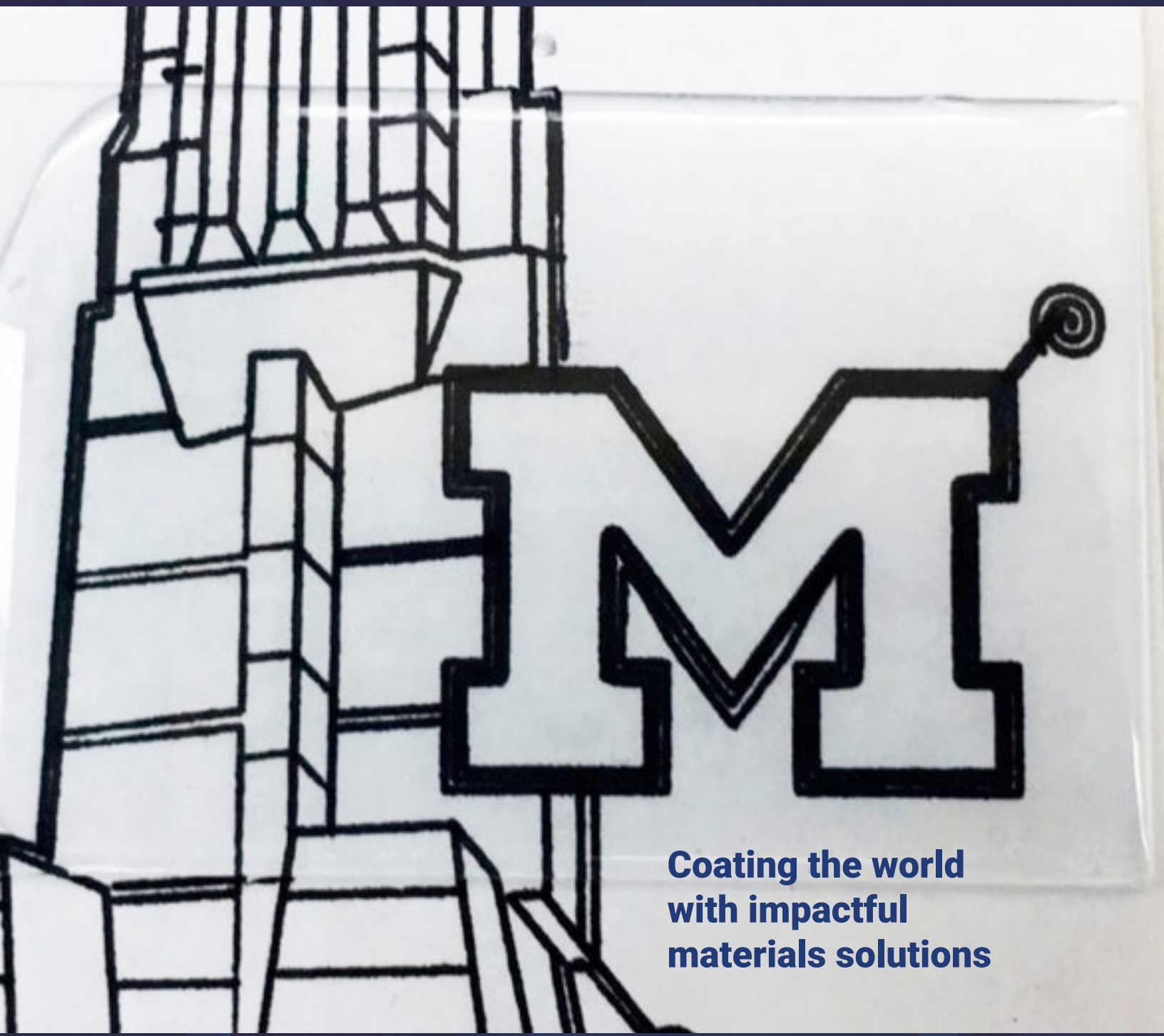
MSE*news*

COLLEGE OF ENGINEERING
MATERIALS SCIENCE & ENGINEERING
UNIVERSITY OF MICHIGAN

Winter 2023



Coating the world with impactful materials solutions

Table of Contents

Materials Science & Engineering
3062 H. H. Dow Building
2300 Hayward Street
Ann Arbor, MI 48109-2136
734.763.2445
mse.engin.umich.edu

Department Chair
Elizabeth Holm

***MSE News* Editor**
Kristen Freshley

Contact
mse-newsletter@umich.edu

Connect with us!

@ummse

Linkedin.com/groups/3849299/profile

Front cover: The image remains clear even through a thick layer of the antimicrobial coating.
Image: Anish Tuteja

Image below: Visualization of a single channel from the VGG16 classification model that is highly activated when an image of ultra high carbon steel microstructure is passed through the model.
Image: Kyle Farmer, Holm group

Holm *takes the* Helm

MSE welcomed alumnus Elizabeth (Liz) Holm back to the department effective January 1—this time as a professor and department chair.

Holm earned a dual PhD (1992) in Materials Science and Engineering and Scientific Computing and a BSE (1987) in Materials Science and Engineering at Michigan Engineering, as well as an SM in ceramics from MIT in 1989.

"U-M is my home place, and I'm energized by the opportunity to bring back what I've learned and contribute to the continuing evolution of MSE," Holm said. "My highest priority is to support an inclusive community where every individual can excel."

Today, her research focuses on the intersection of data science and materials science. Her lab works to identify useful concepts from data science including machine learning, computer vision, evolutionary computing and network analysis and develop them to answer materials science questions.

Holm uses these methods to study a variety of materials systems and phenomena. Her research areas include the theory and modeling of microstructural evolution in complex polycrystals, the physical and mechanical response of microstructures, mechanical properties of carbon nanotube networks, atomic-scale properties of internal interfaces, computer vision for automated microstructural classification and machine learning to predict rare events.

Prior to joining U-M, Holm spent ten years at Carnegie Mellon University, most recently as a professor of MSE. She also spent 20 years as a computational materials scientist at Sandia National Laboratories, working on computer simulations of microstructure evolution, microcircuit aging and reliability, and the processing and welding of advanced materials.

"Professor Holm brings exciting new ideas in computational materials research, as well as a decade of experience as a renowned, innovative instructor," 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. "I look forward to her building on MSE's long history of developing materials that help solve society's most pressing challenges."

"U-M is my home place, and I'm energized by the opportunity to bring back what I've learned and contribute to the continuing evolution of MSE."

—Liz Holm

'Medal'lurgists

In 2022 Professors Amit Misra & Alan Taub were honored with named professorships.

"Endowed professorships are among the highest honors presented by the College of Engineering. They help attract, reward and retain outstanding faculty members. They acknowledge faculty members' research, teaching and service."

—Alec D. Gallimore, Dean of Michigan Engineering

Amit Misra,

Edward DeMille Campbell Collegiate Profesor of Materials Science & Engineering

Prof. Amit Misra takes a ceremonial "first seat" in his professorship chair while Dean of Engineering Alec Gallimore and wife Monica look on.

After a neary two-year delay because of the pandemic, **Professor Amit Misra** was finally officially inducted as the Edward DeMille Campbell Collegiate Professor of Materials Science & Engineering in a special ceremony/lecture in the Lurie Building on January 14.

The event began with Mohsen Taheri Andani, former Ph.D. student and current postdoc in the Misra lab speaking about what it was like to advised by Misra. Professor John Allison followed, reading comments by two other former students: Ben Derby (PhD '20), now at Los Alamos National Lab (where Misra worked before coming to U-M), and Max Powers (PhD '21), currently a materials engineer with Apple.

Misra then presented a high-level lecture titled "Laser Processed Hierarchical Metallic Alloys," highlighting examples of hierarchical composite morphologies induced by laser rapid solidification that improve the strength and plastic deformability.

"Exciting developments are happening in the field of structural materials," Misra said. "We're seeing an increase in interest in the fundamental scientific aspects of studying metallic alloys with complex chemistries and defect structures. There are new alloys and a demand for better and more predictable performances in energy-efficient and sustainable technologies of the future. We're seeing advances and improvements in the making, modeling, and measuring of metallic materials. We have the entire materials research community interested because there's something new for everyone."

Alan Taub,

Robert H. Lurie Professor of Engineering

On June 7, Alan Taub was inducted as the Robert H. Lurie Professor of Engineering in a special ceremony/lecture in the Chrysler Center.

Speakers at the event included Taub's former Ph.D. student, Caleb Reese, now a materials researcher at GM; MSE Associate Professor Ashwin Shahani, and Miki Banu, a collegiate research professor in ME who talked about how influential Taub is in the materials field: "He is an invincible leader, exceptional researcher, creative engineer and wonderful collaborator," she said.

After the speakers' remarks, Taub presented a lay lecture, "Contributions of a Materials Researcher Towards Sustainable Mobility," highlighting his thirty-plus-years career with Ford and GM, and how he is still very much a part of the automotive industry's push to produce a more sustainable product, specifically in the area of making vehicles lighter so they need less energy to accelerate. Currently he is researching polymer composites and thermoplastics to help recycle "enemy of the environment" plastics, and creating negative-CO2 materials using natural fibers. To that end, Taub and his team are growing plants in-house with the goal of making natural fibers strong enough to replace glass fibers.

"It's not a moon shot," Taub said. "It's all within reach."

College of Engineering Dean Alec Gallimore presents Alan Taub with his professorship medal.

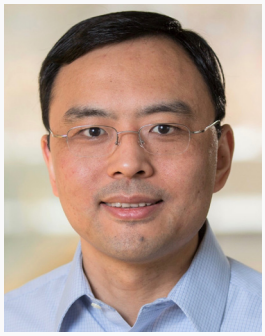
2022 Faculty Awards/Recognition

John Allison
AIME Honorary Member

John Heron
MSE Outstanding Faculty Award

Nick Kotov
AAAS

Yiyang Li
Intel Rising Star Award



Wei Lu
U-M Distinguished University Innovator of the Year

Amit Misra
TMS Fellow

Abdon Peña-Francesch
Winner of first MRS "Sustainability in Action" video contest

Ashwin Shahani
ASM Bradley Stoughton Award for Young Teachers and TMS 2023 Frontiers of Materials Award

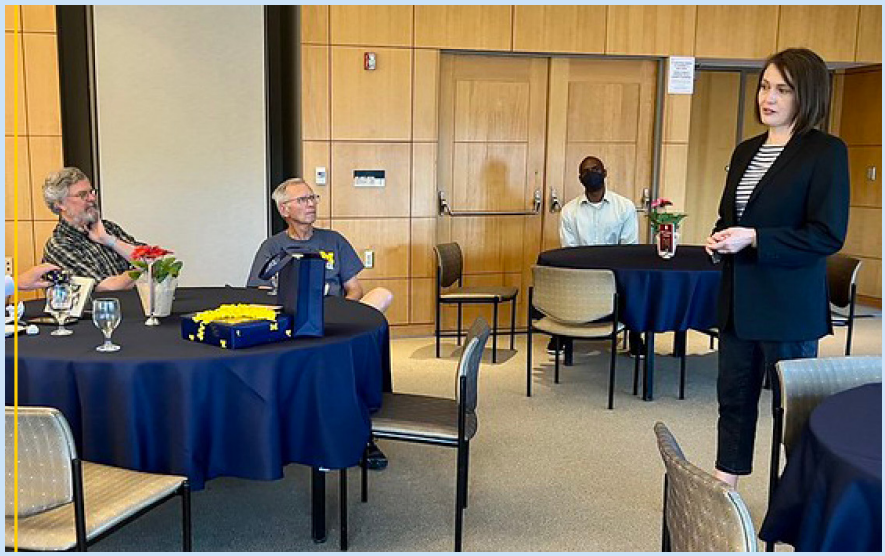
Wenhao Sun
Camille & Henry Dreyfus Foundation Award for Machine Learning Classification of Materials Synthesizability

Michael Thouless
Adhesion Society Award for Excellence

MSE says farewell to Joanna Millunchick with special send-off

On June 21, MSE faculty, staff and students gathered to wish Joanna Millunchick well before she left to become dean of the Luddy School of Informatics, Computing and Engineering at Indiana University in Bloomington. Farewell presentations included remarks by faculty emeritus Wayne Jones and video messages from several former students.

"I take each of you with me in my heart," she told attendees.



Chambers takes on full-time teaching role

Tim Chambers has undergone a career phase transformation of sorts.

In the fall Chambers' role morphed from instructional lab supervisor/adjunct lecturer to full-time teaching faculty member, primarily instructing ENGR100.

"As much as I enjoyed working with the research users in Van Vlack, it was really tough to balance supporting their needs and the facilities work with undergraduate teaching," Chambers explained. "I'm greatly enjoying dedicating myself to undergraduate education and giving one hundred percent to making our classes and student experience the best they can be."

