

MSE*news*



COLLEGE OF ENGINEERING
MATERIALS SCIENCE & ENGINEERING
UNIVERSITY OF MICHIGAN

Winter 2021



Engineering around Covid

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Front cover: MSE lecturer George Wynarsky teaches his MSE 250 class virtually from an empty classroom in Chrysler last spring. Talking about items made of composite fibers, he told his students, "I'm so sad that you're not here; I would love to pass these around for you to look at."

Opposite page: Lauren Duke '22 collects data for her MSE360 final project in the Van Vlack Lab while wearing gloves and a mask, part of the Covid-19 safety protocols put in place in all labs last summer.

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A note from the MSE Department Chair

It all happened so fast. On March 11, 2020 the university announced it was suspending all operations for two days to prepare for a shut-down and abrupt shift to remote learning. On March 16, then, all campus buildings and labs closed, many students returned home, and all classes were offered online. Like the rest of the country, words like “social distancing” and “Zoom” quickly became part of our daily lexicon. Campus event cancellations were announced like toppling dominos: the NCAA basketball tournament, the spring sports season, graduate recruiting visits, and the biggest gut-punch of all: graduation festivities, including our annual MSE graduation awards dinner.

In an effort to still celebrate our graduates, we recorded a graduation video with faculty messages and mailed packages of MSE swag to each graduate’s home. In a heartwarming gesture of solidarity, more than 30 alumni stepped up and wrote messages of encouragement and congratulations to our graduates that we published in the annual graduation program. In a time of uncertainty, it was an inspiring moment for which I commend and thank each and every alum who took the time to lift up our students.

Finally, in mid-summer research labs opened on a limited, rotational basis with strict COVID protocols in effect, including temperature checks to gain entrance to buildings. Slowly, begrudgingly, life settled into the “new normal,” meaning virtual.

Everything from classes to advisory meetings to Ph.D. defenses were conducted virtually via Zoom.

But while the pandemic disrupted academic life as we knew it, MSE didn’t just survive, we thrived. Important research projects and the PRISMS Center landed research grants from federal and industrial sponsors; faculty won prestigious awards and celebrated career milestones; and we hired three new faculty members whose research passions and interests adds new research directions and diversity to our department.

Engineering around the pandemic has presented major challenges to be sure, but it has also taught us valuable lessons in patience, flexibility and resiliency. In reflecting back on the past eight months, it is with deep gratitude that I applaud all of our students, faculty and staff for keeping a positive attitude and facilitating a seamless transition to remote learning and working from home. To all MSE alumni and members of MSE community, I thank you for your continued invaluable support and wish you good health and happiness in this new year. I very much look forward to the day when we can once again welcome you back in-person on campus safely.

Go Blue!

Amit Misra



“Engineering around the pandemic has presented major challenges to be sure, but it has also taught us valuable lessons in patience, flexibility and resiliency.”

**—Amit Misra,
MSE Chair**

Meet our newest faculty members

“We are excited to welcome Yiyang, Abdon and Claudia to the MSE team. They bring passion and expertise in the fields of machine learning, bioinspired materials and extracellular matrix manipulation that significantly expands and enhances what we offer as a department.”

—Amit Misra, MSE Chair



Yiyang Li

Education: Ph.D., Materials Science and Engineering, Stanford University, 2016; BS, Electrical and Computer Engineering, Olin College of Engineering, 2011

Research interests: My research is to develop new materials for energy, currently focused on batteries and energy-efficient computing. Many are aware of the role of batteries in electric vehicles, but might not know that certain machine learning algorithms consume as much energy as flying Air Force One across the country. We are finding that the same classes of materials used for energy storage can also be used to make machine learning orders of magnitude more energy efficient.

Q: Why did you choose to come to U-M?

U-M offered just the right balance between teaching, research, and service for me. This semester, I'm very excited about teaching the senior capstone design class with Prof. Max Shtein, where all students work on real-world problems in materials science with industry partners. The partners range from Fortune 500 companies to local startups, and the problems have diverse applications in energy, electronics, healthcare, and informatics.

Q: Why did you choose to come to U-M?

I'm looking forward to meeting the MSE community once we come back to campus. I've probably only met about 10% of the faculty, students, and staff in since arriving in person. I'm especially looking forward to meeting the undergraduate students.

New courtesy appointments



Becky Peterson, EECS

Oxide semiconductor materials and devices; 3D-IC heterointegration of oxide-based thin film electronics with silicon CMOS; solution-processed inorganic electronic materials; crystalline gallium oxide for power devices.



Abdon Pena-Francesch

Education: Ph.D., Engineering Science and Mechanics, The Pennsylvania State University, 2017; M.Sc., Chemical Engineering, Institut Químic de Sarrià (Barcelona, Spain), 2013; B.Sc., Mechanical Engineering, Institut Químic de Sarrià (Barcelona, Spain), 2011

Research interests: My research is centered around biomaterials science, polymer chemistry, soft matter physics, biology, and nanotechnology to develop advanced and programmable soft materials for robotic applications in healthcare, bioengineering, and environmental science.

Q: Why did you choose to come to U-M?

I believe U-M really stands out when it comes to its people. There is a big and healthy community in U-M working on important global challenges and making an impact on many different fields. It takes very creative and collaborative multidisciplinary teams to achieve that, from students to faculty and staff. I think this is what makes U-M one of the top research institutions in the world, and I am very honored and excited to be a part of it.

Q: What are you looking forward to most?

I am very much looking forward to sharing my research with students and building our team, and establishing new collaborations within the MSE department and also with other departments and programs like MACRO or Michigan Robotics.



Claudia Loebel

Education: Ph.D., Health Science and Technology, ETH Zurich (Zurich, Switzerland), 2016; M.D., Martin Luther University Halle-Wittenberg (Halle, Germany), 2011

Research interests: My work is inspired by the interface between materials science and regenerative engineering to address specific problems related to tissue development, repair, and regeneration. By developing mechanically and structurally dynamic biomaterials, microfabrication, and matrix manipulation techniques we aim to recreate complex cell-matrix interactions and model tissue morphogenesis and disease to ultimately develop more effective therapeutic treatments for diseases such as fibrotic, inflammatory, and congenital disorders.

Q: Why did you choose to come to U-M? I am excited to join U-M for its leading researchers, diversity of expertise and emphasis on collaborative research, which is supported by an immense number of basic and translational research institutes and facilities. In this resource-rich environment, I expect to build a research program that develops engineering tools for directing tissue regeneration/repair and be able to translate our findings into regenerative medicine applications.

Q: What are you looking forward to most? The part I am looking forward to most are the interactions with students and trainees. By building a cultural and intellectual diverse research group I hope to get them excited about science, and look forward to being part of their journey to become critical and diverse thinkers.



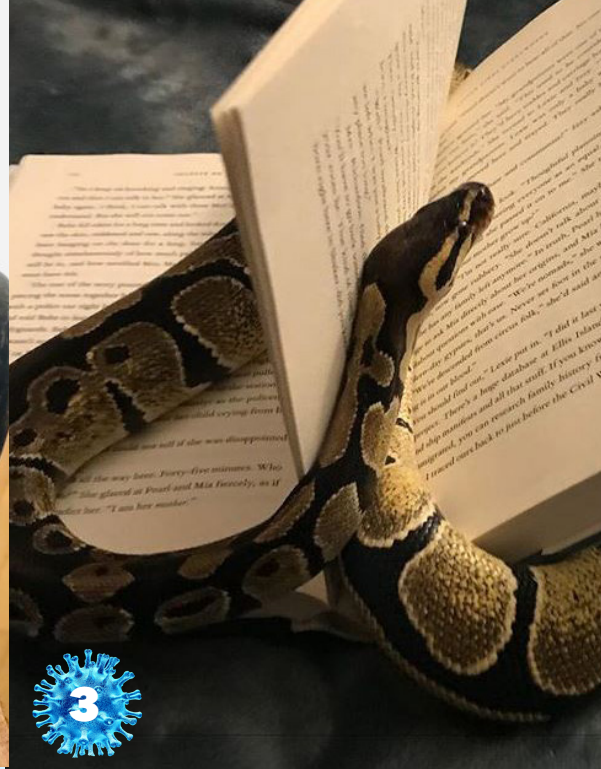
Neil Dasgupta, ME

Renewable energy and energy storage; nanomanufacturing; atomic layer deposition; high-resolution microscopy and spectroscopy of nanomaterials; surface science and catalysis; electrochemistry; nanowires; energy policy and economics



Xiwen Gong, ChE

To address the challenge of aging and healthcare, the Gong group aims to advance knowledge and technology through the lens of material innovation, advanced spectroscopy, and engineering of soft bio-electronics.



COPING WITH COVID



WHY WON'T MY HUMANS EVER
LEAVE HOME SO I CAN NAP IN PEACE!

Contests serve as a distraction from an unprecedented, stressful situation

When campus shut down, MSE launched *MSE QuarantEAM* to stay connected.

In an effort to keep the community feeling connected while scattered far and wide, MSE created *MSE QuarantEAM*, a weekly electronic newsletter that showcased research and advertised virtual events. Through *MSE QuarantEAM*, the department implemented a pet photo contest (and later a Halloween costume contest) that had a huge response from students, faculty, staff and alumni. MSE was the only engineering department to initiate the contests which were originally meant to lift spirits, but ended up providing an even greater benefit.

“We originally initiated the contests as a fun activity to distract from all the

distressing pandemic news,” said MSE chair Amit Misra, “but they ended up serving a much deeper purpose: we learned more about each other in a way we wouldn’t have otherwise.”

“The contests were a fun diversion from the uncertainty and stress we were facing as we adjusted to life in lockdown,” said senior IT administrator Kevin Worth, whose dog Duncan won the pet photo contest (see opposite page, upper lefthand corner). Winners of the pet photo contest are featured on the opposite page, while the Halloween contest winners are pictured below.

“We originally initiated the contests as a fun distraction, but they ended up serving a much deeper purpose: we learned more about each other in a way we wouldn’t have otherwise.”

—Amit Misra, MSE Chair



Halloween costume contest winners were:
1. Apollo Sun, submitted by Assistant Professor Wenhao Sun,
2. Anya Qi, submitted by Assistant Professor Liang Qi,
3. Hocus Pocus trio, submitted by Mse staff member Kathy Kuhn.

Opposite page: Pet photo contest top finishers were: **1.** “Duncan is all of us right now!” submitted by Kevin Worth, senior IT administrator, **2.** Nanu, submitted by Assistant Professor Ashwin Shahani. **3.** Jefferson the python, submitted by Ph.D. candidate Aaron Gladstein. **4.** Maizey, submitted by graduate advisor Renee Hilgendorf. **5.** A recreation of “The Sleeping Gypsy” by Henri Rousseau, submitted by Ph.D. candidate Alex Kate Halvey. **6.** “Why don’t my humans ever leave so I can nap in peace?” submitted by Ph.D. candidate Kelsey Steinke.

CLOSED
WEEK OF
MARCH 16

COPING
WITH
COVID

“It was neat to be able to present a well-thought-out solution... that aimed to address such a pressing and globally domiatnt problem.”

—Bethany DeMarco ‘20



480 Capstone course does a 180

When Covid hit mid-course, Profs. Taub and Shtein quickly reworked the syllabus to give students the option of designing Covid-related projects.

Prior to March 16, the MSE 480 Capstone Design course was hands-on learning as usual. Eight student teams were following a system engineering approach with projects like converting the lower control arm of a Dodge Ram truck from aluminum to ADI (austempered ductile iron) that reduced both the weight and cost of the original component by 10 percent. Next up was building a physical prototype.

Then Covid hit. “The teams had completed the steps of defining user needs, engineering requirements, down-selecting the best concept and producing a detailed design,” explained MSE 480 instructor Professor Alan Taub. “They were about to move on to producing and testing

a physical prototype when the Covid crisis closed the laboratories.”

Taub and co-instructor Professor Max Shtein then reworked the syllabus to allow each team to make a choice between a) continuing on with their present project with more detailed design and modeling, or b) changing to a new project aimed at designing products that would support the battle against the coronavirus.

In the end, two teams stayed with their original projects and six teams opted to switch to a new, Covid-related project.

The teams who stayed with their original projects, “Incremental Sheet Forming of Titanium” for ME Professor Miheala Banu and “Improved Ocular Conformer for

Anophthalmia Patients” for Dr. Nelson of the Kellogg Eye Center, were able to see the projects through with positive outcomes.

“Both teams who stayed with their original projects ended up delivering detailed design and simulations of their concepts to their sponsors, who were very pleased with the results,” said Taub.

Meanwhile, the other six teams chose between designing a decontamination unit for N95 respirators, designing a negative pressure room to mitigate the spread of Covid-19, and producing better respirator masks by improved sealing and adapting a snorkeling mask for isolated non-invasive ventilation during treatment of Covid-19.

Of course, with half of the semester gone, time presented one of the biggest obstacles to those changing mid-project.

“For our new project, we had to make as much progress in a month that had taken about three months to complete for our original project,” said Bethany DeMarco, who switched to designing a negative pressure room. “It was difficult to absorb and understand so much information about the virus in such a short amount of time, and then use it to develop an effective solution, especially since the information was changing daily. Another challenge was just adjusting to all of the struggles that come with working on a very collaborative project in a remote capacity. Fortunately, my team was quick to delegate project tasks and set up many meetings throughout each week to discuss

ideas and monitor our progress. It also helped that we had gone through the design process before for our original project, so we were familiar with what deliverables needed to be completed.”

Group dynamics were also an issue as the teams had to work together – while apart. “Our group often had varying ideas on how the affordability vs effectiveness trade off should be broken, and it was extra challenging since we weren’t able to meet face to face to discuss,” said David Allen, also a member of the negative pressure room team. “We overcame this challenge by taking votes as a team after weighing the pros and cons of each team member’s stance over Bluejeans.”

Through it all, Taub said he was “very impressed” with how quickly the teams adapted to the unprecedented situation – an unintended but highly useful life skill in and of itself.

