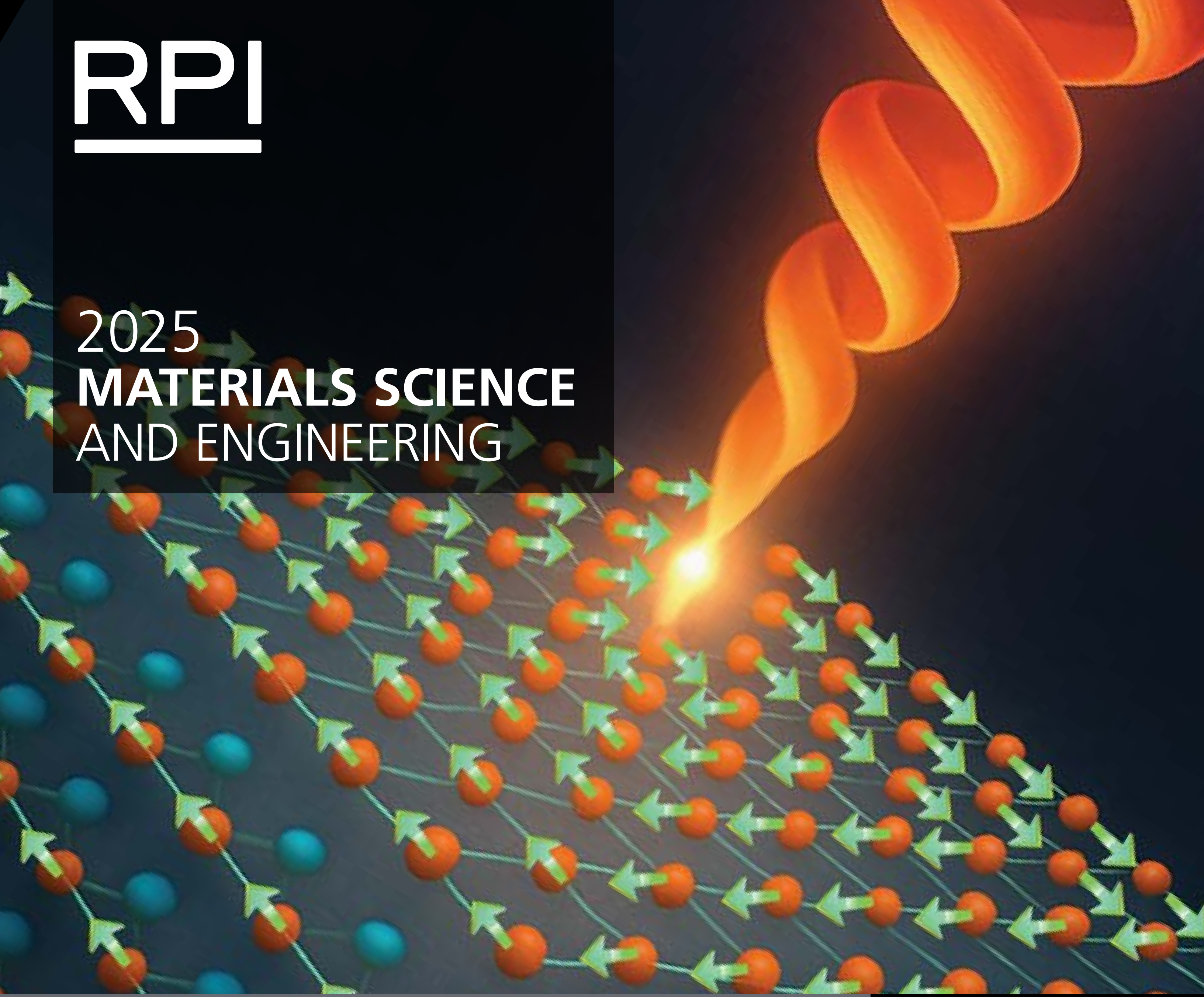


2025 MATERIALS SCIENCE AND ENGINEERING

Welcome

Pawel Keblinski

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

Greetings to our MSE alumni and friends,

Every year in early Fall I have the privilege and immense pleasure to share the highlights of RPI materials community achievements, activities, and stories from our last academic year. As is our tradition, we use this annual sharing to reflect the community spirit of materials endeavor at RPI. Thus, you will read a lot of stories involving our undergraduate and graduate students, staff, faculty, and alumni.

Let me first reflect on the passing of our distinguished alumnus Hugo S. Ferguson. He first earned a B.S. in Physics in 1956 and a PhD in Metallurgy in 1962. Early in his career he worked with RPI Profs. Warren F. Savage ('54) and

05 Student Awards & Honors

09 Graduate Student Spotlight

10 Molecularium

19 Research Milestones

22 Alumni Spotlight

Ernest F. Nippes ('38), and founded a company Dynamics Systems Inc. that invented the Gleeble system: a pioneer of the physical simulations concept. The current version of the Gleeble system is capable of exerting as much as 20 tons of static force, heating specimens at a rate exceeding 10,000ºC/sec and achieving stroke rates up to 2,000mm/sec. Dr. Ferguson was a great friend of the department and established an endowment serving our students.

Occasions like the passing of alums, faculty and people connected with Metallurgy and the later Materials Science department bring a realization that our community exists not only in space, but also in time and our presence here and now is strongly influenced by those that were here before us. I will reflect on this when visiting a cemetery on Nov. 1st (All Saints Day where Christians, in general, but Polish, in particular visits the graves of their ancestors) and standing at the grave of our department founder, Prof. Matthew Hunter, the creator of the Hunter process was the first industrial process to produce pure metallic titanium. I am sure that Prof. Hunter taught and mentored Profs. Savage and Nippes, both RPI alumni and later RPI faculty.

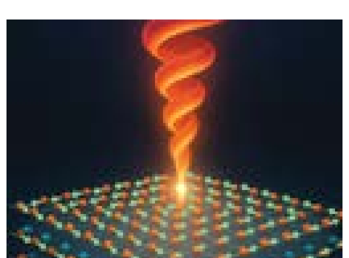
While those memories might appear to just refer to the past glory and the golden years of metallurgy, they directly connect to the renaissance of metallurgy in the context of additive manufacturing and recent advances in metallic alloys development. The metallurgy roots of our department enabled seminal contribution of materials faculty at RPI to metallization processes that are critical in modern microelectronics. For example, Prof. Shyam Murarka worked on copper to replace aluminum as a material for interconnects. An article on the CHIPS acts related activities at RPI describes recent developments including Prof. Daniel Gall's leading the search for copper replacements in the era of nanoscopic interconnects.

