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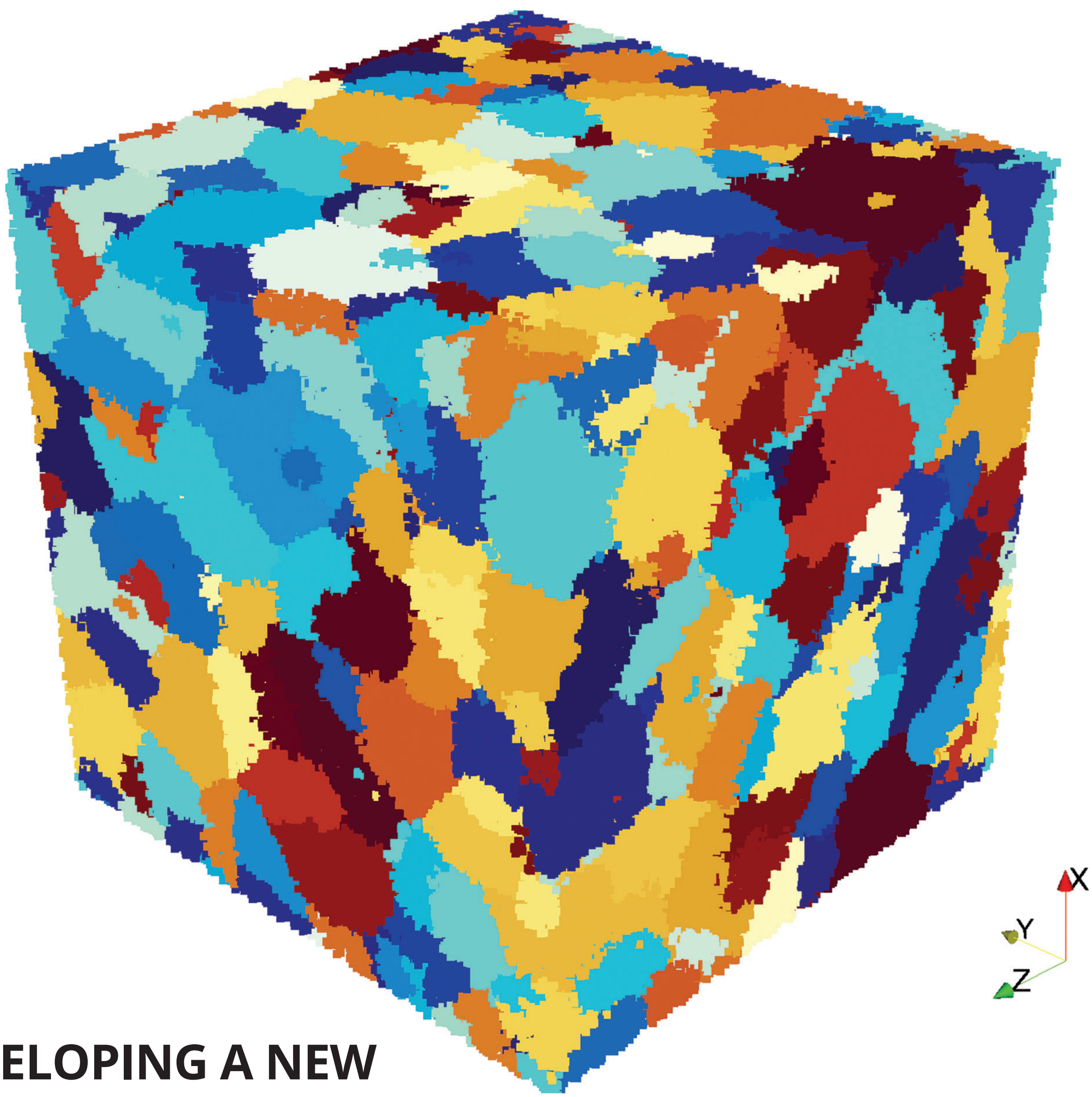


DEVELOPING A NEW MICROSTRUCTURE SIMULATION APPROACH

See story on page 3

A NOTE FROM THE DEPARTMENT HEAD
Gregory S. Rohrer
W.W. Mullins Professor

Greetings to our MSE alumni! With this issue of *MSE News*, we're moving to longer, more in-depth stories that highlight our faculty, alumni, students, and news about the Department. For current news items — such as those discussed in this letter — please visit our website at www.cmu.edu/engineering/materials.

I'm happy to report that the Department continues to thrive, as new students arrive and others graduate. At the MSE commencement ceremony in May, 49 students were awarded bachelor's degrees, 33 received master's degrees, and 20 were awarded doctoral degrees. We met our goals of enrolling more than 10 percent of the undergraduate engineering students at Carnegie Mellon and graduating more than one Ph.D. per full-time equivalent faculty member.

