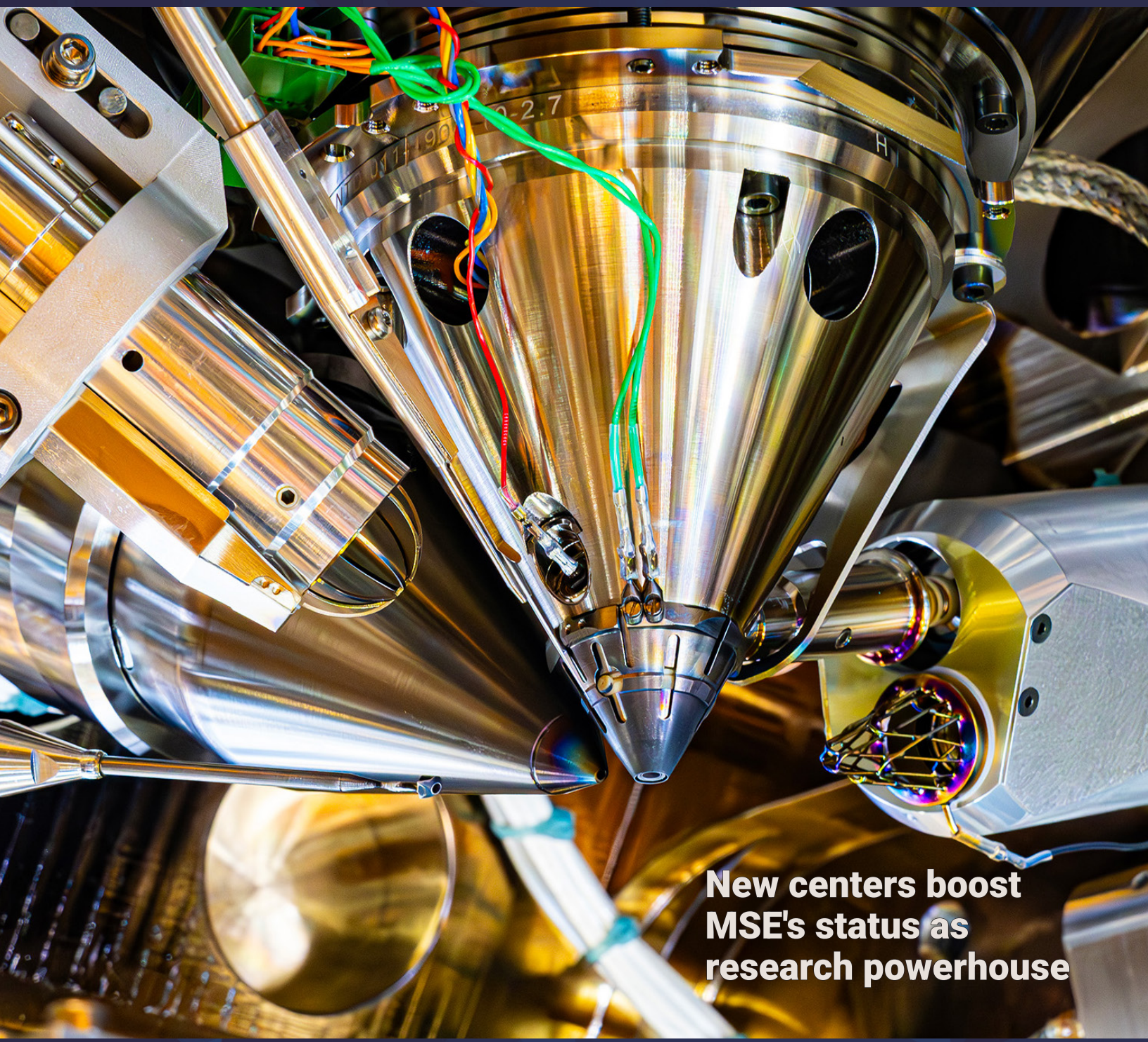
MSE*news*

COLLEGE OF ENGINEERING
MATERIALS SCIENCE & ENGINEERING
UNIVERSITY OF MICHIGAN

Winter 2024



New centers boost MSE's status as research powerhouse

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Front cover: "Gateway to materials researh" - sample on the specimen holder and electron, ion-beam and various sensing columns in TFS Helios G4 Plasma FIB UXe together while the sample is waiting to be loaded into the tool for focused Ion beam milling and cross sectional imaging. The Helios FIB/SEM is one of the most widely used tools at the Michigan Center for Materials Characterization $(MC)^2$ - image by Jinhong Min, Li group

Image below: "Dazzling Geometry: The Spectrum of Colored Diamond Facets" - faceted pit in Zinc - image by Shanmukha Kiran Aramanda, Shahani group

Feeling at Holm

MSE chair Liz Holm offers candy to seniors Thomas Rusli and Aaryan Patel during an MSE trick-or-treating event on Oct 31.

It has been my privilege to serve as Department Chair of Materials Science and Engineering for a year now – and what a year it's been!

As you'll see in the stories that follow, MSE has made notable achievements in every aspect of our mission. We began 2023 with a flurry of research successes. A new NSF MRSEC, a DoD MURI, and a significant DARPA project joined the renewed DOE PRISMS Center to substantially increase the research footprint of the department. MSE also plays a leadership role in the new, State of Michigan supported Electric Vehicle Center. These interdisciplinary centers represent the culmination of years of building our faculty, our facilities, and our collaborations. They speak directly to our status as a research powerhouse in MSE.

Our accomplishments were duly recognized by a bevy of awards. Faculty were cited for service, mentorship, research excellence, and lifetime achievements. Our newest faculty won prestigious early career awards, including a Packard Fellowship for Professor Claudia Loebel – a first for an MSE professor at U-M. Particularly gratifying for me as a computational materials scientist, MSE courtesy Professor Vikram Gavini and MSE PhD student Vishal Subramanian were awarded the Gordon Bell Prize for high-performance computing – proving that materials scientists really can do it all!

Needless to say, our undergraduate and graduate programs continued our tradition of training the next generation of Leaders and Best. Take a look at the Senior Design project list to see how our students are making an impact in healthcare, manufacturing, sustainability, transportation, and beyond. At all levels, our students and alums are recognized by awards, scholarships, and opportunities – all enabled by their experiences in U-M MSE.

None of our accomplishments is possible without the support of our exceptionally capable staff, who attend to every detail and meet every deadline to keep our research, educational, and administrative missions on track and moving forward. I would like to especially call out the staff support of our Dow Right Now initiative, which makes immediate and tangible changes to improve our community space in the H.H. Dow Building.

Finally, my deepest appreciation to you – every member of the MSE community – for this fantastic Michigan homecoming. Your engagement, your successes, and your contributions make all of this happen. Stop by and see us anytime – and as always,

Go Blue!

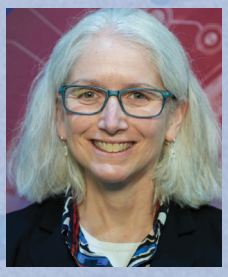
"...MSE has made notable achievements in every aspect of our mission. We began 2023 with a flurry of research successes... They speak directly to our status as a research powerhouse in MSE."

—Liz Holm

Faculty Awards & Updates

PROMOTIONS APPOINTMENTS AWARD RECOGNITION TMS2023

John Allison: TMS2023: AIME Honorary Member Award

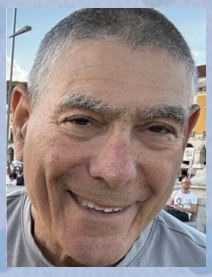


Rachel S. Goldman: Named Maria Goeppert Mayer Collegiate Professor

Liz Holm: Named Richard F. and Eleanor A.Towner Professor of Engineering; chairs College of Engineering Dean Search Advisory Committee; TMS 2023: SMD Distinguished Service Award

Robert Hovden: Promoted to Associate Professor and earned DOE Early Career Award

Manos Kioupakis: Promoted to Professor

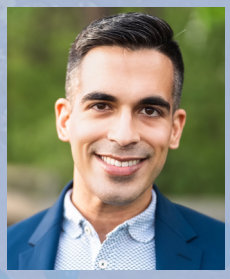


Rick Laine: Recognized with EPA Green Chemistry Award

Emmanuelle Marquis: TMS2023: Brimacombe Medal

Abdon Peña-Francesch: Earned Air Force Office of Scientific Research (AFOSR) Young Investigator Program Award (YIP)

Liang Qi: Promoted to Associate Professor and earned 2023 MSE Faculty Outstanding Achievement Award

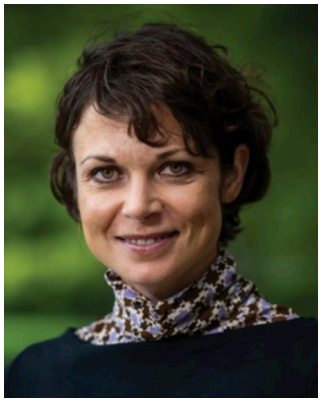


Ashwin Shahani: TMS2023: Frontiers of Materials Award

Yiyang Li: UROP Outstanding Research Mentor Award

Wenhao Sun: Named Dow Corning Assistant Professor

Claudia Loebel selected as 2023 Packard Fellow



"This award places her in the rarefied group of Packard Fellows, which includes some of the most creative and influential thinkers in the nation."

—MSE chair Liz Holm

Memories of disease could impact human lives down to the cellular level. That's U-M researcher Claudia Loebel's idea at least, and it landed her a fellowship from the David and Lucile Packard Foundation.

Loebel is one of 20 early-career researchers who were selected as 2023 Packard Fellows for Science and Engineering. The fellows were chosen from 100 nominees for their groundbreaking work and creative approaches.

The fellowship includes $875,000 of discretionary funding over five years to support her research on how chemical signatures of disease can be recorded inside tissues as memories for future generations of cells.

The work aims to advance biology and has the potential to lead to discovery of new ways to treat diseases such as fibrotic, inflammatory, and congenital disorders.

"Professor Loebel's truly transformative work exemplifies the cross cutting nature of engineering research today. With an MD and a PhD, she applies the principles of materials engineering to biological systems," said Elizabeth Holm, chair of the Department of Materials Science and Engineering and the Richard F. and Eleanor A. Towner Professor of Engineering.

"This award places her in the rarefied group of Packard Fellows, which includes some of the most creative and influential thinkers in the nation," Holm added.

With funds from her new fellowship, Loebel hopes to better understand what she calls the "data stored in the telephone line" at different stages of disease and how cells sense that data at different stages of their lives.

Vikram Gavini wins 2023 Gordon Bell Prize

ME and MSE Professor **Vikram Gavini**'s DFT-FE team, which includes MSE PhD candidate **Vishal Subramanian**, recently won the very prestigious Gordon Bell Prize -- the highest honor for high-performance computing -- for developing a systematic path to realizing large-scale materials simulations at quantum accuracy. As part of their Gordon Bell Prize submission, Gavini's team conducted a calculation of a dislocation in magnesium with random yttrium solute atoms—a system involving ~620,000 electrons. They achieved an unprecedented sustained performance of 660 petaflops (660 quadrillion floating point operations per second) on the world's most powerful supercomputer: the Frontier exascale system housed at the Oak Ridge National Laboratory. Notably, this is a ten-fold improvement in sustained performance demonstrated for any ground-state DFT calculation.

"This has been a multi-year effort involving graduate students, research scientists, and collaborators," Gavini said. "We are very pleased that the work is recognized via this year's Gordon Bell Prize."

