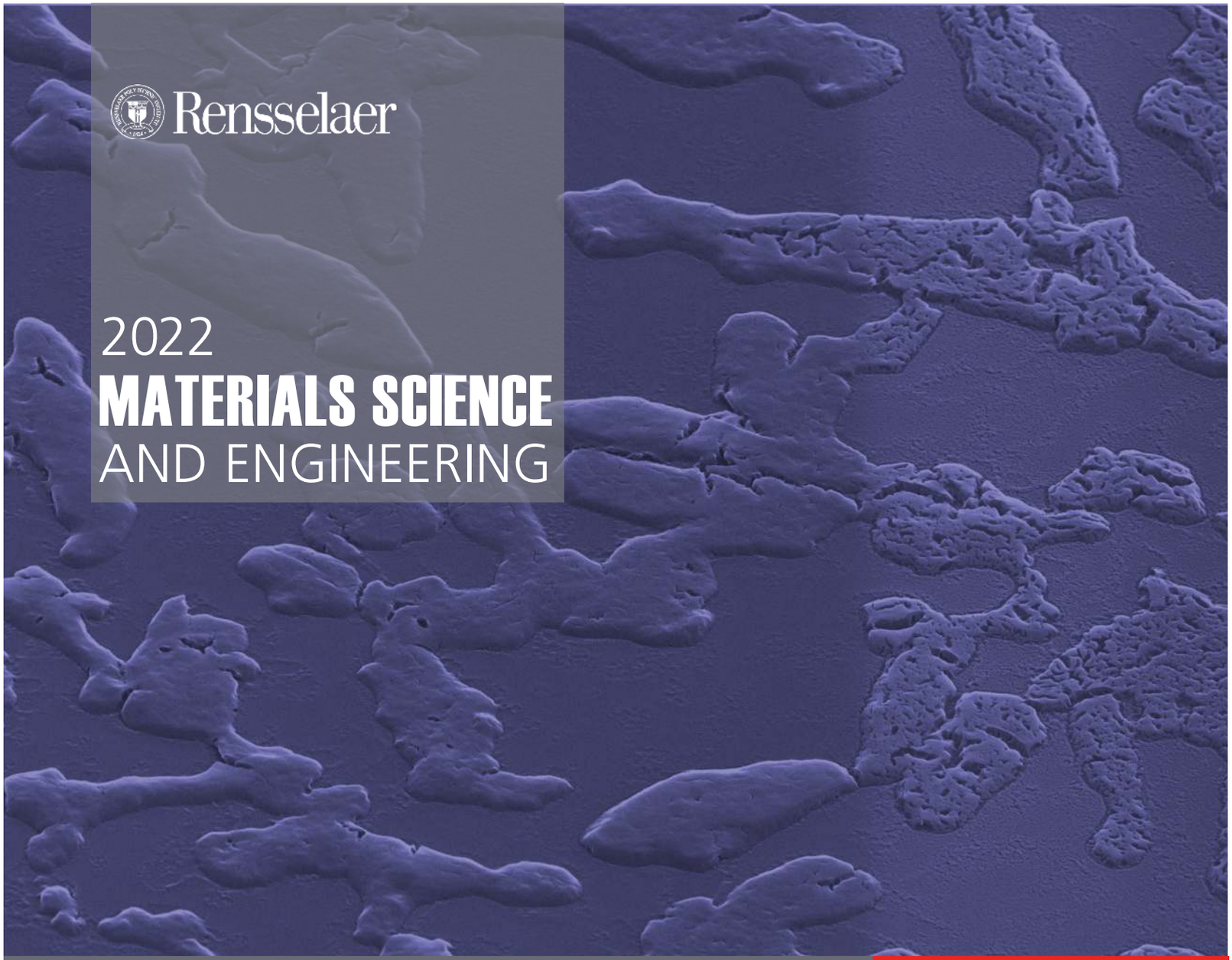
Rensselaer

2022 MATERIALS SCIENCE AND ENGINEERING



Microscopy award winning photo by graduate student Prachi Pragnya

Pawel Keblinski

Professor and Department Head, Department of Materials Science and Engineering (MSE)

WELCOME

Greetings to our MSE alumni and friends,

The last academic year signaled a transition from a COVID-19 epidemic dominated world to a welcomed business as usual world. Here at RPI we faced some limitations on various activities, such as events including external visitors and travel for our community, but we have transitioned to almost exclusive in-person learning and fully restored our undergraduate research. The mask mandate became optional in August marking, as least symbolically, the end of the pandemic at RPI.

The end of the pandemic coincided with the transition of the RPI Presidential administration after the 20+ year reign of President Shirley Jackson. We are all looking forward to the new Presidency of Dr. Martin

mse.rpi.edu

WELCOME [CONT.]

Schmidt. President Schmidt has encouraged open discussion with all RPI constituencies, including holding numerous small-group meetings of faculty, students, and staff. We look forward towards the new Institute leadership and its partnership with RPI community, including those at RPI campus and our alumni. It is critical that we all contribute to strengthen RPI by reversing some negative trends, and help lead RPI to a brighter future.

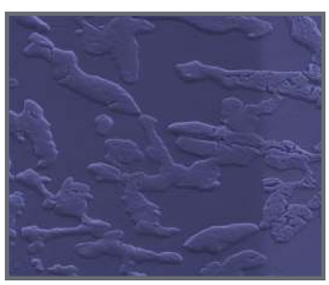
In the context of Covid related and institute Presidential transitions, I am happy to report that the MSE department, including faculty, staff and students, continues to perform at the highest professional level, and at the same time focus on the well-being of the materials community at RPI. A significant event this year was the retirement of Prof. Richard Siegel, who has a long (sixty years!) and distinguished career in the field of material science and engineering, including the last 26 years at Rensselaer. Over decades of active research, he distinguished himself in many areas, starting with fundamental studies of defects in metals in the 1960s, continuing in the 70's and 80's with studies of microstructure property relationships while in academia (Stony Brook) and government (Argonne National Laboratory), and finally shaping and developing the field of nanoscience and nanoengineering, including being a founding director of RPI Nano Science and Technology Center . His major educational impact at RPI is associated with his leadership of the "Molecularium" project that brought audiences worldwide to the amazing nanoscale world of atoms and molecules. On a personal note, I truly admire Dr. Siegel as one of the few scientists that can converse on a broad range of topics with virtually anybody including leaders of academia, industry and politics. On a more personal note, he hired me at RPI over 20 years ago, for which I am quite grateful.