Also of note: The 2016 Paxton Award for the best doctoral dissertation was given to **Justin Freedman**. His thesis was recognized because of his discovery of the universal phonon mean free path spectra in crystalline semiconductors — as well as the first-ever measurements of thermal interface conductance across metal alloy-dielectric interfaces as a function of metal alloy composition.

As evidenced by our cover story, the Department of Materials Science and Engineering continues to increase its emphasis on computational materials science, which is enhancing the Department's reputation. A paper describing a new simulation technique developed by doctoral student **Philip Goins** and **Professor Elizabeth Holm** was selected as the Editor's Choice in a recent issue of *Computational Materials Science*. Holm's research group also recently attracted attention for a machine learning algorithm that automatically recognizes and categorizes images of material microstructures. The team's goals are to make it more efficient for materials scientists to search, sort, classify, and identify important information in their visual data.

In addition, **Ankita Mangal**, a graduate student focusing on computational research, recently won a prize in the Data Science Challenge. Mangal developed a method of predicting internal failures using data from thousands of measurements and tests of components along an assembly line. **Professor Noa Marom** has won a DOE INCITE award that provides 160,000,000 CPU hours at the Argonne Leadership Computing Facility at Argonne National Laboratory.

This is, of course, only a snapshot of the current activity in the Department in this important and growing area, but it signifies the bright future ahead.

Yet another major development in MSE is the launch of the Next Manufacturing Center. This new initiative is focused on additive manufacturing, and current research targets the 3D printing of metals and alloys, as well as 3D bioprinting. The Center consists of CMU engineering faculty — including five from MSE — and students, in addition to a consortium of 13 companies that are developing the printing technology. Because this technology relies on a combination of design, automation, and materials processing capabilities, it is an excellent basis for an interdisciplinary Center.

Finally, please take a moment to read the open letter to alumni from the Department's **Marygrace Antkowski** on page 10. We really enjoy keeping in touch with our MSE extended family — and we hope this letter will motivate you to reach out and share your latest professional and personal news with us. We'd love to hear from you!

GREGORY S. ROHRER

[Ankita Mangal]

[DOE INCITE Award]

[Next Manufacturing Center]

Emeritus Professor Henry Piehler has decided to retire to Pawley's Island, South Carolina, with his wife Margaret Forbes. He came to work at the College of Engineering in 1967, when it was still known as Carnegie Tech. Piehler held appointments in MSE, Engineering and Public Policy, and Biomedical Engineering. The Department thanks him for his years of service and wishes him a happy retirement!

Piehler in June, with CMU Engineering Dean Jim Garrett

The Future in Focus

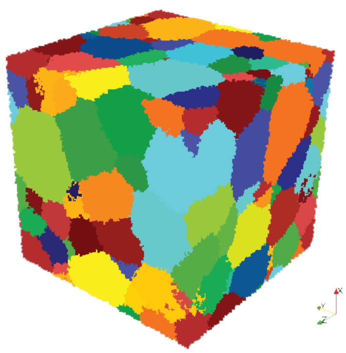
A new simulation method will help illuminate the process of materials transformation

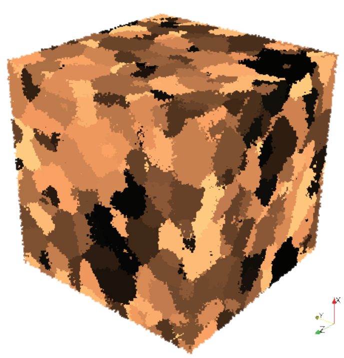
Recent MSE graduate **Philip Goins** *(Ph.D. 2016)* has worked in partnership with **Professor Elizabeth Holm** to create an innovative simulation method that more effectively reveals the microscopic changes that occur as materials evolve. By developing a model that better matches physical systems, they may impact how materials are studied, developed, and manufactured.

"If we can understand how materials evolve at the smallest level of detail, we can better engineer materials for a given application," explains Goins. "For example, we can change the structure of metals, ceramics, and other materials to resist deformation at the micro level. We can help optimize annealing and other treatment processes to improve their properties."

Goins' simulation method, called the Material Point Monte Carlo (MPMC) model, is based on a class of numerical methods called Monte Carlo models. This mathematical technique, developed by United States government researchers during World War II, is based on the idea of statistical randomness.

Materials scientists have used this kind of model in the past to map a material's microstructure onto a set of points and then evolve those points to simulate grain growth, recrystallization, and other processes. Traditionally, the points have been arranged in a grid, which is relatively simple to work with, but introduces unphysical biases in the simulation.