You will find in this issue many other interesting and compelling stories reporting our students and alums' achievements and perspectives on academic and workplace experiences. Prof. Edwin Fohtung continuously masters our abilities to image materials, including their electronic and magnetic structure and advances techniques to manipulate ferroelectrics with "twisted light". Prof. Jian Shi shared in recent Nature Reviews article his thoughts on photogalvanic effect in halide perovskites. Photogalvanic effect is phenomenon of a DC current generation in non-centrosymmetric materials under light illumination, which is distinctly different from that occurring at the p-n junction.

On the education and outreach side of our endeavors we celebrate 25 years of the Molecularium™ project and 20 years of the release of a planetarium dome theater show "Riding Snowflakes". The project fully blossomed under the auspices of the NSF Nanoscale Science and Engineering Center for Directed Assembly of Nanostructures led by recently retired Prof. Richard Siegel. The Riding Snowflakes show introduced cohorts of children to the magical world of atoms and molecules. Riding Snowflakes has garnered awards and accolades around the globe and continues to thrill young audiences worldwide in several languages, including Arabic, Korean and Turkish and Polish. The show was adapted to the IMAX format and later inspired creation of a game app allowing children to build molecules.

As usual we also report on activities and achievements of our students, including the always active Material Advantage RPI Chapter focusing on professional development of MSE undergraduates that includes their effort to popularize the materials field among K-12 students. We also report on a recent award recognizing seminal contribution to glass science and glass technology of Dr. Timothy Gross, a Corning Corporation Research Fellow. Tim made a major contribution to Gorilla Glass technology and Bendable Glass program where he served as the research lead. Tim is one of the prime alumni of the RPI Prof. Minoru Tomozawa's Glass Science Stable comprehensively represented at Corning. A recent graduate of Prof. Tomozawa pointed out that his supervisor is Dr. Peter Lezzi, another MSE alumni, and Peter's supervisor is none other than Dr. Timothy Gross!

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



On the Cover: This work was recently published in Advanced Materials, 2415231, (2025) Led by Professor Edwin Fohtung, using twisted light that carries orbital angular momentum to induce ferroelectric vortices and topological defects in quazi-2D materials. The first author of this work is MSE Graduate student, Nimish Narzirkar.

~ 2025 MSE Newsletter ~
Editor: Tess Lecuyer
Associate Editor: Kate Swed
Producer: RPI Materials Science & Engineering Department
Designer: Jill Evans

COMMENCEMENT AWARDS 2025

Doreen Ball-DiFazio Award

– given to a female senior in Materials Science & Engineering with outstanding academic achievements and service to the community.

Winner
May Kimura

Istvan S. Moritz Award

– given to a senior or co-terminal student in Materials Science & Engineering who has demonstrated a keen interest in materials field and shows further growth in their future career.

Winner
Adam Leicester

The Matthew Albert Hunter Prize in Metallurgical Engineering

– awarded annually to the senior in Materials Science & Engineering who has demonstrated outstanding ability in academic work leading to a career in that field.

Winner
Peter Crisileo

Scott Mackay Award

– given to a senior in Materials Science & 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 RPI creditably.

Winner
Matthew Sibila

Duquette Capstone Award

– given to a senior student in Materials Science & Engineering based on their Materials Selection and/or Capstone performance.

Winner
Ethan Booth

Teaching Assistant Excellence Award

– given annually to a graduate student in Materials Science & Engineering who has exemplified the world-class pedagogical quality at RPI through outstanding performance as a teaching assistant.

Winner
Collin Rowe

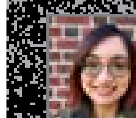
The Materials Science & Engineering Graduate Studies Award

– given to a graduating senior, who has exhibited outstanding academic performance and leadership abilities, and goes on to pursue graduate studies.

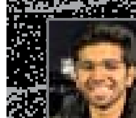
Winner
Sara Seelman

PhD

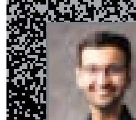

Dr. Julie Barringer


Dr. Shaheen Hasan


Dr. Yang Lou

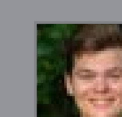

Dr. Varad Mahajani

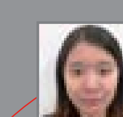

Dr. Collin Rowe


Dr. Anshuman Thakral

We are so proud of our newest Materials Science & Engineering Masters and PhD graduates!

Someday you'll look back and think, Wow, I graduated at the most amazing 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.


Connor Foreman (MS)


Mengyao Wen (MS)

masters

Pawel Keblinski, Professor and Department Head, Department of Materials Science and Engineering (MSE), greeting students at Annual Holiday Party.

Lunar New Year Party

The Materials Science & Engineering department throws a Diwali party every year for all of our students!

The students help decorate and contribute delicious Indian food to share. It is one of many celebrations which take place in our Student Lounge.

Best Poster Award: Collin Rowe, "Nanomolecularly-Induced Effects on the Synthesis and Properties of Inorganic/Organic Multilayer Nanolaminates," MRS Fall Meeting and Exhibit, Boston, MA, December 1-6