MSE chair Amit Misra enthusiastically endorsed the move, commenting: "Dr. Tim Chambers has had a transformative impact on students' learning through innovative pedagogy in the Van Vlack Undergraduate Laboratory, creating an inclusive, engaged and personalized learning environment. In his new role as full-time teaching faculty member, he will be able to broaden his impact."

Tim Chambers gives a lesson on superconductivity during an MSE365 class last spring as junior Harrison Biggs looks on.

The new position has also allowed him to serve on the undergraduate committee and work on curriculum/course development. He's even managed to squeeze in a little time for his own research again. But for those who will miss Chambers in his old role, rest assured he will still be a presence in the Van Vlack Lab, still teaching MSE360/365, and still wearing, of course, his signature "business tropical" attire.

MSE adds three courtesy faculty

Bol | Bucsek | Raiman

In 2022 MSE welcomed three new faculty into our affiliated faculty ranks, bringing the total to 23. The latest MSE courtesy appointments include **Professor Ageeth Bol** (Chemistry), **Assistant Professor Ashley Bucsek** (Mechanical Engineering), and **Assistant Professor Stephen Raiman** (Nuclear Engineering and Radiological Sciences).

Faculty/staff thank outgoing chair Amit Misra for his service

Amit Misra (right) accepts a parting gift from unit administrator Todd Richardson at the MSE staff/faculty luncheon on Dec. 16.

In December Amit Misra stepped down as MSE chair after serving in the role for eight years. MSE faculty, staff and alumni expressed their appreciation for his leadership:

"A little more than three decades ago, I initiated a research project on how interphase interfaces might be optimally designed to operate as beneficial dislocation sources. A new graduate student, Amit Misra, accepted the GSRA appointment to attack the problem. The rest is history, but in an especially profound and positive way for the department over the past eight years!"

—Faculty emeritus Ron Gibala

"Under Amit's leadership, MSE has grown in a lot of different ways. Communications, alumni engagement and alumni donations have all increased. We have also significantly retooled the Van Vlack Lab with much-needed equipment updates."

—Todd Richardson, MSE Unit Administrator

"I really appreciate the work Amit has done for the department, his support my research program, and freedom he gave me in pursuing new topics for courses to teach. I find Amit to be a very enthusiastic supporter of our department and discipline, and someone who can relate very well to all members, spanning all levels of scholarship and staffing."

—Professor Max Shtein

"As a new faculty Amit's advice has not only been extremely valuable but has also shaped my vision of how I can be part of our department's future directions."

—Assistant Professor Claudia Loebel

"I consider myself so fortunate to begin my academic career under the direction and guidance of Amit Misra. He cares deeply about the junior faculty in the department, in advising us, advocating for us, and promoting us at every opportunity. I hope to follow his example of quiet humility despite all that he has achieved. I give my thanks to Amit for his tenure as chair and look forward to many more years of his wisdom and mentorship."

—Associate Professor Ashwin Shahani

"Of the many initiatives fostered by Amit, his organizing of the External Advisory Board and the initiation of the Michigan Materials Research Institute stand out."

—Dr. Ray Decker, EAB member

"Amit improved the MSE department by every objective measure, even while guiding it through Covid. U-M MSE is one of the top programs in the nation, both graduate and undergraduate. Engagement, both internal and external, has been improved. Amit steps down from the Chair leaving a strong program, well positioned for an even better future.

—John "Chip" Keough, EAB member

IT desktop specialist Chris Cristian poses with his star volleyball captain, Harper Murray, on the day of her committing to play for the University of Nebraska..

Cristian coaches #1 high school volleyball player in the country

"[Coaching the number one player in the country] and having Miss Michigan Volleyball as part of the Skyline program is something that I feel comes once in a lifetime."

—Chris Cristian

In the fall, when he's not in Dow keeping computer operating systems running smoothly, IT desktop support specialist Chris Cristian is most likely on the volleyball court at Skyline High School coaching the girls' varsity volleyball team. His team captain this year was Harper Murray, the #1-ranked high school volleyball player in the country and 2022 Michigan Miss Volleyball. Over the course of her four years at Skyline, the 6'2" senior racked up 2,425 kills. In October she committed to playing volleyball for perennial powerhouse University of Nebraska. Cristian commented how he's enjoyed watching his star player develop into a leader the past four years. "Having [the number one-recruited player in the country] and Miss Michigan Volleyball as a part of the Skyline program is something that I feel comes once in a lifetime," he said. "This was a special season for the school, for Harper and her family, and the Skyline volleyball program."

STAFF NEWS

Lourdes Jorgensen and Justin Scanlon (re)join MSE staff

In January, **Lourdes Jorgensen** joined the MSE staff as a financial specialist, replacing Debbie Johnson, who retired last December after 14 years with MSE. Jorgensen most recently worked at Ross Business School and brings business, accounting, and university procurement experience accounting to her role.

In October, **Justin Scanlon** returned to MSE as an engineering technician. Scanlon worked in the same position from 2006-2015 but left to focus on raising his family.

"It's been great to old faces and meet new ones," Scanlon said, adding, "I'm enjoying reconnecting with faculty and engaging with students again."

Lourdes Jorgensen

Justin Scanlon

MSE IT duo earns College of Engineering's 2022 Creativity, Innovation & Daring (C.I.D.) Award

In December, the MSE IT team of **Kevin Worth** and **Chris Cristian** were chosen as recipients of the College of Engineering's 2022 Creativity, Innovation & Daring (C.I.D.) Award.

Part of the Michigan Engineering Strategic Vision, the incentive program for staff recognizes and rewards people who embody Michigan Engineering's values of creativity, innovation and daring.

Worth, an MSE alum (BSE '96), has been with the department for 26 years and currently serves as senior IT administrator. Cristian, an intermediate IT desktop support specialist, started with MSE in 2007.

Kevin Worth

Chris Cristian

Longenbarger celebrates 20 years with U-M

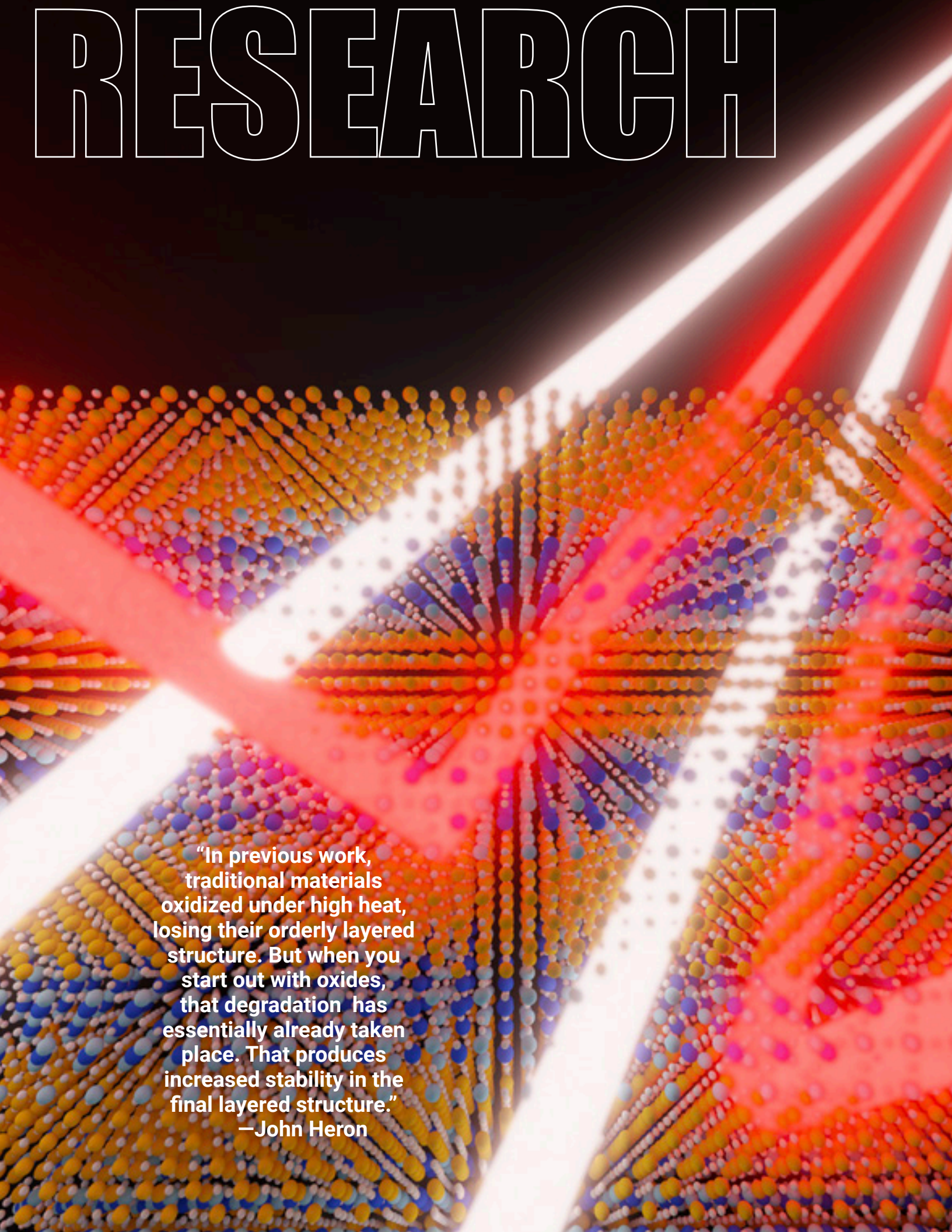
In August executive secretary **Tina Longenbarger** celebrated her 20th anniversary with U-M. Longenbarger joined Michigan Medicine in 2001, left the university briefly, and re-joined MM in 2005 as an administrative assistant in the Department of Surgery, Transplant Center. She then went on to hold two more positions at MM before joining MSE in 2018.

2022 Staff Service Awards presented to Fellers, Kuhn, and Hou

MSE staff members **Shelley Fellers** (receptionist for MSE and Chemical Engineering), **Kathy Kuhn** (research administrator senior), and **Ellen Hou** (research administrator intermediate) received the 2022 staff service awards presented on Dec. 16 at the annual faculty/staff holiday luncheon held at Weber's Inn.

Shelley Fellers, Kathy Kuhn and Ellen Hou

RESEARCH



“In previous work, traditional materials oxidized under high heat, losing their orderly layered structure. But when you start out with oxides, that degradation has essentially already taken place. That produces increased stability in the final layered structure.”
—John Heron

Heat-resistant nanophotonic material could help turn heat into electricity

A new nanophotonic material has broken records for high-temperature stability, potentially ushering in more efficient electricity production and opening a variety of new possibilities in the control and conversion of thermal radiation.

Developed by a U-M-led team of chemical and materials science engineers, the material controls the flow of infrared radiation and is stable at temperatures of 2,000 degrees Fahrenheit in air, a nearly two-fold improvement over existing approaches.

The material uses a phenomenon called destructive interference to reflect infrared energy while letting shorter wavelengths pass through. This could potentially reduce heat waste in thermophotovoltaic cells, which convert heat into electricity but can't use infrared energy, by reflecting infrared waves back into the system. The material could also be useful in optical photovoltaics, thermal imaging, environmental barrier coatings, sensing, camouflage from infrared surveillance devices and other applications.

The approach is a major departure from the current state of engineered thermal emitters, which typically use foams and ceramics to limit infrared emissions. These materials are stable at high temperature but offer very limited control over which wavelengths they let through.

Nanophotonics could offer much more tunable control, but past efforts haven't been stable at high temperatures, often melting or oxidizing (the process that forms rust on iron). In addition, many nanophotonic materials only maintain their stability in a vacuum.

The new material works toward solving that problem, besting the previous record for heat resistance among air-stable photonic crystals by more than 900 degrees Fahrenheit in open air. In addition, the material is tunable, enabling researchers to tweak it to modify energy for a wide variety of potential applications. The research team predicted that applying this material to existing TPVs will increase efficiency by 10% and believes that much greater efficiency gains will be possible with further optimization.The team developed the solution by combining chemical engineering and materials science expertise. Lenert's chemical engineering team began by looking for materials that wouldn't mix even if they started to melt.

They hypothesized that a combination of rock salt and perovskite, a mineral made of calcium and titanium oxides, fit the bill. Collaborators at U-M and the University of Virginia then ran supercomputer simulations to confirm that the combination was a good bet.

MSE Associate Professor John Heron (also a corresponding author on the paper) and graduate researcher Matthew Webb then carefully deposited the material using pulsed laser deposition to achieve precise layers with smooth interfaces. To make the material even more durable, they used oxides rather than conventional photonic materials; the oxides can be layered more precisely and are less likely to degrade under high heat.

