Georgia Tech College of Engineering

School of Materials Science and Engineering

Fall 2022

Inside

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Cover photo: Elham Mirkoohi and Dyuti Sarker in the Georgia Tech Advanced Manufacturing Pilot Facility at the OPTOMEC metal printing tool. Inset: A tile showing various 3D structures made of sintered metal powders (testing mechanical properties of the metals combos and structures). Photo credit Christa M. Ernst

Notes from the Chair

Natalie Stingelin

Dear Alumni, Colleagues, and Friends,

Greetings from the School of Materials Science and Engineering at Georgia Tech! Having started as MSE's new chair this fall, I would like to use this opportunity to introduce myself. Before joining Georgia Tech in August 2016, I held positions at Imperial College London and Cambridge University (UK), the Philips Research Laboratories in Eindhoven (The Netherlands), and the Swiss Federal Institute in Zurich (Switzerland). I was a first-generation college student and was trained as a materials scientist. Although I specialized in polymer physics, which is evident in my approach to science, research and teaching, I have generally conducted research in the broad areas of energy materials and materials for sustainability. This experience allows me to bring a broad perspective on the wider materials science field, and the various materials classes and their functions. I am determined to cultivate a highly inclusive and impactful community, one that employs transformative learning and teaching practices and enables creative and collaborative science and engineering discovery, innovation, and entrepreneurship.

As you know, MSE at Georgia Tech has established itself as one of the nation's leading materials science departments. The School has been highly successful in generating groundbreaking science, educating scores of outstanding students, and forging liaisons with industry and other partnerships, including national laboratories. It has also pioneered and spearheaded several initiatives tailored to cultivating broad aspects of diversity, equity, and inclusion within the College of Engineering. This includes the MSE DEI Council, which I had the pleasure to serve on after it was founded in 2020.

However, challenges remain before us. These include, notably, the decrease in MSE undergraduate student enrollment, a direct result of the disruptions caused by the Covid-19 pandemic. In addition, there are growing pressures to adapt to the ever-changing landscape of undergraduate and graduate education, including online teaching, use of virtual learning tools, and the integration wherever possible (courses, concentrations, projects) of topics of societal interest and impact, such as sustainability, circular economy, data-driven materials research, quantum science, and aspects of the human-technology frontier. As the MSE chair, I pledge to work with our faculty, staff, and students, as well as internal and external partners and stakeholders. We will embrace the acceleration of new technologies and educational options. We will adapt to the increasingly multidisciplinary nature of the materials science field, both in education and in research. We also will strengthen existing alliances and identify new partnerships with a broad range of collaborators to achieve the School's vision. Among the most important objective is broadening existing platforms to serve the needs and aspirations of our students, our most precious 'output' and future ambassadors. We will grow and innovate our undergraduate and graduate curriculum and further the integration of activities across campus, with the goal of making training more convergent. We also will develop and advance distance-learning tools to provide higher flexibility and inclusivity, especially for students from underrepresented groups and/or those from low-income backgrounds. These tools that may evolve in the future to also include lifelong learning options and modalities that may be of interest to our alumni and corporate partners.

Finally, our School is at a turning point: the fact that 27 of 36.2 full time faculty (FTE) are full professors, seven are associate professors, and only three are assistant professors means that MSE will undergo a 'rejuvenation' process over the coming years. While this may lead to loss of knowledge, expertise, and skills, the years ahead will provide tremendous opportunities. I am ready and excited to lead the School through a transition toward an even higher level of excellence. I am excited to collaborate with you as we create a brighter, post-pandemic future!

N. Stingelin

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Fellow of the Materials Research Society
Fellow of the Royal Society of Chemistry

BEST COLLEGES US News & World Report RANKINGS

No. 5 undergraduate materials science and engineering program

No. 7 graduate materials science and engineering program

Faculty and Staff News

Welcome New Staff


Laura Alger


Masood Ebrahimi


Brandi Howard


Jonathan Jones


Tristen Jones


Catherine Washington

Faculty Awards and Promotions

Juan-Pablo Correa-Baena, MSE Faculty Service Award

Lauren Garten, ONR Young Investigator Program Award, Air Force Office of Scientific Research (AFOSR) Grant through the Young Investigator Research Program

Mark Losego, COE Education Innovation Professorship, AVS for Innovation in Peer-to-Peer Mentoring & Experiential Education

Sandy Magnus, U.S. Astronaut Hall of Fame, Fellow of the National Academy of Engineering

Matthew McDowell, GT Outstanding Achievement in Early Career Research

Dong Qin, promoted to full professor

Meisha Shofner, Fellow of the Royal Society of Chemistry

Robert Speyer, ACerS Outstanding Educator Award

Natalie Stingelin, Fellow of the National Academy of Inventors

Naresh Thadhani, Jefferson Science Fellow

Gleb Yushin, Fellow of the International Society of Electrochemistry

Staff Awards

Teresa Nelson, MSE Exemplary Performance Award

Hope Payne, COE Soaring Jacket Award

James Godard Retires After 30 Years at Georgia Tech

After eight years of service as assistant director - administrative operations in MSE, James Godard retired on June 30, following a 30 year career at Georgia Tech. His retirement celebration event included present and past staff colleagues and faculty, who talked about James' dedicated service to the School and caring for all staff, faculty, and research scientists. Dracy Blackwell, formerly the MSE academic advising manager, is now in the role of assistant director - administrative operations.

Welcome COE President's Postdoctoral Fellow Naomi Deneke

Naomi Deneke will be joining Georgia Tech through the prestigious College of Engineering President's Postdoctoral Fellowship program where participants are coupled with faculty mentoring, professional development, and academic networking opportunities.

"I am very excited to have been selected as a Presidential Postdoctoral Fellow at Georgia Tech" said Deneke. "My Ph.D. thesis centered on designing surface-modified adhesives for pick-and-place material handling applications and studying the surface properties of highly deformed elastomers. I plan to use my expertise in soft materials mechanics and metrology to design sustainable adhesives for packaging materials."

Deneke earned her bachelor's degree in chemical engineering in 2017 from Prairie View A&M University, Houston, TX, and her Ph.D. in materials engineering from Purdue.

MSE Student News


2022 MILL Fellows Tianqi Sun, Astrid Savaresse, Grace Godwin, and Maggie Meller.

2022 MILL Fellows

The 2022 MILL Fellows spent the summer working at the MILL. This included reorganizing the space, maintaining and training users on equipment, and giving tours to research groups, new students, and even to President Cabrera. In addition, the fellows helped with projects from industry partners. Tianqi was tasked with characterizing paint coating samples from Mueller using the MILL's equipment, and Astrid developed a procedure to efficiently synthesize and measure silica particles for a machine learning program, funded by the National Science Foundation. The fellows also enjoyed helping users with Create-X, Capstone, and other research projects.

Student Recognition

Malik Blackman, Graduate Assistant in Areas of National Need (GAANN)

Shuaib Balogun, Sloan Foundation Fellowship

Mathew Kuner, NSF Graduate Research Fellowship

Thomas Marchese, NSF Graduate Research Fellowship

Steven Ochoa, Sloan Scholar

Daniel Ranke, National Defense Science and Engineering Graduate Fellowship (NDSEG)

Emily Ryan, National Defense Science and Engineering Graduate Fellowship (NDSEG)

Stephanie Sandoval, DOE Office Science Graduate Student Research program (SCGSR)

Aubrey Toland, NSF Graduate Research Fellowship

Li Zhang, Graduate Assistant in Areas of National Need (GAANN)

Team Recreational Sleepers Takes Top MSE Honor at 2022 Capstone Design Expo

The student team, Recreational Sleepers, took the top MSE honor at 2022 Capstone Design Expo, held Tuesday, April 26, at McCamish Pavilion. More than 200 teams competed in the Expo.

This semester 218 teams spanned four colleges — Engineering, Computing, Design, and the Ivan Allen College of Liberal Arts — and 12 schools. Seven disciplines within engineering were represented: aerospace, biomedical, electrical and computer, industrial and systems, materials science, mechanical, and nuclear and radiological.