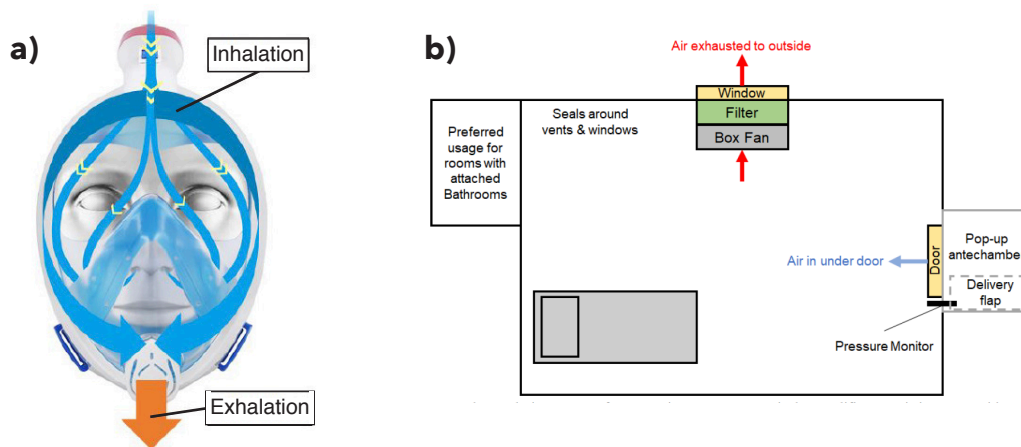
“While it seemed unfortunate to have to go through the Covid crisis, it did have one upside,” commented Taub. “The reality is that often in engineering careers there are times when there are interruptions and changes to the product-development processes, so this was actually a good thing to experience and learn from.”

DeMarco agreed that the end result was worth the upheaval: “It was neat to be able to present a well thought out solution at the end of the semester that aimed to address such a pressing and globally dominant problem.”



“While it seemed unfortunate to have to go through the Covid crisis, it did have one upside. The reality is that often in engineering careers there are times when there are interruptions and changes to the product-development processes, so this was actually a good thing to experience and learn from.”

—Professor Alan Taub



a) Two teams took on ways to produce better respirator masks by improved sealing and adapting a snorkeling mask for isolated non-invasive ventilation during treatment of Covid-19. **b)** Two other teams chose to develop a Negative Pressure Room to mitigate the spread of COVID-19.

FACULTY NEWS

Special Awards, Promotions & Recognition



John Allison received a Distinguished Alumni Award for Academic Excellence from The Ohio State University (where he earned his master's degree).



Emmanouil (Manos) Kioupakis is MSE's new Graduate/Ph.D. chair and recipient of 2020 MSE Faculty Outstanding Accomplishment Award.



Emmanuelle Marquis was one of only six professors from across the U-M campus to receive a 2020 Faculty Recognition Award.



This fall **Geeta Mehta** was promoted to Associate Professor.



Amit Misra is now the Edward Campbell DeMille Collegiate Professor of Materials Science & Engineering.



This fall **Pierre Ferdinand P. Poudeu** was promoted to Professor.



Wenhao Sun won a DOE Early Career Award for "Temperature-Time-Transformation (TTT) Diagrams for Predictive Solid-State Ceramic Synthesis."



Alan Taub was the 2020 recipient of TMS' Research to Industrial Practice Award.



Katsuyo Thornton won TMS' 2021 Julia and Johannes Weertman Award for notable contributions to education in metallurgical engineering.

Faculty External Professional Service 2020

John Allison



- National Academy of Engineering, Materials Engineering Section, Vice Chair
- National Academy of Engineering, Nomination Committee, Past Chair
- TMS Fellow Committee, Chair
- TMS Materials Innovation Committee, Member
- TMS, ICME Committee, Member
- Integrated Materials and Manufacturing Innovation, Editorial Board

Michael Atzmon



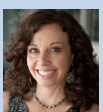
- Past President, International Mechanochemical Union (member Society of the International Union of Pure and Applied Chemistry)
- Steering Committee, International Symposium on Metastable, Mechanically Alloyed and Nanocrystalline Materials

Stephen Forrest



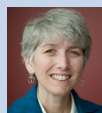
- Distinguished Visiting Professor of Electrical Engineering, Technion Israel Institute of Technology (2015-present)
- National Academy of Sciences Defense Acquisitions Board (2019-present)
- National Academy of Engineering Nanomaterials and Manufacturing Board (2017-Present)
- The Technion, Israel Institute of Technology Board of Governors (2012-present)
- Physical Review Applied, Lead Editor (2016-present)
- Nano Energy, Editorial Board (2014-Present)
- Applied Materials Board of Directors (2008-present)
- Applied Materials Growth Technology Advisory Board (2020-Present)
- Universal Display Corp. Scientific Advisory Board (1994-Present)
- National Academy of Engineering Section 7 Vice Chair (2018-2020); Chair (2021-Present)

Sharon Glotzer



- Member, National Academy of Sciences Committee on Chemical Engineering: Challenges and Opportunities in the 21st Century
- Associate Editor, ACS Nano, 2015-present

Rachel Goldman



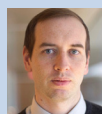
- Chair, Scientific Advisory Committee, Center for Integrated Nanotechnologies, Department of Energy
- Chair Line, Division of Materials Physics, American Physical Society, 2019-2023
- Associate Editor, Journal of Applied Physics, 2017-present
- Editorial Board, MRS News, 2012-present
- Executive Committee, Electronic Materials Conference
- NAS/NAE Panel Extramural Basic Research at the Army Research Laboratory, 2019-2020
- Chair, Adler Award Committee, American Physical Society, 2019

John Heron



- Lead organizer of ACerS EMA Meeting, "Frontiers in Ferroic Oxides: Synthesis, Structure, Properties, and Applications," Jan. 2021
- Lead organizer of MRS Spring Meeting, "Topological and Quantum Phenomena in Oxides and Oxide Heterostructures," 2020
- Member, American Ceramics Society, Materials Research Society, and American Physical Society
- NIST Center of Neutron Research Beam Time Allotment committee

Robert Hovden



- DOE Proposal Review Board at the Lawrence Berkeley National Electron Microscopy Center and the Brookhaven National Center for Functional Nanomaterials.
- Symposium Chair for APS March Meeting 2020 Denver, Co., M&M 2020 Milwaukee, Wis., M&M 2019 Portland, Ore.

John Kieffer



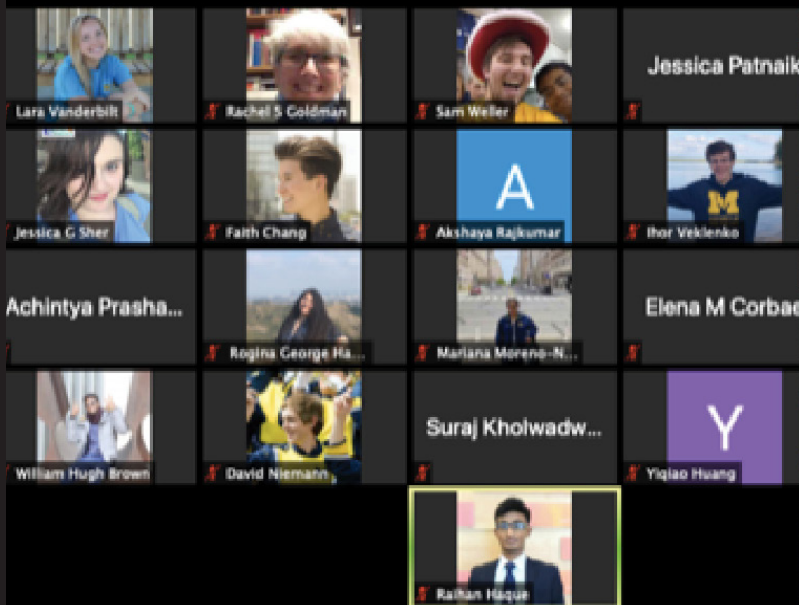
- Board of Directors of the American Ceramic Society
- 2020 Alfred R. Cooper Distinguished Lecturer

Peter Ma



- Tissue Engineering and Regenerative Medicine International Society-Americas Meetings Committee Member
- International Chinese Musculoskeletal Research Society, Board Member, President-Elect
- Chinese Association for Biomaterials, Advisory board member
- International Advisory Committee, The School of Biological Science and Medical Engineering, Beihang University
- Grant reviewer: NIH, NSF
- International Advisory Committee, the Tissue Engineering and Regenerative Medicine International Society World Congress
- International Advisory Committee, the Tissue Engineering and Regenerative Medicine International Society World Congress (TERMIS-WC), Maastricht, The Netherlands, 2021

(Continued on pg. 12)



Goldman goes extra mile to make remote learning interactive

After four years of teaching MSE 250 in person, Professor Goldman met the challenge of providing a rigorous—and still hands-on—learning experience for students with home-delivered crystallography mini-kits.

This spring Professor Rachel S. Goldman taught MSE 250 with 17 students. In the following interview, she discusses what it was like adapting the course to a remote-learning format.

Q: How was the remote class structured?

Since it was spring term, we had an accelerated schedule, meeting for two hours, four days per week, but we otherwise retained many features from the “live” class during the Fall or Winter term. Prior to each class meeting, I uploaded to Canvas a “packet” of slides which contained key illustrations and diagrams, along with planned blank spaces. During our synchronous class meetings, each packet was transmitted via Zoom as I annotated them while speaking and fielding questions as they arose. After each class, the annotated slides and the Zoom cloud recording were made available on Canvas.

Q: What were your personal goals for the course?

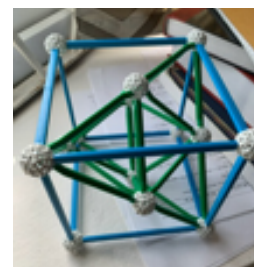
My goal was to facilitate remote learning of materials science for all of our students. I feel a strong sense of obligation, especially in this moment, to provide a rigorous learning community which combines hands-on and visual learning in a remote environment. To achieve these goals, I introduced a new “remote crystallography lab” -- using a home-delivered crystallography mini-kit for live visualization of atoms and planes in crystals.

Q: What specific challenges did you have teaching remotely and how did you overcome them?

The greatest challenge in remote instruction is establishing a rapport with and between students. To facilitate rapport building, we took a few minutes’ break during each class meeting to share a fun fact such as “What city are you in?” or “What are you most looking forward to doing once the lockdown is over?”

Q: Please explain the crystallography kits and why you felt it was important to mail them to each student.

Often, the greatest challenge for materials science learners is visualization of atoms and planes in crystals. During on-campus learning, multiple crystal structure models are available for students to hold and rotate in their own hands, solidifying their understanding of atomic configurations. During remote instruction, it is important provide each student with an at-home “hands-on” opportunity—namely, a crystallography mini-kit. The students were very excited about the kits. One told me: “Thank you for the effort you’re putting into getting me this kit!”



Crystallography kit

Four staff members earn 2020 Staff Service Awards



Tim Chambers



Kristen Freshley

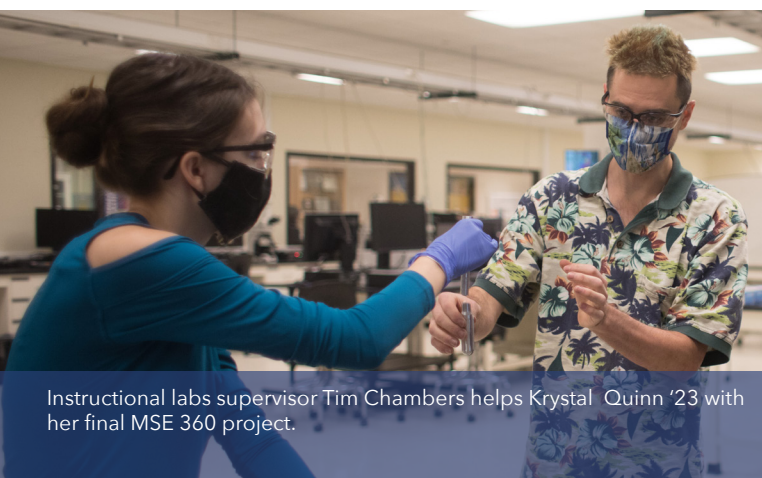


Tina Longenbarger



Kevin Worth

Given for going “above and beyond” one’s job description, this year’s Staff Service Awards were presented to four staff members at the virtual holiday party last month: **Tim Chambers** (instructional labs supervisor), **Kristen Freshley** (senior communications & marketing specialist), **Tina Longenbarger** (executive secretary), and **Kevin Worth** (senior IT administrator). Staff awards are determined each year by faculty, and this year was a “tough contest,” according to MSE Chair Amit Misra, who noted that almost every staff member received at least one faculty recommendation. “Given the difficult circumstances this year, I wish we could have given each and every staff member an award,” Misra said.



Instructional labs supervisor Tim Chambers helps Krystal Quinn '23 with her final MSE 360 project.