ON THE COVER:
The cover image is a simulated microstructure generated in the Material Point Monte Carlo model, featuring a <100> fiber textured material after a period of grain growth. Different colors denote different grain identity values.

MATCHING THE SOLUTION TO THE PROBLEM

Goins has taken the idea of randomness a step further by eliminating the idea of a grid and making the materials sampling process even more statistically random.

"If you think about grain boundaries represented in an image file, they wouldn't be a straight line — they're more of a zigzag that follows the pixels," Goins points out. "Since grids don't match the geometry of real materials, why should we apply a grid as we study them? Why not make our sampling truly random?"

The Material Point Monte Carlo model, which is the subject of Goins' doctoral thesis, operates in a more scattered manner. So-called "material points" are placed at random and then shuffled as they evolve. Every location in the material is equally weighted and has the same statistical probability of being targeted for analysis, which eliminates these lattice artifacts.

"Philip's method represents a dramatic improvement because it is more realistic," notes Holm. "Real materials do not have an underlying grid-like geometry, so the MPMC model provides a much more accurate picture of changes that are occurring over time inside a material." Goins and Holm have demonstrated that the lattice artifacts found in the widely used Monte Carlo Potts model are eliminated in the MPMC.

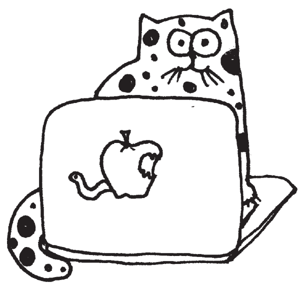
A paper on the MPMC model, co-authored by Goins and Holm, was published in the May issue of *Computational Materials Science* and was named "Editor's Choice."

"It's really gratifying to see my work with Professor Holm recognized as being important to the future of materials development," says Goins. "If you want more accurate results, you need to develop a more accurate tool. By developing a new simulation method without the lattice artifacts, we've eliminated one of the largest sources of errors found in a popular model for microstructural evolution. I am already starting to see a good bit of interest from people who want to use the MPMC model to study their material systems of choice."

Computational Materials Science

Success by Design

An artist her entire life, today Noa Marom turns her attention to designing better materials



As a child growing up in Israel, **Assistant Professor Noa Marom** always had an interest in science and the natural world. Her father, an engineer, encouraged this passion.

"Sometimes, instead of telling me a bedtime story, my dad would answer my questions about nature. I would ask about clouds, volcanoes, earthquakes, dinosaurs, and—when I was a bit older—atoms, stars, and relativity," Marom recalls. "This scientific education was never forced on me. I was a curious child and always had a million questions about the world around me. I was fortunate to have someone with the patience to answer these questions."

At the same time, Marom always loved to draw. "I've been creating art since I was old enough to hold a crayon," she says. Today, her website at MSE (www.noamarom.com) is populated with her whimsical and inventive drawings. While she once dreamed of being an artist or fashion designer, now Marom has found the perfect application for her dual passions: designing custom materials for specific applications.

This energetic professor, who joined the Department of Materials Science and Engineering back in June, uses computer simulations to predict the properties of materials, based solely on the knowledge of their elemental composition and the laws of quantum mechanics.

"A great deal of a product's performance depends on the materials it is composed of," Marom explains. "For example, if you're trying to design the highest-performing solar cell, you need to begin with a material that absorbs as much of the solar spectrum as possible. My research is focused on optimizing the structure and properties of materials so they contribute to a stated performance goal."

This research dovetails perfectly with her natural curiosity and creativity. "What I love about my work is the high level of intellectual challenge and the chance to explore interesting problems," says Marom. "I am constantly thinking about new materials strategies and asking 'what if' questions."

In July, Marom won a Faculty Early Career Development (CAREER) Award from the National Science Foundation (NSF). This five-year award provides $650,000 in funding for her work to predict and design the structure of molecular crystals. In addition, Marom's research proposal, "Materials and Interfaces for Organic and Hybrid Photovoltaics," was recently selected for a 2017 Innovative and Novel Computational Impact on Theory and Experiment (INCITE) award by the Department of Energy. She will be able to leverage 160,000,000 CPU hours on Mira, the world's sixth-largest supercomputer, at the Argonne Leadership Computing Facility.

