the ASM Design Competition Committee selected an MSE Capstone project to receive the second-place award. The team members included 2014-15 MSE seniors **Kate Groschner**, **Kellie Painter**, **Dylan Quintana**, and **Patrice Daniel**. MSE's **Professor Robert Heard** acted as faculty advisor and ATI, Inc. was the industry sponsor. As the second-place winner, the team received a cash prize of \$1,500, along with travel assistance to attend the MS&T'15 Conference in Columbus, Ohio.

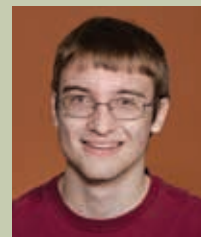
The team's project was titled "Recycling of Specialty Metal Plant Byproducts." It focused on recycling several waste streams from stainless steel production that contain nickel and chromium—expensive alloying elements added to stainless steels. The first portion of this project targeted detailed characterization of the waste materials. The second part focused on designing a method for recovering valuable elements from these waste streams, which required identification of a cost-effective reductant and binder material. An Excel-based system for simulating the recycling process was developed to compare combinations and identify optimal methods.



Kate Groschner



Kellie Painter



Dylan Quintana



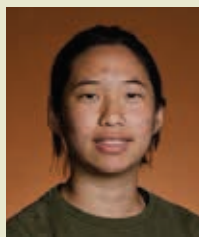
Patrice Daniel

“Between 2005 and 2015, the *Number of Undergraduates Majoring in MSE* nearly *Doubled*—growing from 65 to 125 students.”



MSE SHINES AT “MEETING OF THE MINDS”

The Undergraduate Research Symposium, or the “Meeting of the Minds,” is a university-wide celebration of undergraduate research held each spring. This event provides an opportunity for Carnegie Mellon undergrads engaged in research and creative projects to share their work with the entire campus community. Students can give an oral presentation, design a poster, display art, or give a live performance. The event also features a number of special competitions, and three students from MSE were recognized during this year’s symposium, held on May 4 in the Cohon University Center.



Junior **Patricia Xu** (now a senior) was one of three winners of the SRC-URO Poster Competition. Open only to students who participated in the SRC-URO (Semiconductor Research Corporation–Undergraduate Research Opportunities) program, this competition seeks to recognize significant and creative work, as well as encourage

students to develop visual and oral presentation skills suitable for academic conferences and industrial research venues. All students give a five-to 10-minute oral presentation, using their poster as a visual aid. Xu’s research presentation was titled “Performance of Nanocomposite Soft Magnetic Materials in Electric Motors.”

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Blair Graham

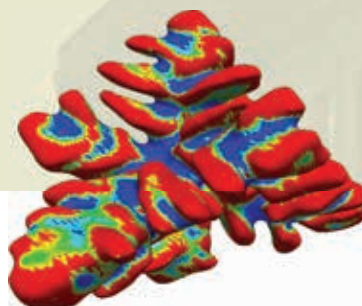
In the Undergraduate Environmental Research Award competition, a first-place winner is chosen each year, along with two runners-up. This year’s runners-up were both from MSE: senior **Blair Graham** (now a grad student) and junior **Manali Banerjee** (now a senior). Open to all undergrads undertaking projects with a strong environmental component, this competition is sponsored by the Steinbrenner Institute for Environmental Education and Research, along with the Green Design Institute.



Manali Banerjee

Students’ research could be demonstrated via a poster or presentation. A dual major in Chemistry and MSE, Banerjee presented her research entitled “Electrochemical Carbon Dioxide Reduction Using Nanocarbons.”

Graham’s presented research was called “Renewable Resource Polymer Nanocomposite Materials.”



MATERIALS SCIENCE TAKES THE LEAD

Amid concerns about weight and power efficiency, MSE is driving innovation at CMU Racing



Last spring, rising senior **Josh Kubiak** became the first MSE student to be elected president of Carnegie Mellon Racing (CMR), the student chapter of the Society of Automotive Engineers (SAE) at Carnegie Mellon. Every year, this ambitious team designs, builds, and races cars in SAE Formula competitions across the United States.

Not only is Kubiak the first chapter leader from MSE, but he believes he is the first CMR member to hail from the department.

"Traditionally, Carnegie Mellon Racing has been composed mostly of mechanical engineering students," notes Kubiak. "But some key changes have made the organization much more interdisciplinary — giving MSE a greater chance to contribute."