Faculty External Professional Service (cont'd)

Emmanuelle Marquis



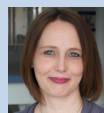
- PTM 2020 (postponed to 2022), scientific committee
- Spring E-MRS 2020 (postponed to 2021), symposium co-organizer
- TMS award committee, member
- TMS nuclear materials committee, member
- TMS chemistry and physics of materials, member

Geeta Mehta



- NIH review panel
- NSF review panel

Joanna Millunchick



- Big Ten Academic Alliance Leadership Fellow (2019-2020)
- Taubman College of Architecture and Urban Planning Advisory Board (2019-)

Amit Misra



- Materials Research Letters, Editor
- MRS Program Development Subcommittee
- MRS Bulletin, Editorial Board, Chair
- ASM, International: Technical Books Committee Member
- TMS Innovation Committee, member-at-large
- University Materials Council, vice-chair
- Oak Ridge National Lab, Advisory Committee (Physical Sciences)

Becky Peterson



- Treasurer (2019-2021), Electronic Materials Conference
- Technical Program Chair (2021) and Vice Chair (2020), Device Research Conference
- Chair of the 2020 Sub-Committee for Optoelectronics, Displays and Imagers, IEEE International Electron Devices Meeting (IEDM)
- Chair, IEEE Southeastern Michigan Trident Chapter IV (Joint Chapter of Electron Device Society/APP/MTT/Photonics) (2018-present)

Ashwin Shahani



- Guest editor of *MRS Bulletin* thematic issue: “Processing Metallic Materials Far from Equilibrium” November 2020
- Key reader, Metall. Mater. Trans. A, September 2018 to present
- Member of ASM Emerging Professionals Committee, August 2018 to present
- Member of TMS technical committees: Solidification Committee and Phase Transformations Committee (Materials Processing & Manufacturing Division), March 2017-present
- Member of Proposal Review Panel for National Synchrotron Light Source II (2019-2022)

Don Siegel

- Affiliate member, U.S. DRIVE Hydrogen Storage Technical Team
- Member of the Directorate, Joint Center for Energy Storage Research

Alan Taub

- NAE - Council member and chair Audit Committee
- ASM - Awards Committee
- MIT Visiting Committee for MSE
- UC Davis – Strategic Advisory Board
- Member - Boy Scouts of America STEM Advisory Committee
- MainForum Conference Organizing Committee

Katsuyo Thornton

- Technical Advisory Board, Center for Hierarchical Materials Design (CHi-MaD), an NIST Advanced Materials Center of Excellence (2014-present)
- Chair of Advanced Research Computing Advisory Team (ARCAT), providing guidance and advice to the Vice President and Chief Information Officer and the Associate Vice President for Advanced Research Computing on strategic directions relating to the advanced research cyberinfrastructure
- Contributor, Report on Creating the Next-Generation Materials Genome Initiative Workforce (TMS).

Gary S. Was

- Editor-in-Chief, Journal of Nuclear Materials, Elsevier
- Editorial Review Board, Metallurgical Transactions
- Member, Scientific Advisory Committee for IL TROVATORE, European program on Innovative Cladding Materials for Advanced Accident-Tolerant Energy Systems
- Selection Committee, Robert Cahn Award, Journal of Nuclear Materials and NuMAT
- Academic Advisory Committee, Versatile Reactor-based Fast Neutron Source (VFNS) Research and Development Initiative
- Independent Technical Review Committee, U.S. High Performance Research Reactor – Fuel Development
- Organizing Committee, International Conference on Environmental Degradation of Materials in Nuclear Power Systems – Water Reactors
- Originator and Organizing Committee, Conference on Materials in Nuclear Energy Systems
- Chair, International Atomic Energy Agency, Coordinated Research Project
- Member, Board of Directors, International Cooperative Group on Environmentally Assisted Cracking

Steve Yalisove

- MRS Academic Affairs Committee
- MRS Education Sub-Committee Academic Affairs
- MRS Bulletin Energy Quarterly Editorial Board
- Co-Chair, Materials Education Symposium Advisory Committee
- MRS Fall 2021 Symposium Organizer for “Developing an open source textbook for the materials community”

New DEI Initiatives on tap for 2021

MSE is partnering with other departments within Michigan Engineering to launch two important new DEI initiatives.

First, a new center for DEI will work horizontally across all departments and divisions and will focus on:

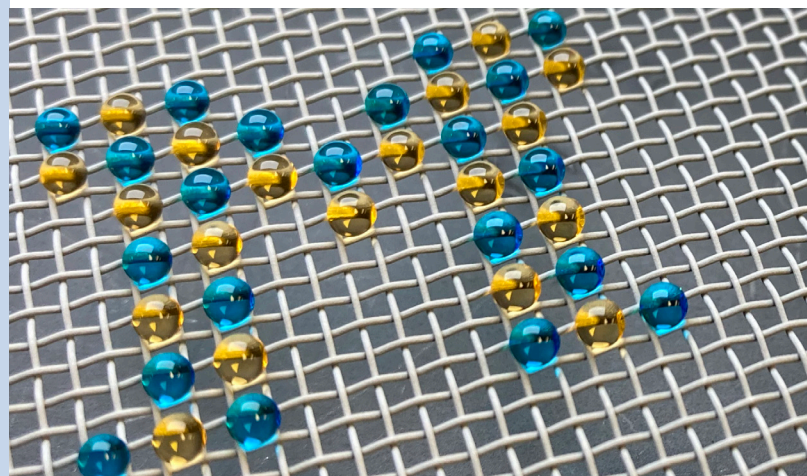
- Leading and facilitating collaboration to advance Michigan Engineering’s vision of an inclusive and equitable community gathered in pursuit of its academic mission.
- Providing resources and best practices for administrative units and individuals.
- Expanding pipelines and pathways by delivering flagship programming across K-20 designed to increase representation of students from underserved and underrepresented communities.

Second, over the next year, new education initiatives will be launched around issues of race, ethnicity, unconscious bias, and inclusion, which will be required for everyone in engineering – students, faculty and staff.

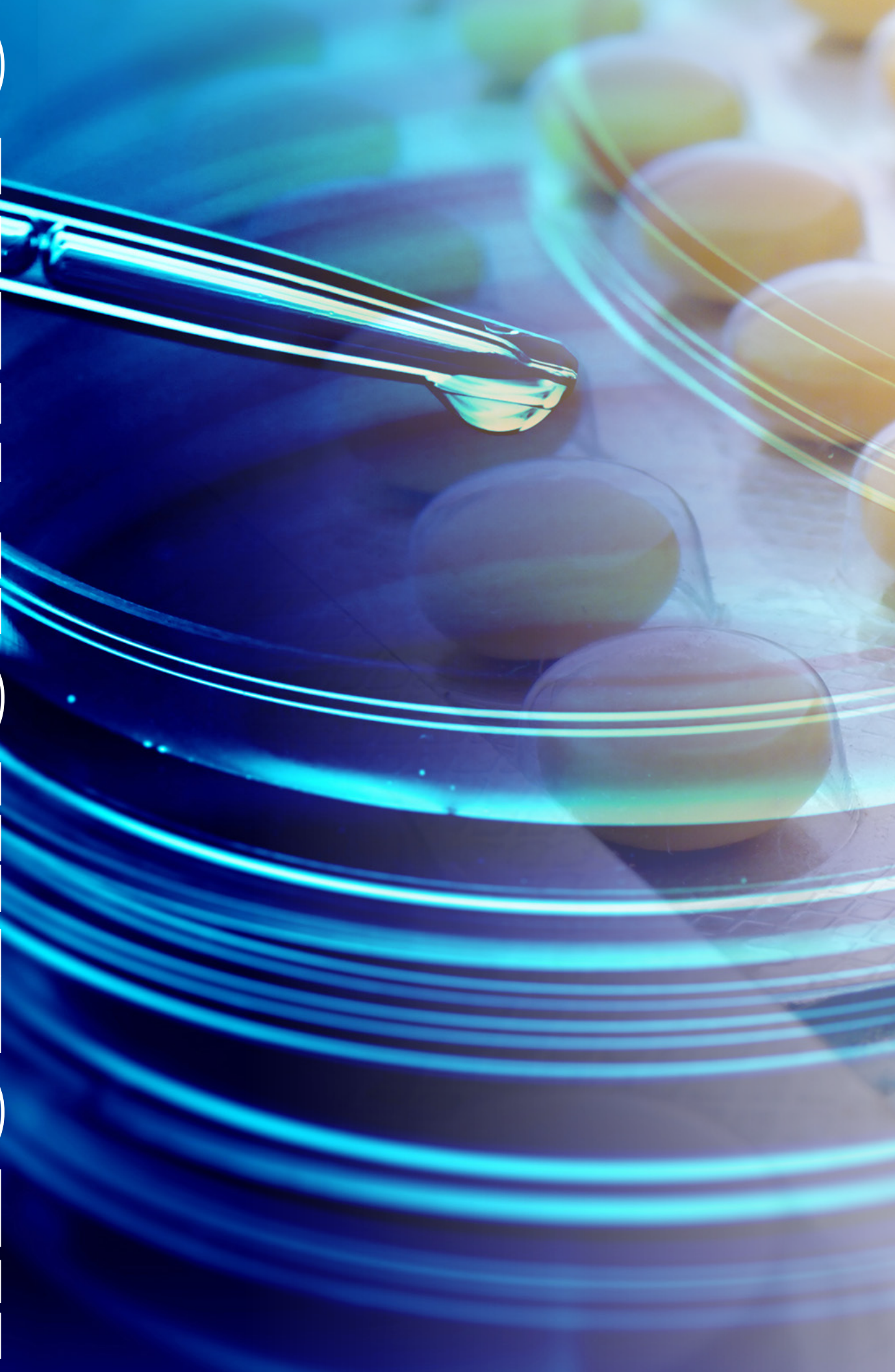
“Both the center and teaching initiatives are big steps forward in achieving our ultimate goal of creating a culture that values and welcomes the experiences, talents, and contributions of all students, staff and faculty,” said Kathy Sevener, DEI Department Lead and DEI Lecturer.



Kathy Sevener, MSE DEI Lead



RESEARCH NEWS



“Instead, imagine cancer medicines being administered in the same way headache medicine is taken now.”

—Professor Max Shtein

NSF grant gives personalized meds project a shot in the arm



Max Shtein

A U-M research team, led by MSE Professor Max Shtein, recently received a \$2 million NSF Emerging Frontiers in Research and Innovation grant, propelling the project closer to its vision of personalization of medicine at costs and convenience better than the current practice.

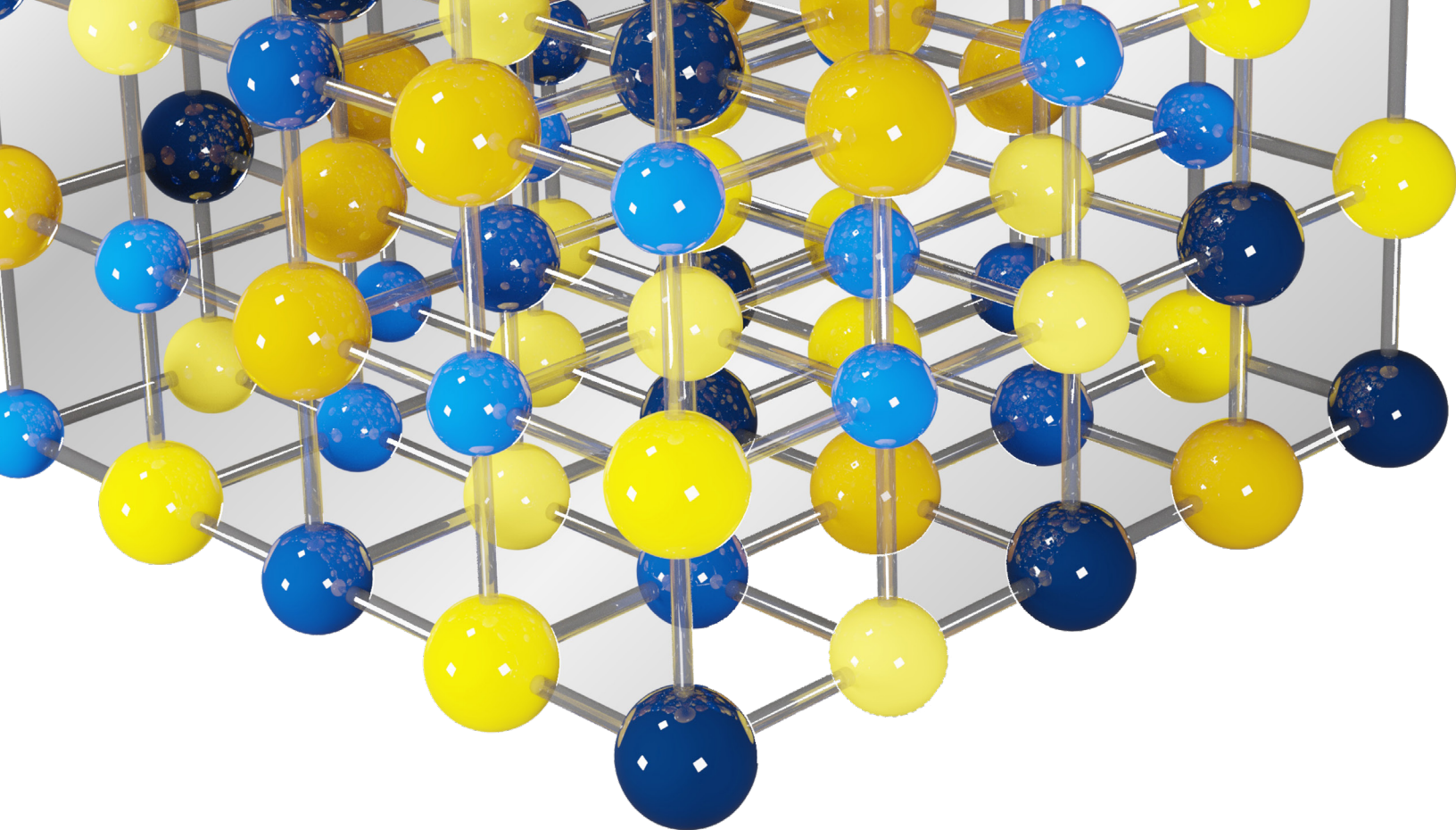
According to Shtein, this project paves the way toward distributed manufacturing of medicines, focusing initially on cancer drugs. The cutting-edge cancer drugs have to be highly personalized to each patient. Additionally, many cancer medications have to be administered in special infusion clinics under professional supervision. All this takes much time from the patients, requires expensive labor, and thus costs a lot of money. In situations like Covid, delays can be deadly, as the clinics can't easily see as many patients.