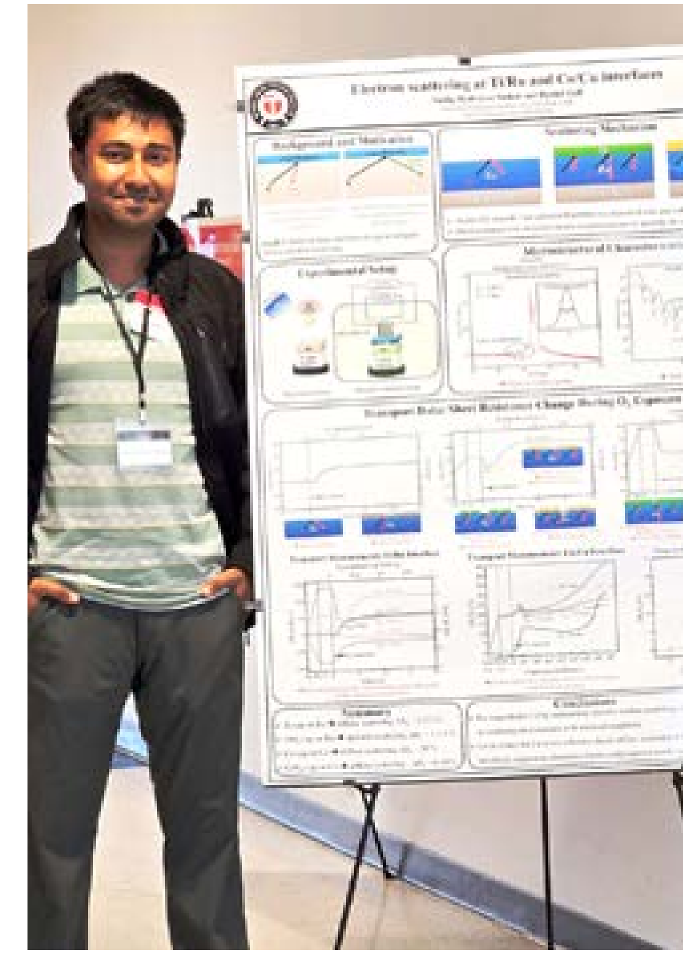
About Dr. Rowe

Dr. Collin Rowe received his PhD in Materials Science & Engineering in May 2025.

Happiest Memories at RPI: Passing my qualifying exam; generating a plasma for the first time in our newly built UHV system; group dinners organized by Dr. Sharma; realizing I actually finished and am well prepared for the next thing!

Thanking: First and foremost, my advisor Prof. Ramanath; the RPI cleanroom staff, especially Bryant Colwill, Kent Way, and John Barthel; MS&E, purchasing, and OGE administration, specifically Tess, Kate, Joanne, Christina, and Liz. Other RPI professors who interacted with me in various capacities (e.g., collaborated with, TAed for, helped my qualifier prep, etc.), such as Prof. Keblinski, Prof. Borca-Tasciuc, Prof. Ullal, Prof. LaGraff, Prof. Fohtung, Prof. Lewis, Prof. Gall, etc.)

Plans for after graduation: I'll be starting the position of 'R&D Materials Engineer' at MORSE Corp. in Cambridge MA.



Best Poster Award: Sadiq Shahriyar Nishat and Daniel Gall, "Electron scattering at Ti/Ru and Co/Cu interfaces," IEEE Albany Nanotech Symposium, Albany, NY, October 30, 2024.

The poster presentation was at the IEEE Albany Nanotech Symposium, Albany, NY, October 30, 2024. In the poster Nishat represented their work on quantifying electron surface scattering on Ti/Ru and Co/Cu interface during oxygen exposure. The results suggest that Ru outperforms Cu by maintaining specular surface scattering, even in oxidizing environments with minimal roughness.

STUDENT NEWS

Undergraduate Research Scholars Program Students Showcase Research Projects

RPI undergrads toured Corning's R&D Facilities in April 2025

On April 26, 2025, a group of RPI undergraduate students showcased research projects in the areas of materials science, computer modeling, chemical engineering, and more at a symposium held at Corning's Sullivan Park Science & Technology Center just outside of Corning, New York.

Through the Undergraduate Research Scholars Program in the Center for Materials, Devices, and Integrated Systems, these students worked with mentors at RPI and Corning over the course of two semesters to investigate research questions related to Corning's work in the glass and materials industry.

Before their presentations, the students and their faculty mentors toured Corning's R&D facilities and got to connect their research projects to Corning's work in the areas of fiberoptics, display glass, pollution reduction, pharmaceutical technologies, and more.

The students' research projects covered a range of topics:

- Peter Crisileo '24 was mentored by Minoru Tomozawa, Ph.D., professor in the RPI Department of Materials Science and Engineering, and Emily Aaldenberg '15, Ph.D.'19, a research scientist at Corning who earned her doctorate at RPI and was Tomozawa's student. Crisileo's project investigated why glass is more likely to crack when exposed to water or water vapor, a phenomenon that is still not well understood in the field of glass science.

- Natalie Gavin '25 was mentored by Liping Huang, Ph.D., professor in the Department of Materials Science and Engineering and associate vice president for research, and Jesse Kohl, Ph.D., senior research associate at Corning. Gavin worked on developing and testing protective coatings for ceramic parts used in high-power engines such as those in airplanes.

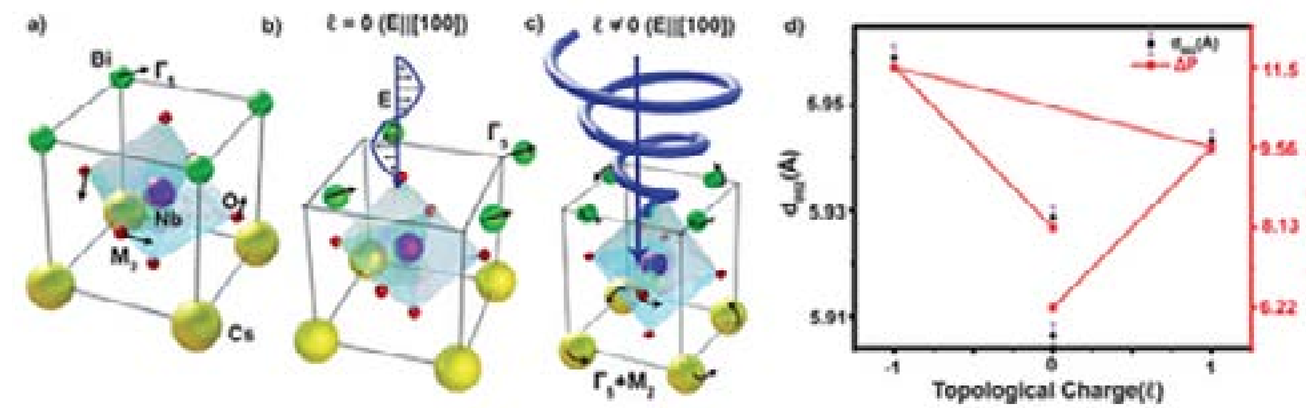
- Zach Knowlan '24 was mentored by two RPI faculty members, Jacob Merson '15, Ph.D. '21, assistant professor in the Department of Mechanical, Aerospace, and Nuclear Engineering (MANE), and professor and MANE Department Head Antoinette Maniatty, Ph.D.; and Francisco Moraga, '96G, Ph.D. '98, senior precision engineer at Corning. Knowlan used computer algorithms to model the complex physics involved in the glass forming process.

Fohtung Research Group publishes "Manipulating Ferroelectric Topological Polar Structures with Twisted Light" in the journal Advanced Materials

Nimish Nazirkar and his co-authors recently published "Manipulating Ferroelectric Topological Polar Structures with Twisted Light", exploring how twisted ultraviolet light —light carrying orbital angular momentum—can be used to dynamically control topological polar structures like vortices, merons, and Bloch points in quasi-2D ferroelectrics.