"In previous work, traditional materials oxidized under high heat, losing their orderly layered structure," Heron said. "But when you start out with oxides, that degradation has essentially already taken place. That produces increased stability in the final layered structure."

After testing confirmed that the material worked as designed, MSE PhD student and first author on the paper Sean McSherry used computer modeling to identify hundreds of other combinations of materials that are also likely to work. While commercial implementation of the material tested in the study is likely years away, the core discovery opens up a new line of research into a variety of other nanophotonic materials that could help future researchers develop a range of new materials for a variety of applications.

—Excerpted from a story by Gabe Cherry

Durable coating kills the COVID virus and other germs in minutes

The coating could be a game changer in traditionally germ-laden public spaces like airports and hospitals.

Humans may soon have a new weapon in our centuries-old battle against germs: the first durable coating that can quickly kill bacteria and viruses and keep on killing them for months at a time.

Developed by a U-M team led by MSE Professor Anish Tuteja and MSE Associate Professor Geeta Mehta, it proved deadly to SARS-CoV-2 (the virus that causes COVID-19), E. coli, MRSA and a variety of other pathogens in a recent study. It stood up to months of repeated cleaning, abrasion and other punishment on real-world surfaces like keyboards, cell phone screens and even chicken-slathered cutting boards.

The coating could be a game changer in traditionally germ-laden public spaces like airports and hospitals, according to Tuteja, co-corresponding author of the paper published in Matter.

"We've never had a good way to keep constantly-touched surfaces like airport touch screens clean," he said. "Disinfectant cleaners can kill germs in only a minute or two but they dissipate quickly and leave surfaces vulnerable to reinfection. We do have long-lasting antibacterial surfaces based on metals like copper and zinc, but they take hours to kill bacteria. This coating offers the best of both worlds."

The coating, which is clear and can be brushed or sprayed on, gets its durability and germ-killing power by combining tried-and-true ingredients in a new way. It uses antimicrobial molecules derived from tea tree oil and cinnamon oil, both used for centuries as safe and effective germ killers that work in under two minutes. The coating's durability comes from polyurethane, a tough, varnish-like sealer that's commonly used on surfaces like floors and furniture.

"The antimicrobials we tested are classified as 'generally regarded as safe' by the FDA, and some have even been approved as food additives," Tuteja said. "Polyurethane is a safe and very commonly used coating. But we did do toxicity testing just to be sure, and we found that our particular combination of ingredients is even safer than many of today's antimicrobials."

The results of the study's durability tests suggest that the coating could keep killing germs for six months or longer before its oil begins to evaporate and reduce its disinfectant power. But even then, Tuteja says it can be recharged by wiping it with fresh oil; the new oil is reabsorbed by the surface, starting the cycle again.

Tuteja estimates that the technology could be commercially available within a year; it has been licensed to Hygratek, a spinoff company that Tuteja founded with assistance from the U-M Office of Technology transfer.

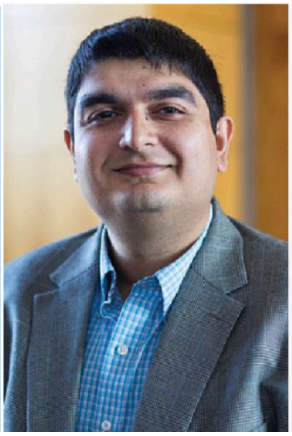
Tuteja also emphasizes that they're not locked into one specific formula.

"It's never our goal just to develop a one-off coating, but instead to develop a library of underlying material properties to draw from," Tuteja said. "If we can understand those properties, then we can develop any number of coatings to meet the needs of specific applications."

—Excerpted from a story by Gabe Cherry

Getting the world's attention

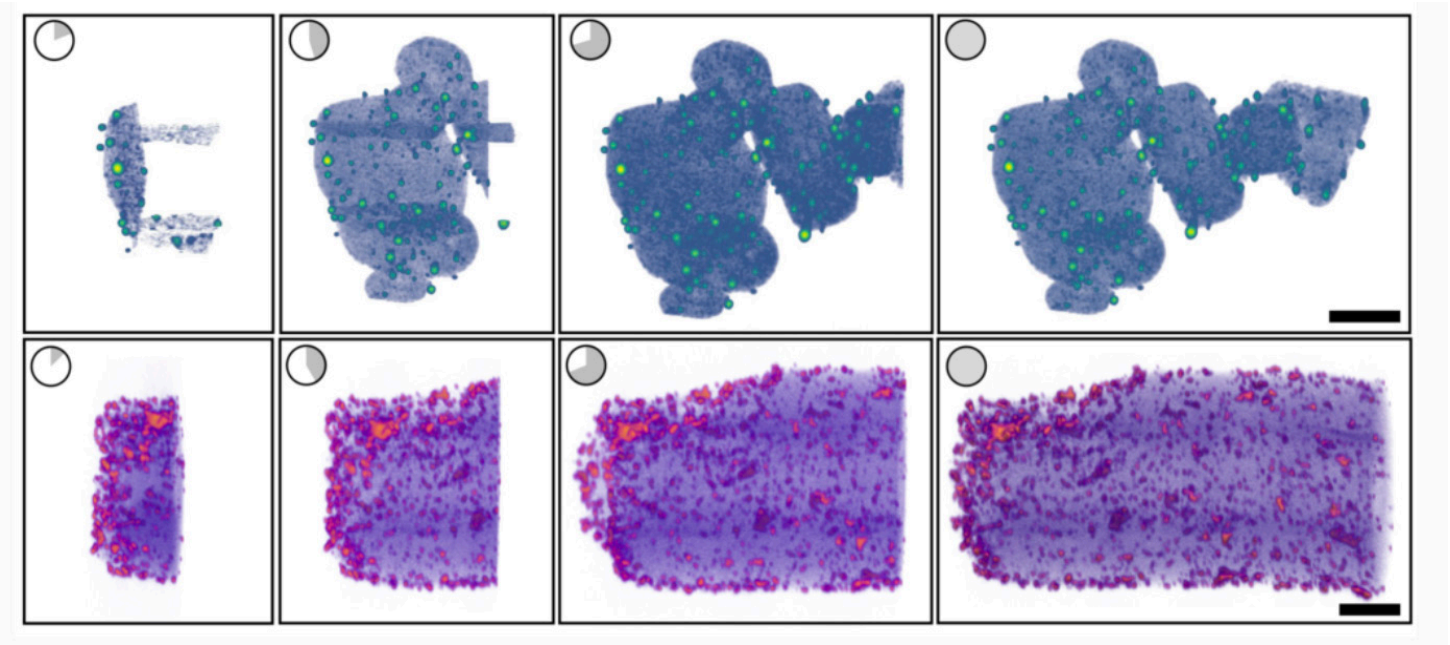
The excitement for Anish Tuteja and Geeta Mehta's new coating spread across the globe this fall, having been picked up by 44 national and international media outlets. On Friday, Sept. 2 Tuteja was a featured guest of Ira Flatow on NPR's Science Friday, which Tuteja called a highlight of his career.



SCIENCE FRIDAY

"We've never had a good way to keep constantly-touched surfaces like airport touch screens clean. Disinfectant cleaners can kill germs in only a minute or two but they dissipate quickly and leave surfaces vulnerable to reinfection. We do have long-lasting antibacterial surfaces based on metals like copper and zinc, but they take hours to kill bacteria. This coating offers the best of both worlds."

—Anish Tuteja



This rendering of platinum nanoparticles on a carbon support shows how tomviz interprets microscopy data as it's created, resolving from a shadowy image to a detailed rendering.

"It has been a longstanding dream of the semiconductor industry...to be able to do tomography in a day, and here we've cut it to less than an hour."

—Robert Hovden

Computer chip designers, materials scientists, biologists and other scientists now have an unprecedented level of access to the world of nanoscale materials thanks to 3D visualization software that connects directly to an electron microscope, enabling researchers to see and manipulate 3D visualizations of nanomaterials in real time.

Developed by a University of Michigan-led team of engineers and software developers, the capabilities are included in a new beta version of tomviz, an open-source 3D data visualization tool that's already used by tens of thousands of researchers. The new version reinvents the visualization process, making it possible to go from microscope samples to 3D visualizations in minutes instead of days.

In addition to generating results more quickly, the new capabilities enable researchers to see and manipulate 3D visualizations during an ongoing experiment. That could dramatically speed research in fields like microprocessors, electric vehicle batteries, lightweight materials and many others.

"It has been a longstanding dream of the semiconductor industry, for example, to be able to do tomography in a day, and here we've cut it to less than an hour," said Robert Hovden, an assistant professor of materials science and engineering at U-M and corresponding author on the paper, published in Nature Communications. "You can start interpreting and doing science before you're even done with an experiment."

Hovden explains that the new software pulls data directly from an electron microscope as it's created and displays results immediately, a fundamental change from previous versions of tomviz. In the past, researchers gathered data from the electron microscope, which takes hundreds of two-dimensional projection images of a nanomaterial from several different angles. Next, they took the projections back to the lab to interpret and prepare them before feeding them to tomviz, which would take several hours to generate a 3D visualization of an object. The entire process took days to a week, and a problem with one step of the process often meant starting over.

The new version of tomviz does all the interpretation and processing on the spot. Researchers get a shadowy but useful 3D render within a few minutes, which gradually improves into a detailed visualization.

"When you're working in an invisible

world like nanomaterials, you never really know what you're going to find until you start seeing it," Hovden said. "So the ability to begin interpreting and making adjustments while you're still on the microscope makes a huge difference in the research process."

The sheer speed of the new process could also be useful in industry—semiconductor chip makers, for example, could use tomography to run tests on new chip designs, looking for failures in three-dimensional nanoscale circuitry far too small to see. In the past, the tomography process was too slow to run the hundreds of tests required in a commercial facility, but Hovden believes tomviz could change that.

Hovden emphasizes that tomviz can be run on a standard consumer-grade laptop. It can connect to newer or older models of electron microscopes. And because it's open-source, the software itself is accessible to everyone.

"Open-source software is a great tool for empowering science globally. We made the connection between tomviz and the microscope agnostic to the microscope manufacturer," Hovden said. "And because the software only looks at the data from the microscope, it doesn't care whether that microscope is the latest model at U-M or a twenty-year-old machine."

To develop the new capabilities, the U-M team drew on its longstanding partnership with software developer Kitware and also brought on a team of scientists who work at the intersection of data science, materials science and microscopy.

At the start of the process, Hovden worked with Marcus Hanwell of Kitware and Brookhaven National Laboratory to hone the idea of a version of tomviz that would enable real-time visualization and experimentation. Next, Hovden and Kitware's developers collaborated with U-M materials science and engineering graduate researcher Jonathan Schwartz, microscopy researcher Yi Jiang and machine learning and materials science expert Huihuo Zheng, both of Argonne National Laboratory, to build algorithms that could quickly and accurately turn electron microscopy images into 3D visualizations.