MSE had 10 teams competing and six inter-disciplinary teams that included MSE members. Recreational Sleepers, consisting of Cameron King, Dio Oey, Lakshmi Panchumarti, Elijah Tan, Thomas Thwaite, and Wendi Wu, received the top MSE prize. Their project, sponsored by Serta Simmons Bedding, addressed overheating while sleeping on memory foam mattresses by designing a sustainable solution to provide increased cooling to the sleeper. "Our team was really interested to work with the consumer product side of a company to create something that people will actually use," said Cameron King of Tyrone, GA. "It was a great experience working with Simmons to get their expertise and see them get excited about the ideas we presented about creating a sustainable layer for their mattresses."

The 2022 Prize for Best Overall Project went to the interdisciplinary team, Tired Techies, who created a sleep-monitoring mask and smart alarm that reduces drowsiness by waking the sleeper during the correct sleep cycle. The device measures eye movement throughout the night and processes the data to classify sleep stages.

Overcoming Challenges:
A Student Perspective on Success

Victoria Quirós Cordero

I am in the fourth year of my Ph.D., and it is surprising how much this experience has helped me grow. My decision to come to Georgia Tech was mainly driven by their pioneering research, their core faculty, and their interdisciplinary shared facilities. And I was not wrong. Georgia Tech is an amazing place to be. I have learned and enjoyed so much as my Ph.D. has progressed, but the change that is more noticeable day to day is that I have become a much more confident scientist. I have learned to mentor undergrads and younger Ph.D. students. I am better at identifying what others are asking from me and communicating with my mentees, peers, and advisors. I have written conveying papers and proposals. And, I have contributed to shaping various research projects.

"As an international student, becoming confident enough to feel equal with my peers has not been an easy task."

Being able to feel secure is a journey that all of us have to undertake and that is unique for everyone. Mine encompasses the challenges of being a female international student, and it has been long, difficult, and not yet ended. It is no secret that women and minorities are constantly trying to prove ourselves worthy of our achievements, especially in academic environments, up to a point where we do it unconsciously. But the systematic questioning that we face is the source of many of our insecurities. As an international student, becoming confident enough to feel equal with my peers has not been an easy task. I am originally from Costa Rica, where I did my undergraduate degree. Back home, I did my best to take advantage of the education and research opportunities that were offered. But when I arrived in the U.S. for my Ph.D., I could not help feeling very impressed, yet intimidated by the experiences of many students from my incoming class. Outgrowing these insecurities has required a lot of persistence, putting myself and my work out there, ignoring rejections and failures (that are a big part of everyone's career path even though we don't talk much about them), and holding onto the small and big successes. This year, thanks to the support of my advisors, Natalie Stingelin and Carlos Silva, and the Georgia Tech Quantum Alliance, I received a scholarship from the International Society for Optics and Photonics (SPIE) for our potential contribution to photonics research, and I was selected to participate at the first Advancing Graduate Leadership Conference funded by the American Physical Society (APS). I am immensely thankful for these reminders that hard work pays off.

What I want to convey is that, despite the different challenges we face and backgrounds we have, we are constantly developing academically and personally in an environment that provides us tools to be equally competent and confident professionals in any career path we choose. We have Georgia Tech and the School of Materials Science and Engineering to thank for that. I encourage you to take advantage of these opportunities and advocate relentlessly for you and your work. And, once you become the distinguished, confident professional that you wanted to be, stay mindful of the process that you went through, and most importantly, be humble, kind, and supportive to others undergoing it.

Highly photo-luminescent perylene-diimide-derivative films under black- light or UV-A light.

Victoria with advisors Natalie Stingelin and Carlos Silva.

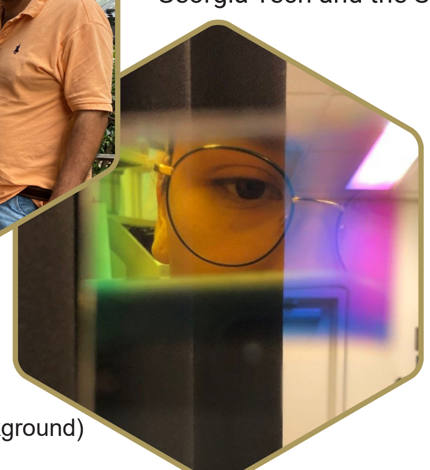
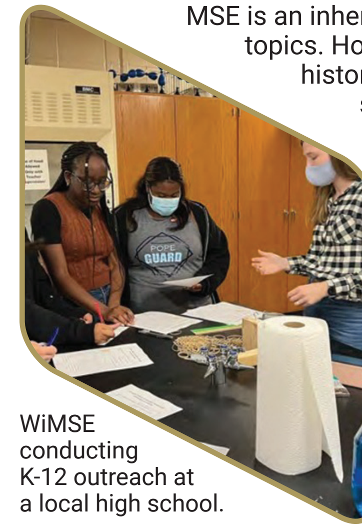


Image of Victoria in a solution-processed Bragg mirror reflecting green and yellow light (dark background) and transmitting blue and ultraviolet light.

Women in Materials Science and Engineering – WiMSE

WiMSE @ Georgia Tech®

MSE is an inherently interdisciplinary field that spans diverse engineering and science topics. However, the composition of Georgia Tech's MSE student population is historically less than 30% women. While organizations for women in STEM, such as the Society of Women Engineers, serves the broader population, an informal group of female graduate students within MSE created the "Women in Materials Science and Engineering – WiMSE" in 2017. WiMSE was established as a crucial and needed resource for connecting women with overlapping academic interests and similar experiences. Within three years of its inception, the organization grew into a team of more than 10 undergraduate and graduate students and more than 100 members.



WiMSE conducting K-12 outreach at a local high school.

WiMSE hosts professional development events to connect members to experts in the broad MSE industry, informing them of the many career paths post-graduation. The group also affirms each person's ability to succeed both as a student and future workforce member. Over the course of the last year, WiMSE has hosted information sessions with Sandia National Laboratories, Lam Research, and the Applied Physics Laboratory at Johns Hopkins University. In addition to connecting students to industry, these events allow WiMSE to share the importance of supporting women and other groups that have historically been excluded from STEM careers and to exchange ideas on the best ways to achieve gender equality in the academic and work environments. WiMSE's largest professional development event is the annual "Connect and Dine" event, which brings together approximately 100 students, professors, alumni, and industry partners to discuss a specific theme related to diversity and inclusion. The 2022 theme was *'Breaking the Mold,'* inspired by engineer and GoldieBlox CEO Debbie Sterling's quote, "We're not here to say pink and princesses are bad. We just want girls to know they can build their own castles."

2022 Connect and Dine networking event.

WiMSE's outreach efforts connect Georgia Tech MSE students directly with younger students, using demonstrations and hands-on activities to engage and excite younger audiences, while also sharing a welcoming message that MSE is a field where they can have a strong sense of belonging and career success. WiMSE has hosted many outreach events and participated in several camps to share what it is like to be a "woman in MSE" and demonstrate key technical principles of the field. Examples include presentations, hands-on activities, and science experiments given by WiMSE members at a K.I.D.S. Camp, the Women in Engineering summer camp, and high schools.

They also hold monthly social events — "Lunch and Learn," fall welcome brunches, bowling, trivia nights — as a vital part of building a strong network of supportive women and providing an open space to meet other women and men in MSE. Through these connections, members develop a support system for their time at Georgia Tech and beyond. Over the pandemic, WiMSE held virtual game nights, crafting times, and brunches, which gave their members an opportunity to see familiar faces and combat feelings of isolation. They also hosted a group to watch the documentary "Picture a Scientist" and organized a virtual panel with five Georgia Tech professors to discuss their experiences as women in STEM and give advice on how to improve the experiences of individuals and the community as a whole.

WiMSE 2022 Executive Board.

WiMSE continues to grow in its membership, holds successful community building and outreach efforts, and provides impactful professional development opportunities. As this group of dedicated female students strives to broaden participation in MSE as an academic community here at Georgia Tech, as well as a field needing a diverse workforce, WiMSE has accomplished much and stayed strong even during the challenging times of the past several years. WiMSE's achievements showcase how a dedicated group of female scientists and engineers can transform the culture and environment of an academic unit at Georgia Tech.