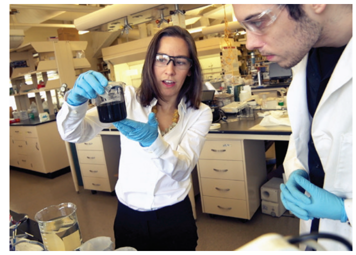
Marom came to Carnegie Mellon from the Physics and Engineering Physics Department at Tulane University, where she was an Assistant Professor. Prior to that, she was a postdoctoral researcher at the Institute for Computational Engineering and Sciences at the University of Texas at Austin. She holds a B.A. in Physics and a B.S. in Materials Engineering, both cum laude, from the Technion-Israel Institute of Technology. She also earned a Ph.D. in Chemistry from the Weizmann Institute of Science, where she was awarded the Shimon Reich Memorial Prize of Excellence for her thesis.

Noa Marom

New Generation

Meagan Mauter wins an NSF CAREER Award for her research aimed at reimagining traditional power plants

“The challenge is that fossil fuel power plants are complex systems. If you make a positive change in one area, it can lead to additional emissons — and negative consequences — elsewhere.”



While there’s no question that the energy industry needs to replace conventional fossil-fueled power plants with greener alternatives, **Assistant Professor Meagan Mauter** takes a pragmatic approach.

“The reality is that coal-fired power plants provide a third of our nation’s electricity, and replacing them overnight would destabilize the grid,” Mauter notes. “The transition to sustainable generation using wind and solar power must be a gradual process. In the meantime, we need to focus on reducing the external impacts of fossil fuel generation through innovation in water treatment and air pollution control.”

This reinvention requires a broad knowledge base — which might make Mauter the ideal candidate. With primary appointments in Civil and Environment Engineering (CEE) along with Engineering and Public Policy (EPP), she also holds courtesy appointments in MSE and Chemical Engineering.

Earlier this year, Mauter won a Faculty Early Career Development (CAREER) Award from the National Science Foundation (NSF) to support her research focused on minimizing air and water pollutant emissions from coal-fired power plants. This five-year, $500,000 grant will help advance the effort to redesign regulated power plants to optimize air-water emissions tradeoffs.

In addition, Mauter has been announced as the recipient of the 2017 James J. Morgan ES&T Early Career Award Lectureship. This award, named for the first editor-in-chief of *Environmental Science & Technology*, honors young researchers who are leading their fields in new directions.

Mauter’s efforts to reimagine existing plant designs are aimed at understanding and minimizing overall impacts. “The challenge is that fossil fuel power plants are complex systems,” explains Mauter. “If you make a positive change in one area, it can lead to additional emissions — and negative consequences — elsewhere. For example, if you increase the use of wet flue gas desulphurization units to reduce air emissions, suddenly you need new water treatment processes to prevent wastewater emissions. As researchers, we must look at plants as cohesive systems and make intelligent trade-offs.”

While Mauter’s research is multidisciplinary, materials science plays a central role. Mauter and her team are investigating the use of new materials for membrane distillation technology — in which low-temperature waste heat from the plant is used to drive wastewater treatment processes. By capitalizing on waste heat to treat water, the auxiliary electricity demands of emissions control processes can be significantly reduced.

“The membranes used for membrane distillation today are commercially produced for other purposes, and their structure is not ideally suited for applications in power plants,” says Mauter. “We’re custom-designing new membranes from innovative materials and custom-engineering them — including larger pore sizes that will improve their performance. This is just one way we’re looking at traditional separation processes and asking, ‘How can we do better?’”

Mauter joined the faculty at Carnegie Mellon in 2012, after serving as a Visiting Scholar and an Energy Policy Fellow at the Kennedy School of Government at Harvard University. She holds a Ph.D. in Chemical and Environmental Engineering, as well as an M.S. and M.Phil. in Chemical and Environmental Engineering, from Yale University. Mauter also earned an M.E.E. in Environmental Engineering, a B.S. in Civil and Environmental Engineering, and a B.A. in History from Rice University.

A Pioneer at Heart

NSF CAREER Award funding will help Tzahi Cohen-Karni explore the electrical activity of cardiac cells

The tiny cells of the human heart hold important keys to understanding not only the mechanics of arrhythmia and other physical problems, but also how drugs might be used to improve cardiac function. But the obvious question is: How can researchers study the workings of cells inside the human body?

Assistant Professor Tzahi Cohen-Karni has an answer. With primary appointments in Biomedical Engineering and MSE, Cohen-Karni is engineering artificial heart cells, or cardiomyocytes, to create small-scale tissue assemblies that can be studied in the laboratory. **Associate Professor Adam Feinberg** of MSE has been an important collaborator in developing this engineered tissue.

To understand how cardiomyocytes function and communicate with one another, Cohen-Karni is developing new methods to measure electrical signals within these tissue assemblies. Recently, Cohen-Karni was recognized with a Faculty Early Career Development (CAREER) Award from the National Science Foundation (NSF) that spans five years and provides $507,000 in funding for this research.