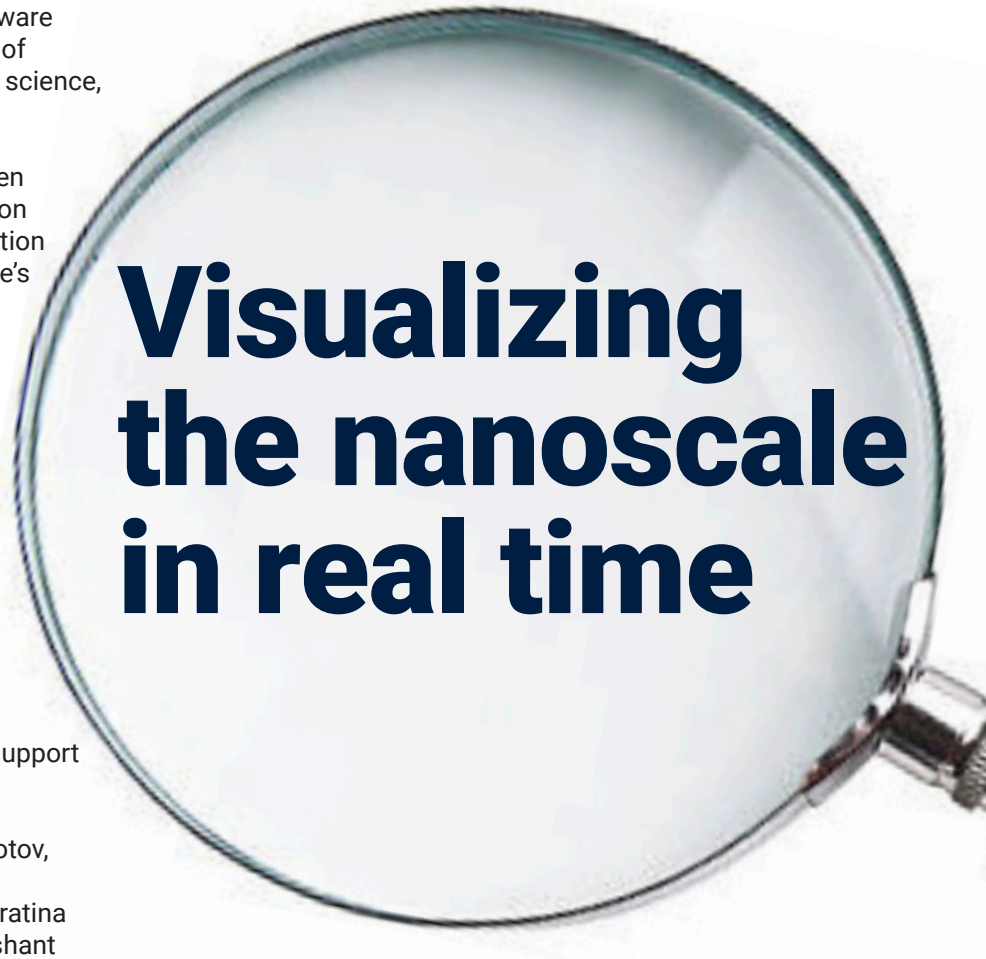
Once the algorithms were complete, Cornell professor of applied and engineering physics David Muller and Peter Ercius, a staff scientist at the Berkeley Lab's Molecular Foundry, worked with Hovden to design a user interface that would support the new capabilities.

Finally, Hovden teamed up with materials science and engineering professor Nicholas Kotov, undergraduate data scientist Jacob Pietryga, biointerfaces research fellow Anastasiia Visheratina and chemical engineering research fellow Prashant Kumar, all at U-M, to synthesize a nanoparticle that could be used for real-world testing of the new capabilities, to both ensure their accuracy and show off their capabilities. They settled on a nanoparticle shaped like a helix, about 100 nanometers wide and 500 nanometers long. The new version of tomviz worked as planned; within minutes, it generated an image that was shadowy but detailed enough for the researchers to make out key details like the way the nanoparticle twists, known as chirality. About 30 minutes later, the shadows resolved into a detailed, three-dimensional visualization.

The source code for the new beta version of tomviz is freely available for download at GitHub. Hovden believes it will open new possibilities to fields beyond materials-related research; fields like biology are also poised to benefit from access to real-time electron tomography. He also hopes the project's "software as science" approach will spur new innovation across the fields of science and software development.

"We really have an interdisciplinary approach to research at the intersections of computer science, material science, physics, chemistry," Hovden said. "It's one thing to create really cool algorithms that only you and your graduate students know how to use. It's another thing if you can enable labs across the world to do these state-of-the-art things."

—Story by Gabe Cherry



Visualizing the nanoscale in real time

Quantum tech: Semiconductor "flipped" to insulator above room temp

The discovery by the Hovden group could pave the way to high-speed, low-energy quantum computing.

A semiconducting material that performed a quantum "flip" from a conductor to an insulator above room temperature has been developed in the Robert Hovden lab. It potentially brings the world closer to a new generation of quantum devices and ultra-efficient electronics.

Observed in two-dimensional layers of tantalum sulfide only a single atom thick, the exotic electronic structure that supported this quantum flip was previously only stable at ultra-cold temperatures of -100 degrees Fahrenheit. The new material remains stable at up to 170 degrees Fahrenheit.

"We've opened up a new playground for the future of electronic and quantum materials," said Hovden, MSE assistant professor and corresponding author on the paper in Nature Communications. "It represents a whole new way to access exotic states."

Hovden explains that exotic quantum properties—like the ability to switch from a conductor to an insulator—could be key to the next generation of computing, providing more ways to store information and faster switching between states. That could lead to far more powerful and more energy-efficient devices.

—Excerpted from a story by Gabe Cherry

> **"We've opened up a new playground for the future of electronic and quantum materials."**
>
> **—Robert Hovden**

Got it covered

We had two researchers score journal covers this year: **Professor Jinsang Kim** had an image featured on the cover of the March 30th edition of *Applied Materials & Interfaces* (right) for the article "Amplifying the Sensitivity of Polydiacetylene Sensors: The Dummy Molecule Approach." And in October, a research team with **Assistant Professor Abdon Peña-Francesch** had its article, "Bacteriophbic Zwitterionic/Dopamine Coatings for Medical Elastomers," selected for the cover of *Advanced Materials Interfaces*. The fun, whimsical cover art was created by Adrian Bago, a professional Spanish comic artist and good friend of Peña-Francesch's. While he admitted it's a bit off-beat for research, Peña-Francesch remarked about the cover: "[It brought] quite a lot of visibility and was especially good for outreach and engaging with students and the press."

Helping make AI smarter

Yiyang Li, a pioneer of electrochemical memory, was recently highlighted in IEEE Spectrum for boosting retention time from a few hours to ***over 10 years.***

The IEEE Spectrum, a widely read magazine for electronic engineering, recently reported an article about a new type of memory technology called electrochemical memory that can make AI much faster and more energy efficient. The article, "Computing With Chemicals Makes Faster, Leaner AI," *highlighted some recent work by Professor Yiyang Li, whose group has been one of the pioneers of electrochemical memory; in their most recently published open-access paper, they found a novel way to utilize phase separation that should enable memory retention times for over 10 years. The following is an excerpt from the article:*

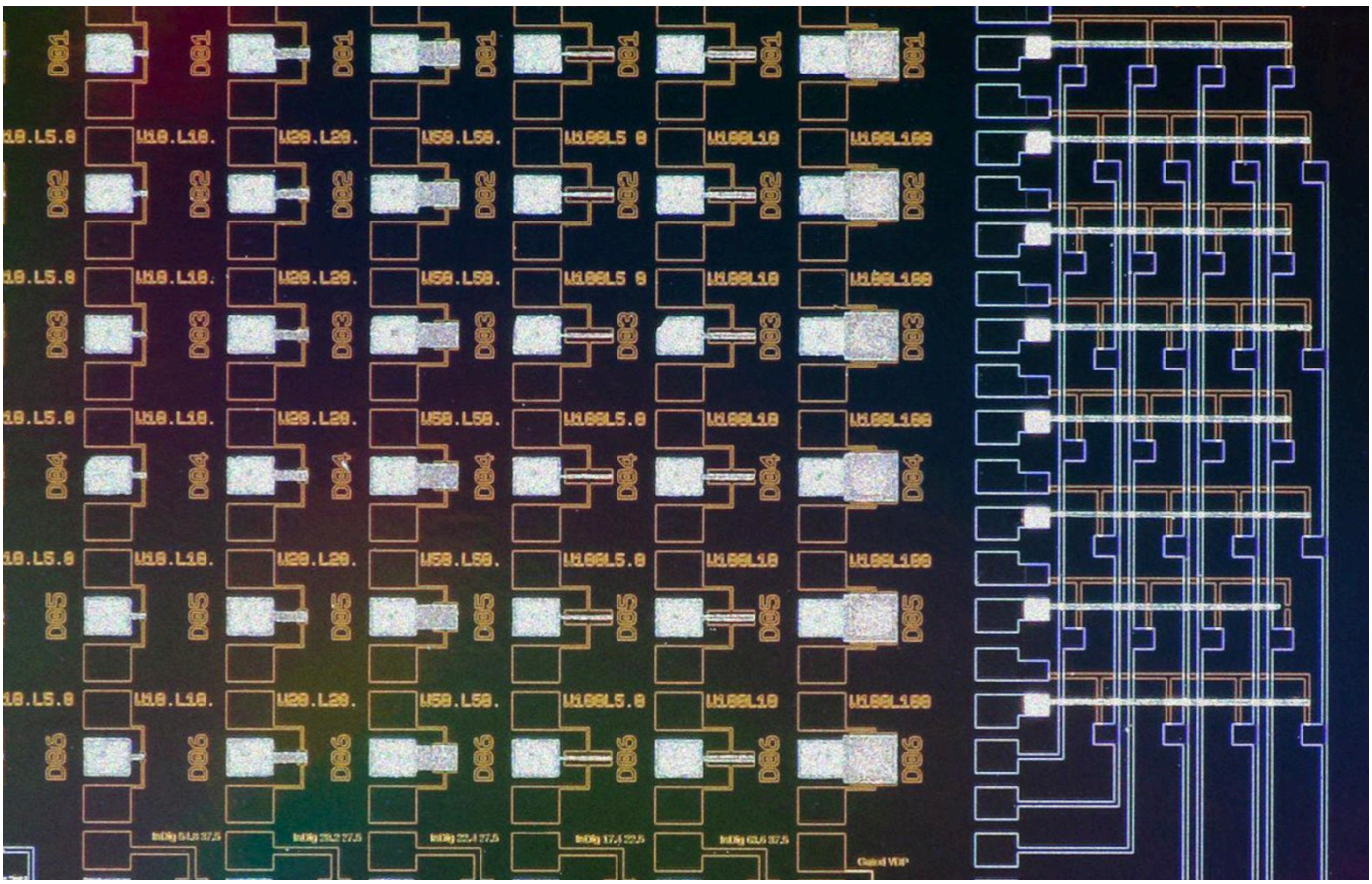
Once programmed, these devices usually hold resistivity for a few hours. Researchers at Sandia National Laboratories and the University of Michigan have teamed up to push the envelope on this retention time—to 10 years. They published their results in the journal Advanced Electronic Materials in November.

To retain memory for this long, the team, led by Yiyang Li, opted for the heavier oxygen ion instead of the proton in the MIT device. Even with a more massive ion, what they observed was unexpected. "I remember one day, while I was traveling, my graduate student Diana Kim showed me the data, and I was astounded, thinking something was incorrectly done," recalls Li. "We did not expect it to be so nonvolatile. We later repeated this over and over, before we gained enough confidence."

They speculate that the nonvolatility comes from their choice of material, tungsten oxide, and the way oxygen ions arrange themselves inside it. "We think it's due to a material property called phase separation that allows the ions to arrange themselves such that there's no driving force pushing them back," Li explains.

Unfortunately, this long retention time comes at the expense of switching speed, which is in the minutes for Li's device. But, the researchers say, having a physical understanding of how the retention time is achieved enables them to look for other materials that show a long memory and faster switching properties simultaneously.

—Excerpted from a story by DIna Genkina



Stanley Whittingham delivers "Overcoming Climate Change: The Critical Role and Challenges of Energy Storage" in Hill Auditorium on May 23.

DISTINGUISHED

Whittingham delivers historic Van Vlack Lecture at Hill

2019 Nobel laureate M. Stanley Whittingham, father of the lithium ion battery, presented the 2020 Van Vlack Lecture to a record crowd in Hill Auditorium on May 23.

After being postponed two years due to the pandemic, 2019 Nobel laureate Stanley Whittingham presented his public lecture portion of the 2020 Van Vlack Lectureship on May 23 to approximately 500 people in Hill Auditorium - a lectureship attendance record.

Whittingham's presentation, "Overcoming Climate Change: The Critical Role and Challenges of Energy Storage" began with the grim reality that climate change (which he calls 'global messing up') is an issue that can no longer be ignored.

"We can't roll back climate change fifty years," Whittingham said. "All we can do now is hold it where it is and make sure it doesn't get any worse."

An important player in the fight against climate change, of course, is the ubiquitous lithium-ion battery, the development of which Whittingham pioneered while working at Exxon in the early 1970s.

"Back then [corporations] looked at research like oil wells," said Whittingham. "Some will work, the majority won't, but let's invest and see what happens."

What happened was that the lightweight, rechargeable and powerful lithium-ion battery came to dominate the market. Today they are used in everything from mobile phones to laptops and electric vehicles; they can even be found on the international space station.

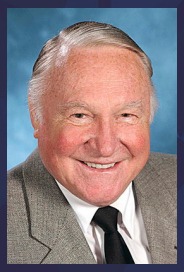
Though it's been fifty years since he helped develop the lithium-ion battery, which is currently made up of a mixture of lithium, manganese, and cobalt, Whittingham is still pioneering improvements to it as part of the Battery500 Consortium. The group is currently working to remove cobalt (due to child labor and cost) from the make-up of the battery.

"There's a huge opportunity for more research by chemists, materials scientists and physicists to come up with new materials...That's what we're trying to do today."

The lecture was followed by a dinner event in the U-M Museum of Art, which was attended by over 90 people—another lectureship record.