“Instead, imagine cancer medicines being administered in the same way as headache medicine is taken now,” Shtein said. “You don't have to go to the hospital to take an ibuprofen. That's not currently possible with many cancer medicines, and our project aims to try and break the trade-off between personalization and low cost, as well as to enhance the medicines themselves to a point where they may be more easily absorbed and formulated to be taken at home. We think this research we are embarking on will be an essential step toward making telemedicine better and dramatically less expensive than the current in-person medicine, which is our ultimate vision.”

The NSF grant, then, will help the team continue the breakthrough work they started several years ago and ensure that the necessary collaborations among the current team members move forward. As Shtein remarked: “It will help us build a platform and engage additional expertise required to make this moonshot a reality.”



Team members include MSE Associate Professors Geeta Mehta and Anish Tuteja, ChE Professor Ron Larson, and Professor of Pharmaceutical Sciences Nair Rodriguez-Hornedo.



MSE scientists discover new class of semiconducting entropy-stabilized materials



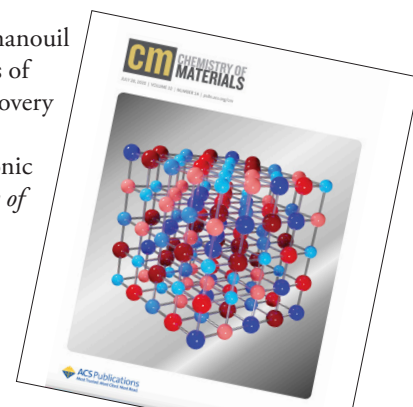
Kioupakis



Poudeu

The Kioupakis and Poudeu groups collaborated on a paper on the theoretical prediction and experimental discovery of a new class of materials.

Semiconductors are important materials in numerous functional applications such as digital and analog electronics, solar cells, LEDs, and lasers. Semiconducting alloys are particularly useful for these applications since their properties can be engineered by tuning the mixing ratio or the alloy ingredients. However, the synthesis of multicomponent semiconductor alloys has been a big challenge due to thermodynamic phase segregation of the alloy into separate phases. Recently, MSE Associate Professor Emmanouil (Manos) Kioupakis and Professor Pierre F. P. Poudeu utilized entropy to stabilize a new class of semiconducting materials, based on GeSnPbSSeTe high-entropy chalcogenide alloys, a discovery that paves the way for wider adoption of entropy-stabilized semiconductors in functional applications. Their article, “Semiconducting high-entropy chalcogenide alloys with ambionic entropy stabilization and ambipolar doping” was published in July in the journal *Chemistry of Materials*.



Advanced Polymer Coatings/Membranes for Naval, Solar & Bioenergy Technologies

Associate Professor Anish Tuteja's group is a partner in three projects that have recently received significant funding from ONR and DOE.

Project #1: Understanding the Principles of Solid Shedding Surfaces

Project Summary: Solid fouling refers to the undesired adhesion of solid contaminants to surfaces. Common hard foulants include ice, inorganic scale, waxes and asphaltenes, and natural gas hydrates, while soft foulants include bacteria, biofilms and proteins. Many different surface modification strategies have been utilized to reduce the attachment of different solid foulants on a variety of underlying substrates. However, typically they only work against a single foulant, over a small area, or for a short period of time. In this research we are studying the similarities and differences in the shedding of different solid foulants, with the aim of developing a single coating that works against a wide range of marine foulants.

U-M's role: Says Tuteja: "Apart from developing novel coatings for reducing or eliminating the accretion of different solid foulants, we will also develop a first of its kind testing facility that compares the performance of different solid-shedding coatings developed around the world using a variety of tests that evaluates their suitability for different marine applications."

Project #2: High value products from organic waste streams through an integrated process

Project Summary: According to the EPA, Americans generate about 250 million tons of solid waste every year, of which about 15 percent is made up of food waste. These wastes can be anaerobically digested to produce biogas, but this conventional approach has many drawbacks. The bottlenecks can include low carbon conversion efficiency, inefficient product separation and CO₂ emission. The project aims to develop a prototype where organic wastes can be pretreated efficiently, converted to target products with high rates in continuous operation, and where the desired compounds can be separated and recovered with high efficiency. Researchers will evaluate every process in terms of economic viability and environmental impact through techno-economic analysis (TEA) and life cycle analysis (LCA). The overall process will be tested at a 5-liter and a 50-liter scale.

U-M's role: "In our work we have developed novel stimuli-responsive membranes that can readily demulsify virtually any emulsion consisting of a polar and non-polar liquid simply under

gravity," says Tuteja. "Next, using these membranes, we engineered a novel, easily scalable, platform separation methodology termed CLEANS (Continuous Liquid-liquid Extraction And in-situ membrane Separation). By using the CLEANS methodology, we aim to significantly reduce the costs associated with the production of VFA's from fermentation, and thereby significantly increase their commercial viability."

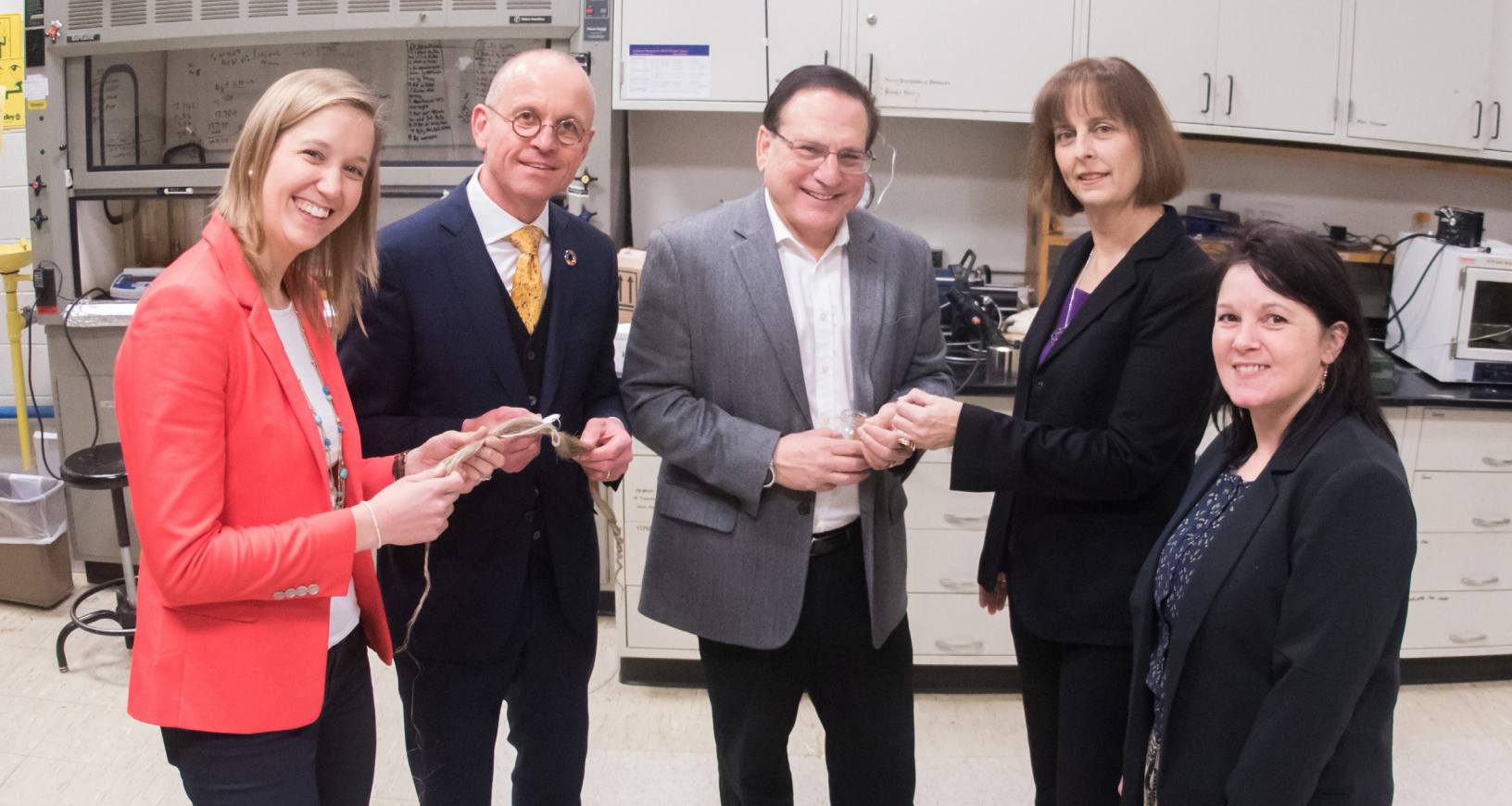
Project #3: Snow as a Factor in Photovoltaic Performance and Reliability

Project Summary: With the rapid growth of solar across northern regions, the impact of snow shading on modules is a growing concern. Published estimates of energy losses range from 1-12 percent annually, with monthly losses as high as 100 percent, depending on location and weather conditions; in addition, snow creates excessive and uneven stress on modules, cells and systems, the long-term impact of which is unknown. This project aims to increase solar performance in regions of the US that regularly experience below-freezing precipitation by identifying the multiple contributors to snow losses; modifying predictive models to more accurately reflect those contributors; and proposing mitigation strategies that boost both performance and reliability

U-M's role: According to Tuteja, "Our goal is to develop coatings that enable the rapid shedding of accumulating snow under its own weight. This would allow the solar panels to keep generating electricity during the winter."



The Tuteja group: (left to right) Zhihe Gao, Jing Wang, Alex Kate Halvey, Brian Macdonald, Taylor Repetto, Abhishek Dhyani, Catherine Snyder, Brian Tobelmann, and Associate Professor Anish Tuteja.



Amy Langhorst (research scientist at Ford and Ph.D. student in Alan Taub's group), ME professor and director of Global CO₂ Initiative Volker Sick, MSE Professor Alan Taub, Deborah Mielewski (Ford) and ME Professor Miheala Banu.

Stronger, stiffer, greener: carbon-negative natural-fiber composites

Professor Alan Taub is leading an initiative to achieve lighter-weight structures that enable better fuel economy using materials that are CO₂ negative

Lightening the weight of the machines that move people by land, sea, and air is beneficial for many reasons, including improved fuel efficiency and the ability to carry higher payloads or added safety systems. A 10% reduction in the weight of a passenger car, for instance, leads to about a 6% improvement in fuel economy.

One key strategy to reduce weight is to design structures using lighter materials with improved properties, such as those with greater specific strength and stiffness. Given their lightweight, neat polymers are attractive materials for weight reduction, but they're neither strong enough nor stiff enough for structural applications. As a result, manufacturers across industries add reinforcing fibers such as glass (and more recently, carbon fiber) to add strength and stiffness to the material.

But producing the fibers — whether glass or carbon — for use in today's advanced structural composites requires

energy, and generating this energy releases greenhouse gases into the atmosphere.

"It takes a lot of energy to make these reinforcing materials," said MSE Professor Alan Taub, who is also a professor in mechanical engineering. "Unfortunately, this makes many types of fiber-reinforced lightweight composites carbon positive and compels us to ask how we can do better. How can we produce advanced materials that are carbon neutral or, better yet, carbon-negative?"

Taub, in collaboration with Ford Motor Company and ME Research Associate Professor Mihaela Banu, are looking beyond carbon neutrality and toward nature for a greener alternative: natural fibers from plants, since they absorb — rather than release — CO₂ as they grow.

Ford Motor Company has been developing natural fiber composites for over 10 years and has implemented many "green" materials in semi-structural Ford parts,

including a wheat strawfilled storage bin, rice hull-filled wiring harness, and a cellulose-based armrest substrate. However, due to strength and stiffness limitations, natural fibers have yet to fully replace glass fiber reinforcement in structural automotive applications. In 2016, Ford's team initiated a project to improve the properties of natural fibers using nanomaterials, and the project evolved into a doctoral thesis investigated by Amy Langhorst, a research scientist at Ford and Ph.D. student in Taub's group.

Triple challenge

Taub's group is working with bamboo, hemp, and flax, adding an environmentally friendly nanomaterial to particular cells in the plants during growth or after harvesting to improve strength and stiffness. The cells form fibers, and these would then be extracted and used to reinforce the polymer composites.

Part of the challenge, noted Taub, is that plant transport mechanisms are extremely complex, which makes getting even nanoscale material to the targeted cells difficult. And therein lies another challenge: the need to work simultaneously at multiple scales. Extracting the strengthened fibers presents yet another hurdle since current methods can cause the fibers to undergo damage. The team is developing new ways to extract them from the plant to avoid this.

Abundant applications

With three decades of auto industry experience, Taub is first looking at automotive applications for the natural-fiber reinforcements under development. "But we're certainly not restricted to one application — everything from appliances and sporting goods to commercial aircraft and ocean-going vessels could make use of natural-fiber-reinforced composites if we're successful," he said. And although the process for producing the strong natural fibers will be different than for glass or carbon fibers, the processing and equipment used for forming the resulting polymer composite into structures remains, for the most part, the same from an industrial perspective.

"What we're looking at is a material substitution that fits into existing processing capabilities," Taub said. This means the natural fibers have potential for large-scale implantation, which is key to positively impacting the environment.

"To have a real impact," he said, "we have to replace tons of material. Fortunately, enough of this plant material is already being grown, so what we're focused on now is improving the properties, improving the extraction methods, and making these advances with minimal cost increases."

The project draws upon expertise across the University and includes collaborator Regina Baucom, associate professor of Ecology and Evolutionary Biology. Students from the Fall 2019 semester of

MSE489, the Materials Science and Engineering senior design course, will conduct an environmental lifecycle and cost analysis.

The project grew out of work by graduate student Amy Langhorst, who earned her bachelor's degree in U-M Materials Science and Engineering in 2013 and took the senior design course with Taub. She now works at Ford Motor Company and is pursuing a doctoral degree with Taub as her advisor.