In this installment of the MSE News, you will find highlights of our recent achievements and new developments within MSE community at RPI. One of the highlights are several recognitions of our faculty, most prominently Prof. Ravishankar Sundararaman was appointed as the Priti and Mukesh Chatter '82 Career Development Chair in recognition of his superb research and educational contributions and his stratospheric global prominence growth. Prof. Minoru Tomozawa continues to receive every conceivable award related to glass science, Prof. Liping Huang was honored by Alfred University and the New York State College of Ceramics to be the 2022 Samuel R. Scholes lecturer, and Prof. Edwin Fohtung was internationally recognized for his leadership in X-ray imaging. We also report on exciting discoveries and advancements made by a joint effort between Drs. Jian Shi and Ravishankar Sundararaman in spin control using electric rather than magnetic fields.

As usual, you will also find other compelling stories, including one on Mary Ellen Rathbun Kolb, one of the very first female graduates at RPI and metallurgy major. We also describe our efforts in popularizing the discipline of materials science via the RPI School of Engineering's 12-day long virtual Introduction to Engineering PREFACE program intended to attract high-school students to the field of engineering. You will also find numerous highlights on the achievements of our undergraduate and graduate students.

Please enjoy the stories we report to you and share any thoughts, ideas and your own successes with us.

Pawel Keblinski
Professor and Department Head
Materials Science and Engineering
Department
Rensselaer Polytechnic Institute



On the Cover: SEM micrograph of Air-exposed thin evaporated film of MgCl2 salt indicating segregation with air exposure.The right of the image (lighter contrast) is the intense electron-beam irradiated region depicting degradation effects of e-beam on hydrated MgCl2 salt.

Microscopy award winning photo by graduate student Prachi Pragnya: This photo won 1st place, Microscopy Competition: "SEM micrograph of air-exposed thin evaporated film of MgCl2 salt", Prachi Pragnya, Robert Hull and Daniel Gall, ASM Eastern NY meeting, November 16, 2021.

ADVANCED DEGREES AWARDED IN 2022

Congratulations and best of luck!

Congratulations to our newly minted Ph.D.s and Masters in Materials Science & Engineering!

Our Dec '21 and May '22 Ph.D.s: Dr. Brent Engler, Dr. Praveen Gupta, Dr. Harrison Lee, Dr. Prachi Pragnya, and Dr. Yang Hu!

Earning a Master's in Engineering: Luke Barba (ME), Kevin Bhimani (ME), Tom Chen (ME), Alexander Fuchs (MS), Alejandro Matos (ME), Alexander Yepikhin (ME)!

We are so proud of our newest Materials Science & Engineering Masters and Ph.D graduates! Someday you'll look back and think, Wow, I graduated at the strangest time ever... Until then, we'll be here for you, cheering you on, looking forward to wherever life takes you next, and feeling so proud of you. Hard work, talent, drive and vision will always outlast tough times. That's how we know you're going to make the world what you want it to be.

GRADUATING CLASS OF 2022

Congratulations and best of luck!

Our 216th Commencement Welcomed Materials BA/BS Graduates: Luke Barba, Chaz Bernstein, Jessey Bruening, Emilee Fortier, Aiden Glennon, James Gomez, Alex Hauck, Liam Huston, Adam Morrow, Freddy Reichelt, Miranda Ross, Ethan Tetteh, Kevin Zheng, and Haolei Zhou!

Congratulations! We look forward to seeing how you change the world!

Emilee Fortier

Jessey Bruening

Luke E. Barba

Miranda Ross

Ainsley Pinkowitz (they/them)

ALUMNI SPOTLIGHT

Why did you choose RPI for your studies?

"My godfather had attended RPI in the 70's and had great stories of the camaraderie that came from enduring a really grueling education. All I knew when I started undergraduate was that I wanted to be some kind of engineer or applied scientist and I needed to be at least an hour away from my hometown of New London, CT. I chose RPI primarily over WPI. RPI had a lot of options for major that WPI did not, which ultimately played out well, because I could not have been a materials engineer had I gone to WPI. I stuck around RPI for graduate school because I loved the close-knit materials department and I felt I hadn't tapped out the opportunities to learn from it. I also ended up being advised in my Ph.D. by one of the professors [Robert Hull] who'd inspired me to pick Materials when I was still an undecided freshman. My other Ph.D. advisor, David Duquette, gave me a really indispensable background to the work that I chose after graduation—so I'd say I chose right!"

What RPI organizations are you a part of? (Polytechnic contributions, clubs, etc)

"I was in RPI Fencing, I led an organization of Materials graduate students which hosted monthly seminars and an annual morale event, was part of the AVS and ECS professional society student boards, and as an undergraduate I worked as staff for RPI's Genericon. I participated in Material Advantage events but never joined the leadership as a student, despite the fact that I'm now the Vice Chair of the local Eastern NY ASM!"

What aspect of Materials Science are you passionate about?

"I specialized in corrosion science, but Materials is an interesting field on a very fundamental level. I love being able to ask why a material has the properties it does, I love that understanding the why gives us (some) control over those properties or that answering the why can tell us what happened in a materials failure scenario. When I die you can bury me in a Structure-Properties-Processing-Performance pyramid."

What research interests you?

"I'm currently interested in high-temperature aqueous corrosion in pressure systems for nuclear power applications. I'm also interested in using in situ techniques to study alloy oxidation behavior in more extreme environments."

What career are you interested in?

"I currently work at Naval Nuclear Laboratory, a Department of Energy-owned contractor-operated laboratory that provides nuclear propulsion to the United States Navy. I'm located at the Knolls Atomic Power Laboratory site, which is nearby to RPI in Niskayuna, NY."

What was your favorite part of being at RPI?

"I loved the people and opportunities at RPI. I felt very supported by my peers and like I had a lot I could learn throughout my education. The professional opportunities paved an easy path into my current career, but didn't railroad me either—I could have chosen the semiconductor industry, I could have moved across the country or to Europe—but I chose to stay near the people and places I got to love while at RPI."

How do you want to change the world?

"My motivation is to leave the world a better place than I found it. I became an engineer because I wanted to invest in the world around me; but I believe it's more than an individual effort as well. Getting the best work done means bringing your best self to your team, and so I hope to change the world not only technologically, but by being a warm and caring teammate who can bring out the best in others. "

Any other comments about your time at RPI?

"I was at RPI long enough to acquire ten GM week mugs. That includes the rare giant viking mug!"

FACULTY AWARDS

Edwin Fohtung

Edwin Fohtung, an Associate Professor in the Department of Materials Science and Engineering at Rensselaer Polytechnic Institute, has been awarded an International Excellence Fellowship from the Karlsruhe Institute of Technology (KIT) in Karlsruhe, Germany.