On Dec. 6 MSE threw a special celebration for Vishal Subramanian (left) and Vikram Gavini, at which the department gave them special "bell prizes."

Faculty emeritus Wil Bigelow celebrates his 100th birthday at a special surprise event in GG Brown's Blue Lounge on March 16.

Wil Bigelow turns 100

In honor of professor emeritus Bigelow's milestone birthday, MSE threw him a suprise party in March.

"I think this is an unprecedented event. I don't think we have had anyone reach 100 years."

—MSE chair Liz Holm

MSE alums from around the country came to Ann Arbor on March 16 to honor professor emeritus Wilbur Bigelow with a surprise 100th birthday party on campus. (His actual birthday is March 18.)

Bigelow taught at MSE for 40 years and then remained active with the university well into his 90s. Many of his former students have gone on to have their own impressive careers, including MSE chair Liz Holm.

"I had Professor Bigelow back when I was a student here in the 1980s. So, this is pretty amazing to have a 100th birthday celebration for someone that I had in my class, and he hasn't changed. I mean he's gotten older, but the attitude is still the same," said Holm.

Bigelow greeted his guests with his characteristic "cranky" yet witty attitude, which his former student Cheryl (Christenson) Dalsin, of Tempe, Arizona, described as his "charm." When those gathered asked how he was doing, he simply said he was "old and cranky," and proceeded to shake hands and converse with his guests.

The surprise party featured an introduction by Holm and presentations by three of his former students who are now well known in the field of materials science and electron microscopy: Larry Allard, of Oak Ridge, Tennessee; John Mardinly, of Chandler, Arizona; and John Mansfield, of Ann Arbor.

Allard, Mardinly and Mansfield presented highlights and photographs from Bigelow's career. This included acquiring two up-to-date transmission electron microscopes in 1962 and 1963, and founding the university's Electron Microbeam Analysis Laboratory in 1969, which he was director of until 1987. Bigelow considers this to be the crowning achievement of his scientific career. In 1985, he also established the Hanawalt Laboratory for X-ray Diffraction.

"I think this is an unprecedented event. I don't think we have had anyone reach 100 years," said Holm. "A century of contribution, and I do mean contribution. Professor Bigelow has continued to contribute to the department and to science."

"Dow Right Now!" initiative aims to make Dow Building more inviting

The main home of MSE, the Herbert H. Dow Building, opened on North Campus 42 years ago, in 1982.
Not much has changed—aesthetically speaking—since.

But that's about to change.

Making Dow a "place where people want to be" is among MSE chair Liz Holm's top priorities.To help fulfill this goal, she launched the "Dow Right Now!" initiative in late spring.

"Not much has changed in the building since I was a student here in the '80s," begins Holm. "Obviously we are limited in how much we can change structurally, but there *are* a lot of things we can do to make the place where we spend the majority of our time on campus more inviting and comfortable."

Target areas of the initiative include the second-floor hallways and student lounge areas.

"We have heard from students and faculty through multiple surveys that they'd like us to make the space more welcoming and warm. We have taken these suggestions to heart and want the students especially to know that we hear them and value their opinions."

MSE is currently working with designers from the university's Architecture, Engineering and Construction (AEC) for enhancement solutions and project management.

As a sample of what's to come, in August a mural was installed on the northeast wall of the second floor (pictured below), which features various colorful student-generated materials images. To say it's been well received is an understatement.

"When it first went up people were overwhelmed with excitement at how the mural instantly brightened the space and boldly proclaimed that this is our home. That we are proud to be MSE."

MSE earns perfect score from accredidation team

Yalisove

After months (and months) of compiling comprehensive data about our curriculum and teaching/grading methods, the ABET accredidation team gave MSE a perfect score.

MSE chair Liz Holm attributes the department's success to the hard work and dedication of Professor Steve Yalisove, who spearheaded the laborious data collection process, which happens every six years.

"We all know that we have a great program," said Holm, "but our ability to convey that effectively to ABET is in largest part due to one person: Steve Yalisove. His ongoing and dedicated work toward a successful ABET review is to be applauded."

MSE adds four courtesy faculty

In 2023 MSE added four new affiliated faculty, bringing the total to 25. The latest MSE courtesy appointments include **Assistant Professor Rebecca Lindsey** (ChE), **Assistant Professor Albert Liu** (ChE), **Assistant Professor Jouha Min** (ChE), and **Professor Yang Zhang (YZ)** (NERS).

Lindsey

Liu

Min

Zhang

Left: Senior facilities engineer Keith McIntyre and Assistant Professor Wenhao Sun pose in front of Sun's 5' Bumble Bee sailboat they built in McIntyre's garage. Above: Sun takes sons Apollo and Arthur out for a sail on the Huron River in August.

Floating their boats

Wenhao Sun and Keith McIntyre combine talents to build two 5' sailboats.

To pass the time during the bleak days of the pandemic, some people baked bread, others copied tik tok dances, and still others pedaled on Pelotons.

Assistant Professor Wenhao Sun and senior facilities engineer Keith McIntyre, however, spent their pandemic down time doing something else entirely: building boats.

In early 2020, before campus went fully remote, Sun came to McIntyre with technical questions regarding a play station he wanted to build for sons Apollo and Arthur. While chatting, McIntyre mentioned plans he had for building a sailboat – a five-foot Bumble Bee by Angus Boat Designs, to be exact - for his grandson in Colorado.

"When Keith told me about the sailboat, I thought 'cool!' I want to do that for my boys, too," Sun recalls.

The first step was ordering Okume plywood, a dense, marine-grade plywood grown in South America that – essential for successful flotation - contains zero knots.

In Fall 2021 Sun and McIntyre took the sheets of plywood and drawings to Maker Works, a local community workshop that caters to DIYers, where they projected the boat drawings onto the plywood and cut out each of the boat's 17 pieces with lasers.

The actual construction of the boats – all the gluing, filling with epoxy, sanding (and more and more sanding), and varnishing -- took place during evening and Saturday sessions in McIntyre's garage over the better part of a year.

"The hardest part was finding the time when we were both available to work on it," says McIntyre. All told, he estimates that they spent about 40-60 hours on the project.

"Of course, that doesn't count the 80-100 hours spent just thinking and staring," he quips.

After the final coats of paint were applied in Summer 2022 (McIntyre chose a yellow hull while Sun's is bright blue), the Bumble Bees were ready for their maiden voyages. In July 2022 McIntyre drove the boat out to Colorado, where his son and three-year-old grandson set sail on a lake near Denver.

"He was so excited and the smile on his face was so worth it," recalls McIntyre of his grandson.

The Sun boat, meanwhile, has taken a total of three voyages closer to home, on the Huron River. The most recent outing was in late August, with McIntyre along as a spectator.

New hires

Jack Eilers

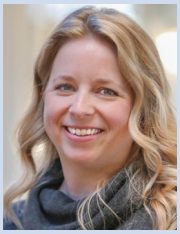
MSE alumnus Jack Eilers (BSE '21) joins Van Vlack Lab staff

Deja vu? Recent MSE alum **Jack Eilers (BSE '21)** is once again a presence in the Van Vlack Lab - this time as a staff member. Hired this summer as an engineering tech, Eilers is responsible for equipment repair/maintenance and training users, including undergraduate and graduate students, on the proper use of laboratory equipment.

"The MSE department prepared me for many challenges I received post-graduation, but not all of them," commented Eilers. "Coming back, I aim to help the department produce students who can answer those new challenges."

Research team grows by four people

The research administration team has added four new staff members since this summer: **Meghan Connolly** (research administrator lead), **Lisa Fields** (research administrator, not pictured), **Huimin Ponchart** (business and research administration manager), and **Wanlei Zhou** (financial specialist).



Meghan Connolly

Huimin Ponchart

Wanlei Zhou

Awards

2023 Staff Service Awards

Tina Longenbarger (assistant to MSE chair Liz Holm), **Kristen Freshley** (marketing/communications specialist) and **Renee Hilgendorf** (graduate program advisor) all received 2023 Staff Appreciation Awards at the Staff Appreciation Luncheon held November 7. Determined by a faculty vote, Longenbarger was recognized for "expertly managing the yearly cycle of department activities and organizing new initiatives during an administrative transition," Freshley was cited for "supporting our space, our events and our community to the highest professional standards," and Hilgendorf was recognized for "expertly and compassionately navigating our graduate students from recruiting to graduation and beyond."

Tina Longenbarger, Kristen Freshley MSE chair Liz Holm, and Renee Hilgendorf

Franklin-Smith and Kuhn earn CoE's 2023 Staff Incentive Awards

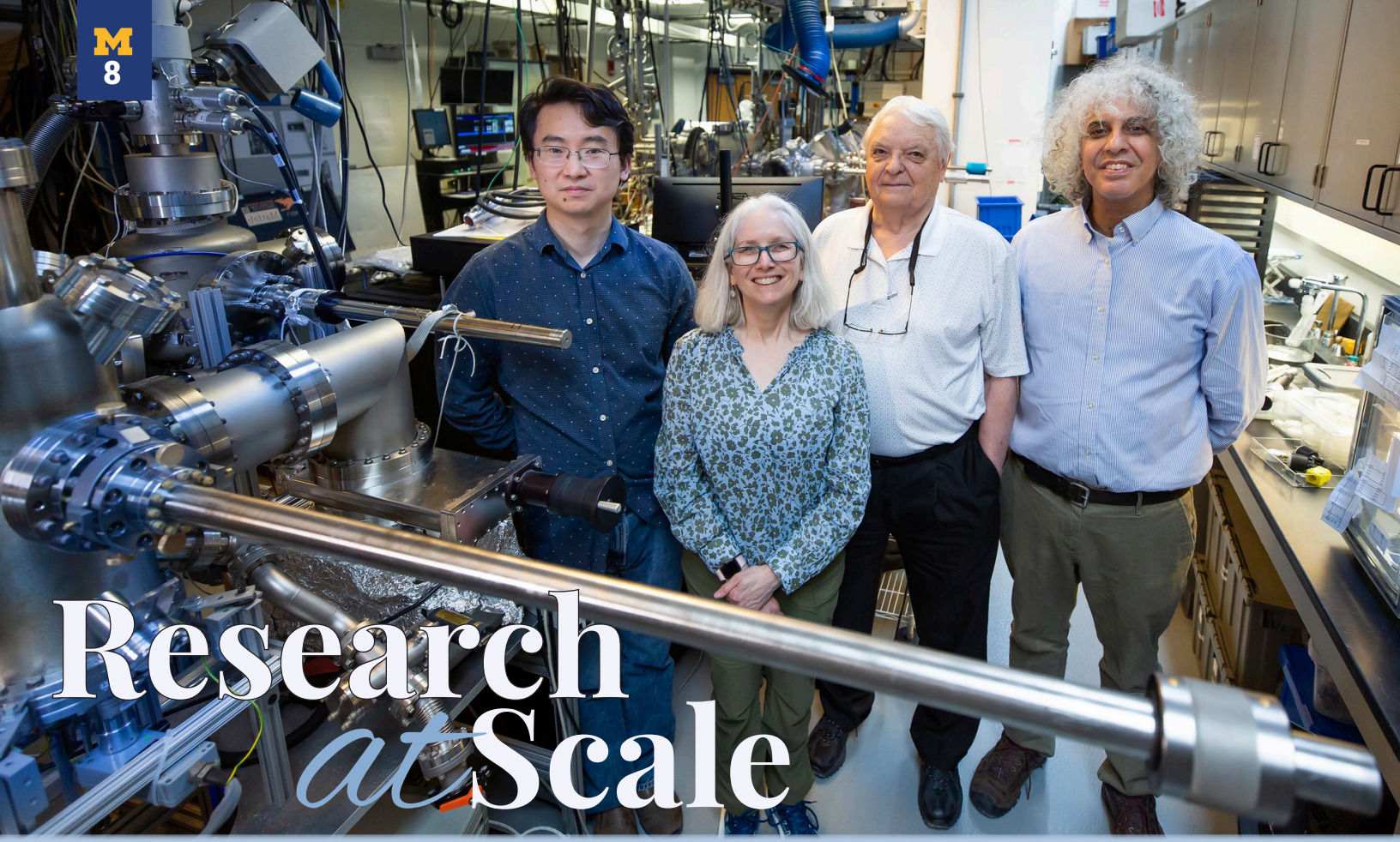
In December, **Cassandra Franklin-Smith** and **Kathy Kuhn** were chosen as recipients of the CoE's 2023 Staff Incentive Award.