Industry News

Materials Research for Innovation Across Disciplines, the Focus of the 2022 Brumley D. Pritchett Lecture and Symposium on Materials Innovation

Family members of the late Col. Brumley D. Pritchett listen to Greene's presentation. Photo credit Christa M. Ernst

Over 100 in-person and virtual attendees gathered at Georgia Tech on April 11th and 12th for the Symposium on Materials Innovation and 2022 Brumley D. Pritchett Lecture, jointly hosted by the School of Materials Science and Engineering and the Institute for Materials. This two-day event featured multiple faculty lectures and two guest keynote speakers. It also featured the Brumley D. Pritchett Lecture, given by Laura Greene, a member of the President's Council of Advisors on Science and Technology (PCAST). Greene is also the Marie Krafft Professor of Physics at Florida State University and chief scientist at the National High Magnetic Field Laboratory.

In her presentation, *The Dark Energy of Quantum Materials*, Greene spoke on correlated electron problems that remain largely unsolved; with one stunning success being Bardeen-Cooper-Schrieffer (BCS) electron-phonon mediated "conventional" superconductivity. Greene touched upon the many families of superconductors that are "unconventional" including the high-Tc cuprates, iron-based, and heavy fermion superconductors. These materials are disparate in many properties but display similarities in their fundamental properties. These topics were presented using an analogy to stress how they remain among the greatest unsolved problems in physics today.

2022 COE Alumni Awards

Keith Hearon, B.M.S.E. '09, Co-founder & CEO Virex Health and Poly6

Keith Hearon received the Council of Outstanding Young Engineering Alumni Award. Hearon graduated from Georgia Tech's undergraduate materials science and engineering program in 2009. After earning a Ph.D. in biomedical engineering from Texas A&M in 2013, he worked as a postdoctoral fellow in Professor Bob Langer's (Moderna co-founders) group at MIT. Hearon left MIT in 2016 to work as Co-Founder and CEO of aerospace 3D printing company Poly6 Technologies, which was acquired by a $40 billion private equity firm in late 2019. In 2020 at the height of the pandemic, he co-founded rapid diagnostics company Virex Health, which was acquired by Sorrento Therapeutics in February 2022. Hearon has 12 patents pending or issued in biotechnology and aerospace sectors. He was a finalist in the 2014 U.S. Collegiate Inventors Competition and plans to found multiple companies in the future.

Jennifer P. Bailey, B.Cer.E. '70, M.S.Cer.E. '71, Retired, BASF Corporation

Jennifer Bailey received the Engineering Hall of Fame Award. She became a Georgia Tech fan at a young age, attending football games with her father. It sparked her interest in Tech as a destination and engineering as a career. After enrolling in every science class available at her high school, she applied to Georgia Tech and was one of the early coeds on the previously all-male campus. After earning her bachelor's ('70) and master's degrees ('71) in ceramics engineering, she taught pre-engineering classes at Walters State Community College for seven years, sharing her interest in materials, manufacturing, and their applications with students. She then accepted a position with BASF as Process Engineer and worked in both polyester polymerization and nylon staple production. Other positions during her 25-year BASF career included Quality Engineer/Auditor and Regional Account Manager for Pigment Sales in the Northeast. She and her husband, David L. Bailey (B.I.E. '69), both retired from BASF in 2003 and currently live in Tallahassee, Florida. They are loyal and active supporters of Georgia Tech, with 43 consecutive years of giving to Roll Call. The Baileys have endowed scholarships and have established an estate provision for Georgia Tech. She has served on both the MSE and College's External Advisory Boards.

Alumni Update

Kristen H. Brosnan

Kristen Brosnan, B.S. 99, received her M.S. and Ph.D. in Materials Science and Engineering from The Pennsylvania State University in 2002 and 2007, respectively. Her research at Penn State focused on development and testing of fiber textured PMN-PT in tonpilz transducers, and was recognized with the American Ceramic Society Graduate Excellence in Materials Science Diamond Award for this work in 2006.

After graduation, Brosnan joined GE Research in Niskayuna, NY as a Materials Scientist, working on processing-microstructure-properties-performance relationships in thermal spray ceramic coatings – in particular, solid oxide fuel cells (SOFCs), NOx sensors, thermal barrier coatings (TBCs), and environmental barrier coatings (EBCs). In 2015, she moved to the role of Manager of Ceramics Structures and Processing Laboratory where she was responsible for the growth of the ceramics portfolio. In 2017, Brosnan became the Technology Manager of Metals & Ceramics at GE Research, where her team was responsible for delivering key high temperature materials technology for industrial gas turbines, including critical new alloys, Ceramic Matrix Composites (CMCs), coatings for the LEAP and GE9X Aviation engines, repair technologies for legacy engines, new investment casting technology for the GE Power HA gas turbine and additive ceramics and metals for turbine applications (and beyond). During this time, Brosnan was a leader in the GE Women's Network, served as program coordinator for GE Cultivate, a mentorship program for talented early career women, and was the lead mentor for the American Ceramic Society President's Council of Student Advisors.

She joined Collins Aerospace, a unit of Raytheon Technologies, in June 2021, and is currently the Associate Director for Guidance Solutions Technology Development in the Mission Systems business unit. Brosnan currently serves as a Board Member for the Materials Research Society and is an advisor for the Basic Science Division for the American Ceramic Society.

Brosnan has received a number of awards for her work including reaching the distinction of Fellow in the American Ceramic Society in 2019, the American Ceramic Society Global Ambassador Award in 2019, the GE Woman in Technology Award in 2017, and the American Ceramic Society Schwartzwalder-PACE award in 2014.

Sheng Xu

Sheng Xu received his B.S. in Chemistry from Peking University in 2006, then came to Georgia Tech for his Ph.D. study. His thesis was on epitaxial growth of oxide nanowires for energy harvesting and light-emitting applications. His work was recognized by a Sigma Xi Best Ph.D. Thesis Award in 2010. Subsequently, he joined the University of Illinois at Urbana-Champaign as a postdoctoral researcher working on materials design and advanced microfabrication of stretchable electronic devices. His work on a stretchable health monitor named him one of the 35 Innovators Under 35 by MIT Technology Review.

Xu has been on the faculty at the University of California San Diego since 2015, where he is currently an associate professor. His research interests span from functional material synthesis to soft ultrasound technologies and cellular interfaces. Conventional studies on halide perovskites were mostly on polycrystals or bulk single crystals. Xu invented a protocol for controlled epitaxial growth of single crystal halide perovskites thin films. Solar cells built on this material demonstrated, for the first time, a certified open-circuit voltage beyond what's possible by the Shockley-Queisser limit. Existing wearable devices could only sense signals on the skin surface or shallow tissues (<1 cm below the skin surface). Xu developed a wearable ultrasound device that can access deep tissues (>14 cm below the skin surface), which have a stronger and faster correlation to diseases than surface signals, opening a new sensing dimension for the field. Current technologies for recording cellular communications are either limited to low accuracy or a small number of (<10) cells. Xu created an array of three-dimensional field effect transistors that can record cellular communications with high accuracy over a large number of (>100) cells.

Xu has published ~80 papers in total, including 26 of them in *Nature, Science*, and their sister journals. His work has been used as a testimony during a U.S. Congressional Hearing supporting the impact and importance of NIH appropriation. He has received many accolades, including the prestigious MRS Outstanding Early Career Investigator Award (one of the 34 awardees since its inception in 1991). He is a Frontier of Engineering of the National Academy of Engineering and a Kavli Fellow of the National Academy of Sciences.

Materials Everywhere!

Materials are everywhere, but not a lot of people realize it! MSE associate professor Mark Losego is trying to change that. Visiting K-12 classrooms, developing museum exhibits, producing engaging videos and more, Losego has a long history of MSE outreach.

Even before he earned his first degree, Losego was an impassioned MSE champion, persuading one of his best friends in high school to pursue a degree in MSE with him. As an undergraduate, he worked the recruitment phones and participated in the college's annual recruitment event, persuading many more high schoolers to pursue degrees in MSE. As a graduate student and postdoc he worked to refine his MSE demonstration skills to create even more engagement with students at outreach events – techniques he continues to use today in both his outreach and his courses.

Losego talking to 3rd graders at the Atlanta Science Festival.

As faculty at Georgia Tech, Losego continues to engage in outreach, both big and small. Last winter, he began working with the staff at the Tellus Science Museum in Cartersville, GA. They wanted to develop a new, in-house materials-themed exhibit, but needed technical guidance. Besides discussions on how certain demonstrations could be turned into repeatable, reliable museum exhibits, Losego also provided their staff access to his asynchronous "Introduction to MSE" course – which they completed in two weeks and became an invaluable resource for their exhibit development. At launch in March 2022, Losego gave the keynote public lecture at the museum during the evening preview – adding a few more demonstrations for good measure!