This competitive award will allow Prof. Fohtung, a leading expert in the field of x-ray physics at Synchrotrons and X-ray free electron lasers (XFELs) to collaborate on site with KIT researchers.

The research partnership will develop new approaches to study and demonstrate the utility of topological excitations in various applications including sensors, logic, memory, and quantum information processing.

Topological excitations are ubiquitous in condensed matter physics and intersects the field of topology in mathematics to provide a rich, robust platform and emergent platform for studying novel ground states and quasiparticles with properties beyond that of simple electrons. Many such excitations have topological properties that can be leveraged to engineer superior (e.g., low power and more stable) characteristics compared to the conventionally used charge and spin degrees of freedom.

Additionally, Professor Fohtung intends to "explore further collaborative ventures between RPI and KIT — two leading global technology institutions."

The International Excellence Fellowships were established by KIT to strengthen renewal capability and top-level research, expand its network to strengthen international recruiting, and to support strategic cooperation with international top-level universities and research institutions.

Professor Minoru Tomozawa has won the 2022 Mott Award

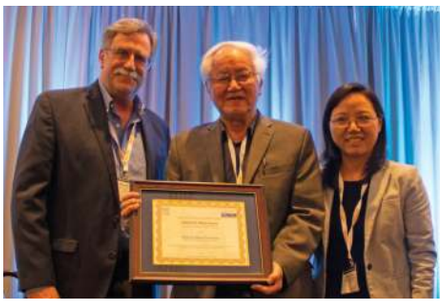
Professor Minoru Tomozawa has won the 2022 Mott Award. Presented by the Journal of Non-Crystalline Solids (JNCS) from Elsevier, this award distinguishes senior scientists based on their continuing relevant contributions to the science of non-crystalline solids over many years. This biannual award consists of a check for $2,000, a certificate and a special issue to honor the awardee in the JNCS-X (an open access companion journal of the JNCS).

Prof. Tomozawa has contributed extensively to studies of oxide glasses, including:

- revealing the physical origin of memory effects in glasses,
- developing a spectroscopic technique to determine the fictive temperature of glasses,
- elucidating the effect of fictive temperature on the mechanical strength of glass,
- measuring the rates of water diffusion in glasses and uncovering the mechanisms of diffusion,
- and relating structural relaxation to the strength of glass.

He stands among the most prolific researchers of the glass community and has published more than 100 papers in the JNCS.

As a side note, professor J.D. MacKenzie created the JNCS in 1969 while he was a faculty in the Department of Materials Science and Engineering at RPI. Prof



Liping Huang has been one of the four editors for the JNCS since 2019. Together with Editor Dr. B.G. Potter from the University of Arizona, she had the great pleasure to present this award to Prof Tomozawa at the Glass and Optical Materials Division annual meeting in Baltimore, Maryland.

Congratulations, Prof. Tomozawa!

Miranda Ross received the *Doreen Ball-DiFazio Award* in 2022. This award is given to given to a female senior with outstanding academic achievements and service to the community.

Luke Barba, An annual award based on funds contributed by Meeli Leith, Rahmi Ozisik, and Moritz family; T*he Istvan S Moritz Award* is made to a senior or co-terminal student in materials science and engineering who has demonstrated a keen interest in materials field and shows further growth in their future career.

Emilee Fortier won the annual *The Scott Mackay Award,* an award based on the income from funds contributed by former students of Prof. Mackay, the award is made to a senior in materials engineering who has given time and effort to the service of others without seeking recognition or acclaim, and who has completed the academic program at Rensselaer creditably.

Alex Hauck won the 2022 annual *Matthew Albert Hunter Prize* in Metallurgical Engineering based on the income from funds contributed by former students of Dr. Hunter, the prize is awarded annually to the senior in materials engineering who has demonstrated outstanding ability in academic work leading to a career in that field.

Kevin Zheng is the 2022 recipient of *The MS&E Graduate Studies Award.* This award is given to a graduating senior, who has exhibited outstanding academic performance and leadership abilities, and goes on to pursue graduate studies.

2022 Norman S. Stoloff Research Excellence Award

The Norman S. Stoloff Research Excellence Award is to recognize MSE graduate students for their outstanding research accomplishments, as evidenced by a submitted or published journal article in the past 12 months.

Sushant Kumar (center) and **Bronson Hausmann** (second from right) are the winners of the 2022 Norman S. Stoloff Research Excellence Award.

The award which is given annually to two senior graduate students, recognizes the students for their outstanding research accomplishments, as evidenced by a submitted or published journal article in the past 12 months. Each received a cash prize and an award certificate following their presentation as part of the department seminar series.

This year our award winning presentations are:

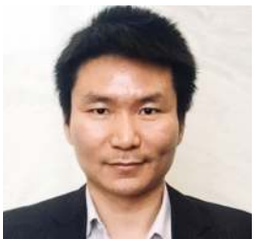
Bronson Hausmann- Photoelastic confirmation of surface stress relaxation in silica glasses: Fiber bending and rod torsion ushant Kumar - Ultralow Electron-Surface Scattering in Nanoscale Metals Leveraging Fermi Surface Anisotropy

Congratulations!

Controlling Electron Spin at Room Temperature To Make Devices More Efficient and Faster

New publication in *Nature Photonics* by Profs. Jian Shi, Shankar and Coworkers

By Katie Malatino



Jian Shi

Ravishankar Sundararaman

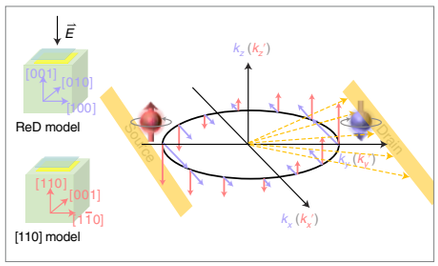
As our devices become smaller, faster, more energy efficient, and capable of holding larger amounts of data, spintronics may continue that trajectory. Whereas electronics is based on the flow of electrons,spintronics is based on the spin of electrons.

An electron has a spin degree of freedom, meaning that it not only holds a charge but also acts like a little magnet. In spintronics, a key task is to use an electric field to control electron spin and rotate the northpole of the magnet in any given direction.

The spintronic field effect transistor harnesses the so-called Rashba or Dresselhaus spin-orbit coupling effect, which suggests that one can control electron spin by electric field. Although the method holds promise for efficient and high-speed computing, certain challenges must be overcome before the technology reaches its true, miniature but powerful, and eco-friendly, potential.

For decades, scientists have been attempting to use electric fields to control spin at room temperature but achieving effective control has been elusive. In research recently published in *Nature Photonics*, a research team led by Jian Shi and Ravishankar Sundararaman of Rensselaer Polytechnic Institute and Yuan Ping of the University of California at Santa Cruz took a step forward in solving the dilemma.