Franklin-Smith, an HR generalist, was selected for expertly navigating the landscape of international work authorizations and on-boarding personnel for our growing complex research centers. Her contributions directly enable MSE to realize our mission on a global scale.

Throughout Kuhn's eight-year career with MSE, she has demonstrated excellence in the practice of research administration. Notably, Kuhn maintained stability and resilience during the recent restructuring of the research administration team. She not only weathered the challenges, but she has also assumed a pivotal role in leading the newly reconstructed team.

Cassandra Franklin-Smith

Kathy Kuhn



Research at Scale

Kai Sun, professor of physics, Rachel Goldman, Maria Goeppert Mayer Collegiate Professor, Ctirad Uher, the C. Wilbur Peters Collegiate Professor of Physics, and Cagliyan Kurdak, professor of physics, in the Goldman Group Molecular Beam Epitaxy Laboratory.

This was the biggest single-year influx of center-level programs in MSE history.

Macro PhD student Matthew Wu grows ice for surface adhesion tests at the Tuteja lab,

Three exciting new centers only add to MSE's already-robust portfolio of large-scale, interdisciplinary research centers.

This past year, U-M MSE added substantially to our portfolio of large-scale, interdisciplinary research centers. Professor Rachel Goldman spearheaded a successful NSF MRSEC grant as well as a major DoD MURI award. Professor Anish Tuteja received a substantial DARPA grant, and Professor John Allison renewed the longstanding DOE PRISMS research center (see story on next page). This was the biggest single-year influx of center-level programs in MSE history.

Funded with $18 million from NSF and led by Goldan, the Center for Materials Innovation seeks to build a campus-wide ecosystem of researchers that converge on material solutions to problems facing society, such as plastics recycling. The center also has the goal of broadening participation in materials research through year-round opportunities for students and teachers.

Another project led by Goldman and funded by a Department of Defense $7.5 MURI award will embrace imperfections in next-generation electronic devices, possibly enabling faster and more efficient information processing. Specifically, the project aims to understand how dislocations could be used as nano-pipelines to channel electrons while manipulating their spins.

ICECycle, led by Professor Anish Tuteja and funded by the Defense Advanced Research Projects Agency, is a new $11.5M project that seeks to develop new, nontoxic materials that could one day keep solar panels and airplane wings ice-free, or protect first responders from frostbite and more.

To achieve this, ICECycle researchers plan to find molecules that can be used to manipulate ice and snow in several ways, including changing the temperature at which water freezes, increasing and decreasing how strongly ice adheres to surfaces, changing the structure of the formed ice and inhibiting or encouraging ice crystals to grow on surfaces.

PRISMS Center gets renewal funding from DOE

The U-M PRISMS Center was recently renewed for another three years by the US Department of Energy - Basic Energy Science program. Over these three years the PRISMS Center will receive $6.5M. Since its inception in 2012, the Center has received $32.7M in total funding. According to Center Director and MSE Professor John Allison, this sustained funding has enabled development of advanced computational materials science tools and a data infrastructure with unsurpassed capabilities.

The PRISMS Center's free, open-source software has been downloaded by more than 7000 researchers. The data infrastructure is also publicly available and houses more than 5 million files of materials research data. Thirty graduate students and post-docs have conducted research within the center and, since 2012, 22 have completed their degrees.

The scientific focus of the Center is on accelerating understanding of microstructural evolution and mechanical behavior of light weight magnesium alloys. According to Allison, the Center is making exciting new progress in understanding alloy effects on complex deformation mechanisms and microstructural evolution - which will enable design of new Mg alloys for improved formability to enable new applications in the automotive, biomedical and electronics industries.

"We have an exceptional team of faculty, staff and students and we are delighted that this renewal has allowed us to add a new faculty member, Professor Liz Holm," stated Allison. "Her theoretical capabilities on microstructural evolution and use of machine learning are a very important addition to the team."

Misra new director of MMRI and $(MC)^2$

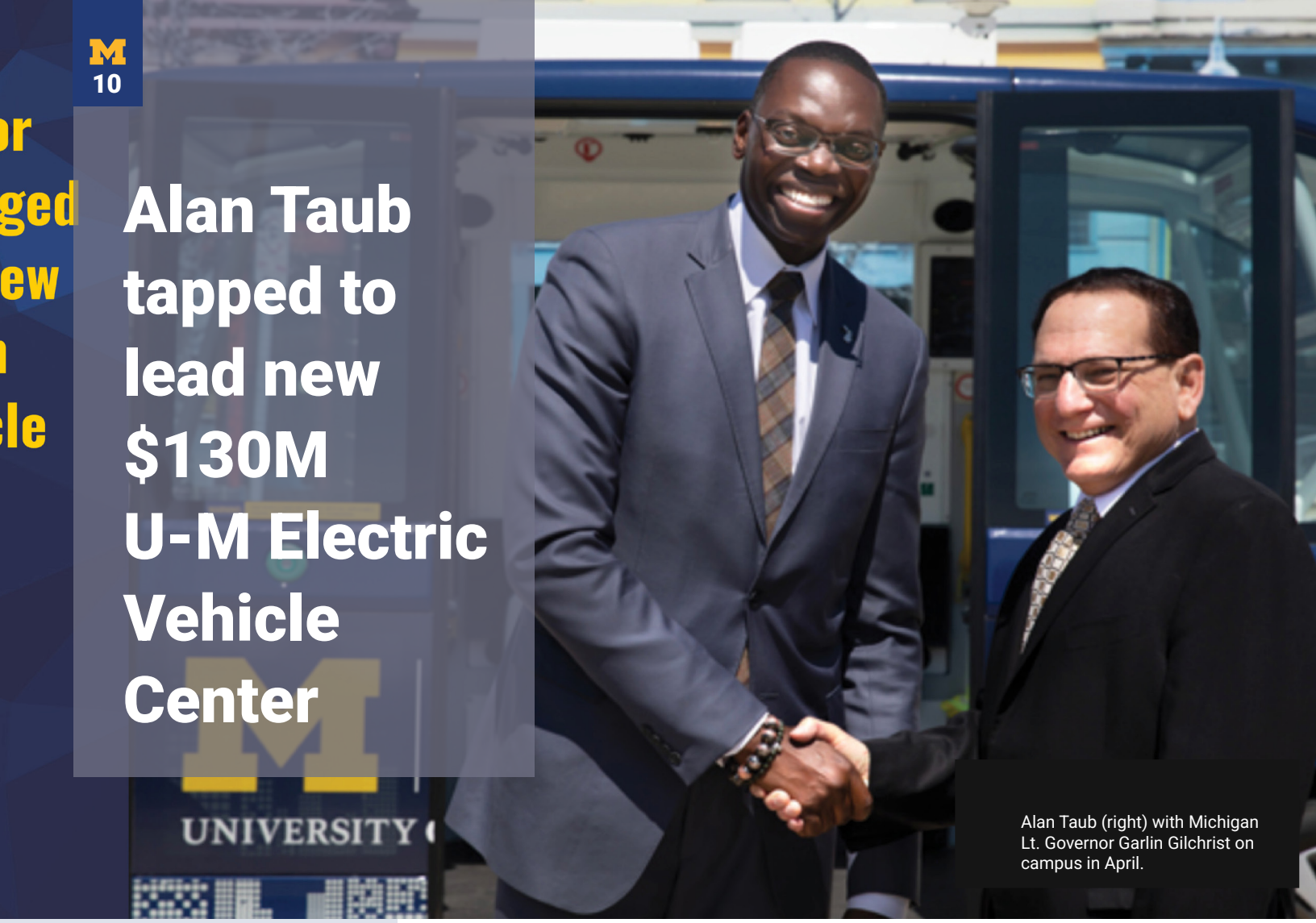
Amit Misra, the Edward DeMille Campbell Collegiate Professor of Materials Science and Engineering, has been named director of the Michigan Materials Research Institute (MMRI) and Michigan Center for Materials Characterization $(MC)^2$.

"I am excited to take on these new roles as director of MMRI and $(MC)^2$," said Misra. "Professors Alan Taub and Emmanuelle Marquis served as inaugural directors of MMRI and $(MC)^2$, respectively, and I thank them for their leadership in building the critical infrastructure that positions the University of Michigan to become a global leader in the interdisciplinary field of advanced materials."

Launched in 2019, the MMRI now includes170 members from all areas of campus and has become a central point of contact for federal agencies and industries. Misra, who served as MSE department chair from June 2014 to December 2022, succeeds founding MMRI director Alan Taub, Robert H. Lurie Professor of Engineering, who was recently tapped by the University to lead its new $130M Electric Vehicle Center (see pg. 10 for story).

PRISMS Center members who attended the workshop in August include (front row from left): Kyle Farmer, Duncan Greeley, Sambit Das, Amit Misra, John Allison (director), Ashley Bucsek, Sangwon Lee, David Montiel, and Brian Puchala. Back row: Mohammadreza Yaghoobi, Nick Armano, Katsuyo Thornton, Qianying Shi, Tracy Berman, Glenn Tarcea, Michael Pilipchuk, Vaidehi Menon, Anton Van der Ven, and Eunji Song.

Alan Taub tapped to lead new $130M U-M Electric Vehicle Center



Alan Taub (right) with Michigan Lt. Governor Garlin Gilchrist on campus in April.

"We're undergoing a redefinition of personal mobility in a way we haven't seen in a century. It requires changes to the vehicles, the infrastructure, consumer behavior, policy and more. We need academia, industry and government to work together to enable a smooth transition."

—Alan Taub

In an effort to cultivate a robust EV ecosystem in the place where the modern auto industry was born, the University of Michigan Electric Vehicle Center is launching with these three focus areas: accelerating collaborative R&D, developing a highly skilled workforce, and establishing advanced campus infrastructure and facilities to support both research and education.

U-M and the state have finalized the contract for the $130 million center. Michigan lawmakers approved funding for it last year in the FY 2023 budget.

"This prudent investment from the state is going to be pivotal in ushering in a mobility future that is sustainable, safe, and equitable for Michigan workers, our communities, and the nation," said Alec D. Gallimore, the Robert J. Vlasic Dean of Engineering, the Richard F. and Eleanor A. Towner Professor, an Arthur F. Thurnau Professor, and a professor of aerospace engineering.

"While the EV revolution is well underway, there's an immense amount of work to do in order to meet—and then push beyond—the US goal that half of new car sales be electric by 2030. We need to address areas like the workforce, cost, vehicle range, charging infrastructure and sustainability. Our center will build on more than a century of U-M leadership in transportation to tackle these and other critical areas."