Top: More than 90 guests enjoy a dinner at the U-M Art Museum following the lecture. Center: MSE Chair Amit Misra and Katsuyo Thornton, L.H. and F.E. Van Vlack Professor of Materials Science & Engineering, with Bruce Van Vlack, son of lectureship namesake Professor Larry Van Vlack. Bottom: Stanley Whittingham receives his award from Katsuyo Thornton.

LECTURESHIPS



ROBERT D. PEHLKE LECTURESHIP IN MATERIALS PROCESSING

MIT's Don Sadoway headlines third Pehlke Lectureship in Materials Processing

Don Sadoway, chair of MIT's Materials Science & Engineering department, was the featured speaker of the third annual Robert D. Pehlke Lectureship in Materials Processing, which took place on April 7.

In his lecture, "Towards Profitable Sustainability via Liquid-Metal/Molten-Salt Electrochemistry," Sadoway talked about his research regarding electrochemistryin nonaqueous media that is focused on the technological challenges of environmentally sound electrochemical extraction of metals, liquid metal batteries for stationary storage applications, and solid-polymer-electrolyte batteries for portable power applications.

"Professor Doń Sadoway leads the way as a materials science and chemistry professor who develops and implements innovative solutions to engineering problems at the industrial scale for affordable, clean energy, while making an impact as a mentor of doctoral students and classroom instructor of freshmen chemistry," commented MSE chair Amit Misra. "His lecture was a fitting tribute to the legacy of Professor Bob Pehlke."

The Pehlke Lectureship was established in 2018 by former MSE professor and chair Bob Pehlke, who passed away in 2019.

"Professor Don Sadoway... develops and implements innovative solutions to engineering problems at the industrial scale for affordable, clean energy... His lecture was a fitting tribute to Bob Pehlke." —Amit Misra

Don Sadoway delivers remarks at the dinner event of the ithird Robert D. Pehlke Lectureship in Materials Processing.

Lawrence H. Van Vlack
LECTURESHIP
in
Materials Science & Engineering

Computational pioneer Susan Sinnott of Penn State presents 2022 Van Vlack Lecture

While on campus this fall, 2022 Van Vlack Lecturer Susan Sinnott delivered two lectures: "Material Design and Discovery" on October 6 and "Developing new materials with insights from computational methods" on October 7.

Currently professor and head of the Materials Science & Engineering department at Penn State, Sinnott's scholarly work focuses on computational materials science, with an emphasis on the development and utilization of atomic-scale methods to investigate the structure-property relationships of material systems, especially those that contain heterogeneous interfaces, surfaces, or defects.

"Professor Sinnott pioneered computational materials science when computational materials scientists were few and far between, women even rarer," commented Katsuyo Thornton, L.H. and F.E. Van Vlack Professor of Materials Science & Engineering. "She develops and applies atomistic modeling techniques to gain insights into surfaces and interfaces and enable materials discovery. Her leadership, service, mentorship, and teaching, along with research accomplishments reflects her contribution to the materials science community in which Professor Van Vlack's legacy endures."

Recent Van Vlack lecturers include Nobel laureate Dan Shechtman (2017), Ramamoorthy Ramesh (2017), Subra Suresh (2018), Frances Ross (2019), and Nobel laureate Stanley Whittingham (2020).

"To be included in this incredible group of award recipients is humbling," Sinnott said at a special dinner event following her lecture on Oct. 6. "I thank you for this wonderful honor."

2022 Van Vlack Lecturer Susan Sinnott delivers her public lecture, "Material Design and Discovery" on Oct. 6 in NCRC.

Ben Justus and Ruth Oliver react during a cornhole game at the Welcome Back Picnic on Sept. 1 in Gallup Park.

EVENTS

1. Xander Mensah '22 plots his next Connect 4 move at the Welcome Back Picnic in Gallup Park on Sept. 1. 2. Graduate students gather by the Huron River at the Welcome Back Picnic. 3. GSC President Loulou Batta sings "Santa Baby" accompanied by MSE grad students Ben Justus and Marcel Chlupsa at the Holiday Party on Dec. 8. 4. Undergrads Teju Srinivas, Sabrina Huynh, and Haley Whelan pose at the photo booth at the Holiday Party.

Picnics/parties see spectacular turnout

After more than two years of social disruption caused by the pandemic, MSE's Welcome Back Picnic and Holiday Party both rebounded big this year with increased attendance.

One of the biggest tell-tale signs that the pandemic is no longer deemed a major threat (at least for the moment) has been the incredible excitement and turnout for our two biggest annual community events: the Welcome Back Picnic at Gallup Park on September 1 and the annual MSE Holiday Party at the Michigan League on December 8. Both events enjoyed record-breaking numbers this year –180 and 160, respectively, which are well above previous numbers at events held pre-pandemic.

"The pandemic was obviously really rough on students socially," said Forrest Wissuchek, GSC secretary and PhD student in the Misra group. "I think people are just happy to be able to get together and hang out and have fun with classmates again."

This fall the Welcome Back Pinic was held at Gallup Park on Sept. 1 during the first week of classes. In addition to a catered dinner, activities included lawn games, a swag give-away and a get-to-know-you activitiy. The weather was picture perfect and the setting relaxing; all agreed it was a great way to start the year.

The semester-ending event, the annual holiday party, was held on Dec. 8 at the Michigan League, and it, too, had the highest attendance in recent memory: 160 students, faculty and staff. Highlights included a catered dinner, cookie decorating, wreath making, a photo booth, Ugly Sweater contest and sing-alongs with GSC president Loulou Batta on vocals and MSE guitarists Ben Justus and Marcel Chlupsa, who are part of the band "Slow Start" with fellow Michigan Engineering students Micah Thorpe (drums) and William van den Bogert (piano). It was a fantastic way to wrap up the semester.

> **"The pandemic was obviously really rough on students socially. I think people are just happy to be able to get together and hang out and have fun with classmates again."**
> **—Forrest Wissucheck, PhD student in the Misra group**

Ugly Sweater contest winners at the Holiday Party were: Ben Justus, Geordie Lindemann, and the team of Ben Stimac (NAME graduate student) and Kate Moo.

From fast fashion to packing peanuts— MSE 481 projects take on real-world problems

This fall's MSE 481 projects were diverse, creative and extremely topical, taking on issues such as carbon capture technologies to reduce CO_2 emissions in construction materials, biodegradable materials for packaging, chemical recycling of textiles to mitigate waste from the fast fashion industry, water desalination and filtration systems, 3D printing, and aluminum recycling (see full list on next page).

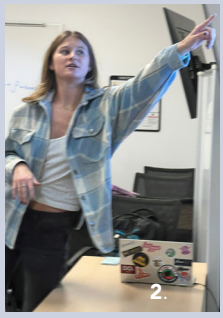
"I was impressed with the collegiality and collaboration between team members, clarity of presentations, knowledge of sustainability issues in society, and the use of ANSYS tools in solving real world problems through sustainable and eco-friendly designs of materials, processes and products," commented MSE chair Amit Misra.

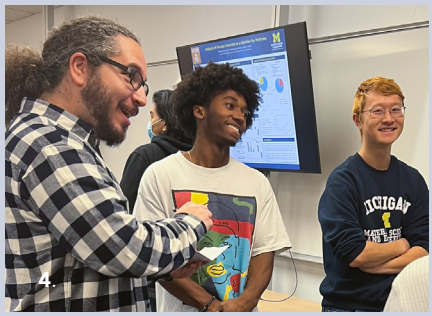
According to class instructor Abdon Peña-Francesh, one of the most valuable lessons students take away from the course is learning to work in open-ended projects and with multiple constraints. "We rarely have a single and unique good solution to real problems, and often we have many different not-so-good solutions each with its own pros and cons," said Peña-Francesch. "In the class we learn to identify trade-offs between not-perfect but realistic solutions to realistic problems, and consider not only the technical requirements for the desired applications but also their economical, environmental, social, legal, and ethical implications."

Because materials science and engineering does not happen in a vacuum, he added, it's important to develop a holistic approach.

"We hope that the students can take the technical skills but also the holistic design and communication skills that they learn in this class and apply them in their future careers in MSE, and hopefully drive the change towards a more sustainable industry and society," concluded Peña-Francesch.

EDUCATION



1. Dakota Thies (right) explains the data behind his team's Sustainable Water Filtration Systems for Rural Ethiopia project to Tim Chambers. 2. Mackenzie Darling points out a finding on her group's final poster about carbon-capture on concrete. 3. Konnor Walter talks about the science behind his team's Chemical Recycling as a Fast Fashion Disposal Alternative project. 4. MSE 481 instructor Abdon Peña-Francesch questions Virgil Watkins and Austin Lan about their research.

MSE 481 projects and team members

Cornstarch-based Packing Peanuts for Sustainable Packaging
Serena Gupta, Eli Rotman, Druva Krishnaswami, Allen Zhao, Isaiah Stokes

In-Home 3D Printer Filament Recycling Solution
Harrison Biggs, Charisse McComas, Chloe Parr, Krystal Quinn, Matthew Walker

Solar Powered Desalination
Lazlo Cline, Leah Fleming, Kalyn Fuelling, Rachel Rajkumar, Edward Spengler

Sustainable Water Filtration Systems for Rural Ethiopia
Falon Fletcher, Gillian James, Megan Klein, Raj Koorapaty, Dakota Theis

Miracle on Concrete: Carbon-Capture
Jonah Berman, Kellie Chu, Mackenzie Darling, Xander Mensah, Kevin Wang

Plastic Bottle Alternatives
Jason Landini, Erdem Ozdemir, Andrew Ray, Daniela Tavarez

Chemical Recycling for Fast Fashion Disposal Alternatives
Jenny Chong, Gabi Grey, Austin Lan, Konnor Walter, Virgil Watkins

Analysis of Porous Concrete as a Solution for Potholes
Andrew McCreadie, Denise Schlautman, Gillian Tubay

Reducing Co2 Emissions Via Active Carbon Capture Utilizing Post-Combustion Calcium Looping
Aaron Cooke, Elliott Gorshek, Nina Perry, Cole Tubman, Josh Wilwerth

◂MSE 481 instructor Abdon Peña-Francesch (far right) and MSE chair Amit Misra (center) listen to Jenny Chong (second from right) discuss chemical recycling as an alternative to fast fashion disposal during the MSE 481 project presentations on Dec. 7.

Falon Fletcher (right) explains the research behind her group's "Sustainable water filtration systems for rural Ethiopia" project to Tim Chambers.

"We hope that the students can take the technical skills but also the holistic design and communication skills that they learn in this class and apply them in their future careers in MSE, and hopefully drive the change towards a more sustainable industry and society."
—Abdon Peña-Francesch

Jesse Hu, second from left, gives a keychain demonstration during a forging session in the Van Vlack Lab on Dec. 2.

Blacksmithing Club makes the cut to Sponsored Student Organization (SSO)

Last spring the MSE Bladesmithing team was upgraded to a university-level student organization. They are now an official Sponsored Student Organization (SSO), registered as The Michigan Blacksmithing Club. Senior Megan Klein is the club president.

"Becoming an SSO gives us school support and grants access to many resources for the club so we can better represent the department and college," explained club adviser Tim Chambers. "We are so excited to continue to share the art of blacksmithing and study the science behind our work. From the leadership clinics to the SOAS system, we look forward to seeing how far we can grow the blacksmithing club as an SSO."

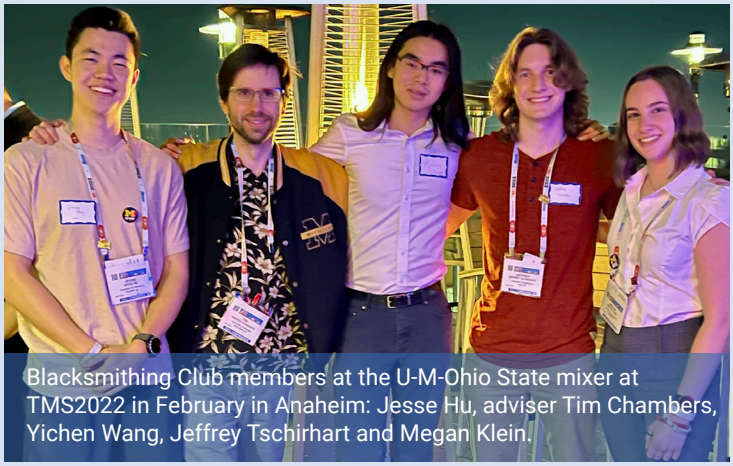
The club spent the fall semester teaching a large number of new recruits the foundational skills for safe and effective blacksmithing through beginner projects like hooks and keychains.

"Now that everyone knows which end of the hammer to hold, it's time for some more exciting projects like tools and blades and art pieces," Chambers said.