By combining Bragg Coherent Diffractive Imaging (BCDI), Raman spectroscopy, and DFT, we demonstrated reversible and irreversible domain transformations in $CsBiNb_2O_7$ nanoflakes — opening new possibilities for non-volatile memory, straintronics, and light-driven devices.

We worked alongside an amazing team of collaborators at RPI, Argonne National Lab, and beyond. Special thanks to my co-authors: Viet Tran, Pascal Bassène, Atoumane Ndiaye, Julie Barringer, Jie Jiang, Wonsuk Cha, Ross Harder, Jian Shi, Moussa N'Gom, and Edwin Fohtung.



Schematic of the manipulation of FE using vortex field from twisted light and its experimental detection. a) The CsBiNb2O7(CBNO) crystal unit responsible for FE, shown in the absence of twisted light. When driven by a plane-polarized 375 nm UV field in a Laguerre-Gaussian (LGℓ) mode carrying orbital angular momentum (OAM) quantized at ℓħ per photon, the twisted light interacts with mid-gap states and defect-mediated pathways through non-resonant mechanisms, inducing localized strain gradients and multiphoton absorption effects. This interaction dynamically modulates ionic displacements and ferroelectric (FE) polarization textures. b,c) Twisted UV light topological charges ℓ = 0 and ℓ ≠ 0 create quasi-static strain fields that couple to vibrational modes, driving polarization changes. b) Zone-center FE modes and c) zone-boundary octahedral tilting modes respond to the localized strain and OAM-induced torques, dynamically modulating the symmetry and polarization textures. d) Experimentally observed changes in polarization and atomic displacements along the [002] direction in CBNO arising due to the strain and phonon modes depicted in (b and c). These observations confirm that twisted UV light stabilizes non-equilibrium topological phases via defect-coupled and strain-mediated mechanisms.

Material Advantage

Material Advantage (MA) is a student society for materials engineering that provides undergraduate and graduate students with a platform to engage with professional materials engineers in both industry and academia. By partnering with four leading professional organizations—The American Ceramic Society (ACerS), Association for Iron & Steel Technology (AIST), ASM International, and The Minerals, Metals & Materials Society (TMS)—the RPI Chapter of MA supports the interests and varied goals of its members through well-established programs, including conferences, campus events, and educational outreach.

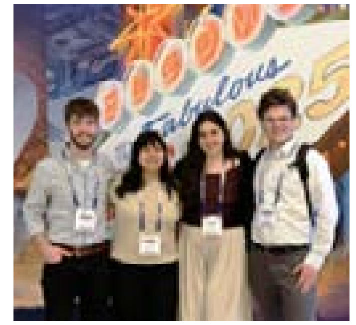
This year has been an exciting one for our chapter, filled with opportunities to learn, travel, and grow. In March, members attended the 2025 TMS Conference in Las Vegas, Nevada, where they participated in poster sessions, joined technical workshops, and connected with professionals across the field. On campus, students explored the art and science of glassblowing, gaining first-hand exposure to working with molten glass, and continued the annual Undergraduate Research Fair, which connects students with professors and research groups to encourage early involvement in research.

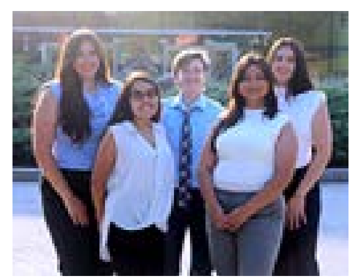
Our chapter also remained active in the broader community. Through programs with the Cub Scouts, local after-school groups, and RPI's Exploring Engineering Day, members introduced younger students to STEM through interactive demonstrations.

These events not only inspired future engineers but also gave our members the chance to practice leadership and communication in meaningful ways.

Looking ahead, the RPI chapter of MA is eager to expand opportunities for students. Plans for the coming year include attending additional conferences to broaden members' professional exposure, strengthening mentorship efforts for younger students, and launching new hands-on activities such as a bladesmithing project. These initiatives will allow members to continue exploring the creativity and craftsmanship within materials science while preparing for future careers.

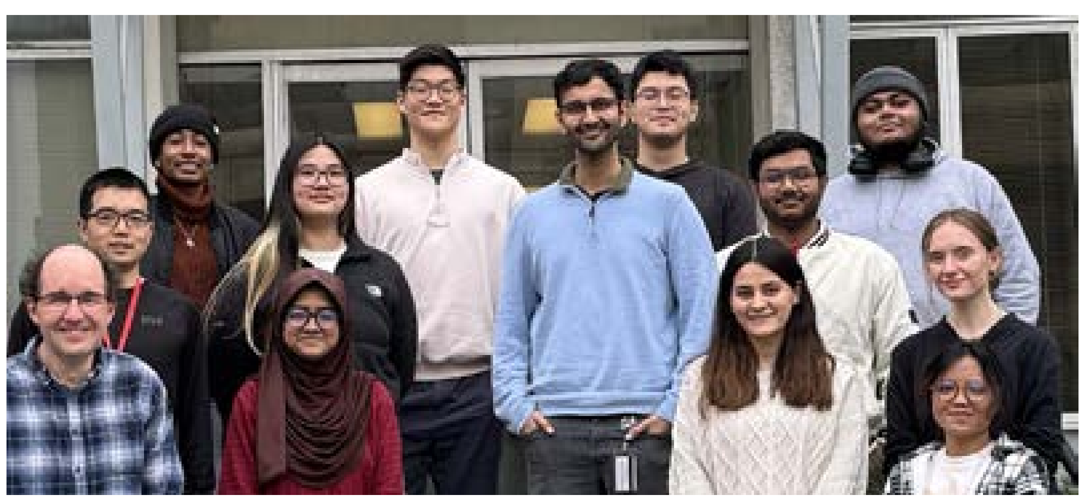
Cristina Gandolfo





Top – MA in Las Vegas,
Middle – The Undergrad Research Fair,
Bottom – The 2025 Material Advantage Executive committee:
Cristina Gandolfo: President
Yuri Maltos: Vice President
Mariana Gavilan: Treasurer
Andrea Rueda: Secretary
Bennet Marte: Activities Director

Professor Daniel Gall and his research Group



Front, left to right: Daniel Gall, Sanzida Rahman, Zahra Ahmadian, Oishy Roy *Back, left to right:* Rui Shu, Jynene Alfay, Nancy Wang, Ethan Han, Anshuman Thakral, Ethan L. Hendrix, Mehedi H. Prince, Ariful Islam, Emma Sponga

Yilin Meng

Yilin Meng

"I am excited about expanding people's understanding of the world through materials science, and to see that enriched knowledge ultimately translates into applications."