"You want the Rashba or Dresselhaus magnetic field to be large to make the electron spin precess quickly,"said Dr. Shi, associate professor of materials science and engineering. "If it's weak, the electron spin precesses slowly and it would take too much time to turn the spin transistor on or off. However, often a larger internal magnetic field, if not arranged well, leads to poor control of electron spin.



Nature Photonics | VOL 16 | July 2022 | 529–537

"The team demonstrated that a ferroelectric van der Waals layered perovskite crystal carrying unique crystal symmetry and strong spin-orbit coupling was a promising model material to understand the Rashba-Dresselhaus spin physics at room temperature. Its nonvolatile and reconfigurable spin-related room temperature optoelectronic properties may inspire the development of important design principles in enabling a room-temperature spin field effect transistor.

Simulations revealed that this material was particularly exciting, according to Dr. Sundararaman,associate professor of materials science and engineering. "The internal magnetic field is simultaneously large and perfectly distributed in a single direction, which allows the spins to rotate predictably and in perfect concert," he said. "This is a key requirement to use spins for reliably transmitting information."

"It's a step forward toward the practical realization of a spintronic transistor," Dr. Shi said.

The first authors of this article include graduate student Lifu Zhang and postdoctoral associate Jie Jiang from Dr. Shi's group, as well as graduate student Christian Multunas from Dr. Sundararaman's group.

This work was supported by the United States Army Research Office (Physical Properties of Materials program by Dr. Pani Varanasi), the Air Force Office of Scientific Research, and the National Science Foundation.

Antiviral Coatings for N95s in the Fight Against COVID

New Publication by Profs. Zha and Palermo in ACS Applied Materials & Interfaces

Edmund Palermo

Helen Zha

Rensselaer Polytechnic Institute researchers have developed an accessible way to make N95 face masks not only effective barriers to germs, but on-contact germ killers. The antiviral, antibacterial masks can potentially be worn longer, causing less plastic waste as the masks do not need to be replaced as frequently.

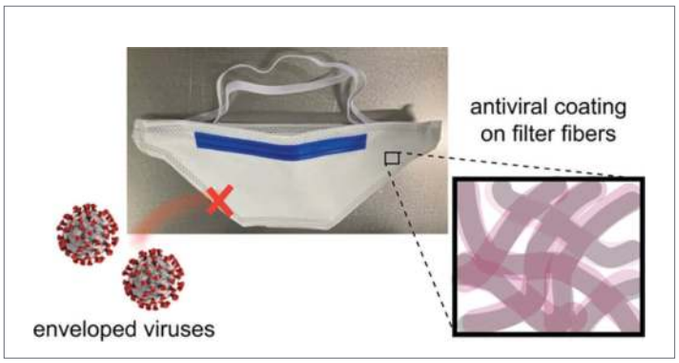
Helen Zha, assistant professor of chemical and biological engineering and a member of the Center for Biotechnology and Interdisciplinary Studies at Rensselaer (CBIS), collaborated with Edmund Palermo, associate professor of materials science and engineering and a member of the Center for Materials, Devices, and Integrated systems (cMDIS) at Rensselaer, to fight infectious respiratory disease and environmental pollution with the perfect recipe to improve face masks.

In research recently published in Applied ACS Materials and Interfaces, the team successfully grafted broad-spectrum antimicrobial polymers onto the polypropylene filters used in N95 face masks.

Zha and Palermo, along with other researchers from Rensselaer, Michigan Technological Institute, and Massachusetts Institute of Technology, covalently attached antimicrobial quaternary ammonium polymers to the fiber surfaces of nonwoven polypropylene fabrics using ultraviolet (UV)-initiated grafting. The fabrics were donated by Hills Inc. courtesy of Rensselaer alumnus Tim Robson.

"The process that we developed uses a really simple chemistry to create this non-leaching polymer coating that can kill viruses and bacteria by essentially breaking open their outer layer," said Zha. "It's very straightforward and a potentially scalable method."

The team used only UV light and acetone in their process, which are widely available, to make it easy to implement. On top of that,



the process can be applied to already manufactured polypropylene filters, rather than necessitating the development of new ones.

The team did see a decrease in filtration efficiency when the process was applied directly to the filtration layer of N95 masks, but the solution is straightforward. The user could wear an unaltered N95 mask along with another polypropylene layer with the antimicrobial polymer on top. In the future, manufacturers could make a mask with the antimicrobial polymer incorporated into the top layer.

Thanks to a National Science Foundation Rapid Response Research (RAPID) grant, Zha and Palermo started their research in 2020 when N95 face masks were in short supply.

Healthcare workers were even reusing masks that were intended to be single use. Fast forward to 2022 and face masks of all types are now widely available. However, COVID rates are still high, the threat of another pandemic in the future is a distinct possibility, and single use, disposable masks are piling up in landfills.

"Hopefully, we are on the other side of the COVID pandemic," said Zha. "But this kind of technology will be increasingly important. The threat of diseases caused by airborne microbes is not going away. It's about time that we improved the performance and sustainability of the materials that we use to protect ourselves."

Anna Capuano

UNDERGRAD SPOTLIGHT

Why did you choose RPI for your studies?

The thought that I would be immersed in a whole school of driven, STEM focused peers, who would have similar aspirations and interests to my own intrigued me and quickly propelled RPI to the top of my list. My interest in materials engineering began after attending a condensed matter physics and material science summit early on in high school. While in attendance, I was able to learn, and even practice, different types of microscopy including SEMs and TEMs. This experience stuck with me throughout my college search and led me to investigate each school's materials program. Even without any extensive knowledge in the field, I was able to make connections and discover how exciting the research conducted in the materials program at RPI was.

What RPI organizations are you a part of? (Polytechnic contributions, clubs, etc)

I have been an officer in RPI Society of Women Engineers (SWE) since my freshman year. As a part of SWE, I hold the position of outreach director, where I plan events to introduce local K-12 students to both engineering and the sciences. I am also a student athlete, competing on both the RPI cross country and track teams.

What aspect of Materials Science are you passionate about?

I'm most passionate about electronic materials because I enjoy exploring the connections between microscale differences in a material's atomic structure and the bulk optical and electrical properties. Over the summer of 2022 I have been involved in an electronic materials Research Experience for Undergraduates (REU). During this REU I have been able to apply my knowledge of electronic properties right alongside the knowledge I gained from my computer science minor to create analysis software for electronic materials. The connection between computer science and electronic materials has enhanced my interest in the field.

What research interests you?