To lead the center, Gallimore appointed Alan Taub, an engineering professor and former auto industry executive, as director. Taub previously served as vice president of global R&D at GM and held leadership roles at Ford and General

Electric. He has a track record of successfully launching public-private partnerships, including the $148 million Detroit-based Manufacturing USA Institute known as Lightweight Innovations for Tomorrow, or LIFT.

"We're undergoing a redefinition of personal mobility in a way we haven't seen in a century," said Taub, who also is the Robert H. Lurie Professor of Engineering. "It requires changes to the vehicles, the infrastructure, consumer behavior, policy and more. We need academia, industry and government to work together to enable a smooth transition."

"Southeast Michigan drove the evolution of mobility from the horse and carriage to affordable automobiles100 years ago. We have what it takes to do it again, but the stakes are as tremendous as the opportunity."

Michigan's workforce is among those most vulnerable in the EV transition. In a preliminary U-M study on how various automotive job categories could be affected,researchers found that Michigan, Indiana and Ohio hold more than half of the jobs in the most at-risk category of auto parts manufacturing.

Of all the auto-related job types examined, auto parts manufacturing has the highest number of positions directly tied to internal combustion engine technology—and is susceptible to downsizing. In those three states, 22% of all auto parts manufacturing jobs are vulnerable.

At the same time, Michigan is expected to see some of the highest growth in battery manufacturing capabilities by 2030, according to a report by Argonne National Labs that looked at where automakers and joint ventures are planning battery projects.

Workforce is one of the center's three focus areas, along with technology research and advanced campus facilities.

"Southeast Michigan drove the evolution of mobility from the horse and carriage to affordable automobiles100 years ago. We have what it takes to do it again, but the stakes are as tremendous as the opportunity."

—Alan Taub

MSE part of new $30M complex particle systems center

To bring nature's efficiency and flexibility to advanced materials and additive manufacturing, U-M will lead an international team of scientists, engineers and educators in a five-year, $30 million center funded by the National Science Foundation.

One of the major technological goals of the Center for Complex Particle Systems (COMPASS) is to design materials that are more than the sum of their parts and can be rapidly translated to manufacturing using 3D printing.

MSE-affiliated faculty who will play key roles include center director **Nicholas Kotov**, the Irving Langmuir Distinguished University Professor of Chemical Sciences and Engineering, who holds a courtesy appointment in MSE; **Sharon Glotzer**, the John Werner Cahn Distinguished University Professor of Engineering, Anthony C. Lembke Department Chair of Chemical Engineering, and professor of MSE (science lead); and **MSE Professor P. Ferdinand Poudeu** (knowledge transfer lead).

"Understanding and designing complex systems requires a diversity of knowledge, expertise, and ideas. COMPASS brings researchers from physics, chemistry, mechanical engineering, materials science and engineering, and applied math together with seven Michigan chemical engineering faculty to develop this new class of materials," said Glotzer.

Sharon Glotzer and Nicholas Kotov draw particle arrangements on the blackboard in Glotzer's office.

"It's like a barcode that's woven directly into the fabric of a garment.We can customize the photonic properties of the fibers to make them invisible to the naked eye, readable only under near-infrared light or any combination."

—Max Shtein

RESEARCH

Max Stein and Brian Iezzi analyze the fabric with photonic fibers woven into it.

Photonic Fibers Enable Invisible, Indelible Sorting Labels

New technology could be a game changer ifor clothing recycling

Less than 15% of the 92 million tons of clothing and other textiles discarded annually are recycled—in part because they are so difficult to sort. Woven-in labels made with inexpensive photonic fibers, developed by a team led by Professor Max Shtein, could change that.

"It's like a barcode that's woven directly into the fabric of a garment," said Shtein, corresponding author of the study in Advanced Materials Technologies. "We can customize the photonic properties of the fibers to make them visible to the naked eye, readable only under near-infrared light or any combination."

Ordinary tags often don't make it to the end of a garment's life—they may be cut away or washed until illegible, and tagless information can wear off. Recycling could be more effective if a tag was woven into the fabric, invisible until it needs to be read. This is what the new fiber could do.

Recyclers already use near-infrared sorting systems that identify different materials according to their naturally occurring optical signatures—the PET plastic in a water bottle, for example, looks different under near-infrared light than the HDPE plastic in a milk jug. Different fabrics also have different optical signatures, but Brian Iezzi, a postdoctoral researcher in Shtein's lab and lead author of the study, explains that those signatures are of limited use to recyclers because of the prevalence of blended fabrics.

"For a truly circular recycling system to work, it's important to know the precise composition of a fabric—a cotton recycler doesn't want to pay for a garment that's made of 70% polyester," Iezzi said. "Natural optical signatures can't provide that level of precision, but our photonic fibers can."

The team has applied for patent protection and is evaluating ways to move forward with the commercialization of the technology.

The research was supported by the United States National Science Foundation INTERN program (no. 1727894) and the Under Secretary of Defense for Research and Engineering under Air Force (no. FA8702-15-D-0001).

CRACKING

in lithium-ion batteries speeds up electric vehicle charging

Cracks in predominant lithium-ion electrodes shorten battery lifespans, but a neuroscience-inspired technique shows that they have an upside.

"On a road trip, we don't want to wait five hours for a car to charge. We want to charge within 15 or 30 minutes."

— Yiyang Li

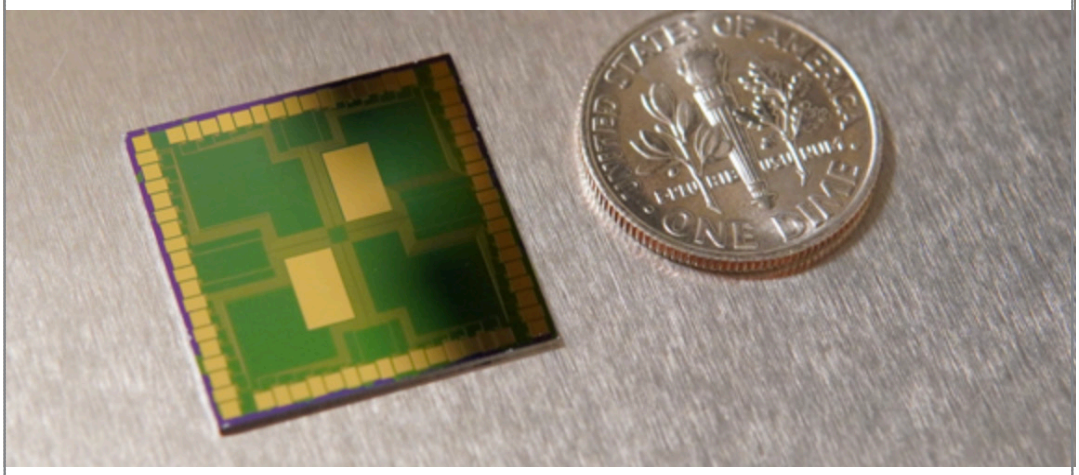
Rather than being solely detrimental, cracks in the positive electrode of lithium-ion batteries reduce battery charge time, research done in MSE Assistant Professor Yiyang Li's lab shows.

This runs counter to the view of many electric vehicle manufacturers, who try to minimize cracking because it decreases battery longevity.

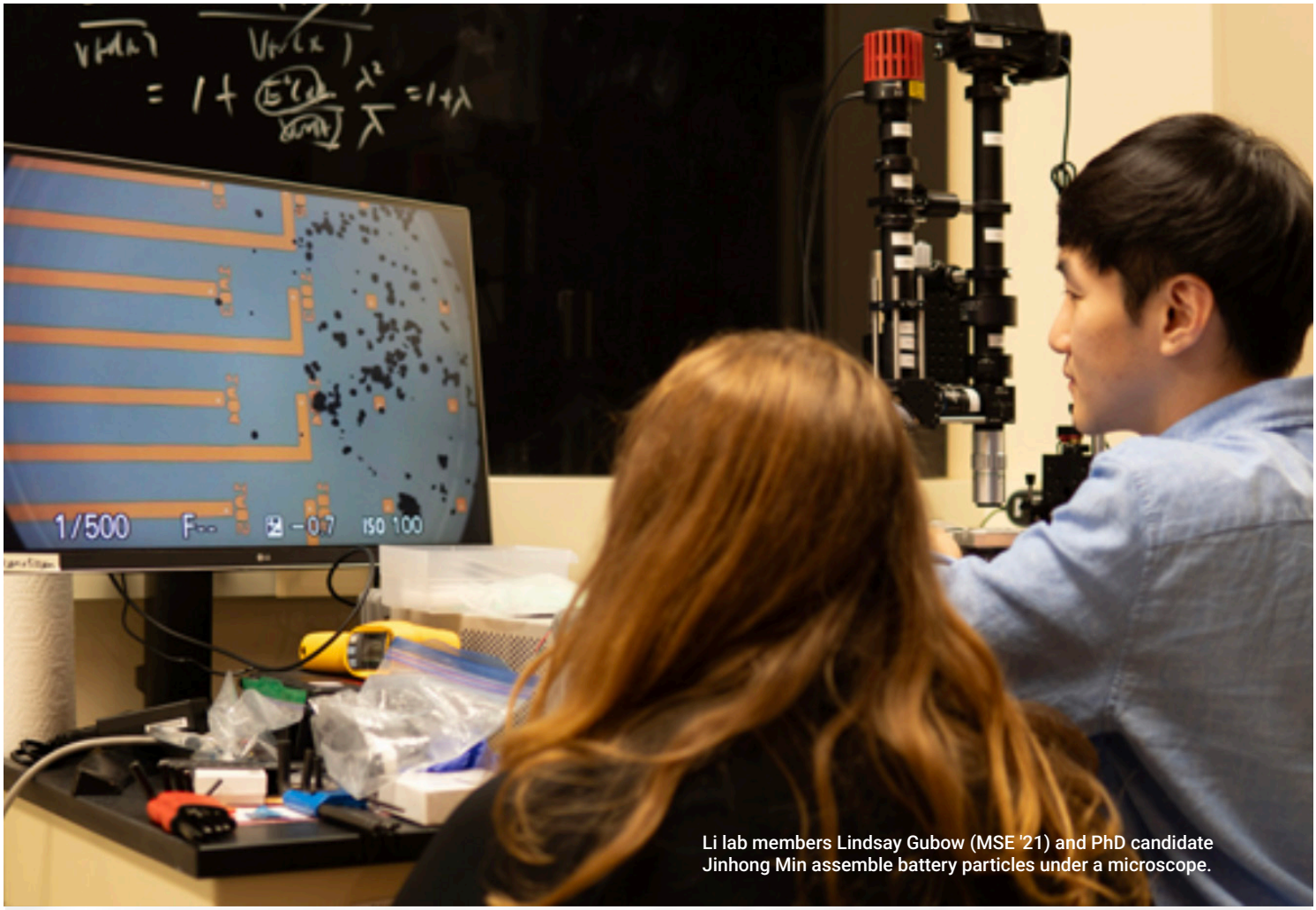
"Many companies are interested in making 'million-mile' batteries using particles that do not crack. Unfortunately, if the cracks are removed, the battery particles won't be able to charge quickly without the extra surface area from those cracks," said Li, a corresponding author of the study published open-access in Energy and Environmental Sciences.

"On a road trip, we don't want to wait five hours for a car to charge. We want to charge within 15 or 30 minutes," he added.