What did you choose RPI for your studies?
When I visited RPI, I was very impressed by the rich history and cutting-edge research at Department of Materials Science and Engineering. I was initially drawn to Dr. Wei Bao's work, and during my visit I realized how valuable it is to be in a place where experts in so many areas are just down the hall. I love that I can walk into conversations across different fields and learn from experienced researchers anytime at RPI.

What RPI organizations are you a part of?
I regularly attend the MSE department seminar series and often volunteer to help escort visiting speakers during their time at RPI, which gives me more opportunities to talk about ideas. I'm also in the RPI UPAC Cinema group to meet movie lovers on campus.

What aspect of Materials Science are you passionate about?
I'm passionate about research that advances our understanding of the fundamental principles in materials science. I'm fascinated by the physics and philosophy behind why materials behave as they do, especially in phenomena that remain mysterious, such as superconductivity. I am excited about expanding people's understanding of the world through materials science, and to see that enriched knowledge ultimately translates into applications.

What research interests you?
I'm currently focused on how light interacts with materials. I believe that light is a powerful probe for uncovering microscopic behavior and a precise tool for tuning macroscopic properties. In Dr. Wei Bao's group, I have access to all kinds of resources and equipment for optical materials fabrication and measurements, which makes my work here very rewarding.

What career are you interested in?
I'm aiming for an academic career where I can design experiments to tackle open questions in materials.

What is your favorite part of being at RPI?
The people. No matter how boring I think my research might sound when I explain it, classmates and faculty here always quickly grasp the core problem and offer fresh insights. Being surrounded by people who share the same passion for research makes this a great place to work and learn.

What are your spare time hobbies?
I love reading fiction and watching films. I like to explore how art captures the shared emotions and behaviors that connect us as people despite different cultures. For me, searching for these underlying patterns in emotions and behaviors through artworks feels a lot like doing scientific research (both are about finding the rules behind the phenomena I guess). I also enjoy quick trips to the East Coast's seaside towns; being by the ocean is my favorite way to clear my mind.

How do you want to change the world?
I want to be part of the effort to solve the unsolved questions of materials science, solving or at least contributing to solutions for problems that people still can't fully understand or harness. I hope to become an expert in one certain field, so to expand people's knowledge and inspire new application possibilities.

What was your favorite memory of your time at RPI?
The end of each semester! By that point, I'm usually exhausted from RPI's high-standard, challenging courses and research. But after that when I can relax, I always feel grateful for the progress I've made. Each semester leaves me with the memory of having worked hard, learned deeply, and made real progress.

The Molecularium Project 20 Years Later

In 2005, RPI showcased its Molecularium® Project at the 10th Annual Coalition for National Science Funding (CNSF) Exhibition in Washington DC.

The Molecularium Project began as a ground-breaking constituent of the educational and outreach program of RPI's NSF-funded Nanoscale Science and Engineering Center (NSEC) for Directed Assembly of Nanostructures founded in 2001. The NSEC was directed by Richard Siegel, the Robert W. Hunt Professor of Materials Science and Engineering at RPI (now an RPI Emeritus Professor).

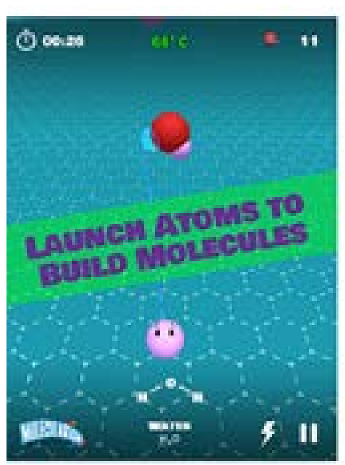
Siegel said, "An initial NSF grant supplemented by NSF-NSEC funds enabled us to produce short multimedia shows intended, and then proven, to captivate students in grades K-3 while exploring the states of matter — solid, liquid, and gas. These first Molecularium shows were designed to be projected in a planetarium dome theater, but instead of taking people from earth to space, the digital-dome show would take the viewers on an audio-visual journey into the molecular-scale world consisting of atoms."

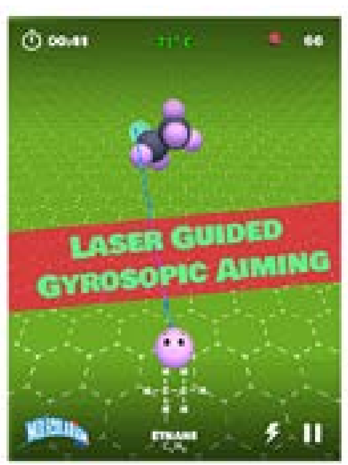
"We were pioneering the use of dome theaters for molecular science education for young people and brought together a team of researchers, artists, museum curators and educators, technology designers, elementary school teachers, students, and professors to reach our goal," said RPI Professor Linda Schadler (now at the University of Vermont) the initiator of this effort in the NSEC. "We were designing the shows to be available to planetariums large and small all across the country and around the world." The first such show created, "Riding Snowflakes", captured audiences from its initial release in 2005 and remains in world-wide circulation today.

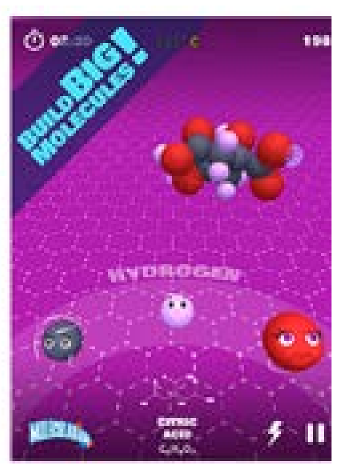
In 2025, the app "My Molecularium", available for free on a variety of platforms, is a molecule-building game that allows players to launch atoms at target bond-sites to assemble essential molecules of increasing complexity and difficulty. Players will learn to use the chemical and structural formulas to help build a wide range of important molecules, from water and vitamin C to caffeine and adrenaline. Launch atoms to build molecules of increasing complexity and difficulty. Learn to use chemical and structural formulas while you play!

Catering to students of all ages, parents, teachers, and homeschoolers, these educational resources—and more information—are available at www.molecularium.com. And best of all, most of these resources are free!