> “By studying how electrical information is propagated in tissue — and then transmitted across three-dimensional cellular assemblies — we can gain insights into this electrical activity and increase our understanding.”

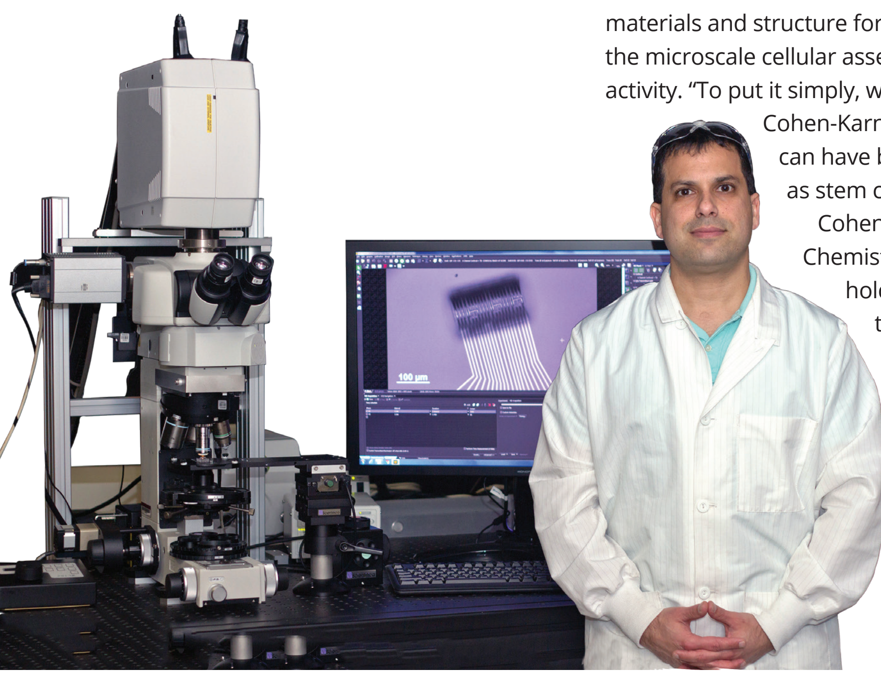
“Why do some people develop cardiac arrhythmias or other heart problems? We believe the answer might be found at the cellular level,” explains Cohen-Karni. “By studying how electrical information is propagated in tissue — and then transmitted across three-dimensional cellular assemblies — we can gain insights into this electrical activity and increase our understanding. Perhaps we can help amend damaged tissue, develop better drug delivery strategies, or otherwise improve patient outcomes with our research.”

Cohen-Karni’s work is truly groundbreaking because it represents the first effort to study cardiac cellular assemblies in three dimensions, just as the tissue exists inside the human body. “In the past, research was done on tissue that was pinned down to a flat surface, which permits only a two-dimensional analysis,” he points out. “My goal is to create more accurate results by measuring electrical activity in 3D.”

The research team will not only have to determine the best structure and materials for the artificial heart tissue under investigation — but it will also have to engineer the materials and structure for a series of nanosensor arrays. These arrays will surround the microscale cellular assembly and record intra-cellular and extra-cellular electrical activity. “To put it simply, we are observing how heart cells talk to each other,” notes Cohen-Karni. “The insights we gain into intra-cellular communication can have broad benefits for other bioengineering applications such as stem cells and neurons.”

Cohen-Karni received a B.Sc. in Materials Engineering and a B.A. in Chemistry from the Technion-Israel Institute of Technology. He also holds an M.Sc. degree in Chemistry from the Weizmann Institute of Science and a Ph.D. in Applied Physics from Harvard University. He joined the Carnegie Mellon faculty in 2014.

A materials scientist, chemist, and applied physicist by training, Cohen-Karni was drawn to the field of bioengineering because of its rapid pace of innovation and discovery. “Every day we are learning new things, but there are still so many unanswered questions about the workings of the human body,” he says. “Bioengineering is like the Wild West, and I believe there is a real opportunity for researchers like me to act as pioneers and make a lasting impact.”



A New Beginning

Following his groundbreaking research at MSE, former post-doc Young Jo Kim embarks on a new journey

As a postdoctoral researcher at MSE for nearly five years, **Young Jo Kim** was gratified by his work with **Associate Professor Christopher Bettinger**, which focused on edible electronics for biomedical applications. Their collaborative work targeted the development of biodegradable battery technologies that could help make medical procedures such as colonoscopies and endoscopies less expensive and less invasive.

"Professor Bettinger is incredibly talented and energetic, and I was honored by the chance to work with him for so long," says Kim. "He's achieved great success at a young age, which inspires all his students and postdocs." Following in Bettinger's footsteps, Kim recently accepted a position as Assistant Professor of Chemical Engineering at the University of New Hampshire.