My current research interests include optoelectronics and nanofabrication. I've found research in both of these fields very exciting due to the growing

applications they have in our daily lives. In recent classes I learned how the electronic structure of materials affects interatomic bonding along with the produced optical and quantum effects. I applied this information to investigate the relationship between photon illuminations and short circuit currents in materials lacking inversion symmetry while a part of Dr. Shi's optoelectronic research group at RPI. My goal is to conduct further research in the field of electronic materials, gaining more experience in the fields of nanofabrication and photonics.

What career are you interested in?

After graduation I hope to attend Graduate School to get a PhD in the materials field. My eventual goal is to obtain a research position at a national laboratory or university conducting electronic materials research.

What are your spare time hobbies?

When I'm not running or doing homework, I enjoy hiking the Adirondacks, skiing in the winter, or making the trip downtown for ice cream at Dutch Udder.

How do you want to change the world?

I would love to be a part of changing the world in two fundamental ways, I would like to see the ability to create and manipulate materials be used to create a more sustainable world and I would like to be an active female role model in engineering.

What was your favorite memory of your time at RPI?

One of my favorite memories at RPI involved smashing wine bottles to dust with a sledgehammer at 11 PM for a class project with my best friend. Who knew attempting to make concrete with glass sand could be so loud and fun? Just happy we didn't end up as a late-night RPI alert.

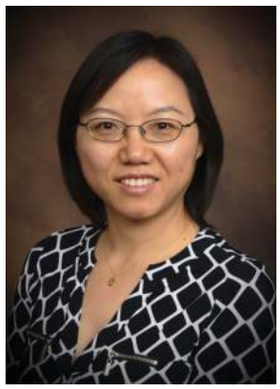
FACULTY NEWS

Dr. Liping Huang, Professor of Materials Science and Engineering and Associate Dean for Research and Graduate Programs in the School Engineering, was honored by Alfred University and the New York State College of Ceramics to be the 2022 Samuel R. Scholes lecturer for her tremendous contributions in understanding of glass under extreme conditions.

Dr. Huang delivered her lecture titled "Glass under Pressure" at Alfred on April 28th, together with the 2020 Scholes lecturer Dr. Alastair Cormack during the Super Scholes Lecture Day in celebration of the United Nations International Year of Glass in 2022.

Dr. Samuel R. Scholes established the first glass science program in the United States at Alfred University in 1932. RPI's excellence in glass science was recognized by the Scholes lecture series multiple times in the past: Prof. Minoru Tomozwa in 2015, Prof. Cornelius T. Moynihan in 2007, Prof. Robert H. Doremus in 1996, Prof. John B. Mackenzie in 1995 (he left for UCLA in 1969). The 2021 Scholes lecturer Dr. William LaCourse obtained his PhD in glass science in 1969 under the supervision of Prof. Mackenzie at Rensselaer.

Dr. Samuel Ray Scholes served Alfred University and the Alfred community for over 40 years as dean (1946-1948), associate dean (1948 - 1952), head of the Department of Glass Technology, and professor of glass science (1932 - 1946). He established the first glass science program in the United States at the College of Ceramics in 1932. As a scientist devoted to the English language, Dr. Scholes developed the program for teaching technical writing at Alfred University. Dr. Scholes was educated at Ripon College (BA, 1905) and Yale University (PhD, 1911). He was a poet, scholar, and a scientific educator of the highest caliber who believed in glass as the "eye of science, the carrier of light."



Liping Huang

Materials Profs **Edmund Palermo** and **Chaitanya Ullal** are on the Teaching and Learning Collaboratory Board.

The group of people comprising the TLC is the Rensselaer teaching community, led by a board of faculty advisors. The goals of the TLC board are:

- To cultivate an Institute-wide culture of pedagogical excellence in the classroom and to encourage innovations in teaching.
- To host workshops where teaching best practices are disseminated, new technologies are introduced, and broader discussions around pedagogy take place.
- To encourage and create teams of faculty to compete for external funding for research into pedagogical innovations.
- To identify and support promising pedagogical innovation seed projects.

The TLC board is comprised of Rensselaer faculty members committed to pedagogical innovation. To support active and blended learning they provide faculty with resources that define various concepts and tools to use in their classroom to promote student participation and engagement with the course content, instructor, and students.

Chaitanya Ullal

Edmund Palermo

DEPARTMENT HISTORY

Mary Ellen Rathbun Kolb

Mary Ellen Rathbun Kolb was one of our first female graduates, after 116 years of RPI being an all-male college. She graduated from RPI in 1946 with a Materials/ Metallurgical Engineering degree. At this time, the Department of Metallurgical Engineering was a relatively new department at RPI, the first B.Met.E degree having been granted in 1937.

Mary was born on March 4, 1923 in Palmer, Massachusetts and raised in Hoosick Falls, NY. She grew up loving science, math and music, and attended Bradford Junior College until she saw an announcement in a Troy newspaper that girls were going to be admitted to RPI, and promptly applied to go for a metallurgical engineering degree because "it was something you could dig into" after attending less than challenging schools. She commented "I was really glad that the courses sounded like they delved into things. You know. I was sick of stuff on the surface… you could dig into something. They go back into how it started and how it developed and so forth--things you like to know about something."

Attending college in war times created an unusual mood. Mary commented, "you have to remember there was still a war going on. It wasn't your normal student relationship with the surroundings that you have now. The guy next to you was liable to be in the army tomorrow and liable to be dead the next day. I mean it was a very different atmosphere."

Some parts of her RPI education were fun – like her Welding class, "Somebody that was holding the bit of metal with a large pair of tongs--you were out here and the fellow was over there and you had a sledgehammer--you were pounding that thing and he was holding it, I mean that's a good memory!"

She was involved in some early Microscopy – "some of the work … as a metallurgical engineer, was finding what materials could be used to build the microscope that would be most effective at containing the radiation and also not interfering with the results you looking for."

Mary Ellen Rathbun Kolb died at 96 on June 15, 2019. She was the only child to Oliver and Daisy Rathbun. Mary attended Bradford Junior College before attending Rensselaer Polytechnic Institute (RPI) in 1942 as one of the school's first two matriculating female students. After graduating with a degree in metallurgical engineering, Mary worked for a short period for the Engineering Division at Chrysler Corporation, where she was the lead author on a bibliography of electronic microscopy in industrial labs in the United States at the time. Mary married fellow RPI graduate Edward (Ed) Paul Kolb, and they raised five children – Mary Jane, Paul, Jean, John and Nancy – in Nyack, NY.