During the pandemic, Losego also developed a "What is MSE?" video to use for the annual COE recruitment event that he usually did in person – now that video is used even more broadly by Tristen Jones, MSE's recruitment coordinator – helping many more students discover MSE.

Last Spring, Losego participated in the Atlanta Science Festival (ASF) visiting a local Title I school in Fulton County as part of the "meet a STEM professional program." There, he shared demonstrations and got the 3rd graders excited about engineering and MSE. A few weeks later he did the same at his own kids' elementary school for their annual STEAM day! This year he hopes to get more faculty involved in the ASF school visits.

On campus, Losego continues to serve as faculty director for the MILL, advising the student leadership on operations and overseeing the summer MILL Fellows program. This year, the MILL Fellows did outreach for a special guest – President Cabrera – who was particularly impressed with the resilient superpowers of thermoplastic elastomers.

Recently, Losego led Georgia Tech's first Joint Maker Space Workshop, bringing together the student leadership from all the maker spaces in the College of Engineering to share best practices and make connections that are driving new collaborations this academic year.

Materials are everywhere, and professor Losego tries to be as well! For his efforts, Losego was recently honored with the 2022 College of Engineering's Outstanding Service Award, and this past July he was appointed to be one of the two inaugural College of Engineering Dean's Education Innovation Professors.

President Cabrera with MILL Fellows Maggie Meller, Grace Godwin, Astrid Savaresse, Tianqi Sun, and MSE associate professor Mark Losego.

Materials Innovation, Research Translation and Commercialization

Rampi Ramprasad

Creating better materials, faster and cheaper. This has been the mantra driving materials innovation for a long time. In recent years, virtual approaches, including computer simulations and machine learning, have matured to a point that they are a vital part of the accelerated and cost-effective materials development portfolio, both in academia and industry.

The Ramprasad Group is deeply involved in virtual materials discovery. In a dedicated effort spanning many years, Ramprasad has been able to nurture a polymer informatics ecosystem (Figure 1; see also polymergenome.org). This portfolio of virtual materials discovery tools is impacting applications in energy storage (including batteries, fuel cells, and capacitors), electronics, chemical separation, and recyclability (including biodegradability and depolymerizability).

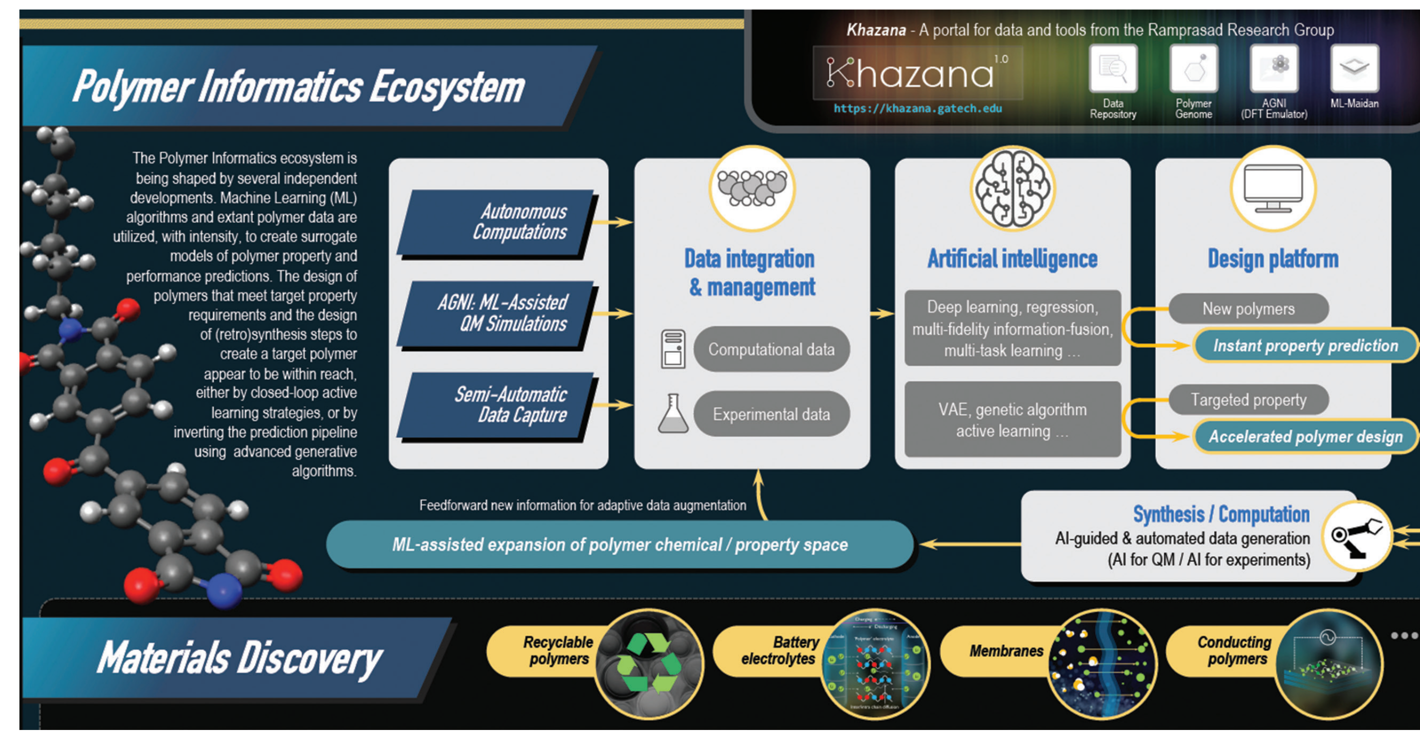


Figure 1. A polymer informatics ecosystem nurtured in the Ramprasad group.

A recent highlight of Ramprasad's research relates to his work on polymer insulators for electrostatic energy storage, funded by the Office of Naval Research (ONR), through the Multidisciplinary University Research Initiative (MURI). Through a close coordination between synthesis, characterization, modeling and machine learning efforts, this and a previous MURI have led to the discovery of dozens of new-to-the-world materials, far superior to conventional materials both in terms of performance and the capability to handle and function well at high temperatures.

Another active MURI grant led by Ramprasad seeks to create polymers that are thermally and mechanically resilient but recyclable (or more precisely, depolymerizable) on demand. This MURI is an entirely Georgia Tech initiative, and has participants from the Schools of Materials Science & Engineering, Chemistry, Chemical & Biomolecular Engineering, Mechanical Engineering, and Computer Science & Engineering.

Another of Ramprasad's passions is translational research. Georgia Tech not only provides a landscape that is technically top-notch and conducive for collaboration and execution of big ideas, it also offers an ecosystem for the commercialization of innovations. Ramprasad is a major beneficiary of the latter aspect of Georgia Tech as well. The core IP surrounding his polymer informatics tools has been licensed by a startup company, Matmerize (matmerize.com), launched by Ramprasad with the assistance of Georgia Tech's VentureLab. To address immediate industry needs for the accelerated development of polymers and formulations, Matmerize has built an industry-grade, cloud-based, machine learning software platform which can make instantaneous predictions of the properties of yet-to-be-made materials, and helps plan the next round of experiments, to efficiently steer the search for new materials with the right target properties. The emergence of Matmerize is a story that resembles the speed embedded in the company's value proposition (Figure 2).