Kim has traveled a long way since his childhood in Seoul, Korea, where he was always interested in chemistry, physics, and math. He earned a B.S. in Chemical Engineering in 2004 from Sogang University, then accepted a position as a research scientist at Korea Institute of Science and Technology (KIST) in Seoul. "At KIST, I met many colleagues who had studied in the United States, and I realized it would help me expand my expertise and make new connections," recalls Kim.

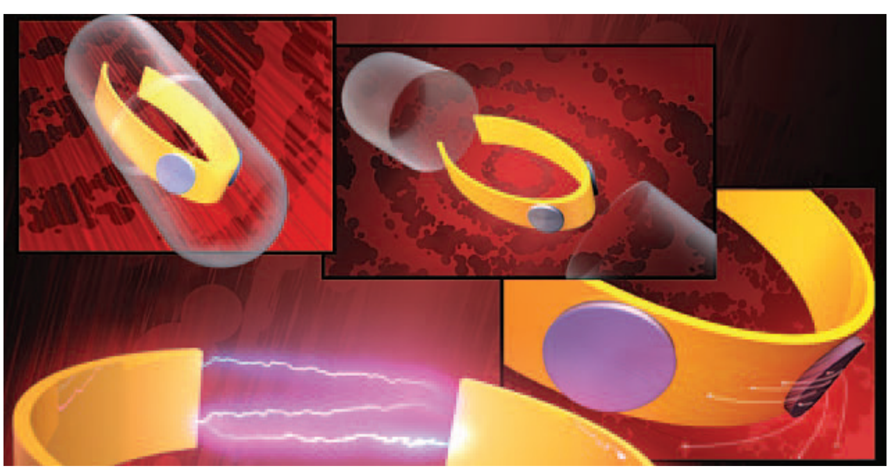
He moved to the U.S. to enroll in the Ph.D. program in Chemical Engineering at the University of Missouri, finishing his degree in 2010. His doctoral work in the Center for Surface Science and Plasma Technology focused on developing electrochemical biosensors.

At the University of New Hampshire, Kim is currently teaching "Energy and the Environment" to a class of 220 undergraduate students, while considering his own research interests. "I'll most likely continue my focus on biodegradable and sustainable energy technologies," he notes. "Energy is one of our most pressing challenges today, and I would love to make an impact in both the laboratory and the classroom. We need to develop innovations, but also inspire the next generation to make its own contributions."

Kim travels back to Pittsburgh often to see his wife Sun-A Park, an Associate Professor of Communication at Robert Morris University, and their four-year-old daughter Soobin. "It's difficult to be separated from your family, but I'm grateful that my wife and daughter support my dream of being a professor," says Kim. "I'm becoming very familiar with the airports in Pittsburgh and Boston."

TASTE FOR INNOVATION

Over the past five years, Young Jo Kim has been a critical member of the Bettinger research group's efforts to develop biodegradable batteries made of cuttlefish ink extracts. These batteries rely on the human pigment melanin for power, and current prototypes have a life of about 16 hours. This innovative technology could supply the power needed for pacemakers, neurostimulators, drug delivery devices, glucose monitors, and tiny cameras used for endoscopies and colonoscopies. Not only would procedures become far less invasive, with fewer side effects, but costs could be lowered significantly.



Man of Steel

With three degrees from MSE, Bill Slye has forged a successful career in the global steel industry

As Global R&D Director for Vesuvius, **Bill Slye** *(B.S. 1992, M.S. 1995, Ph.D. 2000)* leads the development of innovative refractories for steelmaking processes, managing three research centers and five support laboratories around the world. He is at the forefront of creating new technologies that help drive the global steel industry.

This successful career had its beginnings when Slye was a teenager growing up in Irwin, Pennsylvania, and was focused on long-distance cycling and competitive bike racing. "I was a passionate cyclist as a teenager and used to read all the cycling magazines. I became absolutely fascinated by how the metal chemistry and microstructure impacted the bicycle frame's weight, design, and ultimately performance," recalls Slye. "I was always interested in chemistry, but that was the first time I realized the real-world impact of metallurgy and materials science. I was hooked."

Slye's decision to attend CMU was an easy one, since his father Milo had earned a B.S. in Electrical Engineering from Carnegie Tech in 1950 after he served in World War II. "I've always looked up to my dad, and I wanted to follow in his footsteps," Slye says. "That desire, combined with the MSE Department's excellent reputation, made it an easy choice."