The project is part of U-M's Global CO₂ Initiative, which supports development of sustainable and commercially viable carbon-negative technologies. Funding for early-stage, exploratory work is provided through the U-M College of Engineering Blue Sky Initiative, designed to help faculty develop high-risk, high-reward concepts. Additional funding is being provided by Ford Motor Company.

The project has high reward potential indeed. "When we're successful, we'll have a CO₂ negative material," Taub said. "Not only does using plant fibers prevent CO₂ emissions during fiber production, our methods also reclaim CO₂ as the plants grow. We should be able to achieve lighter-weight structures, enabling better fuel economy using materials that are CO₂ negative. Our challenge is to improve the mechanical properties of the fibers while maintaining low cost."

"To have a real impact, we have to replace tons of material. Fortunately, enough of this plant material is already being grown, so what we're focused on now is improving the properties, improving the extraction methods, and making these advances with minimal cost increases."

—Professor Alan Taub

Ferroelectronics Lab pushes the frontiers of complex oxide electronic materials



New grants give a boost to the Heron group's goals of designing otherwise unstable complexes in correlated oxides, advancing transformative performance in memory and logic devices, and realizing chemically identical yet electronically distinct nanoscale thin film superlattices of materials.

Project #1:

Non-volatile Magnetoelectric Switching of a Nanomagnet Below 250 mV and 100 aJ Dissipation Through Enhanced Thin Film Magnetostriction

Project Summary: This project seeks to address the need for non-volatile memory and logic devices with 10-100x lower energy dissipation than CMOS utilizing pioneering developments in magnetostrictive materials by the Heron group. Here we will study magnetoelectric performance from micro to nanoscales in our composite multiferroic to realize transformative performance in memory and logic devices while elucidating fundamental scaling laws in ferroic switching.

Project #2:

High entropy oxide metamaterials for control of high-temperature radiative heat transfer

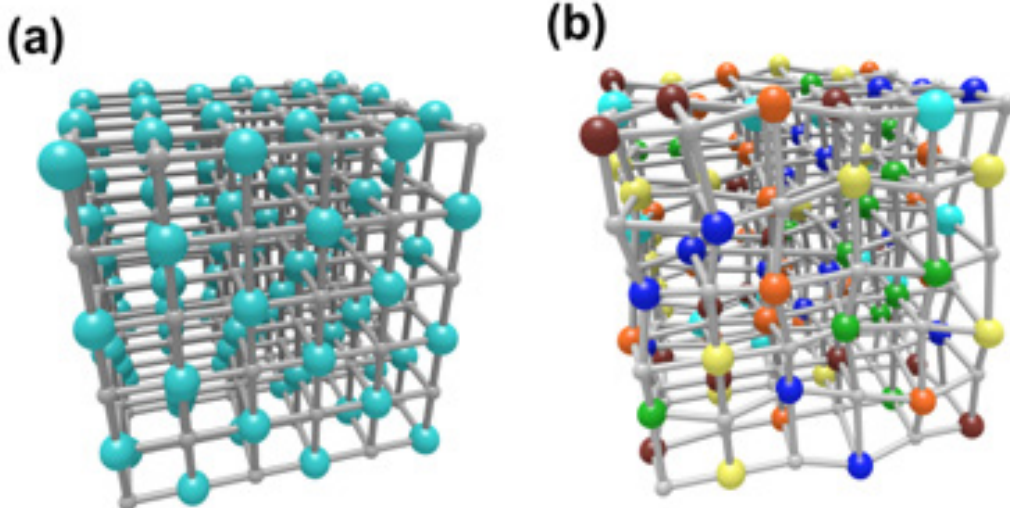
Project Summary: In this project we will precisely control thermodynamic conditions during physical vapor deposition to realize chemically identical yet electronically distinct nanoscale thin film superlattices of materials only stabilized by configurational entropy. We leverage the solubility and stability of entropic hosts to realize novel photonic structures for suppression of high temperature radiative transfer.

Project #3:

Entropy-stabilized correlated oxides

Project Summary: We will explore uncharted territory in entropic materials discovery space to realize atypical chemical environments in oxides. We seek to design otherwise unstable complexes in correlated oxides for metal-insulator transitions and spin Hall effects.

Sponsor: NSF MRSEC: Center for Nanoscale Science, Penn State U, lead institution.



a, Schematics of ideal single cation (light blue spheres) and, b, multi-cation (light blue, dark blue, orange, brown, and green spheres) entropy-stabilized rocksalt crystal. Grey spheres represent the anion such as oxygen. The differing preferred coordinations and sizes of the cations in the entropy-stabilized material create local structural distortions and presents a new degree of freedom for engineering physical properties.

U-M team to create devices with adhesives to capture microplastics



MSE Professor Brian Love is part of a team that received an Emerging Frontiers in Research and Innovation grant from NSF to explore using adhesives to capture microplastics from wastewater. As co-principal investigator, Brian will be designing the engineering tools to capture and redirect microplastics from treatment plants.

Most scientific discovery is incremental: Breakthroughs happen after years and years of tiny steps.

But a recent U-M discovery was a happy accident. It started with a disposal container and led to a \$2 million Emerging Frontiers in Research and Innovation grant from the National Science Foundation to explore using adhesives to capture microplastics from wastewater.

The grant aims to identify the best adhesives for removing microplastics from wastewater and diverting them from wastewater sludge. Ultimately, the researchers would like to engineer a device, outfitted with the ideal adhesive, that would be used in wastewater treatment plants to filter out these tiny plastic particles.

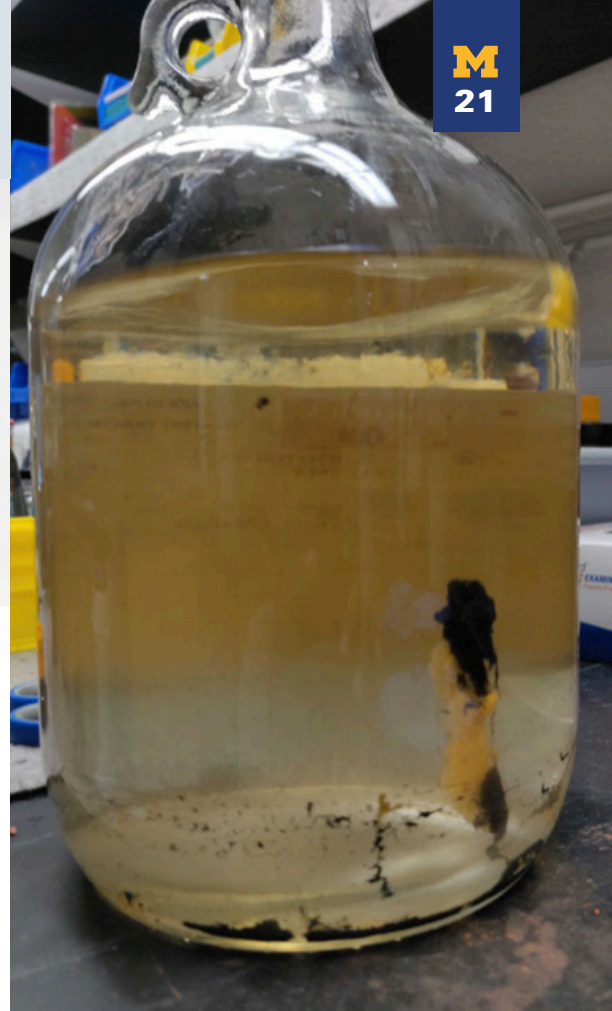
Co-principal investigator Brian Love will undertake engineering structures to capture these microplastics.

“Microplastics are actually captured

relatively effectively at wastewater treatment plants and other distribution processing facilities that are capable of treating effluent runoff water, but the problem we see is that if the sludge is redeposited back on fields and streams, we’ve sort of shot ourselves in the foot,” said Love, professor of materials science and engineering, biomedical engineering, and macromolecular science and engineering.

“It would be nice to be thinking about tools and methods based on our own project that have the capacity to perhaps redirect those microplastic particles in a different direction.”

Love’s contribution will include designing the tools on which these adhesives will be deposited. Engineering these structures will need to take into account how wastewater flows through a treatment plant: the tool’s structure will be determined by the turbulence of the water.



“Microplastics are actually captured relatively effectively at wastewater treatment plants... but the problem we see is that if the sludge is redeposited back on fields and streams, we’ve sort of shot ourselves in the foot.”

—Professor Brian Love

Discovery of 13-atom clusters could mean control in manufacturing materials far-from-equilibrium

An interview with Ashwin Shahani on his team's unexpected discovery



Quasicrystals, or “nature’s forbidden crystals” as they are sometimes called, are structures that are ordered but aperiodic. Their formation has been a long-standing puzzle in condensed matter physics since their discovery in 1984. This is because the growth of metastable

quasicrystals is inaccessible using conventional imaging approaches.

In the paper “Dynamic Observation of Dendritic Quasicrystal Growth upon Laser-induced Solid-state Transformation,” published in *Physical Review Letters*, Assistant Professor Ashwin Shahani’s group tracks *in situ* the solid-state formation of metastable and dendritic quasicrystals. On the basis of their time-resolved experiments and supporting molecular dynamics simulations, they provide an atomic picture of how periodic crystalline (approximant) structures evolve into quasicrystalline structures in terms of their structural similarity and how the interface between the quasicrystal and approximant supports the formation of dendrites (tree-like structures). Ultimately, they show that a 13-atom icosahedral motif is dominant upon rapid annealing, and if a sufficient population of these motifs exist, they could guide phase selection. Such motifs are the essential building blocks for quasicrystal growth from a solid or a liquid precursor.

We asked Professor Shahani more about his findings in the following interview.

How is this research related to your previous work regarding quasicrystal growth?

In this work, we study not the growth of quasicrystals from the liquid phase, but rather from a parent solid phase. We show that the quasicrystals grow in the shape of dendrites, or tree-like structures, which goes against our conventional wisdom. Theory tells us that dendrites

should predominantly form under a liquid-to-solid transition, and yet we see dendrites in the solid-state.

Why is the work you’re doing important?

In order to control structure in manufacturing metallic materials far-from-equilibrium, we need to understand at a very fundamental level where that structure comes from. This is the processing-structure paradigm of materials science. In this case, the solid dendritic quasicrystals “inherit” the structure of the parent solid phase.

What were the most important discoveries and how did you arrive at them?

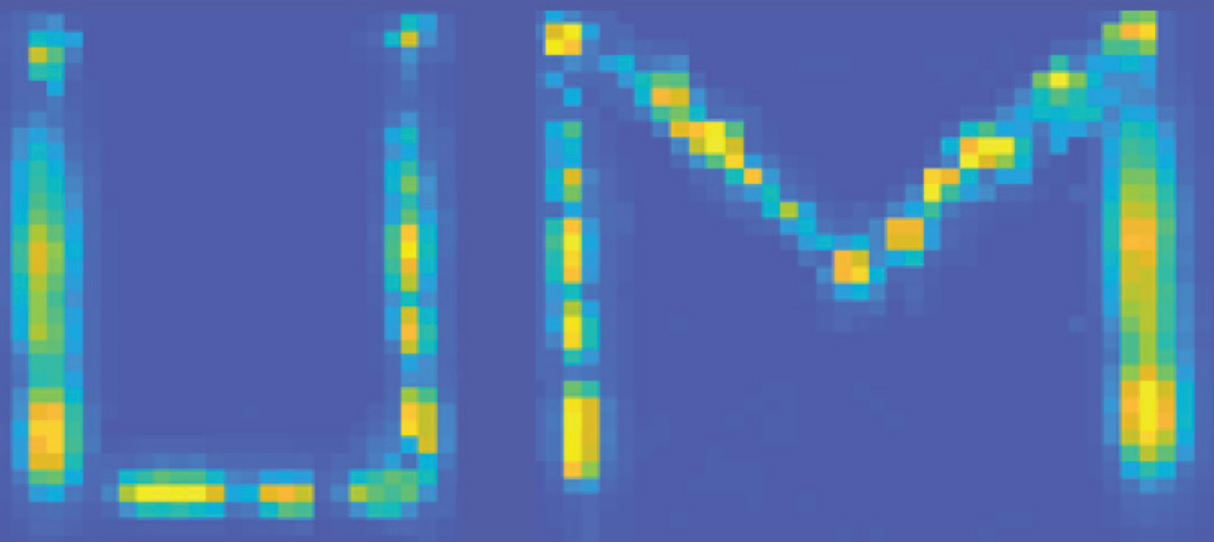
The important discovery was that of 13-atom clusters that facilitate the transition from one periodic phase to a quasicrystalline phase. These “building blocks” are key to the solid-state phase transition, and they also enable the growth of dendritic instabilities. The clusters are in the shape of icosahedra, which look like 20-sided dice. Their existence holds broad implications to the stability of phases and interfaces.

What were the technological barriers to making this project work?

It is notoriously difficult to capture the growth of quasicrystals under far-from-equilibrium conditions via conventional probes and in real-time. That is because it unfolds too rapidly under small spatial scales. To meet the challenge, we imaged the transient growth dynamics at microsecond time-scales via dynamic transmission electron microscopy at Lawrence Livermore National Laboratory.

Did anything surprise you during this project?

Believe it or not, this particular experiment was an accident! We were hoping to visualize the liquid-to-solid transition, but instead we captured only solid-state growth patterns. Our laser power was not high enough to melt our thin film samples. Research is often the product of serendipity, and this is a prime example.



A self-erasing chip for security and anti-counterfeit tech

Self-erasing chips developed at U-M could help stop counterfeit electronics or provide alerts if sensitive shipments are tampered with.

They rely on a new material that temporarily stores energy, changing the color of the light it emits. It self-erases in a matter of days, or it can be erased on demand with a flash of blue light.

“It’s very hard to detect whether a device has been tampered with. It may operate normally, but it may be doing more than it should, sending information to a third party,” said Parag Deotare, assistant professor of electrical engineering and computer science.