The first such show created, "Riding Snowflakes", captured audiences from its initial release in 2005 and remains in world-wide circulation today.







Jian Shi

Interaction in a Promising New Class of Semiconducting Material

Professor Jian Shi reflects on the so-called photogalvanic effect in non-centrosymmetric halide perovskites in a Nature Reviews Physics

Non-centrosymmetric halide perovskites are a class of semiconducting material containing a structural asymmetry with potentially transformative implications for several major industries.

In the field of solar energy, they're being used to engineer lighter, cheaper, more efficient solar cells that can be printed on virtually any surface. They have applications in spin computing, which involves harnessing the spin of electrons, rather than just their charge, to store data. They may also play a critical role in the construction of the next-generation optical sensing devices that will power new breakthroughs in computing and manufacturing.

But our understanding of these materials is still in its infancy, with much of the foundational research into their properties happening in just the past decade. There are also major challenges that must be overcome before they can be manufactured and deployed on a wide scale.

To further knowledge of the major opportunities and challenges in the field, RPI Materials Science and Engineering Professor Jian Shi, Ph.D., and his colleague Joe Briscoe, Ph.D., of Queen Mary University, recently shared their perspective on non-centrosymmetric halide perovskites and their unique optoelectronic properties in Nature Reviews Physics.

"These materials have great structural and chemical flexibility, which means that we can easily tune their symmetry and spin-orbit coupling," Shi said. "This opens windows for designing the physical properties of the materials for applications such as energy conversion, sensing, and computing."

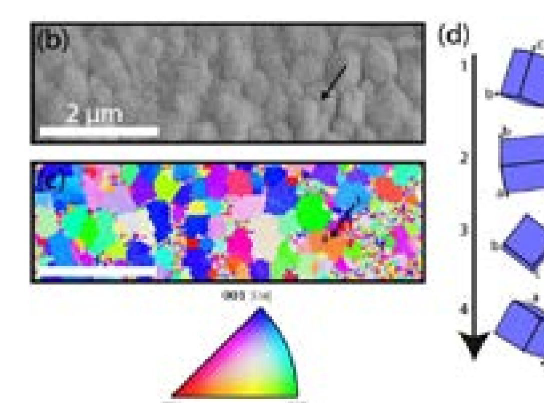
Shi is especially interested in halide perovskites with crystalline structures that lack inversion symmetry, as this allows for unique photogalvanic effects that convert light into electricity. "I am very excited about the use of photogalvanic effects in halide perovskites for basic science research, and for developing new platforms for measuring and understanding the fundamental properties of matter", he said.

Shi cautions that major challenges must be overcome before non-centrosymmetric halide perovskite devices could be manufactured on an industrial scale. They are currently less chemically and thermally stable than traditional materials like silicon, meaning they tend to break down more quickly in real-world situations.

Researchers are looking for ways to either strengthen the materials themselves, or to transfer their unique properties to other materials. It's a big challenge, but the benefits of perovskite materials and their properties are so profound that it's one worth tackling, Shi says.

For more on the findings you can listen to a 6-minute podcast about the paper generated by NotebookLM.

Below: (b) SEM image and (c) Inverse Pole Figure (IPF) map generated from EBSD of a representative CH3NH3PbI3 film with IPF color key.



We are getting a new Transmission Electron Microscope (TEM)!

A new Scanning Transmission Electron Microscope (S/TEM) is being installed in the ESH1501 lab. This 200 kV Field Emission instrument provides high-resolution TEM/STEM imaging and atomic-level spectroscopy with EDS, EELS and EFTEM capabilities. It is also optimized for in-situ work with the available temperature, gas, liquid and biasing holders.

History of the TEM:

By the 1930s, scientists had pushed optical microscopes to their limits. Optical microscopes had been around for centuries, and while you can still find them in classrooms across the country, their dependence on light had become a problem. Light's tendency to diffract, or bend around the edges of optical lenses, limits the magnification capability and resolution of optical microscopes. As a result, scientists began to develop new ways to examine the microscopic world around them and, in 1932, produced the world's first transmission electron microscope (TEM). This instrument directs a beam of electrons through the sample under observation and then projects the resulting image on a fluorescent screen.

Transmission Electron Microscope (TEM)

A Transmission Electron Microscope is a powerful microscopy technique that uses a beam of electrons transmitted through an ultra-thin specimen to form an image.

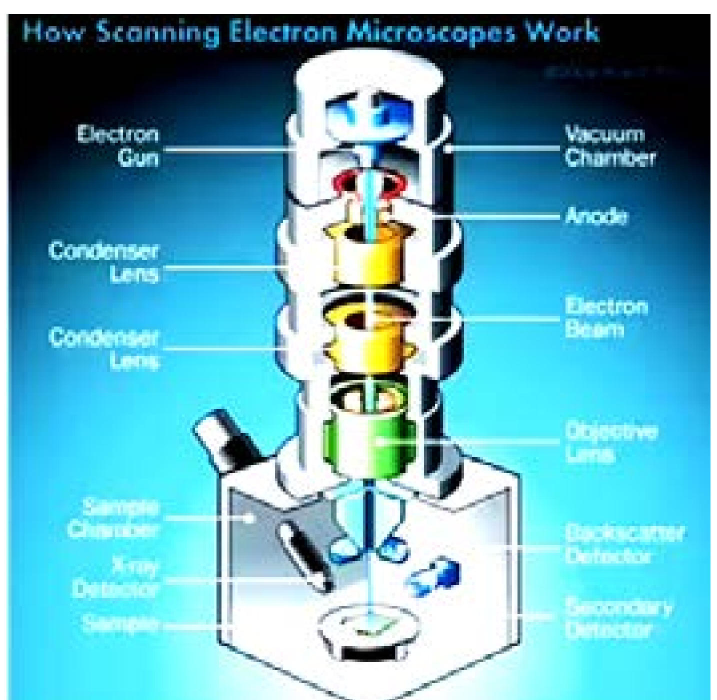
How it works:
- An electron gun generates a focused beam of electrons.
- Electrons pass through a very thin sample.
- Interactions between the electrons and the sample create an image.
- The image is magnified and focused onto a fluorescent screen or a digital camera.