In fact, Slye felt so at home that he remained at MSE for almost 12 years, completing three degrees. His graduate work focused on the thermodynamics of iron-based metallic solutions, but as an undergraduate, his time was divided between classes on campus and four semesters working at J&L Specialty Steel as a metallurgical co-op.

"From the practical problem-solving skills and metallurgical principles I learned in MSE to the experience of being a leader and navigating political situations, my time at CMU really helped shape my career."

Left to right: Bill Slye, son Milo, daughter Melisa, and wife Chris Ann

Slye with his father, Milo
(B.S. Electrical Engineering, 1950)

"I loved my co-op terms because that experience showed me the relevance of the thermodynamics and physical metallurgy we were learning in the classroom," notes Slye.

As a graduate student, Slye was also a politically active and highly visible figure on the CMU campus. He served as President of the Graduate Student Assembly, wrote the organization's bylaws, and won the University's Graduate Student Service Award in 1996.

"I apply what I learned at Carnegie Mellon every single day," Slye emphasizes. "From the practical problem-solving skills and metallurgical principles I learned in MSE to the experience of being a leader and navigating political situations, my time at CMU really helped shape my career. I wouldn't be where I am today without my Carnegie Mellon experience."

Because the University has been so important to him, Slye is committed to giving back by volunteering on the Carnegie Mellon Admissions Council for the past 16 years. Each year, he talks with a number of students who are interested in enrolling at Carnegie Mellon. He meets them in person, reviews their accomplishments, and writes letters of recommendation. "It's important to show young engineers that this is a place where you will make important personal connections," Slye notes. "I'm happy to be one of the first people that prospective students meet — and to share my own positive experience at Carnegie Mellon."

Upon graduation from MSE, Slye worked for Praxair — a leader in industrial gases — for 11 years, rising to become Associate Director for Global Applications Market Development. He joined Vesuvius in 2011. Slye lives in Perrysburg, Ohio, with his wife Chris Ann and their two children — Melisa, age 15, and Milo, who is 11.

Vesuvius

Picture Perfect

Boopathy Kombaiah generates an award-winning materials image

Kombaiah's winning image will be featured in JEOL's 2017 calendar.

Last spring, MSE postdoctoral researcher **Boopathy Kombaiah** created a breathtaking image of a silicon substrate sample that he synthesized through back etching. He submitted the picture to JEOL, a leading global supplier of electron microscopes, ion beam instruments, and spectrometers. JEOL chose Kombaiah's image, which he called "A Silicon Tree," as its Image Contest award winner for June 2016. The award comes with a cash prize, and the image will be featured in JEOL's 2017 calendar.

The picture was captured as part of Kombaiah's work to study how surface imperfections are created on metallic thin films during chemical processing, guided by **Professor Gregory S. Rohrer**. Kombaiah used a JEOL 2000EX transmission electron microscope housed in MSE's Materials Characterization Facility.

In September, Kombaiah left MSE to accept a position as Postdoctoral Research Associate at the Oak Ridge National Laboratory. There, he studies the effects of neutron irradiation on the properties of materials planned for use in nuclear reactors. He currently resides in Knoxville, Tennessee, with his wife Vijayalakshmi Amirtha Vel and their two-year-old son Kavin Boopathy.

Kombaiah holds a bachelor's in engineering from PSG College of Technology, India, and a master's in engineering from the Indian Institute of Science, India. He earned a Ph.D. in materials science and engineering from North Carolina State University in 2015.

Alums: Please Keep in Touch!

Jaehyun Moon

Mina Abadier

The Department of Materials Science and Engineering has often been described as a family, due to its small size and the close relationships it fosters. As we all know, it's easy to feel close when we see each other every day — but more challenging when a member of the family leaves home.

Wherever your career path has taken you since you left the Department, I'm reaching out to encourage you to stay connected to MSE. We love hearing from our alums and sharing their successes, both professional and personal, with the rest of our family.

Recently, I experienced two encounters with alums that reminded me of the importance of keeping in touch.

Jaehyun Moon *(M.S. 1999, Ph.D. 2003)* reached out via email: "Hello there! 13 years have passed but I still vividly remember the corridors of Wean Hall...... Recently I have visited the CMU MSE website.... I would be grateful if you can add me to the 2003 list of Doctoral Theses." Although it was a bit embarrassing to realize that we had omitted Jaehyun's information, it was indeed a great opportunity to reconnect with him. We learned that he is working as a Principal Researcher at the Electronics and Telecommunications Research Institute, with a focus on optics/photonics relevant to organic light emitting diodes. He also has an appointment as Associate Professor at the University of Science and Technology where he is doing research in the field of organic light emitting diodes (OLEDs). He lives in Daejeon, Korea, with his wife Hyesook Lim, who works at Hansalim, a cooperative (coop) of organic non-GMO food chain. The couple has two children, Sooho, age 12, and Sooah, 10.