The team believes the findings apply to more than half of all electric vehicle batteries, in which the positive electrode—or cathode—is composed of trillions of microscopic particles made of either lithium nickel manganese cobalt oxide or lithium nickel cobalt aluminum oxide. Theoretically, the speed at



A custom-built multi-electrode array with 62 microelectrodes is about the size of a dime.



Li lab members Lindsay Gubow (MSE '21) and PhD candidate Jinhong Min assemble battery particles under a microscope.

which the cathode charges comes down to the particles' surface-to-volume ratio. Smaller particles should charge faster than larger particles because they have a higher surface area relative to volume, so the lithium ions have shorter distances to diffuse through them.

However, conventional methods couldn't directly measure the charging properties of individual cathode particles, only the average for all the particles that make up the battery's cathode. That limitation means the widely accepted relationship between charging speed and cathode particle size was merely an assumption.

"We find that the cathode particles are cracked and have more active surfaces to take in lithium ions—not just on their outer surface, but inside the particle cracks," said Jinhong Min, a doctoral student in materials science and engineering working in Li's lab. "Battery scientists know that the cracking occurs but have not measured how such cracking affects the charging speed."

Measuring the charging speed of individual cathode particles was key to discovering the upside to cracking cathodes, which Li and Min accomplished by inserting the particles into a device that is typically used by neuroscientists to study how individual brain cells transmit electrical signals.

The benefits of cracked materials are important to consider when designing long-lived batteries with single-crystal particles that don't crack. To charge quickly, these particles may need to be smaller than today's cracking cathode particles. The alternative is to make single-crystal cathodes with different materials that can move lithium faster, but those materials could be limited by the supply of necessary metals or have lower energy densities, said Li.

The research was funded by LG Energy Solution, Battery Innovation Contest and the University of Michigan College of Engineering. Other contributors included Lindsay Gubow, a former master's student in materials science and engineering, Riley Hargrave, an undergraduate in mechanical engineering graduating next year, and Jason Siegel, a research scientist in mechanical engineering.

MSE Assistant Professor Wenhao Sun and graduate student Joonsoo Kim show off dolomite rocks from their lab's collection. The two scientists have developed a theory that could finally explain a two-century old puzzle surrounding dolomite's abundance on Earth.

Sun team resolves 200-year-old geology mystery

To build mountains from dolomite, a common mineral, it must periodically dissolve. This counter-intuitive lesson could help make new defect-free semiconductors and more.

For 200 years, scientists have failed to grow a common mineral in the laboratory under the conditions believed to have formed it naturally. Now, a team of researchers from the University of Michigan and Hokkaido University in Sapporo, Japan have finally pulled it off, thanks to a new theory developed from atomic simulations.

Their success resolves a long-standing geology mystery called the "Dolomite Problem." Dolomite—a key mineral in the Dolomite mountains in Italy, Niagara Falls, the White Cliffs of Dover and Utah's Hoodoos—is very abundant in rocks older than 100 million years, but nearly absent in younger formations.

"If we understand how dolomite grows in nature, we might learn new strategies to promote the crystal growth of modern technological materials," said Wenhao Sun, the Dow Early Career Professor of Materials Science and Engineering at U-M and the corresponding author of the paper published today in *Science*.

The secret to finally growing dolomite in the lab was removing defects in the mineral structure as it grows. When minerals form in water, atoms usually deposit neatly onto an edge of the growing crystal surface. However, the growth edge of dolomite consists of alternating rows of calcium and magnesium. In water, calcium and magnesium will randomly attach to the growing dolomite crystal, often lodging into the wrong spot and creating defects that prevent additional layers of dolomite from forming. This disorder slows dolomite growth to a crawl, meaning it would take 10 million years to make just one layer of ordered dolomite.

Luckily, these defects aren't locked in place.

Because the disordered atoms are less stable than atoms in the correct position, they are the first to dissolve when the mineral is washed with water. Repeatedly rinsing away these defects—for example, with rain or tidal cycles—allows a dolomite layer to form in only a matter of years. Over geologic time, mountains of dolomite can accumulate.

To simulate dolomite growth accurately, the researchers needed to calculate how strongly or loosely atoms will attach to an existing dolomite surface. The most accurate simulations require the energy of every single interaction between electrons and atoms in the growing crystal. Such exhaustive calculations usually require huge amounts of computing power, but software developed at U-M's Predictive Structure Materials Science (PRISMS) Center offered a shortcut.

That shortcut made it feasible to simulate dolomite growth over geologic timescales.

"Each atomic step would normally take over 5,000 CPU hours on a supercomputer. Now, we can do the same calculation in 2 milliseconds on a desktop," said Joonsoo Kim, a doctoral student of materials science and engineering and the study's first author.

The few areas where dolomite forms today intermittently flood and later dry out, which aligns well with Sun and Kim's theory. But such evidence alone wasn't enough to be fully convincing. Enter Yuki Kimura, a professor of materials science from Hokkaido University, and Tomoya Yamazaki, a postdoctoral researcher in Kimura's lab. They tested the new theory with a quirk of transmission electron microscopes.

"Electron microscopes usually use electron beams just to image samples," Kimura said. "However, the beam can also split water, which makes acid that can cause crystals to dissolve. Usually this is bad for imaging, but in this case, dissolution is exactly what we wanted."

After placing a tiny dolomite crystal in a solution of calcium and magnesium, Kimura and Yamazaki gently pulsed the electron beam 4,000 times over two hours, dissolving away the defects. After the pulses, dolomite was seen to grow approximately 100 nanometers—around 250,000 times smaller than an inch. Although this was only 300 layers of dolomite, never had more than five layers of dolomite been grown in the lab before.

The lessons learned from the Dolomite Problem can help engineers manufacture higher-quality materials for semiconductors, solar panels, batteries and other tech.

"In the past, crystal growers who wanted to make materials without defects would try to grow them really slowly," Sun said. "Our theory shows that you can grow defect-free materials quickly, if you periodically dissolve the defects away during growth."

The research was funded by the American Chemical Society PRF New Doctoral Investigator grant, the U.S. Department of Energy and the Japanese Society for the Promotion of Science.

"If we understand how dolomite grows in nature, we might learn new strategies to promote the crystal growth of modern technological materials."

—Wenhao Sun

Guiding the Design of Silicon Devices with Improved Efficiency

"Ultimately, this work paves the way to understand and mitigate losses in silicon devices such as transistors or solar cells. Considering the size of these industries, even small improvements can lead to massive benefits."

—Associate Professor Manos Kioupakis

Emmanouil Kioupakis

Kyle Bushick

Silicon is one of the most pervasive functional materials of the modern age, underpinning semiconductor technologies ranging from microelectronics to solar cells. Indeed, silicon transistors enable computing applications from cell phones to supercomputers, while silicon photovoltaics are the most widely deployed solar-cell technology to date. The U.S. Department of Energy (DOE) reports that nearly 50% of new electric generation capacity in 2022 came from solar cells, and according to the International Energy Agency (IEA), silicon has a 95% market share. Yet despite silicon's undisputed importance to our modern way of life, many open questions remain about its fundamental physical properties.

With a new implementation of a computational methodology to accurately calculate AMR rates from first principles – that is using only the physical constants of the Universe and the atomic number of silicon as input – Dr. Kyle Bushick (PHD '23) and MSE Professor. Emmanouil Kioupakis have provided the first comprehensive characterization of this important recombination process in silicon. This computational approach is key to gaining a full understanding of the AMR mechanism, because it is a process that does not emit light, making it very difficult to study in the lab. With the aid of supercomputing resources at the National Energy Research Scientific Computing Center (NERSC) of Lawrence Berkeley National Lab, Bushick and Kioupakis were able to carry out the calculations of AMR in silicon, gaining insights to the behavior of the material at an atomic level.

In their report, published in Physical Review Letters, Bushick and Kioupakis unequivocally elucidate the importance of the phonon-assisted AMR process in silicon.

"We found that the electron-phonon interactions not only account for the entirety of the hhe process, which was hypothesized in previous works but never conclusively demonstrated, but also for a significant portion of the eeh process, a finding that had been a subject of unresolved debate in the literature," says Bushick, a recently graduated MSE PhD student and a DOE Computational Science Graduate Fellow. Furthermore, they highlight a potential pathway for altering AMR in silicon by applying strain to the material, a conclusion made possible by their newly implemented methodology.

This work provides a hitherto inaccessible fundamental understanding of an important intrinsic loss mechanism in the world's most important semiconductor. This understanding, which has eluded scientists for decades, can help design better devices with improved performance by reducing the occurrence of the undesirable AMR process.

"Ultimately, this work paves the way to understand and mitigate losses in silicon devices such as transistors or solar cells," commented Kioupakis. "Considering the size of these industries, even small improvements can lead to massive benefits."

$2M to Fast Track Stronger Alloys

Associate Professor Liang Qi is part of a team incorporating AI in its goal to make metal twice its current hardness.

Machine-learning could allow engineers to fast track the search for metal alloys that are both hard and tough. A U-M-led project—funded with $2 million from the National Science Foundation—aims to use this technique to double the hardness of the current record-holders.

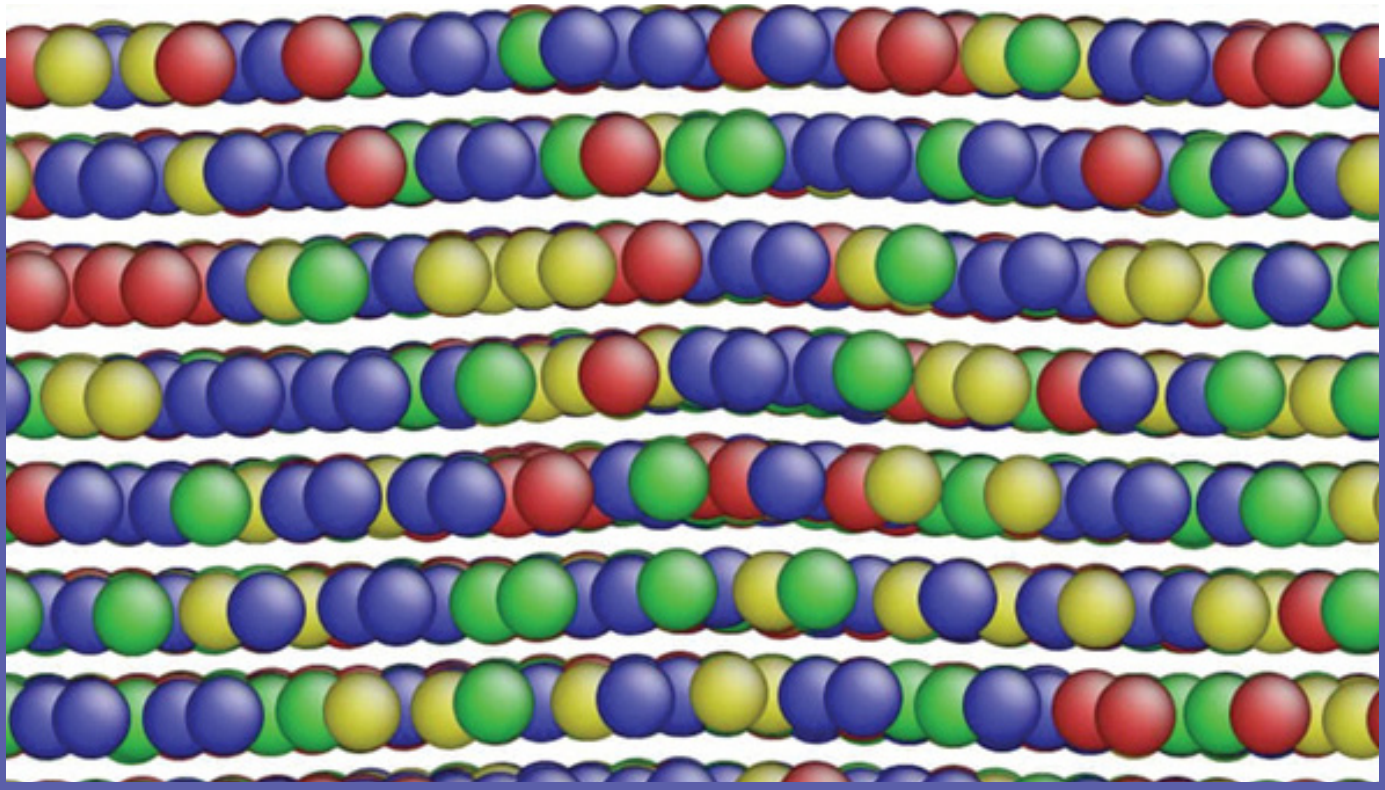
To make alloys both hard and tough, engineers need to tune the composition and arrangement of metals in the alloy. Exhaustively manufacturing and testing each of the many thousands of possible metal combinations slows alloy discovery to a seemingly glacial pace. Now, the team of researchers at U-M, Arizona State University and the University of North Texas will use a combination of machine-learning predictions, experimentation and simulation to speed up the process.