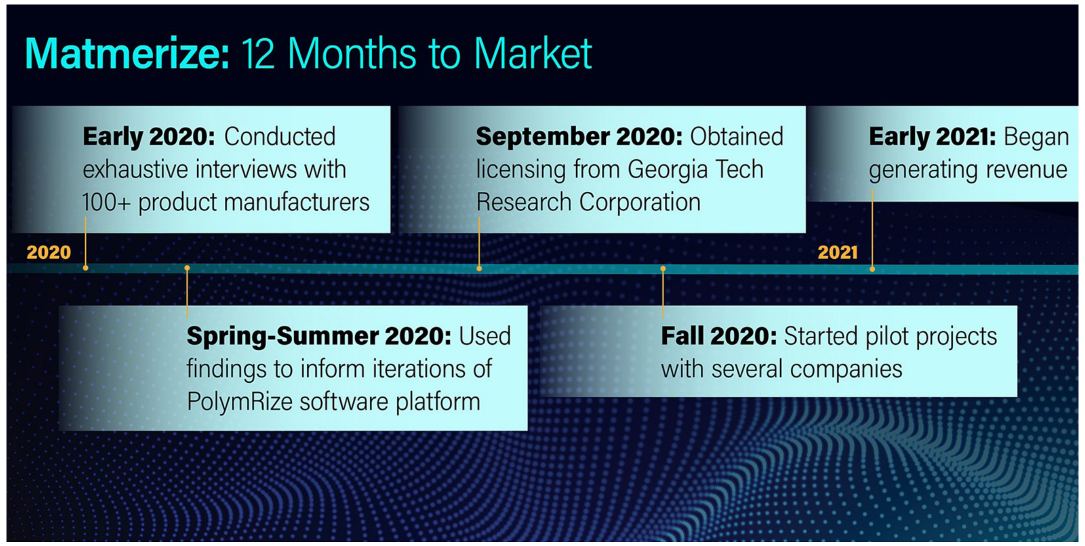


Figure 2. Key milestones in the Matmerize story.

"We had a lot of support getting Matmerize off the ground and into the marketplace so quickly," Ramprasad says. "I'm especially appreciative of Georgia Tech's School of Materials Science and Engineering, plus the Georgia Research Alliance (GRA) and VentureLab, who played a pivotal role with right-time, early-stage commercialization grants and advice." Jon Goldman, VentureLab, who has closely worked with Matmerize says "It's been fantastic to work with Rampi and his team. They were passionate about getting their capability into the hands of customers, building a viable, scalable business model and being disciplined about execution. They are a textbook example of how to commercialize an academic innovation."

Professor Rampi Ramprasad is the Michael E. Tennenbaum Family Chair and Georgia Research Alliance Eminent Scholar in the School of Materials Science & Engineering at the Georgia Institute of Technology. He is a Fellow of the Materials Research Society, a Fellow of the American Physical Society, an elected member of the Connecticut Academy of Science and Engineering, and the recipient of the Alexander von Humboldt Fellowship and the Max Planck Society Fellowship for Distinguished Scientists. He has authored or co-authored over 240 peer-reviewed journal articles, seven book chapters and eight patents. He has been a Guest Editor for the Journal of Materials Science, is on the Editorial Advisory Board of ACS Materials Letters, Journal of Physical Chemistry A/B/C, and npj Computational Materials. He has delivered over 250 invited talks at universities and conferences worldwide, and has organized several international symposia, including organizing and serving as the inaugural Chair of the Gordon Research Conference on Computational Materials Science & Engineering in Summer 2022. Ramprasad received his B. Tech. in Metallurgical Engineering at the Indian Institute of Technology, Madras, India, an M.S. degree in Materials Science & Engineering at the Washington State University, and a Ph.D. degree, also in Materials Science & Engineering, at the University of Illinois, Urbana-Champaign.

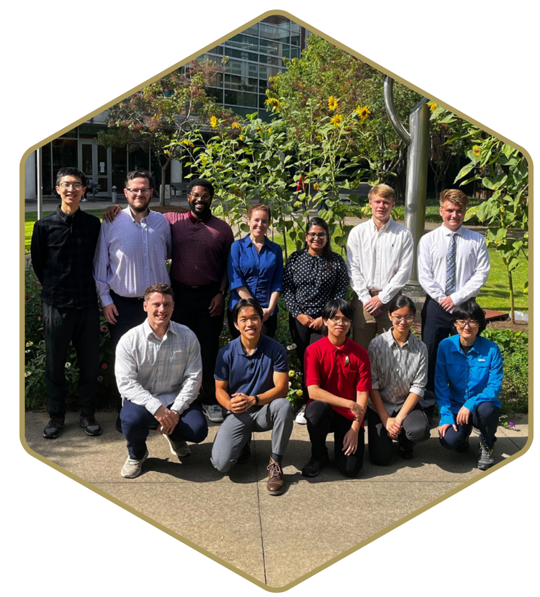
Ramprasad Research Group

The Garten Group at Georgia Tech

Multifunctional Piezoelectric Materials for Energy and Electronic Applications

Lauren Garten

Piezoelectric materials are ubiquitous in many areas of our life, from the capacitors used in most electronics to medical ultrasound transducers, RF filters, actuators, and energy harvesters. What makes piezoelectric materials so useful is their ability to translate mechanical to electrical energy and vice versa. Piezoelectric materials have non-symmetric crystal structures so when stressed a dipole forms in the unit cell leading to a macroscopic surface charge. Alternatively, if an electric field is applied the piezoelectric material will exhibit a linear strain. By selecting specific crystal structures and designing the materials orientation we can create piezoelectric devices to generate electrical signals from mechanical vibrations or create fine displacements from an electrical input. Additionally, piezoelectricity alone is a fascinating property, piezoelectric materials have the added benefit of allowing for additional unique properties, such as pyroelectricity, dielectrics, ferroelectricity, and multiferroicity. Thus, developing piezoelectric devices requires understanding crystallography, phase formation, materials processing, nanofabrication, electrical properties, mechanical properties, and electromechanical measurements.



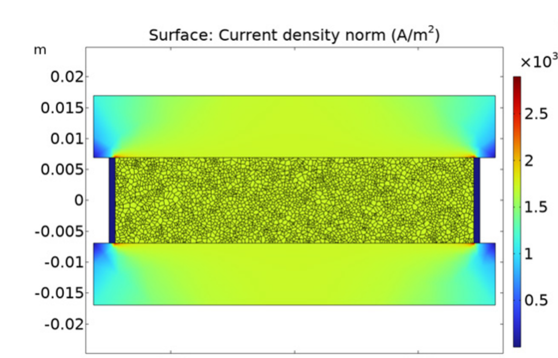
The Garten Group

The Garten Group is developing multifunctional piezoelectric materials for energy and electronic applications. Our goal is to expand the applications of these piezoelectric, dielectric, and ferroelectric materials beyond what is currently available to address needs in renewable energy technologies. Currently, we are working on eight unique but interconnected projects. Below are project highlights from each graduate student in the Garten Group.

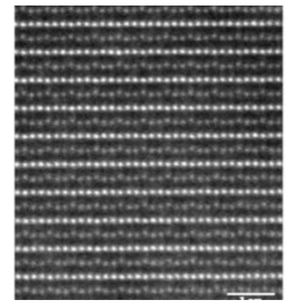
Ian Graham, 2nd year MSE Ph.D. student, is working on "Piezoelectric Enhanced Oxygen Evolution Reaction Catalysts," supported by a grant from the Office of Naval Research. Graham's goal is to create piezoelectric materials with variable oxidation states that can be used in catalysis. He is developing sol-gel processing routes to stabilize complex oxide (primarily nickelate) powders and thin films. Graham's recent successes include developing a processing protocol for barium nickelate and setting up a sol-gel processing system.

Yang Liu, 2nd year interdisciplinary ECE Ph.D. student, is working on the TESLA project supported by an ARPA-E grant led by Lukas Graber**.** Liu is working to improve the life expectancy of metal oxide varistors for DC switch applications. His current research approach includes circuit modeling, finite element analysis (FEA) of the metal oxide grain structure, mechanical fixture development, accelerated aging test design, and failure analysis. Recent successes include creating a testing fixture for high voltage lifetime testing, machining precision contacts, developing a FEA model in COMSOL, and studying DC switch circuit simulations with different nonlinearity coefficients.

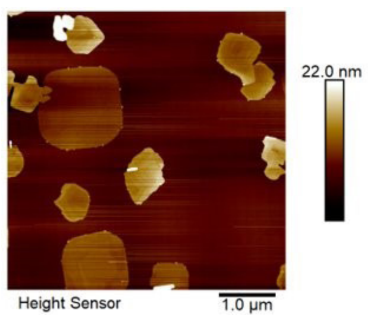
Kayla Chuong, 1st year MSE Ph.D. student, is working on the TESLA ARPA-E project, in collaboration with Liu and Graber. Chuong is developing novel metal oxide varistor (MOV) technology to be used in high voltage DC applications to improve the varistor's life expectancy. This includes optimizing the sintering process, determining the critical failure mechanism, and adjusting the chemical composition to maintain nonlinearity while also addressing failure issues. Her recent successes include winning the President's Fellowship and setting up a ceramic processing lab.