As one might expect of a trailblazing woman, Mary was tenacious, whip-smart, and very witty; even in her waning years she would roll her eyes to express her amused annoyance with family, doctors and anyone else who said or did something with which she generally disagreed. In addition to her keen wit, she passed a love of science, music, and reading to her children and was a model of grace and great inspiration for her extended family. She will be remembered for many things including her fierce competitiveness when playing cards (she was an avid bridge player and teacher for over fifty years), love of coffee ice cream, and famous corn soufflé recipe.

(Article is based on transcripts of an interviews in 2013 & 14 for the RPI Folsom Library archives, and her obituary)

OUTREACH EVENT

A set of nine Introduction to Materials Science and Engineering hands on learning activities, demos and lectures were developed for and run as part of the RPI School of Engineering's 12-day long virtual Introduction to Engineering PREFACE program.

The theme of this year's program was Materials Science and Engineering. As part of the outreach program, 40 junior and senior high school students from across 15 states received a pre-college introduction to the different types of engineering, allowing students to understand what engineers do and what it takes to become an engineer. The 40 selected students were primarily from groups that have been historically and traditionally underrepresented or underserved in science, engineering, and other technological fields.

The nine activities, some of them multi-session, were designed over the course of the Spring semester of 2022 by several MSE Department members including Sydney Neuman, Alexander Hauck, Miranda Ross and Liam Huston, all MSE Seniors at the time, and Prof. Chaitanya Ullal, Prof. Daniel Lewis, Dr. John LaGraff, as well as Mr. William Yarberry, the BOCES QUESTAR III instructor. The activities were specifically chosen and designed to involve the use of materials and chemicals that were relatively inexpensive, safe to use at home and widely available to the general population. The activities built variously on existing activities from the informal science education literature, existing activities from prior NSF projects, and demos and experiments currently used in ENGR 1600. The activities that were run were: (i) An Introduction to Materials Science and Engineering Lecture by Prof. Dan Lewis and Prof. Ed Palermo (ii) Introduction to Microscopy using Echo Brite Wooden microscopes and Carson Pocket Microscopes and in situ observation of Copper dendrite growth (iii) Mechanical properties of ice based composites including pykrete (iv) Virtual session of SEM (v) Mechanical properties of Auxetic paper lattices (vi) Electronic properties using pencil drawn circuits and thermistor measurements using an Arduino (vii) Materials Processing and diffusion using Python based Random Walk simulators and measurements of dye diffusion through agar gels (viii) Kinetics and Mechanical properties of edible alginate gels (ix) Materials Design considerations in a heat rejection system for space shuttles and satellites. Materials and supplies for these activities were mailed to the participants in time for the workshop, which was held virtually.

Figure 1. In all, nine Materials Science and Engineering activities, demo and lectures, were run as part of RPI's 12 day long PREFACE precollege Introduction to Engineering Workshop. The 40 student participants were primarily from groups historically under-represented in Engineering and Science. Left: student submission for ice composites activity Center: PhD student, Shaheen Hasan, conducting the virtual SEM activity Right: student submission of copper dendrite growth imaging activity.

Material Advantage

RPI's chapter of Material Advantage focuses on establishing a community of materials engineers (or anyone interested in materials) by hosting events that create a sense of togetherness.

Last year, general body meetings (GBMs) were open to anybody with themes relating to nearby holidays, like the famous green waffles event for St. Patrick's Day. There were also fun activities like paint nights.

In addition to GBMs, MA holds monthly professional events with professors in the form of "MatChats," where students have the opportunity to learn about professors' paths to RPI and what they are doing now. The recurring event with the highest attendance is the ENGR 1600 exam reviews. MA members go through a slide deck and example problems in a review session open to everyone, and attendees have said they are extremely helpful.

Two new types of events were introduced last year, the first being an advocacy event. The board created a new position called Advocacy Director, and they plan events to promote diversity awareness in materials engineering. The first event featured Professor Liping Huang, who spoke on her experience as a woman in STEM and answered questions. This event had our highest attendance outside the exam reviews, and there were attendees in a variety of majors. These events will be continued, and the position will be expanded upon to collaborate with diversity organizations.

RPI MA also started collaborating with other MA chapters. Purdue University and the University of Washington helped organize an MSE meme competition. Each school collected submissions, and then there was a trivia event where the winners of the meme contest were announced. RPI also led a joint MatChat with Purdue featuring a professor from each school. This connected the smaller RPI chapter to larger chapters, which is great for networking.

Looking back, there was a decrease in engagement due to the COVID-19 pandemic and the related RPI policies. The large class of incoming freshmen allows us the opportunity to have more members and increase our reach on campus.

This semester, MA will continue previous programs, expand upon then, and rebuild the club membership to pre-COVID-19 levels. Our first event of the semester is a Paint and Pizza! More details to come!

Sydney Neuman, Materials Advantage President

IN MEMORIUM

John D. Mackenzie, 94, leader in glass and ceramics processing

By Matthew Chin

John D. Mackenzie, professor emeritus of materials science and engineering at the UCLA Samueli School of Engineering who made pioneering contributions to glass and ceramics processing, died Feb. 19, after a brief illness. He was 94.

Known to friends and colleagues as "Doug," he joined the UCLA faculty in 1969 as a full professor, and was the inaugural holder of the Nippon Sheet Glass Company Chair in Materials Science. He earned his bachelor's degree from Birkbeck College, in London, in 1952, and his doctorate from Imperial College London in 1954. He held postdoctoral and lecturer positions at Princeton University for two years, followed by another postdoctoral appointment at Cambridge University. He was a research scientist at General Electric Research Laboratory in Schenectady, New York, from 1957 to 1963.

Mackenzie then turned to academia, joining Rensselaer Polytechnic Institute, in Troy, New York, as a professor, staying until 1969, when he joined UCLA as a professor of engineering.

Mackenzie retired from full-time teaching in 1994, but continued to conduct research and served for several years as an associate dean for research and planning.

Bruce Dunn, chair of the materials science and engineering department and a former Ph.D. student of Mackenzie's, can name a dozen or so research areas where Mackenzie made seminal contributions. "From fundamental studies of glass structure, to creating semiconducting glasses and designing sol-gel glass chemistry, Doug was constantly at the forefront of glass science," Dunn said.

Mackenzie received major international honors for his research, including election to the National Academy of Engineering in 1976 for "contributions to glass technology through application of principles of chemistry and physics" and the Centenary Award in 1991 from the Japanese Ceramics Society. Mackenzie was a fellow of the British Royal Society of Chemistry and the American Ceramic Society.

In addition to authoring more than 300 publications, Mackenzie was co-editor of 10 books and was awarded 15 U.S. patents. He founded the Journal of Non-Crystalline Solids in 1969 and was its editor-in-chief for 20 years. He was the recipient of the 2019 L. David Pye Lifetime Achievement Award from the American Ceramic Society for his contributions to the field.