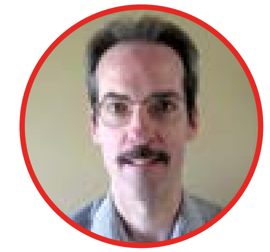
Key features:
- High resolution: TEM can resolve details as small as 0.1 nanometers (much finer than light microscopes).
- Magnification: Up to 1,000,000x or more.
- Sample type: Requires ultra-thin specimens (typically less than 100 nm thick).
- Applications: Material science, biology, nanotechnology, metallurgy, and semiconductor analysis.

Components:
- Electron gun
- Condenser lenses
- Specimen holder
- Objective lenses
- Projector lenses
- Fluorescent screen or camera

Advantages:
- Very high resolution and magnification.
- Ability to see internal structures at atomic or molecular scale.

Limitations:
- Requires vacuum conditions.
- Samples must be extremely thin and specially prepared.
- Samples must withstand electron beam (may cause damage)





John Leman

Dr. John Leman

Name and position:
Dr. John Leman, Research Scientist and Adjunct Lecturer

Where did you grow up?
Flint, MI

Where have you lived?
Flint; Austin, TX; Cambridge, MA; Newport Beach, CA; Schenectady, NY

Where did you go to school, and for what degree?
U of Michigan, BS Chemistry; Harvard University, PhD Chemistry

What did you do after school, and where?
GE Corporate R&D Center (21 yrs); self-employed science & engineering consultant (4 yrs), RPI

When did you come to RPI, and do you enjoy working on research here?
Fall 2021, and yes, it's been great. There is a joy in doing totally new things, the challenge of using fundamental information you long forgot, conjuring that up again, and combining it with all the applied experiences of the last couple decades, to execute on basic science that is important to the RPI faculty and the world.

What is the focus of your research?
I use polymer chemistry to make long-lasting, slow-release forms of physiologically-active molecules, and explore their potential to treat various disease states.

I use polymer chemistry to make long-lasting, slow-release forms of physiologically-active molecules, and explore their potential to treat various disease states.

What is your favorite experience you have had at RPI?
Going back into the classroom after decades of absence, standing at the front of the room, and seeing the excitement and wonder of discovery of topics in materials science, on the faces of the students.

What do you do for fun?
I like playing and listening to music, fishing, and exploring small local breweries.

CHIPS at RPI Team

When RPI was founded 200 years ago for the "application of science to the common purposes of life," that was an innovative idea. In fact, RPI is the oldest continuously operating polytechnic in the Anglophone world.

We distinguished ourselves from the very beginning as pioneers in civil engineering. Our founder and first senior professor were involved with the design and construction of the Erie Canal system, connecting the East Coast with what were then the westernmost United States. Early alumni made their marks on American infrastructure, designing the Brooklyn and Williamsburg Bridges, the transcontinental railroad, and more.

As we enter our third century, we continue to meet the challenges of our time. Semiconductor research has only become more crucial in recent years, as evidenced by chip shortages, developments in international relations, and the impending breakdown of Moore's law. The passage of the CHIPs and Science Act has laid the groundwork for addressing these issues, and the concentration of the semiconductor industry in Upstate New York ensures that all roads to finding solutions will pass through the Capital Region. Across materials, devices, systems, and design, RPI is committed to that effort. As our past shows, we're always ready for the future.

New Materials Solutions Fabrication and Processing

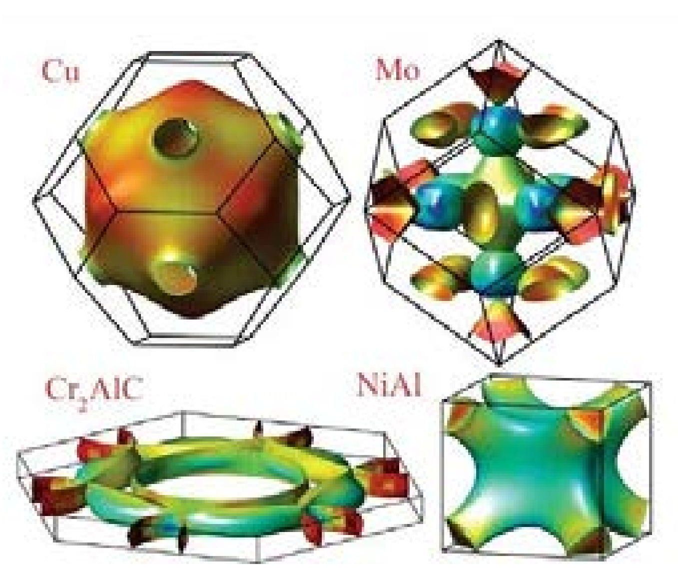
As chip design approaches maximum density, new materials and processes are necessary to optimize performance and functionality while minimizing feature sizes.

Groundbreaking research continues on campus today. RPI researchers and their partners in government and industry take advantage of a 5,900-square-foot, class 100 Microscale and Nanoscale Clean Room, which supports a broad range of processing, measurement, and fabrication tools enabling them to create new structures, devices, and systems at the micro- and nanoscale. The Nanoscale Characterization Core (NCC) provides a powerful suite of imaging, spectrometry, and diffraction instruments to interrogate structure, chemistry, and other properties from the atomic- to microscale.

They also utilize the Artificial Intelligence Multiprocessing Optimized System, or AiMOS, an eight petaflop IBM POWER9-equipped supercomputer configured to enable users to explore new AI applications. A collaboration between IBM, Empire State Development, and NY CREATES, AiMOS is the most powerful supercomputer housed at a private university.

Our greatest strength, though, is our people. RPI faculty and students collaborate across disciplines, with important contributions from Electrical, Computer, and Systems Engineering; Materials Science; Chemical Engineering; Industrial and Systems Engineering; Mechanical Engineering; Biomedical Engineering; Computer Science; Physics; Chemistry; and Math. This culture of collaboration creates the spirit of adventure and versatility for which RPI is known, and which makes our researchers so appealing to partners in government and industry.

Materials Science & Engineering faculty on the team include Wei Bao, Daniel Gall, Liping Huang, Robert Hull, Rahmi Ozisik, Ganpati Ramanath, Jian Shi, Ravishankar Sundararaman, Minoru Tomozawa and Chaitanya Ullal.



Calculated Fermi surfaces used to predict $\rho_0\lambda$. The sperical surface of Cu increases grain-boundary transmission and the antisotropic Fermi velocity (indicated by colors) for Cr2AlC minimizes the electron velocity toward (0001) surfaces, reducing the resistivity from surface scattering.