"We want to know how to change an alloy's atomic structure to increase strength and the manufacturing conditions required to make those alloys at large scales. But, the number of variables is too high," said Liang Qi, one of the project's principal investigators and an associate professor of materials science and engineering at the University of Michigan. "It is impossible to test them by trial and error. The beauty of AI is that we can find the best solution without testing every combination."

Pushing alloy strength in this way could enable more fuel-efficient vehicles.

"If your car or airplane is lighter, it requires less fuel to move, but you still want the vehicle to be strong," said Qi. "With stronger alloys, you can potentially use less material but withstand the same amount of force." Stronger metals also likely withstand higher temperatures, which could allow jet engines to burn fuel hotter and more efficiently, Qi added.

The project began this fall and is part of a larger $72.5 million investment by the National Science Foundation to design new materials.



Colored circles represent atoms of different metals in this model simulation of an alloy. Some rows of metal atoms in the alloy's structure are bending due to natural imperfections in the alloy's structure. How these imperfections move under stress and strain could impact an alloy's strength, which is why the collaborative research team is visualizing them with both microscopy and simulations to train their machine-learning model how to predict alloy strength.

ICMEd Summer School back in session

"...The two-week duration of the summer school is long enough to build long-lasting relationships among the participants at different stages in their career from a wide range of academic institutions."

—Katsuyo Thornton

Thirty participants from around the globe attended the 9th Integrated Computational Materials Education (ICMEd) Summer School June 12-23, the first in-person session since the pandemic.

Led by MSE Professor Katsuyo Thornton, Associate Professor Liang Qi and Assistant Professor Wenhao Sun, the two-week program included a crash course on computational MSE and focus sessions on educational modules that could be adopted into into undergraduate courses on thermodynamics, kinetics, mechanics, and physics of materials.

The first week of the session was dedicated to lectures by the instructors, as well as the overview of modules, and the second week was designed to allow participants to work on their pedagogical skills in the area of computational materials science. The opportunity to practice their teaching skills in the second week is the key to building confidence. A survey conducted during the second week showed that participants' confidence rose drastically, from 42% to 92%, after the teaching practice sessions.

It was just one of the many benefits participants experienced after attending ICMEd Summer School.

"The participants can develop their network, not just by getting to know well established researchers, but also by getting to know the colleagues with whom they will grow in their careers," said Thornton. "While this is true of any type of meeting or conference, the two-week duration of the summer school is long enough to build long-lasting relationships among the participants at different stages of career from a wide range of academic institutions."

"This is the best learning/training experience in the past 19 years of working after graduation," commented Kevin Qu, an aerospace engineer in Segundo, Calf. "The contents taught are extremely useful for my work. The interaction

Left: ICMEd Summer School director **Katsuyo Thornton** leads a module on computational mechanics. Above: Summer school participants take in a lecture on computational thermodynamics.

PhD candidate **Chao Huang** poses with three REU students who worked in the Shtein lab this summer.

MSE labs host summer Semiconductor REU

For 10 weeks this past summer, 16 undergrads from around the country came to North Campus to work on projects related to semiconductors—materials, devices, circuits and systems. The REU was co-sponsored by Intel.

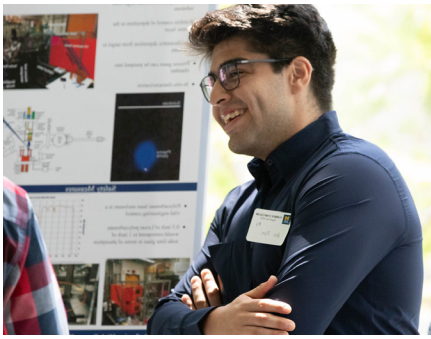
MSE professors who hosted students in their labs included Assistant Professor Yiyang Li, Associate Professor Geeta Mehta, and Professor Max Shtein.

"It was wonderful to see these students obtain hands-on research experience in MSE labs here at the University of Michigan," commented Li. "The students were also very cohesive, often planning activities like going to dinner and even weekend excursions by themselves."

The culmination of the program was a special joint symposium with NSF/SRC Michigan Semiconductor Hands-On Research Experience (M-SHORE) REU program that featured posters and lightning talks about their summer research.

"It was an amazing way to end the REU programs," commented ECE Associate Professor Becky Peterson, one of the PIs of the M-SHORE REU program. "This cohort did incredible work and we can't wait to see their future success!"

In Summer 2024, U-M is hosting another REU program with a three-prong focus on 2D materials, sustainable polymers, and electric vehicles. For more information, go to https://reu.engin.umich.edu



"It was so gratifying to see these students obtain hands-on research experience in our MSE labs."

—Yiyang Li

"I thank the Pehlke family for funding this event, which allows us to celebrate the memory and passions of Professor Pehlke, an individual who had a passion for industry, for creativity, and for making an impact on people's lives."

—Yoel Fink, MIT

MIT's Yoel Fink headlines Pehlke Lectureship in April

This year's Robert D. Pehlke Lectureship in Materials Processing was held April 6-7 and featured MIT professor Yoel Fink, a leader in innovative biomaterials.

At the dinner event on Thursday, April 6, Amit Misra (former MSE chair who was filling in for chair Liz Holm) presented the official awards to Fink, who in turn spoke words of gratitude to the Pehlke family: "I thank the family for funding this event, which allows us to celebrate the memory and passions of Professor Pehlke, an individual who had a passion for industry, for creativity, and for making an impact on people's lives."

The next morning, Fink presented a lecture, "Towards Computing Fibers and Fabrics" to a packed audience in Dow, in which he shared his history and excitement for fibers and fabrics that incorporate technology..He began by answering the quesiton, "Why fabrics?"

"Perhaps he most valuable real estate on the planet is the most underappreciated --- and that is the surface of our bodies, " he said. "Our bodies are beacons, broadcasting information 24/7."

Important insights, he maintains, would be revealed if only fabrics could capture this information.

As an example, Fink talked about fabrics monitoring our health for small changes, say, a fabric fitted with a sensor that could continuously monitor a fetal heartbeat and let a mom or her doctors know if the baby is okay.

Additionally, he cited an advanced optical identification system, where you can identify people from a distance, which could be useful for military operations. He also cited applications for helping hearing loss and optical surgical procedures.

"We're headed to a future where our fabrics are a computational environment," he said in conclusion. "We're not far from realizing that vision."

Professor Max Shtein introduces Yoel Fink, whom he called an "all-around insightful person," at the Pehlke Dinner on April 6.

“Professor Haile is a pioneer in solid state ionics with batteries and fuel cells. Her lectures left us more enlightened, inspired and, best of all, hopeful for the future."

—Katsuyo Thornton, L.H. and F.E. Van Vlack Professor of Materials Science & Engineering

Van Vlack Lectureship

Sossina Haile of Northwestern shares her expertise with solid state ionic materials as the 2023 Van Vlack Lecturer

This fall we were pleased to host Northwestern professor Sossina Haile as our 2023 Van Vlack Lecturer. On October 26, Haile presented a public lecture, "Electrochemical Energy Technologies Enabled by Superprotonic Conductors: Pathways to a Sustainable Future," which presented a hopeful outlook for a sustainable energy future.

"The good news is we have a lot of non-fossil resources available to us – including geothermal and solar – which could more than cover the global demand for electricity," she said."

The next morning, Haile presented a technical lecture, "Towards Computing Fibers and Fabrics" in Beyster.

“We were honored to have Sossina Haile as our 2023 Van Vlack Lecturer,” said Katsuyo Thornton, the L.H. and F.E. Van Vlack Professor of Materials Science & Engineering. “Professor Haile is a pioneer in solid state ionics with batteries and fuel cells. Her lectures left us more enlightened, inspired and, best of all, hopeful for the future.”

Katsuyo Thornton (right), the L.H. and F.E. Van Vlack Professor of Materials Science & Engineering, presents Sossina Haile with the 2023 Van Vlack Lectureship Award at the Van Vlack Dinner event October 26.

2023-24 Undergraduate Student Scholarships

Nathaniel L. Field Scholarship
Aaron Cooke, Edward Spengler

Richard A. Flinn Scholarship
Andrew Danbury

Fontana-Leslie Scholarship Fund
Gabrielle Grey

James W. Freeman Memorial Scholarship
Liam Cotter, Bao Vo

John Grennan Scholarship
Eli Rotman

Jack J. Heller Memorial Engineering Scholarship Fund
Amanda Diddams

William F. Hosford Scholarship
Leah Fleming, Megan Klein, Raj Koorapaty, Rishabh Kothari, Nina Perry, Denise Schlautman, Matthew Walker, Katie Wei

Schwartzwalder Memorial Scholarship
Erdem Ozdemir, Rachel Rajkumar

Clarence A. Siebert Memorial Scholarship
Alexa Goldstein

Alfred H. White Memorial Scholarship
Abigail Ahn, Zeyuan Hu, Reegan Ketzenberger

Senior Virgil Watkins (now pursuing a PhD in MSE at MIT) competes on the paralletl bars during the last U-M home meet on March 18.

Senior Virgil Watkins: Unparalleled Performance

Growing up in an athletic household in Ann Arbor, **Virgil Watkins** (whose dad, Ra-Mon Watkins, played football for U-M 1986-1991) said that through the years his parents put him and his four siblings in a variety of different Rec & Ed sports: basketball, baseball, soccer, gymnastics, and others. Over time he would inevitably quit them all, except one: gymnastics.

"I think what kept me interested in the sport was its emphasis on perfection," Watkins explains. "You can spend so much time trying to perfect a singular skill and once you feel like you've perfected it, there are even harder skills to try. To this day that is my favorite aspect of the sport, chasing that feeling of perfection."

Striving for perfection applies to his studies as well. During his career as a U-M gymnast, Watkins (whose main apparatus is the parallel bars) has earned Academic All-Big Ten honors, 2021-2023, and was named a Big Ten Distinguished Scholar in 2022. In the fall Watkins plans to attend graduate school to pursue research on electronic properties of materials. To that end, he applied to the Top 8 MSE programs in the country. He was accepted at all eight.