CURRICULUM CORNER: MATERIAL SKILLS

By Dan Lewis

A new degree requirement in Materials Engineering teaches introductory materials processing and characterization skills (MTLE-2500). Prior to the introduction of this course, metallographic preparation and microscopy were not uniformly taught to all undergraduates. In this course the students cast aluminum, heat-treat steels, perform metallographic preparation, perform optical microscopy, hardness measurements, Charpy testing and tensile testing. Students get practice at writing lab reports and analysis of data using basic statistics.

The students in MTLE-2500 heat treat and prepare their own specimens for microscopy. A specimen of 1045 steel that has been oil quenched (L) and a 1080 steel that has been furnace cooled (R) are shown. Other specimens prepared by students include: aluminum castings, pewter castings, a Roman coin, and bronze castings. Although the focus of the course in on metals, the skills that they learn in synthesis and characterization are applicable to many other materials. Once students complete this course they are better prepared to complete lab activities in other core Materials Engineering courses and possess skills in the art of metallography that are much sought after in industrial settings. The department has already received feedback from students stating that the characterization skills provided by this course have been useful in securing internships and co-op assignments.

RETIREMENT NEWS

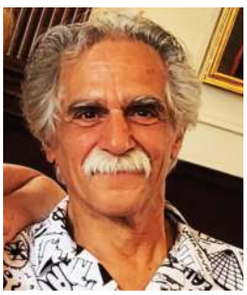
Professor Richard Siegel acquired the rank of Professor Emeritus upon his formal retirement from the RPI Materials Science and Engineering Department on December 31, 2021.

Professor Siegel has a long (sixty years!) and distinguished career in the field of material science and engineering, including the last 26 years at Rensselaer. Over decades of active research, he distinguished himself in many areas, starting with fundamental studies of defects in metals in the 1960s, continuing in the 70's and 80's with studies of microstructure property relationships while in academia (Stony Brook) and government (Argonne National Laboratory), and finally shaping and developing the field of nanoscience and nanoengineering. Most prominently, he chaired the World Technology Evaluation Center worldwide study of nanostructure science and technology (1996-98) for the US government that led in 2001 to the US National Nanotechnology Initiative, and presented his famous nanoscience talk over 500 times worldwide. He introduced in a major way nano science, engineering and technology to Rensselaer via his leadership as the founding Director of the Rensselaer Nanotechnology Center and the US National Science Foundation funded Nanoscale Science and Engineering Center for Directed Assembly of Nanostructures.

His major educational/ outreach impact is associated with his leadership of the "Molecularium" project that brought audiences worldwide to the amazing nanoscale world of atoms and molecules.

He has been the Robert W. Hunt Professor of Materials Science and Engineering at Rensselaer Polytechnic Institute since June 1995, and was Department Head from 1995 to 2000.

From his speech at his retirement party: "Successful careers are built on collaboration. Work with other fields when you can, and learn from each other! One of the pleasures of teaching is interacting with my students - I have learned more from you than you from me. Teaching and learning enriches us all."



Ray Dove retired on June 30, 2022, after 34 years as Laboratory Manager for Materials Science & Engineering at RPI!

Ray supervised the electron microscopy laboratory, trained students in microscopy, and maintained the lab, along with acting as Safety Manager. He leaves many many friends and grateful students, and we will miss his smile and his good humor!

Ray Dove was the facility manager for MSE's electron microscopy laboratory and the MRC building coordinator. He has been a member of the materials science community at RPI since 1987, following industry positions at Georgia Pacific, Valtec Inc., and Norton Co. Ray got his undergraduate degree in Forest Biology at the SUNY College of Environmental Science and Forestry (Syracuse, NY) in 1977.

Ray maintained the electron microscopy labs and trained new graduate students on the SEMs and TEMs. In the early 1990s he worked with Prof. Linda Schadler to develop a centralized Raman lab for polymer research, and in 2015 worked with Prof. Robert Hull on the purchase and installation of our newest SEM, the FEI VERSA 3D which has three vacuum levels including Environmental Mode and is a Dual Beam FEG/FIB.

Ray Dove - "Science is great, discovery is great, but, getting to work with students on a daily basis, helping them educate themselves towards their respective goals, helping them and being a part of their growth as human beings is the best reward I can think of."

William LaCourse ('70)

William LaCourse ('70), retired professor of glass science, delivered the annual Scholes Lecture at Alfred University on September 8, 2022 in Nevins Theater, Powell Campus Center. The lecture, titled "If Chemically Strengthened Glass Is So Great…," was presented as part of Alfred University's Glass Sustainability Conference.

"Ultra-high strength chemically strengthened glass was developed more than 60 years ago, but until recently the primary use was in generating scientific publications, and MS/PhD theses," LaCourse writes in his lecture abstract. His presentation addressed challenges in the production of chemically strengthened glass, "The presentation … proposes a path forward for a broader range of glass fiber, glass container and flat glass compositions with improved manufacturing efficiency and product performance."

William C. LaCourse, known locally as "Doc", is currently Glass Research Professor and Director of the Paul Vickers Gardner Glass Center in the NY State College of Ceramics at Alfred University in Alfred, NY.

He received a B.S. in Engineering Science (1966) and a M.S. in Materials Engineering (1967) from SUNY Stony Brook, and his Ph.D. in Materials Science from Rensselaer Polytechnic Institute (1970) where he studied under Prof. J. Douglas Mackenzie, one of the first L.

David Pye Lifetime Achievement Award recipients in 2019.

Dr. LaCourse won the L. David Pye Lifetime Achievement Award from the American Ceramic Society in May 2022.

Sarah Straub

It has now been 6 years since I graduated from RPI and started my current adventure in Houston, TX. I have been working at one of the largest petrochemical facilities in the world, first in Materials Engineering, then Reliability, and now I'm a supervisor working with a talented team of electrical engineers. My work at ExxonMobil has been fun but challenging as we work to meet the world's energy needs while innovating to reduce emissions. I even had the opportunity to support implementation for an advanced recycling project, which is targeting 500,000 metric tons of annual capacity. Along the way, I have been lucky to marry my high school sweetheart, Nick, complete 3 half marathons, hike many mountains, and adopt a rescue cat, Zelda. Since my first days running around the MRC, I have been drawn to community and service. I was fortunate to be matched with my mentor, Karly, who welcomed me into Material Advantage. My engagement in this organization led me to plenty of STEM outreach with the "Material Buddies" program, several MS&T trips, and connecting with some people I now consider my best friends. My passion for volunteering has continued, most recently I led a United Way campaign that raised $1.25M and I serve on the Board of Governors for the Order of the Engineer - I hope many RPI Materials Engineers are taking the oath to work ethically as they progress in their careers! Even now,

with new opportunities and the life I have built in Houston, some of my best memories will always be with the RPI MSE Department.