Fariha Rubaiya, 1st year MSE Ph.D. student, is working on "Understanding Electromechanical Coupling in Cellulose for Single Component Auxetic-Piezoelectric Energy Harvesters," supported by the Renewable Bioproducts Industry Fellowship and co-advised by Meisha Shofner. Rubaiya is investigating the piezoelectric and auxetic behavior of nanocellulose and how these electro-mechanical properties can be leveraged to produce auxetic-piezoelectric energy harvesters (APEHs). She has developed cellulose nanocrystal (CNC) films using drop casting and blade coating methods with different process parameters. Rubaiya's recent successes include characterizing these films using XRD to effectively iterate the process parameters to produce cellulose films with better alignment for piezoelectricity.



Marshall Frye, 2nd year MSE Ph.D. candidate, is working on the synthesis of thin film ferroelectrics towards the development of high-efficiency ferroelectric photovoltaics. Currently, Frye is depositing complex oxide thin films via pulsed laser deposition (PLD). He is investigating the stabilization of metastable ferroelectric materials that are predicted to have narrower bandgaps, making them ideal for photovoltaics. His recent successes include refurbishing a PLD system, writing a review on ferroelectric characterization, and establishing single point and combinatorial growth protocols.



Jonathan Chin, 2nd year MSE Ph.D. student, is working on the development of monolayer chalcogenides for piezoelectric optoelectronics supported by a grant from the Air Force Office of Scientific Research. Layer control is critical because the materials of interest can only become piezoelectric for odd numbers of layers near the monolayer limit. Chin, in collaboration with Frye, has developed a method for growing chalcogenide thin films by molecular beam epitaxy. His recent success includes creating a monolayer-thick (0.6 nm) chalcogenide film. Now his research will focus on electrical, electromechanical, and optoelectrical measurements of those films to verify the magnitude of piezoelectricity and investigate potential ferroelectric coupled optoelectronics.

John Allen Wellington-Johnson, 2nd year MSE Ph.D. student, is working on developing low-field switching ferroelectric materials to increase energy efficiency in computing and for the future development of energy storage and renewable energy systems. Wellington-Johnson is also working on two collaborative efforts: 1.) focused on creating technology to enable 5G devices, in association with ECE; and 2.) focused on building computational models to simulate his experimental synthesis process, in association with the Nanostructure Physics department at Sandia National Laboratories. Recent success includes being awarded a CINT User Proposal, being awarded an IEN seed grant, synthesizing and characterizing of several AlScN thin films.

The Garten Group is also working on magnetic, magnetoelectric and multiferroic materials development in collaboration with researchers at the Naval Research Lab and the Georgia Tech Research Institute.

Lauren Garten is the PI of the Garten Group and an assistant professor in the School of Materials Science and Engineering at the Georgia Institute of Technology. Since coming to Georgia Tech in fall 2021, she has won the 2022 Intel Rising Star Award, the 2021 AFOSR Young Investigator Award, and the 2021 ONR Young Investigator Award. Previously Garten was awarded the CalTech Young Investigator Lecturer in Engineering and Applied Science, a National Research Council Fellowship, the Jerome and Isabella Karle Distinguished Scholar Fellowship from the Naval Research Lab, and the Postdoctoral Research Competition Award from the DOE-BES. Prior to coming to Georgia Tech, Lauren worked as a staff scientist at the U.S. Naval Research Laboratory, at Sandia National Laboratory, and worked as a post-doc at the National Renewable Energy Laboratory. Her work focuses on the development of new materials for electronic and energy applications, particularly at the nexus between ferroelectricity, ferromagnetism, and photovoltaics. She enjoys developing processing routes to grow complex (difficult) materials and welcomes questions and collaborations on materials growth and multiferroic characterization.

Understanding Deformation and Failure in Metals by Multiscale Electron Microscopy

Josh Kacher

People have been using metals and alloys for thousands of years, and have constantly improved their strength and performance through developing new ways to fabricate and process them. This process of developing better and more versatile metals has relied largely on guess and check. Although people have gotten better at guessing and faster at checking, the foundational knowledge to intelligently design stronger, safer, more resilient metals is still missing.

One of the primary bottlenecks in developing and implementing new metals, and materials in general, is characterizing their structure and linking that structure to how the material performs in practice. The phenomena that govern the behavior of these materials occur over a wide range of length scales, from atomistic processes to macroscale interactions, thus, requiring a multiscale approach. The Katcher group is developing the tools to lay the foundation for rapid, automated analysis of materials. Essentially, teaching microscopes to automatically detect what is interesting in a material, how those areas of interest interact with the environment, and what eventually leads the material to fail. These tools will be applicable to a wide variety of material systems, from the metals and alloys we use to build cars and buildings to the new classes of semiconductors being developed for computers and electronic devices, enabling rapid materials development and deployment. While the ongoing projects in the Kacher lab are focused on a few materials systems, the tools developed and knowledge gained have potential broad impact in accelerating materials discovery.

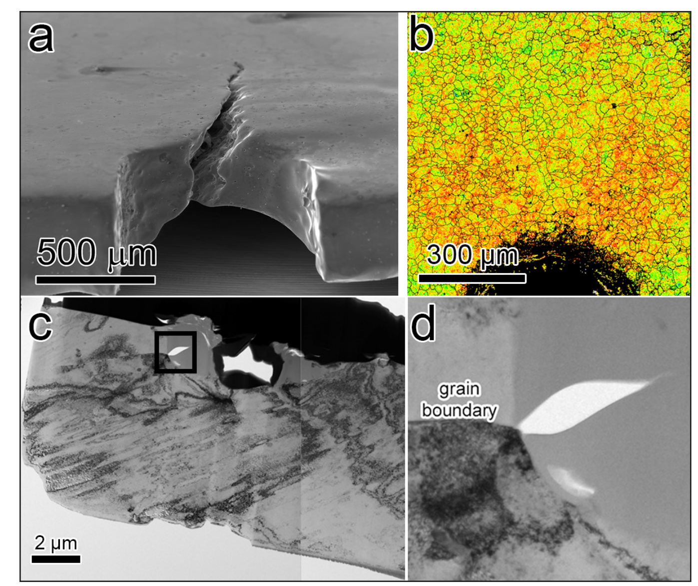


Figure 1. Multiscale analysis of cracking of an Al alloy. a) Scanning electron microscope image of a crack formed at a notch. b) EBSD-based analysis of the spread of defects in front of the notch. c) Transmission electron microscope image of a crack forming at an impurity particle. d) Enlarged image of the boxed region in c [2].

Specifically, the Kacher group uses multiscale and data analytics-based electron microscopy-based tools to connect the behavior of metals and alloys in a range of extreme environments, including high temperatures, corrosive media, fatigue, high strain rates, irradiation, and combinations of these environments, to their local structure to guide processing routines. The primary tool used in this research is electron backscatter diffraction (EBSD) in the scanning electron microscope, which uses a converged electron beam to rapidly collect thousands to millions of diffraction patterns from a polished metal surface. These diffraction patterns are analyzed to extract local information on the crystal orientation, defect state, stress distribution, and phase. By combining EBSD with machine vision, local microstructure characteristics can be correlated with weak points in a material, such as areas of high corrosion susceptibility or likely locations for cracks to emerge. Once these areas are identified, focused ion beam (FIB) machining is used to extract tiny slivers of material, which can be characterized down to the atomic scale in the transmission electron microscope. Similar to EBSD, local diffraction analysis can be used to extract further details at the nanoscale on material characteristics that correlate with damage initiation. Figure 1 outlines this approach in the investigation of the cracking of Al alloys, an important consideration as manufacturers look to replace heavier steel parts with light-weight Al [2].