"Virgil has absolute mastery of all core materials science concepts, and once even solved a problem that stumped me for almost ten years," remarked Assistant Professor Yiyang Li.

Though Watkins originally thought he wanted to be an aerospace engineer, his plans changed after taking MSE220.

"That class was my first exposure to MSE, and I enjoyed it so much I decided at the end of my second semester that I wanted to be a materials engineer," Watkins says.

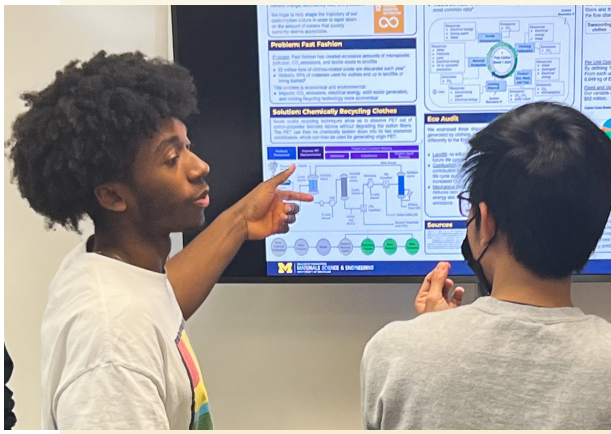
If you think it's rare to hear of a student athlete majoring in materials science (or any engineering major, for that matter), that's because it is. The rigors of an engineering curriculum are extraordinarily hard to balance with the demanding schedule of a Division I sport.

Watkins attributes his ability to balance gymnastics and his challenging MSE courses came down to two key components: proper planning and discipline. He breaks down his weekly game plan during the gymnastics season: "Almost every Sunday after figuring out what assignments I need to complete and the exams I need to study for, I look at my calendar to find times to do them," he explains. "After that, it's just sticking to the plan I set out at the beginning of the week and executing on it."

If there's one thing that Watkins feels he's gained being a student athlete, it's really valuing time.

"During my years here, I've learned to value and maximize my time to the fullest," he says. In addition, I value the time I get to spend with my friends and family more than ever now."

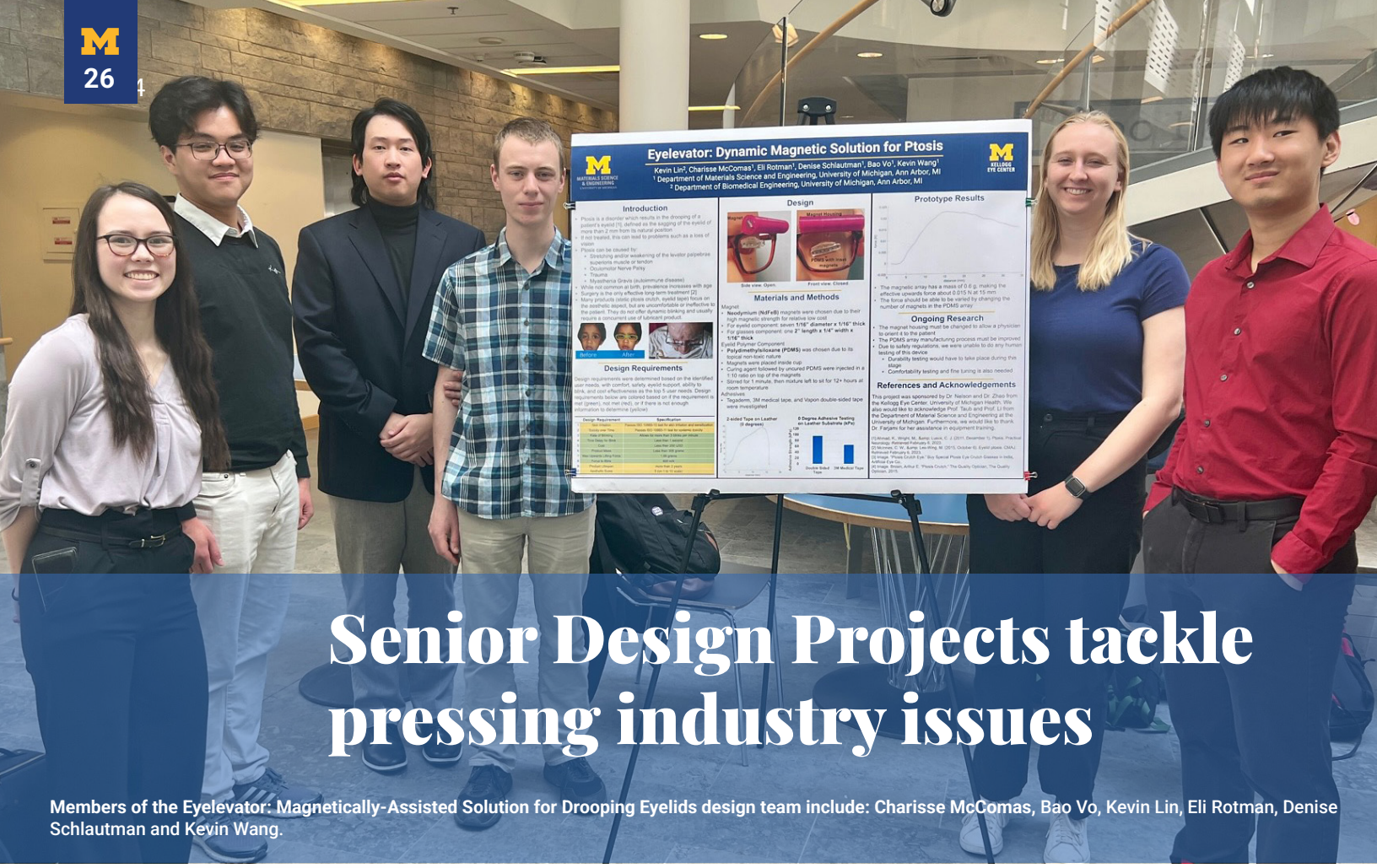
Watkins is now spending time at MIT as a graduate student. Beyond that, but rest assured that whatever he chooses to do, Watkins will stick the landing.



Virgil Watkins explains his team's research project in MSE 481 last fall.

"Virgil has absolute mastery of all core materials science concepts, and once even solved a problem that stumped me for almost ten years."

—Yiyang Li



Senior Design Projects tackle pressing industry issues

Members of the Eyelevator: Magnetically-Assisted Solution for Drooping Eyelids design team include: Charisse McComas, Bao Vo, Kevin Lin, Eli Rotman, Denise Schlautman and Kevin Wang.

"We are very excited that every MSE undergrad had the opportunity to work with an industry partner on their capstone design project. The students did a fantastic job applying their knowledge across diverse industries, including automotive, semiconductors, energy, and consumer products."

—Yiyang Li, co-instructor

This year eight teams worked with industry partners to design innovative solutions to problems ranging from product packaging to drooping eyelids.

1

Examining Electrolysis Failure Modes and Making Green Hydrogen a Reality

Industry partner: EvolOH

Team: Dekota Thies, Laszlo Cline, Austin Lan, Nina Perry, Erdem Ozdemir

2

Hidden Polymer Actuators for Automotive Interiors

Industry partner: Ford

Team: Druva Krishnaswami, Gillian James, Elliott Gorishek, Ryan Blackburn, Maheshwari Kakade, Raj Koorapaty

3

That's a Wrap: 100% Recyclable Packaging

Industry partner: General Mills

Team: Kellie Chu, Alia Cummings, Kalyn Fuelling, Falon Fletcher, Jonah Berman

4

Additive Manufacturing for Aftermarket Window Regulator Parts

Industry partner: Hi-Lex

Team: Harrison Biggs, Jenny Chong, Alex Dewey, Andrew Ray, Rohan Somashakara

5

Eyelevator: Magnetically-Assisted Solution for Drooping Eyelids

Industry partner: Kellogg Eye Center

Team: Kevin Lin, Bao Vo, Kevin Wang, Eli Rotman, Denise Schlautman

6

Investigating Aluminum ConFlat Flange Durability

Industry partner: KLA Corp

Team: Jason Landini, Xander Mensah, Matthew Walker, Konnor Walter, Josh Willwerth, Allen Zhao

7

Characterizing a Sustainable Polymer Composite Alternative for Automotive Interiors

Industry partner: Eaton

Team: Mackenzie Darling, Leah Fleming, Caleb Phelan, Rachel Rajkumar, Robert Tubman, Katie Wei

8

Heat Treatment of High Strength Aluminum 7075 Sheets for Automotive Body Applications

Industry partner: General Motors

Team: Aaron Cooke, Megan Klein, Drew McCreadie, Eddie Spengler, Isaiah Stokes, Gillian Tubay

Falon Fletcher attends NSBE Conference in Kansas City

MSE senior Falon Fletcher attended the National Society of Black Engineers (NSBE) Conference in Kansas City in

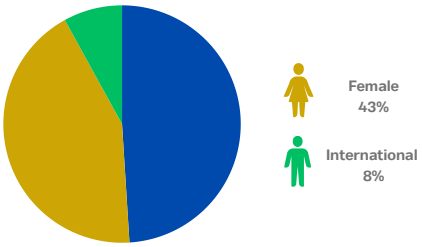
"It was a joy to network with other individuals of similar background and collectively improve our professional skills," Fletcher said. "The opportunity to attend the career fair was particularly rewarding as I had three interviews and made connections with potential employers."

The 49th Annual Convention is a four-day constitutional event with over 10,000 attendees and a 300+ company career fair with numerous networking opportunities.

"I would like to thank the MSE department and alumni for the funding that allowed me to partake in the trip," Fletcher commented. "Black Engineering Conference was an unforgettable experience of personal and professional growth."

Student Statistics

UNDERGRADUATE 91

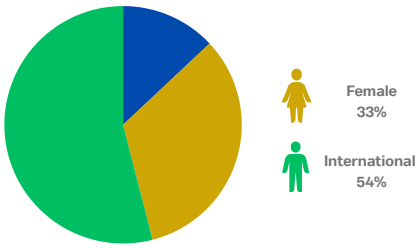


DOCTORAL STUDENTS 119

MASTER'S STUDENTS 47

SUGS STUDENTS 11

177 Total

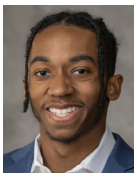


Four undergrads receive NSF Awards

Kalyn Fuelling (Dasgupta group), now at MIT, researches bimetallic Cu catalysts made from Al and Fe to create a more cost-effective CO_2RR catalyst

Rishabh Kothari (Yalisove group) , now at MIT, is working to achieve smaller, faster, and more energy-efficient transistor technology.

Emily Rennich (Hovden group), designed an ultra-low-temperature TEM sample holder to increase capabilities of electron microscopes.



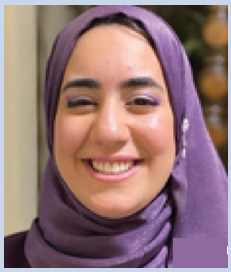
Virgil Watkins (Li group), now at MIT, studies the volatility of analog memory states in oxygen-vacancy based ECRAM devices.