Blacksmithing team finishes fourth at TMS2022

The Blacksmithing Club finished in fourth place (out of over 15 entries), earning the team an Honorable Mention at last year's TMS Bladesmithing Competition.

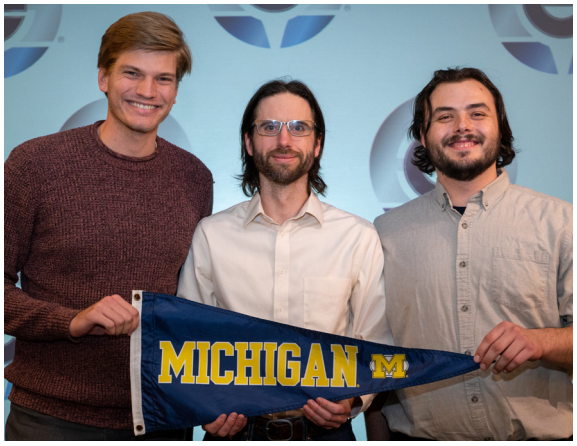
"This was the club's first TMS where they were judged on the quality of the blade itself, not just the technical analysis," said adviser Tim Chambers, adding, "Despite being newcomers, we finished really well."



Blacksmithing Club members at the U-M-Ohio State mixer at TMS2022 in February in Anaheim: Jesse Hu, adviser Tim Chambers, Yichen Wang, Jeffrey Tschirhart and Megan Klein.

Two students attend fall FEF College Industry Conference

The Foundry Educational Foundation (FEF) held its 75th College Industry Conference in Chicago Nov. 17-18. Over 122 students representing 30 FEF schools were in attendance. They were feted by 39 participating companies who came with 200 job openings. The U-M delegation (at right) included **Aaron Cooke**, FEF Key Professor **Tim Chambers**, and **Elliott Gorishek**, who won the George N. Booth Scholarship.



Students attend international solid-state ionics meeting

On July 17-22, an MSE contingent led by Assistant Professor Yiyang Li attended the 23rd International Solid State Ionics Meeting (SSI-23) in Boston. SSI is an international conference on functional ceramic materials. Most participants apply the work to energy storage, energy/fuel conversion, typically either gas to electricity, electricity to gas, or directly from one fuel to another, and for electronics such as resistive memory.

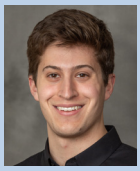
In addition to Li, attendees included MSE Ph.D. students **Jinhong Min** and **Jingxian Li**, MSE alum **Lindsay Gubow** (MSE '22), and undergraduates **Riley Hargrave** (ME) and **Laszlo Cline**.

"I have been attending SSI for eight years, and it has become my favorite conference," said Professor Li, who won SSI's Young Scientist Award as a student in 2017 and is a former symposium organizer. "I was really excited to be able to share this experience with both undergraduate and graduate students, as they see how the fundamental science of ceramics can be used to develop cutting-edge, next generation technologies in batteries, fuels, and microelectronics."

"I learned a lot at SSI," remarked Cline. "I would highly recommend this or any other conference to undergraduates interested in research. It will give insight into how research communities function, and perhaps help them determine whether research is right for them."

SSI-23 attendees: MSE Assistant Professor Yiyang Li, Jennifer Rupp (conference organizer), Jinhong Min (MSE PhD student), MSE alum Lindsay Gubow (MSE '22), Jingxian Li (MSE PhD student), and Laszlo Cline (MSE undergrad).

Seniors Edelman and Mukherji receive NSF Awards



Dylan Edelman, who is currently pursuing a Ph.D. at Stanford, worked toward creating an all-solid-state sodium metal battery.

Malini Mukherji, now pursuing a Ph.D. in bioengineering at Harvard, worked in Prof. Joerg Lahann's lab creating a technology with great promise for tissue engineering applications.

2022-23 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

MMS provides learning and social opportunities for undergraduates

Members of MMS gather outside the Brown Jug during a night out in Ann Arbor in April.

Led by president **Katie Wei** and vice presidents **Mackenzie Darling** and **Jenny Chong**, Michigan Materials Society (MMS) hosts weekly luncheons featuring speakers from industry and professional societies for students to learn about potential career paths and more. (See list at right.) Additionally, MMS organizes professional development events such as elevator pitch workshops and mock interviews. MMS also sponsored movie nights, bar crawls, ice skating and other social events.

"The board members have done a great job of setting and carrying out their own agenda," adviser Tim Chambers commented. "They've also managed to get more student engagement with in-person events and increased the number of professional development opportunities available to our students."

The 2022-23 MMS board is rounded out by **Elliott Gorshek** (secretary), **Kellie Chu** (Treasurer), **Denise Schlautman** (social chair), **Alexa Goldstein** (Outreach chair), and **Erdem Ozdemir** and **Rachel Rajkumar** (UG committee reps).

MMS Luncheon Speakers Fall 2022

Boeing
Cadmus Group
Constellium
Eaton
Materion
Medtronic
Nike
SMS Group

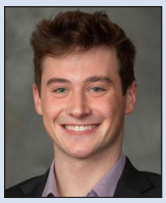
Undergraduates at the Welcome Back Picnic on Sept. 1: From left: Ben Routhier, Eli Rotman, Jason Landini, Mackenzie Darling, Denise Schlautman, Gabi Grey, Gillian James, Konnor Walter, and Andy Danbury.

Congratulations to all our 2022 graduates!

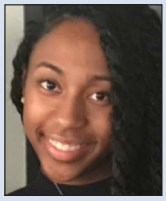

Robin Albert

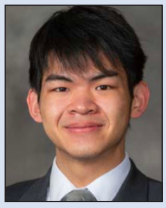

Keon Beigzadeh

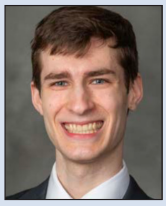

Caleb Bloodworth


Logan Boals

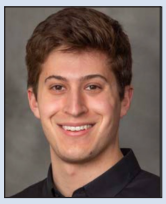

Maggie Bowers

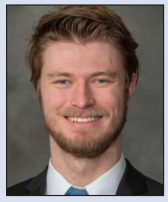

Madison Buford


Tao Cai


Christian Davis


Lauren Duke


Dylan Edelman


Ryan Gast

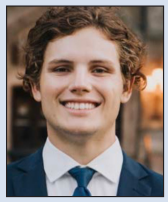

Gabrielle Grey


Nikolai Huotari

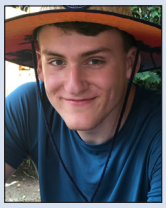

Brodie Kieras


Minseo Kim


Rishabh Kothari


Nicholas Leginza


Ella Leininger


Nick McCarthy


Rishi Merchant


Kate Moo


Malini Mukherji


Conner O'Kane


Erin Parlow


Wesley Pasikowski


Marisa Perez


Sahana Prabhu

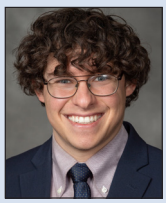

Krystal Quinn


Deborah Reisner


Brianna Roest

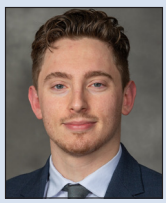

Colin Romine

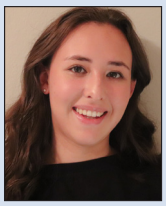

Nicholas Ruble


Julian Sanchez

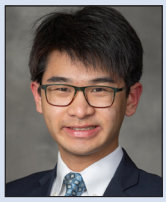

Prasanth Selvadurai


Praveen Soundararajan


Michael Stryk


Daniele Tavarez


Jeffrey Tschirhart


Albert Tsui


Kylie Vittetoe

Eric Yi

Hao Zhu

Not pictured: Arianna Wu

M 27

MSE

2022 Graduation Award winners

James P. Lettieri Award:
Rishabh Kothari & Denise Schlautman

MMS Distinguished Member:
Katie Wei

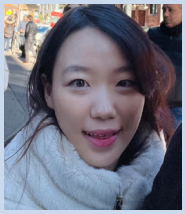
MMS Anvil Award:
Ella Leininger

Alpha Sigma Mu Distinguished Member: Malini Mukherji

The Brian Worth Prize:
Marisa Perez

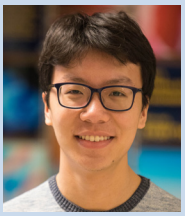
Congratulations to all our 2022 Ph.D. grads!

Winter 2022



Sieun Chae
(Heron/Kioupakis)
"Theoretical discovery and experimental synthesis of ultra-wide-band-gap semiconductors for power electronics"

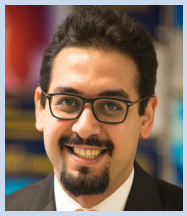
Che-Hsuan Cheng
(Deotare)
"Engineering Hybrid Interfaces of Organic-Inorganic 2D Semiconductors"



Zihao Deng
(Kioupakis)
"First-Principles Calculations on the Thermo- dynamic and Electronic Properties of Defective Semiconductors and Semiconductor Alloys"

Alex Kate Halvey
(Tuteja)
"Design and Applications of Surfaces for Solid Fouling Mitigation"

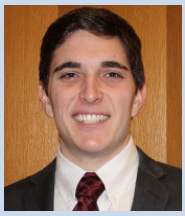
Jiwoong Kang
(Shahani)
"Kinetics and connectivity of grain boundaries in three-dimensional metallic systems"



Mohsen Taheri
(ME -Misra)
"Investigating Microstructural Effects on Hall-Petch Relationship in Mg-4Al Alloy"

Keara Greatwood
(Solomon/Glotzer)
"Large impacts of small particles: the effects of active particles on colloidal gels and crystals and of inulin microparticles on gut retention in mice"

Summer 2022

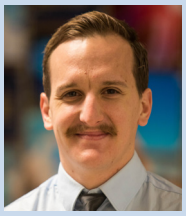


Aaron Gladstein
(Taub)
"Visualization and Analysis of Nanoscale Microstructure Evolution of In situ Metal Matrix Composites"

Brian Iezzi
(Shtein)
"Additive and Fiber Nano-manufacturing of Multi-material, Dielectric Photonic Crystals"

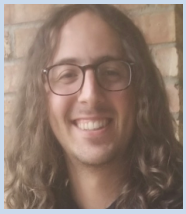
Vazrik Keshishian
(Kieffer)
"Development of Hybrid Electrolytes for Solid-State Batteries"

Minjeong Cha
(Kotov)
"Application of Data-Driven Analysis to Chiral Nanomaterials and Surfaces"



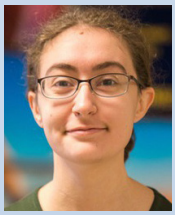
Brian Macdonald
(Tuteja)
"Design and Application of Surfaces that Control Liquid and Solid Fouling"

Aditya Sundar
(Qi)
"Modeling the structural and chemical stability of materials in reactive environments using multiscale methods"



Joey Valle
(Sakamoto)
"Abolitionist Engineering: An Autoethnographic Approach to Understanding How Abolition Can Transform Materials Science & Engineering"

Fall 2022



Veronica Caro
(Millunchick)
"Comparative III-As-Bi Surface Morphologies and Microstructure & Disciplinary Literacy in MSE"

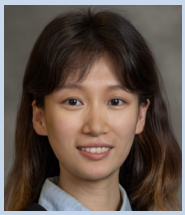
Brandon Carter
(Millunchick)
"A Multi-Faceted Approach to Advancing Materials Science: Investigations in Materials Research and Education"

Randy Cheng
(Taub)
"Investigation of acoustic softening and its application in ultrasonic assisted incremental sheet forming"

Kamruzzaman Khan
(Ahmadi/Hovden)
"Growth and characterization of (In,Ga)N films by plasma-assisted molecular beam epitaxy"

Hongling Lu
(Goldman)
"Nanoscale GaN Epitaxy and Polytype Selection in Liquid-metal Mediated Environments and Writing-to-Learn in Materials Science and Engineering"

Anshul Singhal
(Taub)
"Improved Extraction of Natural Fibers for Sustainable Polymer Composites"



Xiaoyang Zhong
(Lahann)
"Mechanistic Studies into Interfacial Interactions via Chemical Vapor Deposition Polymerization"

2022 Graduation Award Winners

GSC Recognition

GSC Reps: Associate Professor Manos Kioupakis (graduatie program chair), Loulou Batta, Kyle Bushick, Paul Chao, Vishwas Goel, Duncan Greeley, Julia Lenef, Alex Kate Halvey, Forrest Wissuchek, Geordie Lindemann, and Brian Iezzi. Right: GSC Master's reps: Akhil Shettigar, Professor Ferdinand Poudeu (master's program chair), and Tathye Shinde.