AN ELECTRIFYING CHANGE

Historically, Carnegie Mellon Racing's vehicle design featured an internal combustion engine. However, beginning in the 2013-14 season, the student team started building and racing all-electric vehicles, in order to reflect industry trends and prepare graduates for real-world design challenges.

"Automotive technology is increasingly heading toward vehicle electrification," explains Kubiak. "By working with electric vehicles hands-on, our members gain a competitive edge when searching for jobs in the automotive industry."

"In addition, the move to an electric vehicle meant that the team could take greater advantage of the engineering talent across Carnegie Mellon," he continues. "Not only have students from Electrical & Computer Engineering assumed a greater role, but materials science has become much more important."

Kubiak explains that, because Formula SAE electric cars have a strict power limit, removing weight from the vehicle has become critical. Meanwhile, structural stability remains a top priority in order to ensure safety. Enter materials science.

NEW MATERIALS, TECHNIQUES BRING DRAMATIC RESULTS

Led by Kubiak, materials innovations have already made a dramatic impact on vehicle design at CMU Racing. "The car weighs about 475 pounds without a driver, and we've been able to save significant amounts of weight simply by switching from

traditional materials — such as steel — to aluminum, titanium, and carbon fiber composites," says Kubiak. "Through smart analysis and design work, we've made these changes without any negative effects on structural stability, aerodynamics, or other key performance features."

Not only is the team replacing materials, but CMU Racing is also employing new design and fabrication techniques that have their basis in materials science. "We've been able to 3D print some of our parts from titanium and plastics, instead of

relying on typical machining and production processes," states Kubiak. "In addition, we're interested in studying and improving the welding techniques used to assemble the car, to see if we can apply materials science to make stronger welds."

CMU: THE PERFECT TEST TRACK

Last season, CMU Racing won a number of awards for its racecar design, and

Kubiak is looking forward to building and racing a brand-new vehicle during the 2015-16 academic year.

"It's really exciting to bring a new team together and see engineers from various departments contributing their ideas and expertise," notes Kubiak. "The collaborative environment at Carnegie Mellon — coupled with the great facilities and resources we have available — makes this the perfect place to create a winning multidisciplinary design."

To learn more about CMU Racing, visit www.carnegiemellonracing.org or e-mail formula-sae@andrew.cmu.edu.



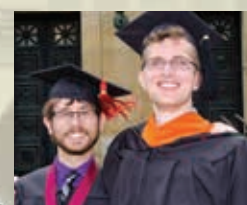
MSE CELEBRATES COMMENCEMENT

On Sunday, May 20, the Department of Materials Science and Engineering hosted its 2015 Commencement ceremony. The event was held at the Twentieth Century Club in Oakland.

The Department awarded 37 B.S. degrees, 34 M.S. degrees, and 10 Ph.D. degrees. The entire MSE family wishes these 81 graduates the best of luck in all their future endeavors!

AWARDS

- *The William W. Mullins Undergraduate Award*
Recipient: **Dylan Quintana**
- *The Hubert I. Aaronson Undergraduate Award*
Recipient: **Kimberly Justl**
- *The James W. Kirkpatrick & Jean Kirkpatrick Keelan Award*
Recipient: **Kellie Painter**
- *The William T. Lankford Memorial Scholarship Award*
Recipient: **Patrice Daniel**
- *The ASM Golden Triangle Chapter Outstanding College Senior Award*
Recipient: **Kate Groschner**
- *The Paxton Award for Best Doctoral Dissertation*
Recipient: **Dr. Congcong Zhu**
- *2015 Krivobok Brooks Award for Excellence in Metallography*
Undergraduate Recipients: **Blair Graham, Zach Cohen, Patrice Daniel, Kate Groschner, Kaeli Halberson, Dylan Quintana**
Graduate Recipients: **Sudipto Mandal, Samikshya Subedi**
- *The Philbrook Prize in Engineering*
Recipient: **Professor Bryan Webler**

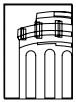


**DEPARTMENT OF MATERIALS
SCIENCE AND ENGINEERING**

Carnegie Mellon University
Pittsburgh, PA 15213-3890



In May 2015, faculty, alumni, and friends of MSE's Center for Iron & Steelmaking Research (CISR) met for dinner at the International Congress on the Science and Technology of Steelmaking in Beijing, China. The group pictured represents the strong collaborations CISR has with universities and companies in Asia.



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