2023 Graduate Student Special Award Winners

NSF - Graduate Research Fellowship Program

Jason Manassa
(Hovden group)

Victor Vogt
(Dasgupta group)



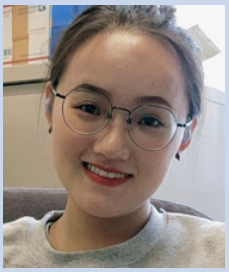
Rameen Ahmad
(Mehta group)

Madeline Eiken
(ME major in Loebel group)

Rackham and College of Engineering Awards

Paul Bushick
(Kioupakis group)
Towner Prize for Distinguished Academic Achievement/ Towner Prize for Outstanding PhD Research

Paul Chao
Shahani group)
J. Robert Beyster Computational Innovation Graduate Fellowship



Chuqi Huang
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Chia-Lun Lo International Student Fellowship

Juwon Lim
(Reddy group)
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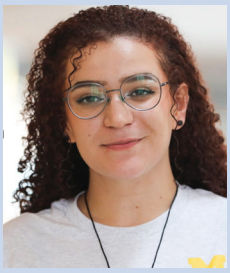
Alex Moy
(Sakamoto group)
Rackham Predoctoral Fellowship

DOE ~ NASA ~ National Defense

Hailey McKenna
(Goldman group)
Department of Energy (DOE) Office of Science Graduate Student Research (SCGSR) award



Celeste Perez
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NASA Speace Technology Graduate Research Opportunity (NSTGRO)

Amanda Wang
(Kioupakis group)
National Defense Science and Engineering Graduate (NDSEG) Fellowship

MRS Graduate Student Award

Jingxian Li
(Li group)

Jinhong Min
(Li group)

2023 MSE Fellowship Recipients

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Gillian James
Zoe Meyer

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Sangwok Bae
Adam Eichhorn
Davy Zeng
Jierui Zhao
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CoE Graduate Fellowship
Yerin Hong
Zhengtao Hu
Konnor Walter

Robert D. and Julie A. Pehlke Fellowship
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Rackham Merit Fellowship
Caroline Harms
Lucero Lopez

Rackham Block Grant Fellowship
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Yi Liang
Prottay Malakar
Alexander Mensah
Abrar Rauf
Andrew Ray
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Frederick N. Rhines Fellowship
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Alexis Luglio

MSE

Congratulations to all our 2023 graduates!

Undergraduate (B.S.E.)

Jonah Berman
Kameron Betz
Harrison Biggs
Jenny Chong
Kellie Chu
Laszlo Cline
Aaron Cooke
Alia Cummings
Mackenzie Darling
Alexandra Dewwey
Leah Fleming
Falon Fletcher
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Gillian James
Megan Klein
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Erdem Ozdemir
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Eli Rotman
Denise Schlautman
Edward Spengler
Isaiah Stokes
Dekota Thies
Gillian Tubay
Bao Vo
Matthew Walker
Konnor Walter
Kevin Wang
Virgil Watkins
Kaie Wei
Joshua Willwerth
Allen Zhou

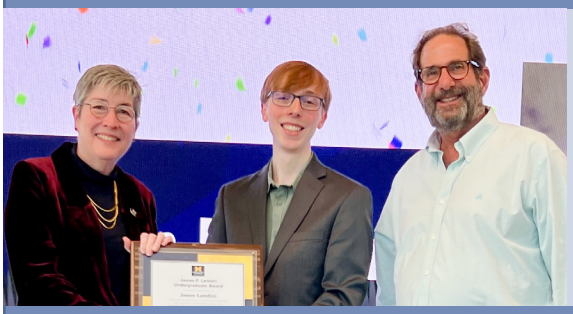
Master's (M.S.E.)

Ahmad Matar Abed
Nishkarsh Agarwal
Attri Bezbaruah
Yi-Hua Chen
Sicen Du
Rain Fredericks
Ryan Gast
Arkajit Ghosh
Zhengtao Hu
Ariba Javed
Benjamin Justus
John Kim
Ching-Yen Lee
Qinyi Liu
Hailey Lovelace
Emily MacInnis
Kate Moo
Daniele Fatto Offidani
Tzu-Yu Ou
Jaime Perez Coronado
Caleb Phelan
Sahana Prabhu
Ziyuan Qin
Krystal Quinn
Avinava Roy
Taylor Repetto
Tathya Shinde
Shibo Tan
Amanda Wang
Yu-Chen Yang
Jierui Zhao
Lingfeng Zhou

Ph.D

Taylor Brandt
Kyle Bushick
Veronica Caro
Brandon Carter
Paul Chao
Randy Cheng
Vishwas Goel
Duncan Greeley
Guanglong Huang
Yiqiao Huang
Anshul Kamboj
Kamruzzaman Khan
Amy Langhorst
Julia Lenef
Anita Li
Juwon Lim
Geordie Lindemann
Hongling Lu
Boning Qu
Jonathan Schwartz
Anshul Singhal
Suk Hyun Sung
Thomas Valenza
Ray Watkins
Daniel Yin
Xiaoyang Zhong

2023 Graduation Awards



James P. Lettieri Award:
Jason Landini

Brian Worth Prize:
Virgil Watkins

Alpha Sigma Mu Distinguished Award:
Alexandra Dewey

MMS Anvil Award:
Denise Schlautman

MMS Distinguished Award:
Elliott Gorishek

Opposite page: MSE graduates in 2023 include (top) undergraduate Virgil Watkins at the CoE graduation exercises on April 28 and PhD graduate Vishwas Goel (with his momadn fiancee) at the U-M Commencement on December 17.

The traditional undergraduate and graduate awards were presented at the MSE Graduation Awards Dinner on April 27 at the Robotics Building. Underge

Graduate Student Council (GSC): Avinava Roy (2nd year PhD rep) Forrest Wissuchek (secretary), Hailey Lovelace (treasurer), Julia Lenef (5th year PhD rep), Alex Moy (4th year PhD rep), Catherine Haslam (3rd year PhD rep), Tolu Lawal (GEO), Tathye Shinde (2nd year MS rep). Not pictured: Loulou Batta (president), Tiernan Baucom (1st year PhD rep), Emily MacInnis (1st year MS rep).

Graduate Service Award for Recruiting: Nicholas David and Ellery Hendrix. Not pictured: Tiernan Baucom.

First to Publish Award: Zijing Zhang (Laine group): "Further Proof of Unconventional Conjugation via Disiloxane Bonds: Double Decker Sesquioxane [vinylMeSi(O0.5)2(PhSiO1.5)8(O0.5)2SiMevinyl] Derived Alternating Terpolymers Give Excited-State Conjugation Averaging That of the Corresponding Copolymers," Macromolecules, September 13, 2022

Marcus Collins (BSE '02) 2023 MSE Alumni Merit Award Recipient

"Even though I've done different careers and studied different things, the overarching thing I've focused on is networks, and I leaned about the dynamics of networks here. Though I don't work in materials science directly, I see the world as an engineer."

—Dr. Marcus Collins

Collins, a clinical professor of marketing at Ross, gave a special talk detailing his unique career path to MSE students and faculty on September 22.

An MSE alum who once worked as digital strategist for Beyonce? If nothing else, this year's MSE Alumni Merit Award winner, Marcus Collins (BSE '02), proves that MSE alums really can do it all! Now a clinical professor of marketing at U-M's Ross Business School, Collins has had a remarkable career in media and marketing - including working at a New York ad agency started by Jay-Z and contributing to the national McDonald's "favorite order" campaign. But, as unorthodox as his career has been, Collins attributes his career success to his MSE training as an undergraduate.

"Even though I've done...different careers and studied different things, the overarching thing I've focused on is networks, and I learned about the dynamics of networks here," Collins explained. "Though I don't work in materials science directly, I see the world as an engineer. Engineers are all about framing the world to solve problems -- taking what we know about systems that make up the world and subverting them to get a certain outcome."

Seeing the world's networks was his overall message to students in his closing comments: "What you do when you leave here, who knows? What's more important is that you learn how to see the world and understand the underlying physics that make the world move so you can bend the world the way you want it to. The opportunities are endless."

Right: Dr. Marcus Collins (second from left) accepts his 2023 MSE Alumni Merit Award from Grace Hsia, an MSE alumna and chair emeritus of the Michigan Engineering Alumni Board, MSE chair Liz Holm, and CoE interim dean Steve Ceccio on September 22.

Alums making news

Jack Hu featured in Forbes' '30 Under 30' List

Jack Hu (BSE '15) was one of the entrepreneurial changemakers featured in Forbes Magazine's recent '30 Under 30' list in the Healthcare category. Hu is the cofounder of Pumpkinseed, which is developing a high-resolution, high-throughput protein sequencing platform. Its technology is using light as a "universal reagent" to pull information from proteins and sequence them. Hu developed the foundational technology during his Ph.D. in materials engineering at Stanford, and the company has raised $5.8 million in funding.

Chris Soles receives MSE's 2023 Distinguished Alumni Award

Dr. Christopher L. Soles (BSE '93 and PHD '98), a materials research engineer in the Materials Measurement Laboratory at the National Institute of Standards and Technology (NIST), came to campus to receive his Distinguished Alumni Award at the 2023 MSE Graduation Awards Dinner on April 27.

Garcia-Mèndez joins Johns Hopkins faculty

In September, **Dr. Regina Garcia-Mèndez (PHD '20)** joined the MSE faculty at Johns Hopkins University as an assistant professor.

Bushick earns NERSEC Early Career Award

Dr. Kyle Bushick (PHD '23), currently a postdoc at the Lawrence Livermore National Lab, was recently honored with a NERSC Early Career High-Impact Scientific Achievement Award for developing a novel computational methodology to calculate the Auger-Meitner recombination rates in silicon.

Kuo pres-elect of TERMIS

Dr. Catherine K. Kuo (BSE '97), an associate professor of bioengineering at the University of Maryland, was named President-Elect of the Tissue Engineering and Regenerative Medicine International Society, Inc. (TERMIS), Americas Chapter. Her term began Jan. 2024.

Alumni deaths

1939
Ralph L. Freeman

1949
John B. Campbell
Jeremy V. Gluck

1955
Leonard (Larry) G. Miller

1956
Harold H. Stier

1961
Leon F. Norris

1963
Michael J. Weins

1964
Kenneth D. Betz

1966
David M. McCann

1967
Kenneth L. Hunt

1968
Branimir Botic

1983
Phillip A. Simpson

2007
Katelyn B. Howay

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Following is a list of our generous donors from 2018-2022, organized by giving category.

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Seniors Sabrina Huynh, Alexa Goldstein, Aaryan Patel, and Laura Bond enjoy a barbecue dinner at the MSE Welcome Back Picnic on August 31 in Gallup Park.

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Kenneth and Judy Betz
Kenneth D. Betz Trust

Nathaniel L. Field Materials Science and Engineering Scholarship Fund for Metals Research
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Kyle Luck and Heather Arnold
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(Cont'd on pg. 36)

(Cont'd from pg. 35)

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Chip Keough, Ron Gibala, Monica Misra, Amit Misra, Liz Holm and Nancy Keough enjoy the opprtunity to mingle at the MSE Welcome Back Picnic at Gallup Park on August 31.

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Diann Moore
John Moore
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MSE seniors, faculty and staff at the 2023 Graduation Awards Dinner on April 27.

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Hail to the Victors!

Like the rest of campus, MSE enjoyed the 15-0 season of the 2023 football team — from rushing the field after defeating Ohio State on Nov. 25 to squeaking by Alabama at the Rose Bowl on Jan. 1 to clinching the national championship in Houston on January 8. It's been quite an exciting ride that has everyone on campus thinking and feeling "It's great to be a Michigan Wolverine!"

Above left: MSE grad students Tathya Shinde, Marcel Chlupsa and Forrest Wissuchek celebrate in the Big House following the Wolverines' victory against Ohio State on Nov. 25. Above right: Despite frigid temperatures, thousands lined State St. on January 13 for a special parade to celebrate the 2023 national championship team.

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