The statistical understanding gained through multiscale analysis to design and run targeted in situ electron microscopy experiments is used by the Kacher group to provide direct visualization and analysis of critical defect interactions, including deformation, corrosion, irradiation, electrical biasing, or combinations of these interactions. Examples of these experiments for a variety of applications are presented in Figure 2. Figure 2a shows microscale tensile tests performed on thin (~100 nm) films, which are potential candidates for microelectromechanical devices [1]. The width of the test samples is about 1/100th of the diameter of a hair. Figure 2b shows phase transformations occurring in a ZrO_2 thin film, a ferroelectric material that has important potential applications in memory storage, but are currently held back by an incomplete understanding of the atomic-scale mechanisms in response to electrical biasing [3]. Figure 2c shows the different stages of corrosion of a 3D printed stainless steel sample [4]. These experiments have shown the importance of

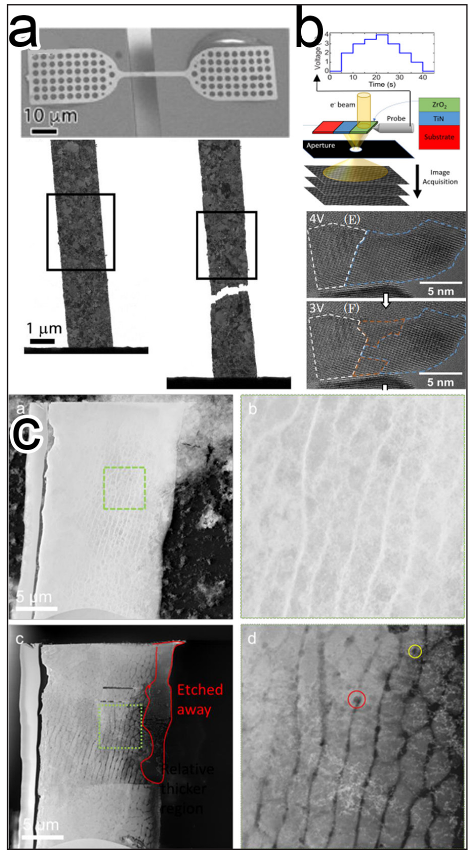


Figure 2. *In situ* electron microscopy experiments. a) Tensile testing of a microscale al sample [1]. b) Biasing a ZrO2 sample [3]. c) Corroding a 3D printed steel part (top before corrosion, bottom after) [4].

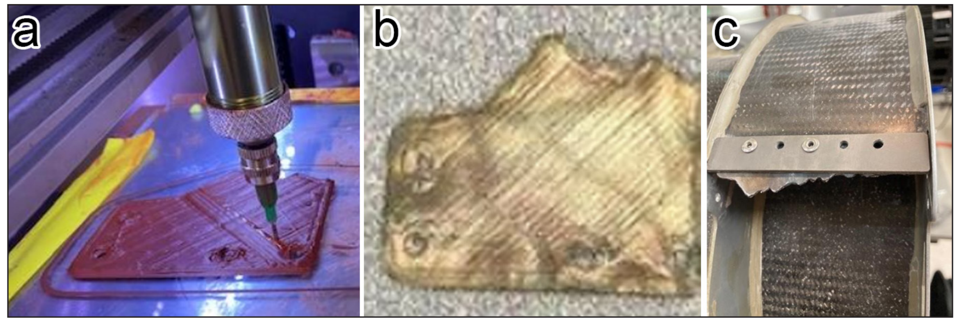


Figure 3. Printing a replacement part for a lunar excavator using direct ink write. a) Printing the polymer 'green body'. b) The metal part after sintering and reducing the green body. c) The printed and reduced part attached to the excavator.

chemical segregation to dislocation clusters as corrosion initiation points. Beyond understanding degradation and failure mechanisms, the Kacher group is actively developing new metal additively manufacturing techniques for low cost applications or rugged environments. Rather than starting from volatile metal powders, this technique, known as direct ink write, uses oxide particles embedded in a polymer binder as the starting material. Parts can be printed using relatively low-cost extrusion-based printers and then post processed in a hydrogen furnace to burn out the polymer and reduce the oxide particles. The final part is a pure metal or alloy with the geometry determined by the initial polymer print. A strength of this approach is the elemental flexibility that it affords, as the final part chemistry can be controlled by varying the ratios of different oxide particles used in the initial mixing. This leads to the ability to print high entropy alloys [5], stainless and carbon steels, and various molybdenum-based alloys that are challenging to print using the more common laser-based metal 3D printing approaches. Different applications, ranging from remote outposts to the moon where supply chain issues are a persistent challenge, are actively explored, including printing a replacement part for a lunar excavator (see Figure 3).

1. Stangebye, S., et al., Understanding and quantifying electron beam effects during in situ TEM nanomechanical tensile testing on metal thin films. Acta Materialia, 2022. 222: p. 117441.
2. Yoo, Y.S.J., et al., Relating microstructure to defect behavior in AA6061 using a combined computational and multiscale electron microscopy approach. Acta Materialia, 2019. 174: p. 81-91.
3. Lombardo, S., et al. Atomic-Scale Imaging of Polarization Switching in an (Anti-)Ferroelectric Memory Material: Zirconia (ZrO2). in 2020 IEEE Symposium on VLSI Technology. 2020.
4. Tian, M., et al., Discovering the nanoscale origins of localized corrosion in additive manufactured stainless steel 316L by in situ liquid cell TEM. arXiv, 2021: p. arXiv:2112.08263.
5. Koube, K.D., et al., Fabrication of 3D printed complex concentrated alloys using oxide precursors. Additive Manufacturing Letters, 2021. 1: p. 100015.

Josh Kacher is an associate professor in the School of Materials Science and Engineering at the Georgia Institute of Technology. His research is focused on relating the microstructure of materials, primarily metals and alloys, to degradation and failure mechanisms, with current ongoing projects investigating corrosion, fatigue, shock loading, irradiation, and combined environments. He is the recipient of the NSF CAREER award, DOE Early Career Award, and ONR Young Investigator Program Award.

Reforming MSE Education

Mary Lynn Realff

Associate professor and associate chair for the MSE undergraduate program Mary Lynn Realff is a transformational leader with a passion for diversity, equity, and inclusion (DEI). She has led efforts at Georgia Tech and in the American Society of Mechanical Engineers (ASME) to change policies and practices to increase diversity. She has been integral in setting organizational strategies across Georgia Tech, the National Science Foundation, and the Center for Puppetry Arts. She has served as the Vice President of Leadership and Diversity in ASME where the resulting policies and training have influenced the diversity and inclusion strategies of a wide range of professional societies. She has the energy to initiate and the dedication to sustain innovative education programs at the graduate, undergraduate, and K-12 levels.

Leading the effort to reform MSE education, Realff first reimagined the MSE undergraduate lab experience and MSE curriculum, with an emphasis on integrating assessment and including post-doc and graduate student development to enable student success. In the summer of 2022, she was instrumental in modernizing the B.S. MSE degree concentrations to incorporate content that was of stronger interest to the students and to the organizations that employ them. "With about 75% of our B.S. students going to industry upon graduation, it is important to include industry in the change process." Inclusion of important stakeholders in MSE is something that Realff has done throughout her career, from the Industry-Student Mentoring Program that she started in 1999, to senior design, she has included our alumni and other members of the industry in creating enduring mentoring relationships and well-grounded design problems.

Working with others is Realff's passion. She is the founding director of the Effective Team Dynamics Initiative (ETD) that delivers on the vision that Georgia Tech will be a community where everyone's unique contributions are recognized. "Students told me that when they had challenges working in teams, they were often told by their professors to 'figure it out.' Hearing this, the students thought that the professor did not care. I found out that I am good at teaching people how to figure it out and doing research to enable others to do the same." ETD cultivates a supportive, productive, and harmonious learning community grounded in strengths-based collaboration.

The ETD initiative, under Realff's operational leadership and strategic oversight, has impacted 7,000 undergraduate and graduate students and 1,800 post docs, faculty, and staff in just the past five years. The initiative collaborated with the Center for Teaching and Learning to develop the curriculum and train faculty and staff as certified facilitators to deliver its content. Realff has shared this program to other institutions such as Okinawa Institute of Science and Technology and University of Texas Health Science Center at San Antonio. She directs an NSF sponsored grant in innovation in graduate education, which draws on best practices in teamwork to develop leaders in engineering practice. She is a participant in the $26 million NSF ERC – CASPER - Center for Advancing Sustainable and Distributed Fertilizer Production," a five university collaboration. In this collaboration, she will lead efforts in developing effective teams across faculty, research staff, and graduate students that strengthens the multi-disciplinary and multi-campus effort.