With a self-erasing bar code printed on the chip inside the device, the owner could get a hint if someone had opened it to secretly install a listening device. Or a bar code could be written and placed on integrated circuit chips or circuit boards, for instance, to prove that they hadn’t been opened or replaced on their journeys. Likewise, if the lifespan of the bar codes was extended, they could be written into devices as hardware analogues of software authorization keys.

The self-erasing chips are built from a three-atom-thick layer of semiconductor laid atop a thin film of molecules based on azobenzenes—a kind of molecule that shrinks in reaction to UV light. Those molecules tug on

the semiconductor in turn, causing it to emit slightly longer wavelengths of light.

Che-Hsuan Cheng, an MSE doctoral student in Deotare’s group and the first author on the study in *Advanced Optical Materials*, is most interested in its application as self-erasing invisible ink for sending secret messages.

The stretched azobenzene naturally gives up its stored energy over the course of about seven days in the dark—a time that can be shortened with exposure to heat and light, or lengthened if stored in a cold, dark place. Whatever was written on the chip, be it an authentication bar code or a secret message, would disappear when the azobenzene stopped stretching the semiconductor. Alternatively, it can be erased all at once with a flash of blue light. Once erased, the chip can record a new message or bar code.

The semiconductor itself is a “beyond graphene” material, said Deotare, as it has many similarities with the Nobel Prize-winning nanomaterial. But it can also do something graphene can’t: It emits light in particular frequencies.

Next steps for the research include extending the amount of time that the material can keep the message intact for use as an anti-counterfeit measure.

The Jinsang Kim group is part of a team developing a memory chip that gets erased when exposed to blue light for security applications.



New advanced neuromorphic computing could reduce the energy of machine learning by 1000 times

A Q&A WITH ASSISTANT PROFESSOR YIYANG LI



What is the current challenge with computer energy consumption?

Computers presently expend a tremendous amount of energy for data-intensive operations like machine learning and artificial intelligence.

One recent paper shows that certain machine learning operations expend as much CO₂ emissions as the life cycle emissions for several passenger cars. This energy demand arises because the silicon transistors in computer chips can be designed into circuits for either information processing (logic) or information storage (memory), but not both. As a result, most energy is expended moving information between logic and memory, resulting in the large quantities of energy consumed during the processing of large data sets.

A highly attractive alternative is to devise new materials and devices with both logic and memory functionality; in some ways this is inspired by human neurons and synapses, which also has simultaneous logic and memory. We call this field “neuromorphic computing.”

A class of electronic devices called “memristors” can be utilized for this purpose, but it is very difficult to control how they switch among analogue information states. The reason is that memristors store information in

discrete numbers of atomic defects in a nanosized “filament.” Because atomic defects, like gas molecules, are in constant random motion (kinetic theory), it is very difficult to reliably control the switching behavior of a few atomic defects. Trying to change the memristor state is like flipping a coin or rolling a dice—we don’t know if we will be successful in any one instance. While we have been able to switch memristors between a “1” and “0,” reliably switching between more analogue states (e.g. 0, 1, 2, 3, 4, 5,...100 etc) is nearly impossible.

How does your research address this problem?

We devised a memristor such that all atoms in the lattice are used to store information, as opposed to just a few atomic defects in the filament. By using the average behavior of millions (or more) atoms, we solved the challenge of stochastic switching because average behavior of all atoms is deterministic even if individual atoms are random. By analogy, if I roll a dice enough times, then I can say with reasonable confidence that 1/6 of the rolls will result in a “6.” By utilizing the statistical behavior of

Yiyang Li’s latest research seeks to reduce energy consumption in computers with a device that contains both memory and logic operations. By co-locating memory and processor, the energy of machine learning could be reduced by a factor of 100-1000. We asked Assistant Professor Li to talk more about his research.

large numbers of atoms, we were able to reliably and reproducibly switch between over 100 analogue states.

How were you able to do what others couldn't?

The ultimate impact is to reduce the energy consumption of computing, especially for machine learning and artificial intelligence. This is especially crucial for an energy-limited application like a smartphone or an autonomous vehicle. Presently, voice recognition software like Siri often require an Internet connection so the data can be processed centrally because it would otherwise consume too much energy. However, if we can make this process more energy efficient, we can start doing these operations locally. Beyond portable applications, we envision this work will also reduce the aggregate energy consumption of computation and artificial intelligence, which often come from fossil energy sources.

This work, recently published in Advanced Materials, was done in collaboration with scientists at Sandia National Laboratories and with the group of Prof. Wei Lu, Professor of ECE and Professor of MSE (by courtesy).

```
elif _operation == "MIRROR_Y":
    mirror_mod.use_x = False
    mirror_mod.use_y = True
    mirror_mod.use_z = False
elif _operation == "MIRROR_Z":
    mirror_mod.use_x = False
    mirror_mod.use_y = False
    mirror_mod.use_z = True

#selection at the end -add back the deselected
mirror_ob.select= 1
modifier_ob.select=1
bpy.context.scene.objects.active = modifier_ob
print("Selected" + str(modifier_ob)) # modifier o
#mirror_ob.select = 0
time = bpy.context.selected_objects[0]
bpy.data.objects[time.name].select = 1
print("Time selected")
```

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PRISMS Center gets renewed for 3rd term with \$7M

The additional \$7M brings the total DOE funding to \$26M through 2023

In light of this exciting funding news, we asked Predictive Integrated Structural Materials Science (PRISMS) director John Allison for an update on the state-of-the-art center.

This is the third round of funding you've received. What do you think that says about PRISMS' value to researchers?

I believe it says that we are providing real value to the field. The PRISMS open-source high performance codes for simulating metallurgical processes are now at a very mature level and are being recognized as a unique and very powerful set of codes. One thing that sets us apart is the integrated nature of these codes, ranging from simulations at the atomistic level to the microstructural scale and these are then integrated with a code for simulating the mechanical behavior of metals and alloys. And the PRISMS science and scholarship are widely recognized for their excellence. We continue to discover many interesting and important phenomena in magnesium and magnesium alloys, which is our focal materials system.

What are some of your current projects?

One initiative we have under way is launching web-based tutorials on our new PRISMS Center YouTube Channel.

This is particularly important now that, because of Covid, our annual training workshop just isn't feasible. These new web-based training modules will make all of our open-source tools accessible to a much wider audience of software users and developers.

What are your goals for the Center?

Conventional wisdom is that it takes at least 10 years to have new open source high performance software tools accepted by the community and widely used. We have five state-of-the-art codes and the Materials Commons – and for the next three years the focus is on continuing to get the word out, adding new features and capabilities and using this capability combined with experiments to rapidly advance our knowledge of magnesium alloys – fulfilling the objectives of the Materials Genome Initiative that is the source of our funding. On the science side, we will continue to discover and understand phenomena ranging from alloying effects on twin formation and grain boundary strengthening, fatigue and cyclic deformation. And we plan to embark on a new area for the Center, understanding how recrystallization affects texture evolution in some new Mg-Ca-Zn alloys, which we think will lead to new, more formable magnesium alloys.

CENTERS

MMRI celebrates 1st anniversary, successful pilot period



Under the leadership of Alan Taub, MMRI continues to build momentum as it integrates (MC)², acquires a next-generation TEM, and looks to catalyze new research in additive manufacturing.

After a successful pilot, the Michigan Materials Research Institute was formally established with a cross-university MMRI Executive Committee that continues to be very active despite the difficult environment of the pandemic. MMRI budget for the next 3 years was approved. Outreach activities for the Institute are accelerating, including opening of the website earlier this year, providing regular communications to the university materials community, and enlisting initial members of the Industrial Advisory Committee from small and large companies.

A key mission of the MMRI is to enable

the sharing of research equipment and we now have access to the university capital equipment database and are performing searches for faculty. That initiative has expanded to incorporating cores within the MMRI. The first of these was the integration of (MC)² into the Institute. One of the first actions in that regard was taking advantage of synergies and moving the administration of the *in situ* ion irradiation TEM in the Michigan Ion Beam Laboratory under the (MC)² umbrella.

To further improve our characterization capabilities, we were approved and have started procurement of a new TEM. With

installation expected to begin Fall term of 2021, the new TEM has an energy range of 30-300kV and is equipped with a next-generation high resolution monochromator along with state of the art detectors enabling ultra-fast beam sensitive *in-situ* materials studies and 4DSTEM. We are also building on prior activities and taking the lead in developing a proposal for establishment of a Center for Additive Manufacturing of Structural Materials. Our pilot program for MMRI seed funds will start in February with a focus on catalyzing new research in additive manufacturing.

(MC)² team earns 2020 Excellence in Staff Service Award



Kerns



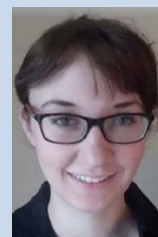
Hunter



Senabulya



Sun



Wendel

A team from (MC)² earned one of CoE's 2020 Excellence in Staff Service Awards. The award-winning ensemble includes **Bobby Kerns** (center manager), **Allen Hunter** (staff scientist), **Nancy Senabulya** (staff scientist), **Haiping Sun** (staff scientist), and **Deanna Wendel** (administrator).

"Over the last four years, the collaborative approach of the (MC)² team has made (MC)² a unique and creative hub for materials research, and the cornerstone of many campus research programs," said former (MC)² director Emmanuelle Marquis. "Together, they have created a welcoming, inclusive, and safe environment for all users; collectively created an efficiently run center for the benefit of the campus research enterprise and an effective training center for students and post-docs."

"Over the last four years, the collaborative approach of the (MC)² team has made (MC)² a unique and creative hub for materials research, and the cornerstone of many campus research programs."

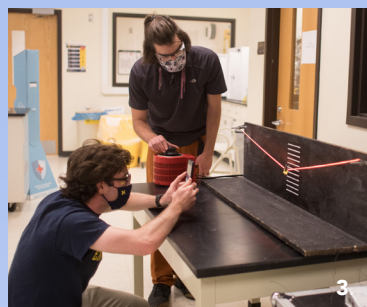
—Emmanuelle Marquis

UPDATE



Brian Iezzi (left) pours liquid nitrogen into a pumpkin while Duncan Greeley live streams it during a virtual outreach event with seventh graders from Washtenaw International Middle Academy on November 2.

VIRTUAL



1. Graduate student Thomas Maulbeck (Marquis group) leads a breakout session in the Van Vlack Lab. 2. Erin Regan leads a Zoom breakout session with 7th graders. 3. PhD candidate Brian Iezzi runs high voltage through an iron wire while Duncan Greeley live streams the demo on his phone. 4. An up-close look at a thermal processing demonstration using a bobby pin.

MSE Outreach adapts to virtual format

Undeterred in their mission to teach materials science to the next generation, Graduate Student Council outreach teams conduct lessons virtually.

The Van Vlack Lab had been officially closed to visitors since March, but on November 2 and 9 it hosted 32 seventh graders from Washtenaw International Middle Academy.

Virtually, that is.

The class, led by Graduate Student Council (GSC) Outreach, was titled “Design in Materials Science: Properties of Metals.” The lesson went over how metals respond to heat and electricity and how this determines their structure and, ultimately, their properties, which are critical to the design process.

In a normal year, GSC teams usually travel to two area schools a semester, but, with local schools not meeting in person this fall, the outreach teams faced new challenges. The first was getting lost in the shuffle as teachers scrambled to adjust their teaching to an all-online format. Not surprisingly, inviting special guests to come do outreach was not a top priority.

“Luckily, once things settled down a bit we got more teachers interested again,” Iezzi said.

The next challenge was ensuring engagement with the students in a virtual format.

“When we are in the classroom, we are free to move around and ask questions as we are doing demonstrations,” commented Iezzi. “We now have to compensate for this by structuring the lesson to utilize moderated breakout rooms with our volunteers.”

Recruiting more volunteers has required more coordination on the organizers’ part, but the reduced time commitment more than makes up for it.

“Overall, I think it is an exciting method because our biggest issue typically is getting volunteers to set aside a half - or whole - day to go out to a school,” said Iezzi. “Now, we can hop on a call for an hour from anywhere - and also to anywhere.”

For all the outreach volunteers, the reward of teaching materials science to the next generation of scientists and engineers is worth the extra effort necessary to adapt lessons to the new virtual reality.

“It’s getting our creative energy flowing trying to figure out how to create a meaningful learning experience virtually,” concluded Iezzi. “Hopefully this can help the outreach program moving forward.”

OUTREACH

Bladesmithing team places first in 2020 International Metallographic Contest

The Bladesmithing team took first place at the IMS 2020 International Metallographic Contest this fall. According to member Karen Ni, the team's submission, "A Tanto-lyzing Analysis of Differential Hardening" included work from last year where they had analyzed the effects of differential hardening on a forged tango blade.

"We forged our blade out of W2 steel, which was then normalized at different stages, heat treated with clay, and quenched," Ni said.

Samples of each step were analyzed using a scanning electron microscope (SEM) and optical microscope to observe the microstructures present at each stage.

"We saw that the spine of our blade that was heat treated with clay contained a lamellar pearlite structure that provides flexible properties," Ni continued. "Towards the edge of the blade, the structure transitioned to needle-like martensite, which contributes to hardness."

Team members include: MSE undergraduate students Jackson Eilers (captain), Grant Saxman, Aidan Charmley, Karen Ni, Jeffrey Tschirhart, Alexander Shaw, Elizabeth Eachus, Kevin Wang, Tyler Lindemann, and Wahaj Ansari. The team is advised by Tim Chambers.

2020 Bladesmithing team captain Jack Eilers uses an angle grinder to remove the scale off the billet at an off-site forge.



MMS provides valuable opportunities

The Michigan Materials Society (MMS) is dedicated to supplementing the undergraduate experience with academic, professional and social opportunities. Although we operated at a limited capacity this academic year due to the pandemic, undergraduates still heard from companies such as Ford, Eaton, and Entegris in our weekly Friday luncheons. We also invited faculty to provide students with career advice for our resume and interview panels in the Winter semester. A fun trivia night hosted by Timothy Chambers also allowed us to keep our MSE Undergraduate Community together. Thank you to everyone who has donated to MMS and everyone that has supported the department through the dedication of time and resources—your help is invaluable. If your company would like to speak at one of our weekly luncheons, please email mmsboard20-21@umich.edu. For more information about MMS, go to mms.engin.umich.edu.