Graduate Recruiting Recognition

Loulou Batta and **Forrest Wissucheck** accept the Graduate Recruiting Recognition award from Associate Professor Manos Kioupakis (graduate program chair).

First to Publish in 2019 & 2020: John Kim & Catherine Haslam

John Kim (above left) was the first person in the 2019 cohort to publish a paper: "Sharing of Strain Between Nanofiber Forests and Liquid Crystals Leads to Programmable Responses to Electric Fields," published in Advanced Functional Materials on April 10, 2022. **Catherine Haslam** (above right) was the first in the 2020 cohort. She published "The effect of aspect ratio on the mechanical behavior of Li metal in solid-state cells," published in the Journal of Power Sources on Dec. 2, 2021.

Master's degrees

The following students earned a master's degree in 2022.

Anirudh Appachar
Lucas Baioni
Jen Bradley
Cameron Cafmeyer
Aidan Charmley
Taorui Chen
Yu-Shan Chen
Elizabeth Eachus
Chao Feng
Vedant Gaikwad
Ryan Gast
Lindsay Gubow
Jindong Huang
Tzu-Yun Hung
Jonah Jarczewski
Anto Jerish Jeyadimal
Maheshwari Kakade
Jialong Ke
Usman Khan
Makoto Kimura
Thomas Korejsch
ChingYen Lee
Zhan Liang
Chia-Heng Lin
Yushen Liu
Emily MacInnis
Leah Marks
Jessica McGahan
Connor Michaelson
Kaitlyn Moo
Karen Ni
Tzu Yu Ou
Caleb Phelan
Zyuan Qin
Grant Saxman
Chaobo Tong
Kang-Ting Tseng
Zenan Zhang
Lingfeng Zhou

GRADUATE STUDENTS

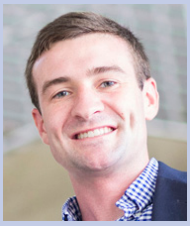
Graduate students earn prestigious College, national recognition

Kyle Bushick
(Kioupakis)
MRS Best Oral Presentation Award

Paul Chao
(Shahani)
CoE Robert J. Beyster Computational Innovation Fellowship

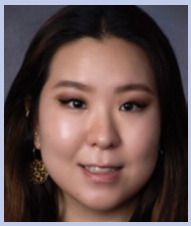
Kelotchi Figueroa
(Deotare)
NSF Award

Vishwas Goel
(Thornton)
Rackham Predoctoral Fellowship



Duncan Greeley
(Allison)
Rackham Predoctoral Fellowship

Hailey Lovelace introduces the Ugly Sweater contestants at the MSE Holiday Party on Dec. 8.



Diana Kim
(Li)
NSF Award

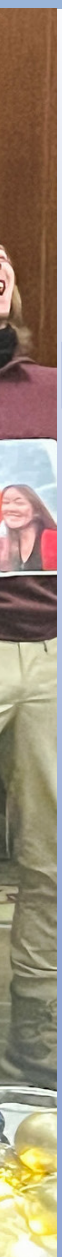
Julia Lenef
(Dasgupta)
Rackham
Predoctoral
Fellowship

Avinava Roy
(Loebel)
Rackham
International
Student Award

Jonathan Schwartz
(Hovden)
DOE SCGSR
Fellowship

Suk Hyun Sung
(Hovden)
Rackham
Predoctoral
Fellowship

Yu-Chen Yang
(Goldman)
Rackham
Chia-Lun Lo Award



GSC organizes F-U-N

A trip to an apple orchard, a chili cook-off, a mentor-mentee trivia contest and a rockin' holiday party are just the beginning of the activities and fun GSC has provided for graduate students this year.

"I have been particularly impressed with this year's GSC board members for their enthusiasm and dedication to providing a wide array of inclusive social activities and professional development opportunities for students," commented Associate Professor Manos Kioupakis, who serves as graduate program chair. "Their thoughtful planning of engaging and fun activities is invaluable in helping maintain students' overall well-being, building community, and bolstering our program as a whole."

On December 8, GSC took the lead in organizing the annual Holiday Party which was held at the Michigan League. In addition to a catered dinner, activities included cookie decorating, wreath making, board games, a photo booth, an Ugly Sweater contest, and a fun sing-along with CoE band "Slow Start" that included MSE grad students Loulou Batta on vocals and Ben Justus and Marcel Chlupsa on guitar. More than 160 people attended the event - a holiday party record.

"Thankfully, we have been able to put on a lot of successful events this year," said GSC president Loulou Batta, "but I think we all agree that the Holiday Party was a massive success. We were able to gather people across all of our affiliations and spend some joyous time together."

First-year PhD students Celeste Perez, Andrew Jalbert and Ellery Hix try to guess a materials image during a GSC-sponsored mentor-mentee event on October 20.

MSE Graduate Fellowships

Kenneth and Judy Betz Fellowship
Tiernan Baucom

CoE Endowed Fellowship
Douglas Heine, Devon Kleeblatt, Dongiae Shin, Victor Vogt

CoE Graduate Fellowship
Soumyadeep Dasgupta, Nicholas David

Harry Ferrari Fellowhip
Ruth Oliver

Robert D. and Julie A. Pehlke Fellowship
Archi Agrawal

Rackham Merit Fellowship
Daniel Delgado, Mahlet Molla, Celeste Perez

Rackham Block Grant Fellowship
Joy Hendrix, Chuqi Huang, Andrew Jalbert, Benjamin Justus, Hailey Lovelace, Jason Manassa, Lingxia Shi, Flora Tseng, Varun Vankatesh

Frederick N. Rhines Fellowship
Archi Agrawal, Celeste Perez

Rita Baranwal (PHD '98) 2022 MSE Alumni Merit Award Recipient

Baranwal returned to campus September 23 to officially accept her award and give a talk at a special all-department luncheon during which she shared her career journey.

Dr. Rita Baranwal, former DOE Assistant Secretary of Nuclear Energy and current Chief Technology Officer for Westinghouse, was this year's recipient of the MSE Alumni Merit Award.

Baranwal returned to campus during Homecoming Weekend to officially receive her award from the College of Engineering at a special dinner in the Robotics Building on the evening of Friday, September 23. She also gave a presentation earlier in the day during a special luncheon for MSE students, faculty and staff.

During her talk she shared her career journey, which inlcuded directing the Gateway for Accelerated Innovation in Nuclear (GAIN) for Idaho National Laboratory, serving as manager in Materials Technology at Bechtel Bettis, Inc. where she led and conducted R&D in advanced nuclear fuel materials for U.S. Naval Reactors, and working in varous roles for ten years with Westinghouse.

"As you go through your career, take time to look around you and have fun," Baranwal told students, which for her, she said, was scuba diving...which she happened to be doing in Australia in 2019 when the call came that she was to be confirmed as the DOE's next Assistant Secretary of Nuclear Energy. It was a position she served in for a year and a half - until the adminstration changed.

"While I was a student here in Dow, I never, ever, ever would have imagined I would end up in the roles I've had," she said as a way of encouraging students to take advantage of opportunities because of where they might lead. Case in point: as a U-M student she received a fellowship with NASA. Almost 15 years later she is still collaborating with NASA — this time to put a nuclear reactor on the moon.

Above: Dr. Rita Baranwal (center) poses with Grace Hsia (MSE alum and current chair of the Michigan Engineering Alumni Board), MSE chair Amit Misra, and CoE Dean Alec Gallimore.

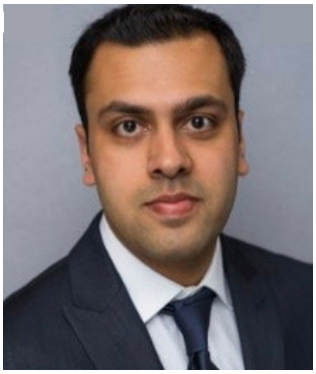
David Martin (BSE '83) receives 2022 Distinguished Alumni Award

This year's Distinguished Alumni Award winner, Dr. David Martin, was presented with his award and gave a brief address to graduating seniors at the MSE Graduation Awards Dinner on Thursday, April 28 in the Ford Robotics Building. A former MSE faculty member, Martin is now a professor of Materials Science and Engineering and Associate Dean of Research and Entrepreneurship at the University of Delaware.

Alums making news

Yurko presents MMRI Lecture

Jim Yurko (BSE '97), Senior Distinguished Engineer at Apple, presented "Alloy Design at Apple" at an MMRI-sponsored seminar on Oct. 28.



Bhattacharya gives special lecture

Riddhiman Bhattacharya (PHD '16), a PTD process engineer with Intel, gave a virtual technical talk, "Yield Analysis Overview at Intel" on Dec. 9.

Ray Decker interviewed for AIME Oral History series

Dr. Ray Decker (who holds three U-M degrees in metallurgy) was recently interviewed about his incredible 71-year career by AIME (American Institute of Mining, Metallurgical, and Petroleum Engineers) as part of its Oral History series. Decker is Chief Technology Officer of Thixomat/nanoMAG, LLC, an MSE Adjunct Professor, and a member of the MSE External Advisory Board. He also is a member of the Board of Managers of QuesTec Innovations, LLC and was elected to the National Academy of Engineering in 1980.

Wenderott joins Drexel faculty

Dr. Jill Wenderott (PHD '18) has been hired as an assistant professor at Drexel University in Philadelphia. After graduating from U-M, Wenderott worked as a postdoctoral researcher first at Northwestern University and then at Argonne National Laboratory, located outside Chicago.

David Adams elected next AVS president in 2024

Dr. David Adams (PHD '94) was recently named the next president of AVS in 2024. Earlier this fall he was elected an AVS Fellow, Class of 2022, for "contributions in the field of reactive materials and thin-film technologies, and for sustained commitment and contributions to national and local AV and the field vacuum science." Adams is a Senior Scientist at Sandia National Labs in Albuquerque, N.M. and was the first PhD student advised by Professor Steve Yalisove.

In Memoriam

Frederick Charles Hull, who very well may have been our oldest MSE alumnus, recently passed away at the age of 106. Born in 1915, Hull graduated from U-M in 1937 with a BS in metallurgy and went on to earn a Ph.D. from Carnegie Mellon in 1941. Hull made his career with Westinghouse (Pittsburgh) as a research metallurgist. He holds 10 U.S. patents, received the Dudley Medal of the American Society of Testing and Materials and the Lincoln Gold Metal of the American Welding Society, and was elected a Fellow of ASM.

Alumni deaths

1948
Eleonore Dorland (Lewisberg, Pa.)

1949
Emanuel Silkiss (Walnut Creek, Calif.)
Arthur Wendt (Saline, Mich.)

1952
Melvin Saunders (Stafford , Texas)

1962
Gerald Schmitt (Greenville, S.C.)

1972
George Baran (Villanova, Pa.)

2013
Prasad Binay (Shelby Township, Mich.)
Xiang Zhou (Lynnwood, Wash.)

DONORS

Following is a list of our generous donors from 2017-2022, organized by giving category.

Named Academic Fellowships/Awards/ Scholarships

Arden L. Bement, Jr. Endowed Scholarship Fund
Arden L. Bement, Jr.

Brian Worth Memorial Account
David Adams and Michelle Griffith
Matthew Daniels
Kelle Snyder Charitable Account at Schwab Charitable
Edwin and Sharon Worth

Da Je and Rui Endowed Fund
John Cheng

David R. Mortensen Fund for Materials Science and Engineering
David R. Mortensen

Dr. Gerald I. and Joyce C. Madden Graduate Fellowship Fund
Joyce Madden
Joyce Riegger

Fontana-Leslie Scholarship Fund
Dr. Robert C. McCune Jr. and Beverly Bealmear
Barbara and James Putney

Frederick N. Rhines Fellowship Fund
Dr. Walden C. and Paula H. Rhines

Harry Ferrari Student Fellowship Fund
Harry Avery
Susan Bailey
Tracy Bilan
Jeff and Sheryl Broadhurst
David Chorski
John Corazzol
Sylvester and Eva Damianos
Anne and Ralph Davies
Sarah and John Drake, Jr.
Thomas and Teresa Dristas
Roy W. Ferrari and Marion J. Ferrari Trust
Kal and Grace Ghoshhajra
Berta and Wishwa Kapoor
Norman Keller
Madeline Kramer
Donna Manesiotis
Thomas Murphy
New South Publishing
Earl H. Novendstern
Jessica and Timothy Obrien

Ben Derby (PHD '20), Kathleen Chou (PHD '21), Clinique Brundidge (PHD '11), Monica Misra, and Aeriel Leonard (PHD '18) hang out at the TMS alumni mixer February 21 in Anaheim.