GEMS – Girls Excelling in Math and Science is an Atlanta Public Schools middle school program that Realff started in 2008. Here the girls are doing hands-on STEM activities that build confidence and competence and this has led to many of these girls pursing STEM degrees and careers. The program was recognized for excellence with the Atlanta Partners for Education Business-School Partnership Award.

Realff envisions more changes to enhance the B.S. MSE program in the near future. "Our students are engaging in many different things that are enhancing their education. For example, 86% of our students conduct research with faculty, graduate students, and post docs. The recent concentration changes encourage students to complete the Research Option and also decreases the number of hours required for the degree." These changes give students more time to do things outside of required classes, such as earning a minor, competing in an innovation or other challenge, leading an organization, or taking some time to relax and pursue hobbies. For example, the new degree accreditation requirements for students training in DEI will drive a professional education component of the curriculum that will be addressed through team training and strengths-based instruction. The need for tighter connections between courses across the curriculum will also drive change. Collaboration across faculty will build student understanding of key MSE concepts to enable them to tackle important material challenges, such as new battery materials for the coming energy transition, bio-inspired sustainable materials development, and data-driven materials design.

Honored for her teaching and mentoring at Georgia Tech, Realff is a dedicated educator who listens to and advocates for students. She has been recognized for her leadership and teaching excellence through the GT Undergraduate Research Mentor Award, Atlanta Partners for Education Business School Partnership Award, GT CETL/AMOCO Junior Faculty Teaching Award, GT Outstanding Faculty Award, GT ANAK Award, GT CETL Educational Partnership Award, and MSE Faculty Teaching Award. Her service has been recognized through the ASME Dedicated Service Award and the GT Diversity Champion Award.

Mary Lynn Realff, B.S. TE 1987, is the associate chair for Undergraduate Programs in the School of Materials Science and Engineering at the Georgia Institute of Technology in Atlanta, Georgia and Cox Faculty Fellow, Co-Director of the Center for Women, Science, and Technology, and a Fellow of the Center for Deliberate Innovation. She earned her B.S. degree in Textile Engineering at Georgia Tech and her Ph.D. in Mechanical Engineering and Polymer Science & Engineering at MIT. She was named Fellow of ASME in 2007. Realff has served on the faculty at Georgia Tech for 30 years and is currently leading the Effective Team Dynamics Initiative.

MSE Concentrations

Giving students the flexibility of tailoring their B.S. MSE degree to gain further knowledge in one of four materials areas

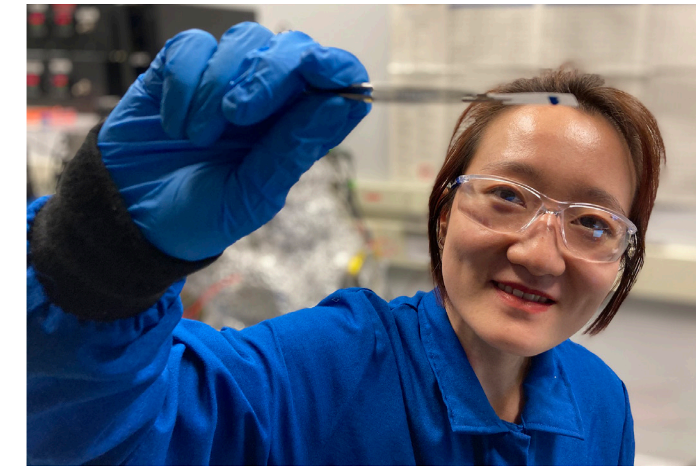
Polymer and Fiber Materials
Polymers are macromolecular materials commonly composed of subunits featuring organic components that have a diverse set of mechanical, electronic, optical, thermal, and chemical properties. Form factors, including sheets, fibers, fabrics, and foams, can be found in a number of products ranging from textiles and composites to electronic and medical devices. Opportunities for employment range from process engineering to new product development across many different industries, including polymer companies, healthcare materials, consumer products, and many others that integrate polymers into products.

Functional Materials
Functional materials exhibit useful electrical, electrochemical, optical, magnetic, catalytic, and/or thermal properties that make them essential for many modern technologies, including electronics, solar cells, batteries, LEDs, lasers, and fiber optics. A concentration in functional materials will position a student to work in areas such as microelectronics, optoelectronics, renewable energy-capture (e.g. in solar cells), energy storage (e.g. batteries), and energy conversion (e.g. fuel cells), as well as emerging fields like spintronics and quantum computing.

Structural Materials
Structural Materials are metals, ceramics, polymers, or composites used for any load bearing application. Such materials may be used to build airplanes, cars, bridges, or micro-scale devices. Career opportunities are available in many different industries. Graduates may work in areas of materials selection, process or design engineering, in quality control laboratories, or in consulting companies as failure analysts.

Biomaterials
The field of biomaterials study how materials interface with biological systems to augment, diagnose, treat or otherwise enhance biological functions. The biomaterial concentration creates many opportunities for employment in biotechnology and biomedical fields to design, synthesize, characterize, and test materials for healthcare-related products like load-bearing prosthetics, comfortable contact lenses, bandages to accelerate wound healing, artificial organs, diagnostic testing for diseases, as well as health monitoring devices that must effectively interface with a human host.

Pushing the Boundaries of Research Through Fellowships



Graduate Fellow Yi Li examining a piece of treated paper that is “sticky” to water droplets, holding on to a blue-dyed water droplet against gravity.

Graduate students are integral to the research engine of Georgia Tech. They teach undergraduates, conduct research, manage labs, and assist faculty with their research. They frequently serve as mentors. All the while, graduate students lend their creative energy and entrepreneurial acumen to our community. They are critical to both high-caliber research efforts and innovative undergraduate programs.

Graduate study is challenging and expensive. Students who pursue graduate work — particularly those in STEM fields — frequently forgo lucrative employment opportunities while seeking advanced degrees. Ensuring that they have the financial resources to both pursue and complete their courses of study is therefore a major priority. “My fellowship helped for lots of reasons – a bigger stipend, as well as other benefits, like covering health insurance costs and student fees. There were also funds that could be used for purchasing lab supplies that helped me do my experiments. Most importantly, the fellowship allowed me go to multiple conferences a year. Before COVID, I was able to go to conferences that I wouldn't have been able to otherwise, and I met a lot of cool people in my field and the opportunity to spread my research,” explains John A. Lewis, recent Ph.D. graduate. “I researched new types of rechargeable lithium-ion batteries, called solid-state batteries, to make batteries that can store more energy and to make them safer. This has important implications for a number of technologies, ranging from rechargeable vehicles to ongoing research and exploration in space.”

Recent Ph.D. graduate, Yi Li, found that her fellowship allowed her to explore out-of-the-box ideas with few restrictions, really allowing her creativity to thrive. “In one of my publications, we were examining how atomic-scale coatings of oxides onto paper could attract adventitious carbonaceous species from the atmosphere – essentially how we could make the paper surfaces collect more “dirt” – and that dirt led to making the paper repel water,” explained Li. “There are not many external funding sources that would support studies on how to make surfaces dirtier, but my fellowship allowed me to do that. Along the way, this led us to a fundamental understanding of the process and how we could actually pattern where this dirt collected, and thus make patterns of how the paper would wet. This patterning process allowed us to make interesting wetting patterns on the paper that are potentially useful in inexpensive, paper-based microfluidics for chemical separations, environmental monitoring, and medical devices.”

“Fellowship funds allow our graduate students to push the boundaries of research. The funds can come from a number of sources – corporate partnership, private philanthropy, governmental and non-governmental organizations – but the bottom line is that this type of funding offers greater freedom to explore, be creative, and network. We see a direct impact on the advancement of science and technology through published papers and patents filed. Yes, the funding supports graduate education, but graduate fellowships really bolster the strength of the entire materials science and engineering program,” explains Matthew T. McDowell, MSE 2008, associate professor with joint appointments in the School of Materials Science and Engineering and the Woodruff School of Mechanical Engineering. McDowell goes on to explain, “Having more graduate fellowship funds available, especially to our first year Ph.D. students, would provide MSE's program with the advantages we need to compete with our highly-ranked peers. This type of support is really a strategic advantage in attracting top talent from around the world, and it would directly impact what we can do for our students and our faculty.”

Well-funded graduate students will more than repay the investment in their education with future success in industry, research, nonprofits, and academia. Their accomplishments are Georgia Tech's accomplishments. For more information on supporting graduate students through fellowships, please contact:

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