—Ella Leininger, MMS president

He named 2022 Schwarzman Scholar



An honors physics student working with the Goldman group, **Jiaheng He** was chosen as a 2022 Schwarzman Scholar and will begin a one-year master's degree program at Tsinghua University in Beijing in August. "I was thrilled that

Jiaheng received an offer from the Schwarzman Scholars program," Goldman said. "The Schwarzman Scholars program is intended to prepare high-caliber individuals to serve as the next generation of leaders to build bridges between China and the rest of the world. Jiaheng is most deserving of this honor as he excels in academics, leadership, and research. In addition to his impressive GPA and being a student leader on campus, he has pursued graduate-level research, including presenting his work at multiple national conferences. He is extremely enthusiastic and meets every challenge with both a smile and a sense of urgency."

Congratulations to all our 2020 graduates!



David Allen



Connor Bennett



Eliza Brufsky



Kayla Byrd



Anna Chambers



Rishav Choudhury



Joshua Cooper



Serena Day



Bethany DeMarco



Henry Gaudin



Matthew Gratoski



Lauren Hamp



Matt Karls



Nabeel Khan



Hailey Kuntz



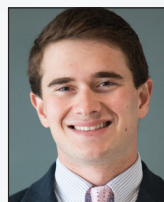
Malhar Kute



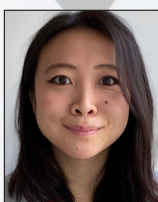
Jonathan Li



Natalie Lillig



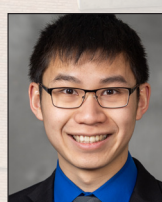
Chad Lindner



Tiffany Liu



Dilara Meli



Nathan Ng



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Kenneth Peterson



Mayme Philbrick



Alexander Pielack



Alexandra Pine



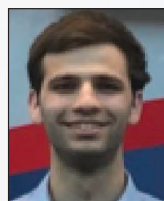
Evan Raeker



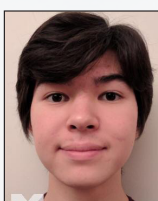
Brendan Rice



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Leonardo Vallejo



Grace VanRenterghem



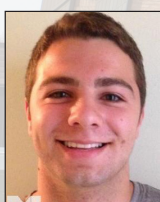
Dawn Wang



Nicole Wang



Brendan Warren



Lucas Wightman



Reed Yalisove



Xiting Zhang

Student Awards & Recognition

Nathaniel L. Field Scholarship

Jackson Eilers, Brodie Kieras, Eli Rotman

Richard A. Flinn Scholarship

Denise Schlautman

Fontana-Leslie Scholarship Fund

Hao Zhu

James W. Freeman Memorial Scholarship

Michelle Pikulinski, Brianna Roest

John Grennan Scholarship

Karen Ni

Jack J. Heller Memorial Engineering Scholarship Fund

Elizabeth Eachus

William F. Hosford Scholarship

Aidan Charmley, Lauren Duke, Julia Healy, Rishabh Kothari, Malhar Kute, Ella Leininger, Tianle Liu, Alexander Shaw, Praveen Soundararajan, Dhruv Tatke, Alexandra Zimmerman

Schwartzwalder Memorial Scholarship

Kaitlyn Moo, Jacob Pietryga

Clarence A. Siebert Memorial Scholarship

Rishav Choudhury, Dhruv Tatke

Alfred H. White Memorial Scholarship

Nathan Ng

James P. Lettieri Undergraduate Award

David Allen

Brian Worth Prize

Kayla Byrd

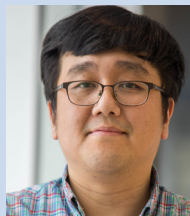
CoE Distinguished Achievement Award

Rishav Choudhury

Graduate students earn prestigious College, national recognition



Jiadong Chen
(Sun)
Chia Lun-Lo
Fellowship 2021



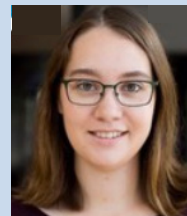
Wonjin Choi
(Kotov)
Rackham Predoctoral
Fellowship



Kathleen Chou
(Marquis)
AIME Henry
deWitt Smith
Scholar



Ben Derby
(Misra)
Towner Prize for
Distinguished Aca-
demic Achievement



Catherine Haslam
(Sakamoto)
NSF Graduate
Fellowship



Tao-Yu Huang
(Goldman)
Chia Lun-Lo
Fellowship 2021



Ph.D. candidate Brian Iezzi (Shtein group) holds one of an estimated one thousand face shields he helped make in early 2020.



Hongling Lu
(Goldman)
Sweetland
Fellow 2020



Peter Meisenheimer
(Heron) Rackham
Predoctoral
Fellowship



Kelsey Mengle
(Kioupakis)
Towner Prize for
Outstanding PhD
Research



Lydia Mensah
(Love)
North Campus
Deans' MLK



Emily Oliphant
(Sun/Kioupakis)
NSF Graduate
Fellowship



Jacob Pietryga
(MACRO-Hovden)
Microscopy Society
of America Student
Scholar Award



Mohsen Taheri
Andani (Misra)
Rackham
Predoctoral
Fellowship

Answering the call

In March, when a friend alerted him that a group on Facebook, Operation Face Shield Ann Arbor, was urgently looking for people with 3D printers to help make medical face shields, Ph.D. candidate Brian Iezzi answered the call.

"We had the printer and they asked, so we were just helping where we could," Iezzi said.

He moved the 3D printer from the Shtein lab to the basement of his home and, using a U-M Medicine-approved model created by a Czech company, started printing the shields. But the process was...so...slow.

"Even with the printer going pretty much nonstop, we were able to produce only two shields every six hours," he said, noting that his brother, Matthew, who came to Ann Arbor from L.A., was assisting him.

He then obtained special permission from CoE to work in NCRC using the Shtein lab's laser cutter. Even though the laser-cut model was more labor intensive, Iezzi and his brother were able to produce 40-50 shields a day, an obvious improvement over the 3D

printing method.

As far as materials, Iezzi says they had to be innovative. The 3D shield headbands were made of ABS or PETG plastic and the laser cut versions were made out of ABS as well. The shielding itself was plastic, too, usually mylar (PET) of a certain thickness to stand up to the sanitation process, but that specific mylar was hard to find.

"They'd been running out of stock almost everywhere and so we had to start to experiment with alternative materials like PVC and polyethylene, which was where we'd been able to help a bit in the lab," Iezzi explained.

Iezzi estimates that he and his brother ended up delivering around 250 fully assembled to U-M/Operation Face Shield in April. In late May he helped laser cut just the face shield plastic sheet for around 750 more for a neighbor who was supplying PPE to teachers and essential care workers. "Other than that it was ad hoc a few here and there so I probably helped make around one thousand shields total," Iezzi concluded.

MSE Graduate Fellowships

Kenneth and Judy Betz Fellowship

Vaidehi Menon
Zhaoqun Wen

CoE Graduate Fellowship

Nishkarsh Agarwal
Yutong Bi
Jiun-Yeu Chang,
Shih-Kuang Lee
Jingxia Li
Max Palmer
Matthew Webb

Harry Ferrari Fellowship

Zhaoqun Wen

Robert D. and Julie A. Pehlke Fellowship

Zhaoqun Wen

Rackham Engineering Award

Ahmad Matar Abed
Emily Oliphant
Mustafa Tobah
Megan Trombley

Frederick N. Rhines Fellowship

Joshua Cooper
Vaidehi Menon

Most 2020 Ph.D. defenses presented virtually



On March 6, Ben Derby (left), now a Director's Postdoctoral Fellow at Los Alamos National Laboratory, was the last candidate to deliver his defense in person. After Covid precautions were implemented on March 16, candidates had to defend virtually. We congratulate everyone for making this extra effort!

Winter 2020



Avi Bregman
(Taub)



Yuchi Chi
(Misra)



Davide Del Gaudio
(Goldman)



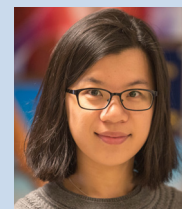
Benjamin Derby
(Misra)



**Regina Garcia
Mendez**
(Sakamoto)



Ashley Hilmas
(Halloran)



Tianjiao Lei
(Atzmon)

"The first Ph.D. student dissertation defense is a big moment in any assistant professor's career, and any Ph.D. defense is a once in-a-lifetime milestone for the student."

—Amit Misra,
MSE Chair

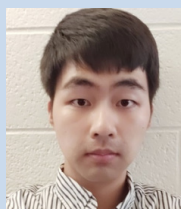


Special career milestones

In the spring, Assistant Professors Ashwin Shahani and Liang Qi had their first Ph.D. students defend their theses – a special milestone for both adviser and advisee.

Saman Moniri presents his Ph.D. dissertation, "Non-classical crystallization pathways in eutectic-forming systems" virtually on March 30.

Summer 2020



Insung Han
(Shahani)

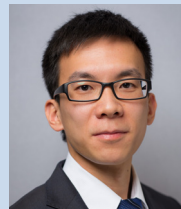


Caleb Reese
(Taub)



Michael Wang
(Sakamoto)

Fall 2020



Kuan-Huang Chen
(Dasgupta)



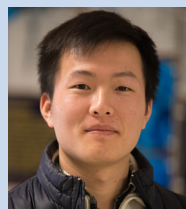
Christian Greenhill
(Goldman)



Li-Jen Yu
(Marquis)

Master's degrees

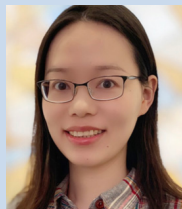
The following students earned a master's degree in 2020.



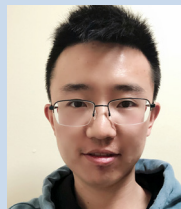
Ruiming Lu
(Poudeu)



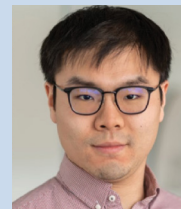
Kelsey Mengle
(Kioupakis)



Dandan Wang
(Thouless)



Chaoming Yang
(Qi)



Mingfei Zhang
(Qi)

Saman Moniri & Ashwin Shahani

Assistant Professor Ashwin Shahani's first Ph.D. student, Saman Moniri, defended his dissertation on March 30: "Non-classical crystallization pathways in eutectic-forming systems."

Moniri joined Professor Shahani's research group in November 2016, after having just earned his master's degree from U-M in chemical engineering.

"My experiences working under the mentorship of Professor Shahani have been overwhelmingly positive," Moniri said. "I am very lucky to have Professor Shahani as my mentor and advisor, and I will forever be grateful to him for helping me grow my career."

"It has been a pleasure to work with Saman and to see him achieve this important and final milestone, a culmination of his hard work in my group," added Shahani. "I am honored to have been a part of his journey."



Saman Moniri & Assistant Professor Ashwin Shahani

Chaoming Yang & Liang Qi

On April 2, Chaoming Yang defended his Ph.D. thesis, "Advancing Atomistic Modeling of Defects in Plastic Deformation of Metallic Crystalline Materials."

Yang joined Qi's group in Fall 2015 and said he chose Qi for an advisor because he was interested in his previous work that revealed intrinsic mechanical properties with first-principles calculations, and also because he found the idea of being the first graduate student of a Ph.D. advisor appealing.

"I learned so much from Professor Qi," said Yang, who now works for Google as a Level 4 software engineer.

"Chaoming is intelligent and hard-working," commented Qi. "It has been a great pleasure and a privilege for me to guide him to reach his current achievements. I appreciate the contributions that he has made to our group. I am confident that he will enjoy a bright future in his new adventure."



Chaoming Yang & Assistant Professor Liang Qi

Tristan Blazney
Kyle Bushick
Aishwarya Chandrashekar
Albert Chang
Jiun-Yeu Chang
Chen-Yao Chao
Tony Chiang
Erik Dammen-Brower
Zihao Deng
Vishwas Goel
Matthew Higgins
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Tao-Yu Huang
Brian Iezzi
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Guangyu Wang
Maria Ward Rashidi
Te Wen
Bingyu Wu
Zhucong Xi
Jiayin Yu
Bokai Zhang
Xiaoyang Zhong
Tianyang Zhu

MSE alums making news



Paul Krajewski (BSE '89, MSE '91, PHD '94)

has been elected to the **National Academy of Engineering** (NAE), the nation's most prestigious engineering association. Currently director of global research and development at General Motors Co. and a globally recognized expert in automobile lightweighting, Dr. Krajewski was selected by NAE "for development and implementation of lightweight automotive materials." In his current position with GM, Krajewski leads teams responsible for developing the vehicle lightweight strategy and mass reduction technology plan for future GM vehicles, as well as having responsibility for mass integration on GM's global vehicles.



Michelle Griffith (PHD '95)

A Distinguished Member of the Technical Staff at Sandia National Labs, Dr. Griffith was selected as the recipient of the College of Engineering's **MSE Alumni Merit Award for 2020**. The rank of Distinguished Member is awarded to no more than ten percent of the technical staff at Sandia whose accomplishments have made laboratory and national impacts. During her distinguished career at SNL, Dr. Griffith has provided technical expertise and leadership in: materials; rapid prototyping/additive manufacturing; nuclear weapon components; satellite telescope design, manufacturing, and operation; missile defense concepts and analyses; and nuclear detonation detection and space payloads.