Last May, **Mina Abadier** *(Ph.D. 2014)* stopped by the Department's offices before moving on to a new job. He works as a Real-Time Defects Analysis Module Engineer at IM Flash, an Intel-Micron joint venture for memory technologies based in Lehi, Utah. Mina conveyed his gratitude for the support of the staff while at MSE. He emailed recently to say he was thrilled to meet other MSE grad students who visited Salt Lake City, Utah, during the MS&T 2016 conference on October 23-27, 2016.

Mina has been enjoying the hiking trails around Salt Lake City, and his favorite spots are Big Cottonwood Canyon and Park City. He plans to use his stay in Utah to discover the many national parks around the area. He decided to start with Arches National Park.

We're not insisting that you scour the MSE website for errors, or make a special trip to Pittsburgh *(but if you are in the neighborhood we will be expecting a visit)*. We would love to hear about your new job, your children, your travels, and memories of the time you spent at MSE — anything you'd like to share! In addition to your successes in the field of engineering, we are interested to learn where life has taken you.

Feel free to contact us via phone or email; our information is available on the MSE website. Please keep in touch!

MARYGRACE ANTKOWSKI

Please keep in touch!

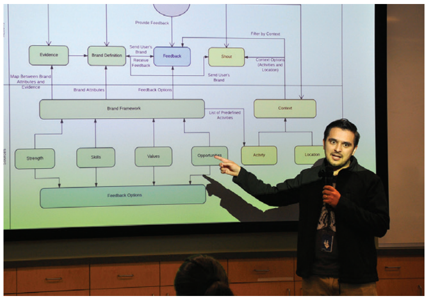
IM Flash

University of Science and Technology

Electronics and Telecommunications Research Institute

Preparing for Start-Up Success

New Master of Science in Technology Ventures (MSTV) degree is offered in collaboration with CMU Silicon Valley



Starting in 2017, students earning a B.S. in Materials Science and Engineering have a unique opportunity to leverage the expertise of CMU Silicon Valley to earn a Master of Science in Technology Ventures (MSTV), while also earning their master's degree in MSE. This dual-degree program, offered though the Carnegie Mellon Integrated Innovation Institute, is a two-year curriculum that allows students to study at both the Pittsburgh and Silicon Valley campuses of Carnegie Mellon.

"Many engineering students today are looking for entrepreneurial success," says **Sheryl Root**, Director of the new MSTV degree program. "They have an idea, but they don't know how to build a successful business model around that idea. We've designed a hands-on curriculum that provides these students with an in-depth knowledge of the emerging technology and skills they need to succeed in the entrepreneurial marketplace."

Graduates of the MSE program will spend two semesters in Pittsburgh during the first academic year, completing their master's in Materials Science and Engineering requirements. Then they will travel to Carnegie Mellon's Silicon Valley campus, where they will spend the summer working with a local start-up company whose product focus matches their own interests. They will remain at CMU Silicon Valley for the following academic year, where they will take classes that encourage teamwork and hands-on learning related to new venture success — whether in a start-up or within an established company.

"The Silicon Valley coursework really focuses on 'learning by doing,'" notes Root. "Students will gain knowledge in how to create a successful business model, how to be effective leaders, and how to work in teams. They'll explore the legal and financial issues associated with founding and running a business. It's really an entrepreneurial boot camp that gives them the skills they need to launch their own company upon graduation."

After students finish their degree requirements, they can leverage a unique program called VentureBridge — as well as their relationships with CMU faculty — to identify and take advantage of venture capital opportunities and strategic partnerships that can provide funding or help them launch a new business.

"Silicon Valley is arguably the world's most exciting and lucrative environment for new venture creation, so it makes sense to bring students here and help them establish a network of contacts," Root points out. "We're fortunate at Carnegie Mellon to have a campus located in a region that's associated with high technology and entrepreneurship."

Gregory S. Rohrer, Department Head for MSE, emphasizes the practical value of this dual-degree program for graduates with an idea for a startup company or a materials innovation.

"Many of today's product challenges are centered on materials," Rohrer states. "Materials are critical to developing new battery technologies, designing impact-resistant and heat-resistant cases for smart products, and building lighter-weight cars and planes. There are so many applications for the knowledge of our MSE graduates. I'm excited that there is now a program that can help them get their ideas from the drawing board to the marketplace."

Interested MSE graduates can visit http://www.cmu.edu/integrated-innovation/ to learn more. To begin the application process, send an e-mail to admissions-iii@andrew.cmu.edu.

Integrated Innovation

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