Tom Rebbecchi

Since graduating from Rensselaer in 2016 with my BS in Materials Engineering, I've gained some incredible life experiences! For the past six years, I have been working at Pratt & Whitney (a Raytheon Technologies company) in East Hartford, Connecticut. Through rotational assignments in various material disciplines, I gained a technical depth in nickel-based alloy processing (e.g. additive manufacturing, forging, casting). I currently serve as a Materials Technology Portfolio Manager, supporting our Commercial Engines division. I recently completed a part-time M.S. in Materials Engineering at Columbia University. My spirit for volunteerism is something that fuels me every day. While at RPI, I volunteered extensively with Engineers Without Borders (EWB-USA) through the university chapter and fell in love with the dual mission of the organization: equipping communities with access to basic human needs and developing engineers to be leaders. My life was changed as a Junior when our EWB-RPI team traveled to our partner community in Panama to construct the water system we designed for our community partners. I learned firsthand the impact that engineers could have on the lives of those who lack access to basic resources like clean water and reliable electricity. I have continued my involvement with EWB-USA and increased my impact by taking on various leadership roles. With the Hartford Chapter of EWB-USA (2016-2020), I worked on water infrastructure projects in Nepal, Ecuador, and Tanzania. In 2020, I founded a Corporate Chapter of EWB-USA at Raytheon. Additionally, I've had the opportunity to serve on the Board of Directors for the nonprofit organization since 2020, which has allowed me to steer the organization through the challenging years of the pandemic. My experience with EWB has absolutely changed my life, and I highly recommend engineers to volunteer with the organization.

(Photo caption: Tom (3rd from left) in Nepal with Hartford Chapter of Engineers Without Borders (2018) celebrating the completion of a major water pumping system in the rural community.)

Rachel Ferebee Maher

After my graduation in 2011 at RPI, I went on to pursue both Masters and Ph.D at Carnegie Mellon University's MSE Department, studying polymer physics and primarily doing characterization work using electron microscopy and light scattering. At the end of my PhD, I married my husband, Chris, who is also a 2011 RPI graduate. In 2016, I joined L'Oréal, a French cosmetics company in New Jersey, as a Senior Scientist doing upstream research on new technologies for hair products. I moved to an applied research group to work on formulations utilizing some of those technologies for hair products and learned about the product launch process. I really enjoyed interacting with consumers during testing and seeing projects eventually

end up on the shelf in the store. About two months before the pandemic began, we welcomed our daughter, Charlotte (now 2.5 years old). We were fortunate to all stay healthy and to get extra time together while the daycares were shut down and many people began working remotely. In 2021, we moved back to Pittsburgh, where we have family, and I began working as a Senior Research Chemist at PPG researching architectural paint formulations. Having just purchased a house, the insights I have gained working in this division and the company store discount have both come in handy. From my first research experience in Professor Lewis' lab at RPI to my current role at PPG, I have enjoyed learning about a wide range of topics, working with great people, and trying to contribute (in my own small way) to society.

Wahaz Nasim

After graduating from RPI in 2015, I moved to College Station, TX where I completed my PhD in material science at Texas A&M University and graduated in 2021. About 1.5 years ago I started my Post Doctorate Research Associate position with the Solid Phase Processing group at Pacific Northwest National Laboratory (PNNL) in Richland, WA. My research and passion are in the field of thermomechanical processing, mechanical testing and crystal plasticity modelling on Magnesium and Aluminum alloys. Working on a variety of projects allowed me to take risks by putting myself in the shoes of a modelling and computational materials scientist as I was originally a pure-hearted experimentalist. I quickly changed this notion as I was combining modelling and experiments to develop more formable Magnesium alloys and started using optimization to predict plasticity properties in our materials before a single billet was physically touched. I have also developed a new hobby of altering my car with plastic dipping and decal work to practice my creative side. Overall, it has been an eventful 7 years away from RPI. If you are interested in thermomechanical processing of light metal alloys, crystal plasticity modelling and optimization, please feel free to look at my google scholar page linked here and if you would like a nice summary of what we did at Texas A&M and Los Alamos please read the Wevolver article written about us here.

FEATURED STUDENT ATHLETE

RPI Football Player and Materials Major Spencer Brockdorf

Position: Defensive Back

Class: Senior

Hometown: Clarksville, MD

Personal: **Materials Engineering major** ... Research in atomic/molecular layer deposition ... Materials Advantage ... Volunteer in community (yardwork) ... Son of Ronna Kirchoff and Brant Brockdorff.

2021: Starting strong safety ... Twelve solo tackles and 12 assisted stops ... Two tackles for lost yards (6) ... Three pass breakups, one interception and one fumble recovery ... Season-high seven tackles (5 solo) with two for lost yards (6) vs. Montclair State ... Four tackles (2 solo) and interception vs. Stevenson ... Liberty League Weekly Honor Roll once ...

2020: Did not compete due to COVID-19 restrictions ...

2019: Played three games ... Three solo tackles and three assisted stops ...

High School: Three-year varsity starter (WR, LB) ... Two-year captain ... All-County wide receiver in 2018 ... Honorable Mention in 2017 ... BTC All-Star Game as senior ... Team's Offensive MVP in 2018 ... Team won 2017 County Championship ... Spanish 2 Student of the Year ...

On attending Rensselaer: "Amazing academics and great facilities." - September 2020

"There weren't any other schools where I could get one of the best Materials Engineering educations in the world while still being able to play football. I was also aided by the support of coaches and players in balancing the stressful workload of both." - July 2021

Benefits of undergraduate community: "You learn amazing work ethic and will be set for whatever your future holds." - September 2020

"It is a great environment with young, bright minds that are hardworking both on the field and in the classroom." - July 2021

A Moment from 2018

Material Advantage members celebrate Plaid Day!

A photo taken of Materials students in 2018!

Left row from front to back:
Tianji Zhou
Emily Aaldenberg
Genevieve Kane

Aditya Prasad

Right row from front to back:
Michael Deagen
Ainsley Pinkowitz
Mary McGahay
Dustin Andersen
Sid Sundararaman

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Materials Science and Engineering
Rensselaer Polytechnic Institute
110 8th Street
Troy, NY USA 12180

mse.rpi.edu

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Rensselaer Polytechnic Institute, MRC 103, 110 8th St., Troy, NY 12180-3590
FAX: 518-276-8554, E-mail: lecuyt@rpi.edu