Aerial Murphy-Leonard (PHD '18)

Dr. Aerial Murphy-Leonard has joined the Department of Materials Science & Engineering at The Ohio State University as an assistant professor. Since earning her PhD with advisor John Allison, Dr. Murphy-Leonard has been a National Research Council (NRC) post-doctoral research fellow at the Naval Research Laboratory in Washington, D.C. Dr. Murphy-Leonard's research interests are directed towards developing microstructure-property-performance relationships in lightweight metallic materials. She has also worked on many teams aimed at increasing the number of underrepresented minorities in engineering, and recently organized a



Victoria (Tori) Miller (BSE '11)

Dr. Miller, currently an assistant professor at the University of Florida, earned a **Bronze Medal from ASM International**, which recognizes early-career members for their significant contributions in the field of materials science & engineering. Dr. Miller was chosen to receive the award "for contributions bridging mechanisms of meso-scale dislocation plasticity with macroscale processing science in a wide variety of alloy systems, and for her devotion to the education and training of students."

ALUMNI

New EAB members



**Keith Bowman
(PHD '87)**

Dr. Keith Bowman was selected by ACerS for Volunteer Spotlight, a program through which they recognize a member who demonstrates outstanding service to The American Ceramic Society through volunteerism. Dr. Bowman is Dean of the College of Engineering and Information Technology (COEIT) and Constellation Professor at UMBC, the University of Maryland, Baltimore County, and a member of the MSE External Advisory Board.



**David Mortensen
(BSE '72)**

After graduating from U-M in 1972 and after six years as a helicopter pilot in the navy, Dave returned to Michigan and earned an MBA with concentrations in marketing and finance. In 1980, he joined GE Lighting and held a number of new product development, product management, marketing and sales management positions with emphasis on OEM customers. He left GE in 1993 to lead an OEM sales group selling power supplies to lighting fixture manufacturers. Then he held the senior sales and marketing position in a number of companies manufacturing hydraulic, pneumatic and power transmission products selling through industrial distributors. He had international experience in Europe, Brazil, Viet Nam and China. He retired in 2012.

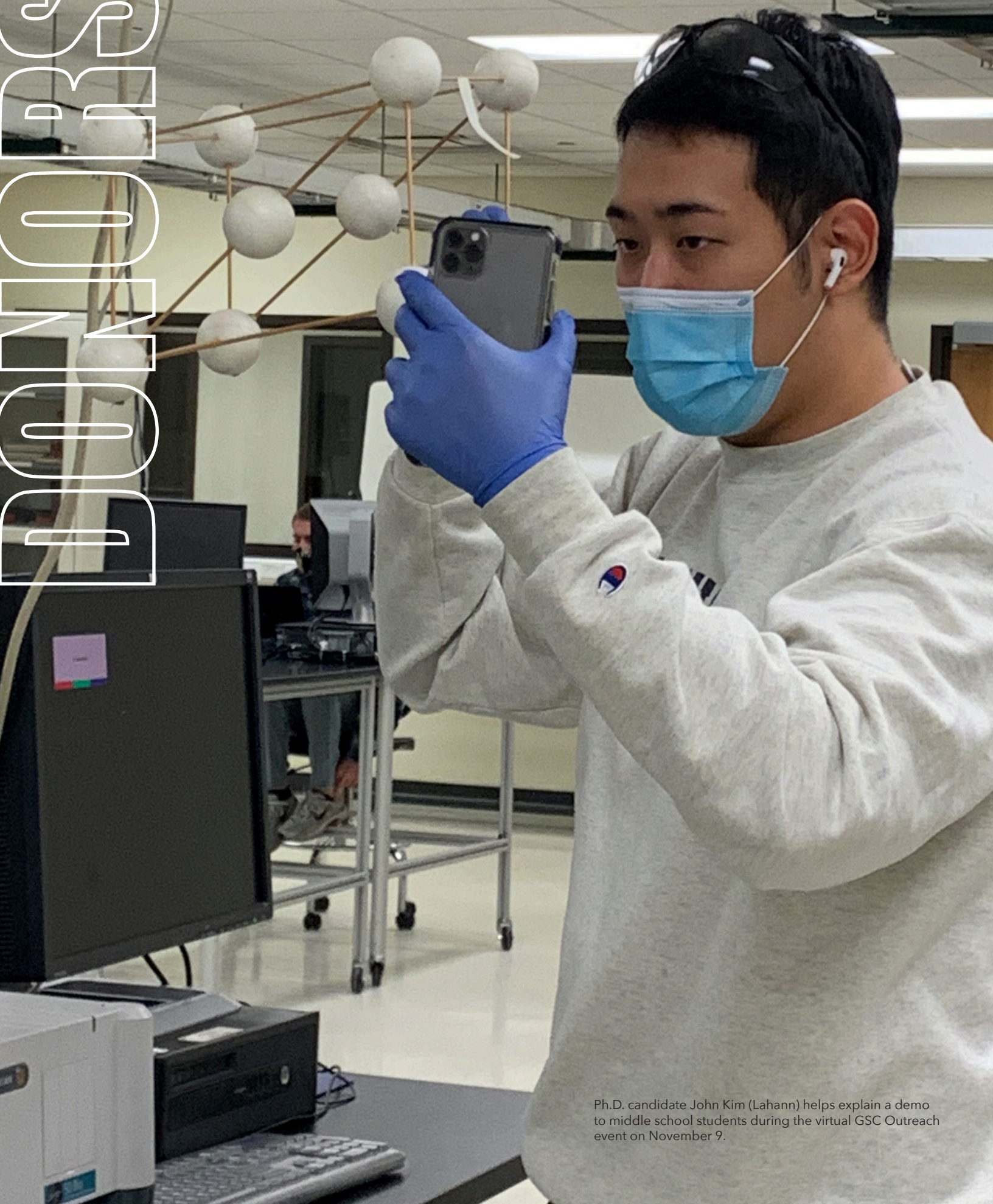


**Irene Peterson
(PHD '95)**

Irene Peterson is a Principal Research Scientist at Corning Research and Development Corporation, in the Process Research group. She studies the thermodynamics and kinetics of phase reactions in ceramic materials, and also provides technical support to glass production plants in the United States, Europe and Asia. Among the many different products she has worked on are ceramic filters for exhaust filtration and glass for display and pharmaceutical applications. She received the President's Black Belt Award for Innovation. She recently developed a new class on glass science and technology for Corning Community College with her colleagues. Irene is an active member of the American Ceramic Society, and serves as the Secretary of the Glass and Optical Materials Division.

NEWS

SCIENCE



Ph.D. candidate John Kim (Lahann) helps explain a demo to middle school students during the virtual GSC Outreach event on November 9.

Following is a list of our generous donors from 2015-2020, organized by giving category.

Named Academic Fellowships/Awards/Scholarships

Arden L. Bement, Jr. Endowed Scholarship Fund

Dr. and Mrs. Arden L. Bement, Jr.

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Dr. David Adams and Dr. Michelle Griffith
Edwin and Sharon Worth

Da Ke and Rui Endowed Fund

Dr. John Cheng and Jingxiao Zhang

David R. Mortensen Fund for Materials Science & Engineering

David R. Mortensen and Susan L. Levy

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Karl and Patricia Betz

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

Judith J. Field

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Neil A. Weissman
Wells Fargo Foundation

Richard A. Flinn Scholarship Fund

Karl and Patricia Betz
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Robert D. and Julie A. Pehlke Endowed Fellowship Fund

Robert D. Pehlke

Schwartzwalder Memorial Scholarship

Intel Foundation
Dr. Kyle Luck and Dr. Heather Arnold

Wilbur C. Bigelow Materials Science and Engineering Scholarship Fund

Wilbur C. Bigelow Trust

William F. Hosford Scholarship Fund

Gwendolyn and Gary Chung
William F. Hosford
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Ian Nilsen
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Leonard Radzilowski
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Drs. Richard and Patricia Robertson
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Dr. James and Jan Schroth
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Jeana Stanley
Dr. Sean Tang
TE Connectivity Ltd.
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Dr. Liya Wang and Dr. Huiqing Chen
Tony K. and Vivian Wang
Emily and Richard Warchuck
Dr. Michael J. Weins
Dr. Charles White
Dr. Zhibo Zhao and Shuzhen Liu

Undergraduate Lab

Metalcasting and Melt Processing Laboratory Program Fund

Applied Process, Inc.
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Keough Family Foundation

Van Vlack Family Fund

Dr. and Mrs. Otto K. Riegger

Van Vlack Undergraduate Laboratory Equipment Fund

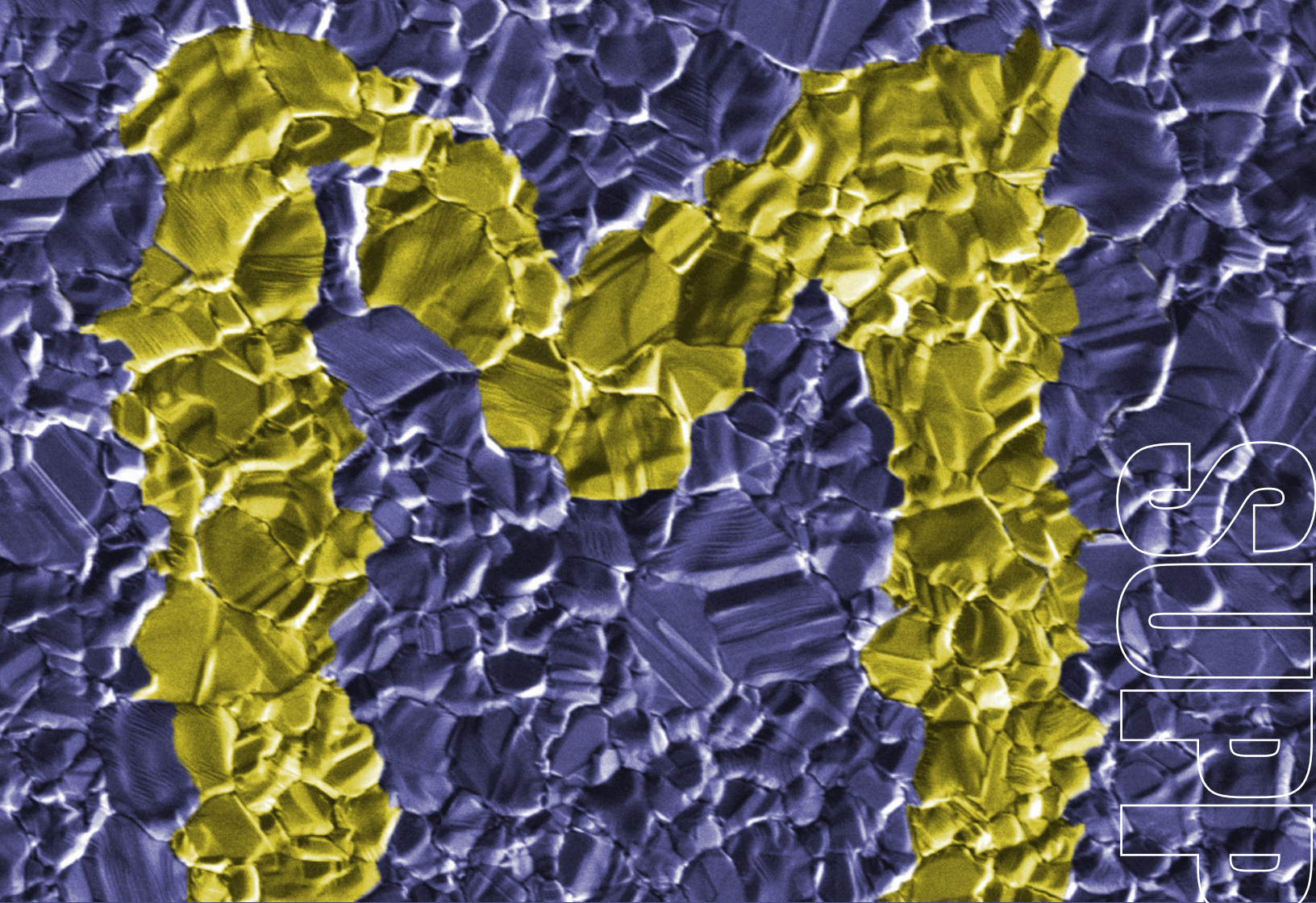
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Dr. Jere H. Brophy
GE Foundation
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Dr. Franklin Lemkey and Marina Movchan-Lemkey
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Dr. Paul and Kathryn Riewald
Drs. Richard and Patricia Robertson
Dennis and Lauren Stuligross
Dr. Jessica Terbush and
Dr. John W. Norton, Jr.

Van Vlack Lecture Endowment

Dr. Robert J. Warrick



Pre-pandemic party. Geordie Lindemann, Tracy Berman, Zhenjie Yao, Aaron Gladstein, Rebecca Perrault, and Duncan Greeley attend the annual TMS U-M-OSU reception held in San Diego on Feb. 24. It was one of the last MSE-sponsored events before the pandemic hit in mid-March.



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MSE is training the next generation of materials scientists who will profoundly impact the world.

When you contribute to MSE, you impact that research and more.

In addition, this year we have Covid-related funding needs that are both immediate and coming in the near future, including:

- an emergency fund for students, who, through no fault of their own, may face personal hardships due to the pandemic and need assistance (help with living costs, food insecurity, etc.), and
- unexpected departmental/program expenses that we will incur as a result of students having to delay their graduations, requiring more resources than were originally budgeted for.

In this extraordinary time, we hope you can help our give our students the experience and tools they need to become the visionary materials leaders of tomorrow. Your gift – no matter the size - is appreciated now more than ever.

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Thank you!



MSE on *Jeopardy!*

**USING HYDROGELS,
SCIENTISTS ACHIEVED
THEIR GOAL OF
CREATING RUDIMENTARY
VERSIONS OF THE
CHARGED ORGANS IN
THESE MARINE ANIMALS**

This question, which aired on *Jeopardy!* September 21, was based on a research study to which MSE Professor Max Shtein's group contributed their electronic device and origami / kirigami device expertise. The Shtein group were coauthors on the study, published in the journal *Nature* (<https://www.nature.com/articles/nature24670>). To learn more about their hydrogels research (and learn the correct answer), go to <http://bit.ly/3p8mK1M>.