John Schano
Lawrence and Susan Scherpereel
Jason and Erin Sekerak
Joanne and Harold Sekerak
Virginia Starr
Tennis Magazine
WBJ Consulting
Gail and Irwin Wedner

Howard D. Garoon Fund
Howard D. Garoon

James P. Lettieri Undergraduate Award Fund
Rita Baranwal and Peter Johnson
James and Joan Yurko

Janine Johnson Weins Endowed Professorship Fund
Michael J. Weins

Kenneth and Judy Betz Fellowship Fund
Kenneth and Judy Betz
Kenneth D. Betz Trust

Nathaniel L. Field Materials Science and Engineering Scholarship Fund for Metals Research
Nathaniel L. Field III

Neil A. Weissman Fund for Materials Science and Engineering
Peter and Carolyn Mertz
Neil A. Weissman

Richard A. Flinn Scholarship Fund
Karl and Patricia Betz
Michael J. Weins

Robert D. and Julie A. Pehlke Endowed Fellowship Fund
Robert D. Pehlke

Schwartzwalder Memorial Scholarship
Kyle Luck and Heather Arnold

Wang MSE Chair Discretionary Fund
Tony Kar-Hung Wang

William F. Hosford Scholarship Fund
Gwendolyn and Gary Chung
William F. Hosford
G.K. & E.M. Rasmussen Trust
Carol and Roy Stansbury

Wilbur C. Bigelow Materials Science and Engineering Scholarship Fund
Wilbur C. Bigelow Trust

Faculty Research

David G Clark Memorial Fund of the Bank of America Charitable Fund
Gordon Clark
Continental Technology LLC
Eaton Corporation
First Solar, Inc.
Ford Motor Company
Foundry Educational Foundation
Yuanjun Guo
Renee W. Hovden
IMRA America, Inc.
Mercedes-Benz Research & Development North America
nanoMAG LLC.
P&C Powerhouse Korea

Materials Science & Engineering Funds

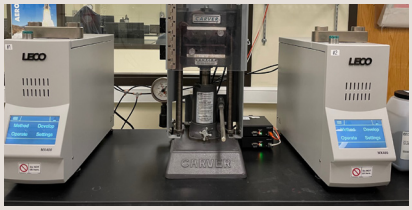
Nina Abani
Usama Abdali and Kisook Park
Ursula and James Allen
Evan and Annalise Anderson
Anonymous
Anonymous
Anonymous
Apple Inc.
Robert and Sue Badrak
Bruce Barth
Thomas and M. M. Battle
Richard Bell
Karl and Patricia Betz
Kelly Bogush
Branimir Botic
Rev. Janice Bowers
Professor Keith J. Bowman
John and Margaret Brokloff
Joe Brooks
Rosemary and James Brooks Jr.
Deborah Campbell
Eric and Camilla Carlson
Robert Carnahan
Timothy Chambers
Kevin H. Chang and Kwanwen Teng
Shirin Chaphalkar
Adam and Suzanne Guise Cheslin
Frank and Wendy Chesworth
Gwendolyn and Gary Chung
Henry Clampitt
Lori Classert
Daniel and Angela Cullen
Marcia and Jeffrey Daniels
DWilliam and Ann Dowling
Karen and Barry Driks
Lisa Eichler and Dr. Stephen Crump
Cynthia Ertle
Obiefune and Ksenia Ezekoye
Carl and Dr. Amy Ferguson
James and Nancy Flasck
Benjamin French and Susan Metosky
James and Carol Fruehling
Robert and Margaret Gamble
Professor Emeritus Ronald Gibala and Janice C. Grichor
Brian Gillis
Jeffrey and Suzanne Groen
Jody and Mark Hall
James Hammond
Karen and Mark Hannum
Susan Hartfield-Wunsch and Christopher Wunsch
Kevin Hartman
William and Susanne Herrnstein III
Craig Hill
Jerry and Nancy Hoffman
Elizabeth Holm
TingXiu Hou and Pang Guiqin
Grace Hsia Haberl and Samuel Haberl
Eric Huang
Johnson Optometric Associates, P.A.
Robert N. Katz
Suzanne and Steven Klein
Michelle and Matthew Kosovec
Ronald and Ellen Krasnow
Craig Kugel and Cynthia Litman
David Kunz
Sanford Lewis
Anton Li
Yiyang Li
Richard and Jami Lind
Kyle Luck and Dr. Heather Arnold
Donald MacDonald and Robert Faulkner
Joyce C. Madden
Thomas and Jennifer Madden
Holly Maloney and Tim Maloney
A. John and Ayse Mardinly
Blair Marks
Charles McLaren
Eileen and Dr. Curt Mikulski
George Mock
Marge Monnot

(Cont'd on pg. 36)

Thank you to all our donors!

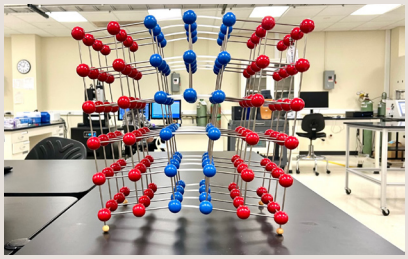
What's new in the Van Vlack Lab

Thanks to the generosity of donors, this past year MSE was able to update the following equipment in the Van Vlack Lab:



Two LECO Sample Mounting Presses (MX400) A touch-screen display provides easy, user-friendly operation for the system. MX400 reduces mourning bottle-necks and increases throughput with full size dual-mount capability.

Grinder/Polisher (Qpol 250 A2-ECO) Sahar Farjami prepares a sample on the newly purchased grinder/polisher. A touch-screen display provides easy, user-friendly operation for the system to adjust force, speed, and polishing.



Models for different crystal structures help students visualize atomic arrange-ment of materials in 3D. The photo above shows the atomic arrangement after edge dislocation where the periodic/regular arrangement of atoms is disrupted.

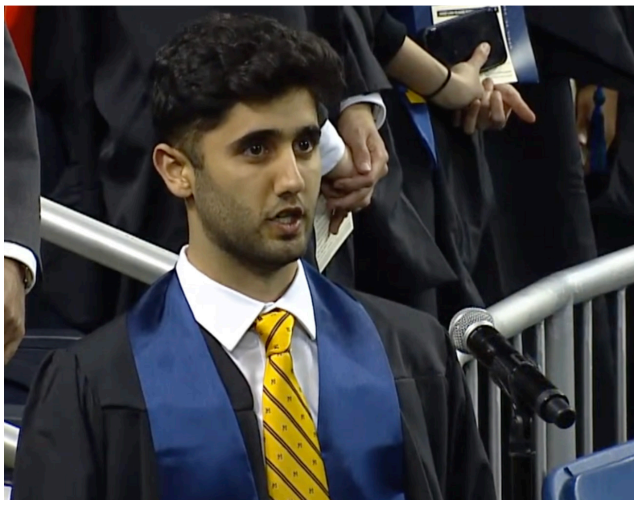
(Cont'd from pg. 35)

Patrick and Peggy Monnot
Dale and Judy Moore
Diann Moore
John Moore
Terri Moore
Alberto Morales
Carl Morin
David R. Mortensen
Leslie Moser and Eric Steigenhofer
Kathryn and David Myers
Dr. Mark and Lin Nichols
Ian Nilsen
Rajiv Parmar
Robert Parsons
A. Murray and Jeanne Patterson
John R. Piazza
QXSTATS, LLC
Leonard Radzilowski
Raymond F. Decker Trust
Joyce Riegger
Dr. and Mrs. Otto K. Riegger
Helen and David Rieland
Paul and Kathryn Riewald
Robertson Family Fund of the Fidelity Charitable Fund
Brian Rogers and Ellen Brockett
Rita Sarno-Hrabie and William Hrabie
Sandra Schaefer
James and Jan Schroth
Christine Seto and Lawrence Chang
Lindsay Shuller-Nickles and Blake Nickles
Terry Shyu
Charles Stickels
Jeffrey Stroble and Lea Purcell
Donald Sturgeon
Jessica TerBush and John Norton, Jr.
Tobelmann Family Fund of the Vanguard Charitable
Gary and Elizabeth Uhring
Hongying Wang and Yin Li
Liya Wang and Huiqing Chen
Tony Kar-Hung Wang
Emily and Richard Warchuck
Jay Weikel
Michael J. Weins
Charles White
James and Joan Yurko
Zhibo Zhao and Shuzhen Liu
Gayle and Robert Zimmerer
Karl and Michele Zimmerman

Undergraduate Lab

Metalcasting and Melt Processing Laboratory Program Fund
Eric Huang
Keough Family Foundation
Leonard Radzilowski

Van Vlack Undergraduate Laboratory Equipment Fund
Anonymous
Anonymous
Robert and Sue Badrak
Susan Behrens
Gwendolyn and Gary Chung
Susan Gentry Giving Fund of the Fidelity Charitable Gift Fund
William and Suzanne Herrnstein III
Eric Huang
Peggy Jones and Andrew Zeek
Franklin Lemkey and Marina Movchan-Lemkey
Scott and Maria Mukavitz
D. Keith and Jacqueline Patrick
G.K. & E.M. Rasmussen Trust
Joyce E. K. Riegger
Paul and Kathryn Riewald
Robertson Family Fund of the Fidelity Charitable Gift Fund
Dennis and Lauren Stuligross
Robert J. Warrick



MSE Class of 2022 graduate Keon Beigzadeh (also a vocal performance major) sang the national anthem at the College of Engineering graduation ceremony in Crisler Arena on Saturday, April 30.

To make a gift online: mse.engin.umich.edu/alumni/giving

MSE faculty and staff with the 2022 spring graduates at the MSE Graduation Awards Dinner at the Robotics Building in April.

Your gift matters!

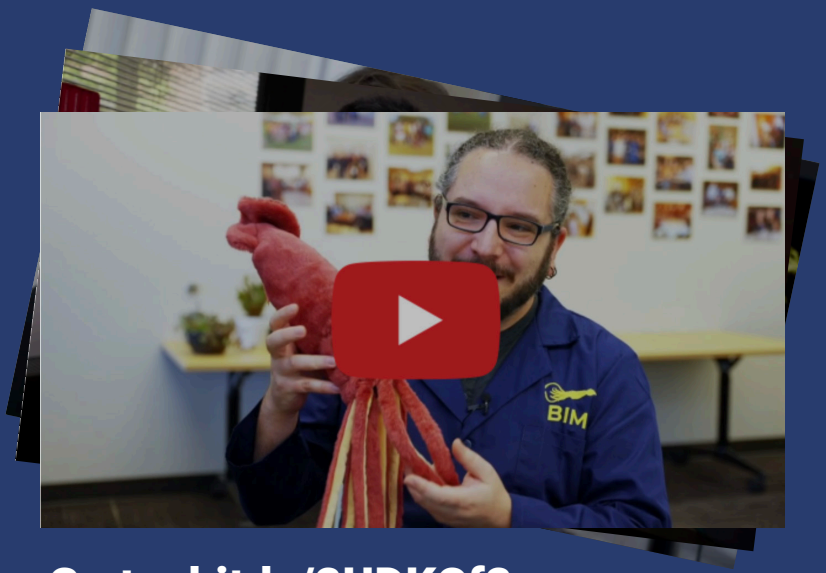
No matter the size, your gifts help us maintain our high standards of excellence in our research labs and classrooms, provide financial support for truly outstanding students in need and enhance the visibility of our department through distinguished seminars, workshops and outreach events. We need to keep attracting the best and brightest materials faculty, staff and students so that we can continue to meet the accelerating demand for quality materials research and education.

Donate today!

Thank you!

Check out the new "A Look at MSE Labs" video series now playing on YouTube!

Created by Professor Steve Yalisove, the first installment of this new video series takes a look at how the Hovden, Li, Loebel, Peña-Francesch and Sun labs are tackling today's most pressing materials issues.



Go to: bit.ly/2UDKCf2

FOCUS ON MSE

Perez gets advice from Trevor Noah

On September 16, the College of Engineering sponsored a special talk just for engineering students with comedian Trevor Noah in Hill Auditorium. Throughout the evening, students (pre-vetted by the College) asked the celebrity questions, including our own first-year Ph.D. student **E. Celeste Perez** (pictured above on the far left, posing backstage with Noah, center), who told Noah that as a first-generation college student she felt a little 'first-generation guilt' and asked if he had any advice for her.

"I do not remember his full response because I was a bit nervous," Perez said, "but I believe he told me that 'there was no reason to carry any guilt.' He said that just by breaking the pattern from past generations I am already helping future generations. He said that I didn't need to feel the pressure of being perfect because I am already exploring unknown territory and that in itself is already difficult, and I should be proud of myself."