Materials and Processing

RPI microelectronics researchers are developing new materials and processes for improved channel, interconnect, and dielectric performance and scaling. With access to our Class 100 cleanroom, they are defining new methods for 3D packaging and heterogeneous integration; leveraging new materials for new technologies, including high power and photonics integration; and devising new metrology methods for relevant materials structure and properties.

In recent research that could have great impact in the chips industry, Professor Daniel Gall is researching new materials that may replace copper as the metal in interconnect lines (the electric wires that connect transistors in a computer chip).

Current Chip Research:

- Computational design of materials for low-resistance interconnects needed for further downscaling chips and for future computing technologies, e.g., spintronics and quantum computers, using simulations of electron transport and quantum dynamics
- Materials synthesis and device fabrication/tests focusing on spintronics, neuromorphic computing, optoelectronics, and ferroelectric logic/memory
- Epitaxial layer growth and in situ transport measurements employed to study and discover new materials for future interconnects which yield high conductivity at small (<10 nm) dimensions
- Interfacial engineering (e.g., metal-dielectric, metal-semiconductor) for tailoring multiple properties (electronic and thermal transport, adhesion, chemical stability)
- Thermoelectric materials and interfaces for thermal management
- Bacterial cellulose and cellulose nanocrystals that provide ordered 2D and 3D matrices to host inorganic nanoparticles, metal ions, carbon nanotubes, graphene, and more to give electro-conducting composites

The Pivot Fellowship

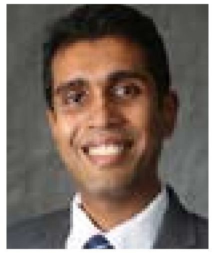
What do carbon sequestration in wetlands, quantum computing and fungi have in common? They are all research areas discussed by the Simons Foundation's second class of Pivot Fellows at their annual meeting this Spring. The Pivot Fellowship, launched in 2022, enables a cohort of scientists who are well respected in their own fields to embark on a new research topic in a different field of mathematics or the natural sciences.

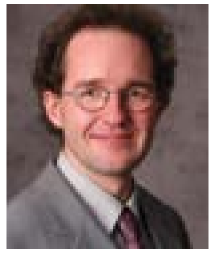
Pivoting from one scientific field to another can enable surprising new breakthroughs. But it can also be difficult. The Pivot Fellowship offers researchers the opportunity to pivot by providing financial support for salary, research, travel and professional development. At the end of the yearlong fellowship, the fellows can apply for an additional five-year research award in their new field.

Quantum computers, which represent the next stage in computation, are currently impeded by environmental sensitivities that limit their accuracy. Materials scientist and Pivot Fellow Jian Shi and his Pivot mentor Andrew Cleland were able to improve the performance of qubits, the basic unit of information used in quantum computing, with a new design.

The work focused on understanding and reducing energy loss in superconducting qubits. The new design developed by Shi significantly improved a factor that quantifies the rate of a qubit's energy loss. His research suggests that there might even be an unidentified mechanism driving energy loss. Shi believes he can further reduce energy loss in a type of qubit with tunable properties. However, the work won't end there. His research found other factors that have yet to be studied may limit qubit accuracy.

"The most exciting aspect is that these findings challenge current understandings and open up new directions for both experimental and theoretical investigation," says Jian Shi.


Ravishankar Sundararaman


Daniel Gall


Jian Shi

MSE Faculty Win RPI School of Engineering Outstanding Team Award for 2024 'Future Semiconductor Chip Interconnect Materials'

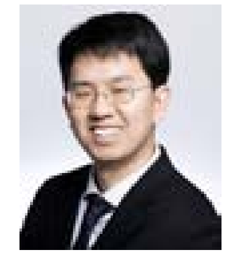
Three MSE faculty, Daniel Gall, Ravishankar Sundararaman and Jian Shi received the RPI 2024 Outstanding Team Award For outstanding contributions as a team that is identifying and developing new materials to circumvent the interconnect resistivity bottleneck of future semiconductor chip interconnect materials.

Summary of Team Accomplishments

The team of Gall, Sundararaman and Shi established the winning research collaboration to develop materials to address a key performance bottleneck in future semiconductor chips: the rapidly increasing resistance of nanoscale interconnects upon downscaling due to electron scattering at surfaces and interfaces.

To address these fundamental challenges, the team (Gall, Sundararaman, Shi) led by Gall has been pursuing a comprehensive co-design of scaled interconnects made of radically different interconnect materials than the elemental metals, most prominently copper, currently utilized. Building upon prior work of Gall identifying elemental metals that outperform best bulk conductors at nanoscale, the team focuses on exploiting topological and directional conduction implemented with synergistic design of the local dielectric interface, strain, charge, and device/computation technology. In the pursuit of future interconnect materials, the research team is equipped with synergistic expertise in vacuum deposition and processing, interconnects, topological semimetals, and first principles transport simulations. Gall is an expert in interconnects, electron transport, and sputter epitaxy, studies electron scattering at co-designed interfaces and also serves as the team leader. Sundararaman is an expert in first-principles electronic structure and transport calculations and uses these to predict material and interface combinations for experimental investigation and expected signatures for characterization. Shi is an expert on strain engineering, synthesis and characterization of materials lacking inversion or mirror symmetry and leads the efforts on studying the effects of strain and dielectric doping.

Over the last four years, supported by 15 government and industry grants (detailed information below; one example is the recent NSF FUSE $1.9 million dollar award), the team has made groundbreaking predictions in the field of next generation interconnects that are essential the microelectronic industry roadmap in this area. The team has published 25 research articles on this topic. Using data science and first-principle calculation they screened over 200,000 possible conductive compounds, followed with 18 materials examined experimentally and identified around ten compounds that could outperform current Cu-based technologies. They discovered that some directional conductors and/or topological semimetals exhibit a suppressed resistivity size effect, that could potentially solve the interconnect bottleneck. Their works have attracted a plethora of attention from both academia and industry, with over 1000 citations and 44 invited talks in the last four years. These recent results, together with Gall and Sundararaman's former works, established RPI as the world leader in microelectronic interconnect materials discovery. The team continues to receive funding from major chip manufacturing companies (IBM, Intel, LAM, TEL, Micron, Globalfoundries, Samsung, TSMC, AMAT).


Wei Bao

RPI Researcher Receives Grants to Study Quantum Materials and Superconductors

Wei Bao, Ph.D., assistant professor in the RPI Department of Materials Science and Engineering, has won the Early Career Program (ECP) Award and Defense University Research Instrumentation Program (DURIP) Award from the Department of Defense to study superconductors and cavity quantum materials, respectively.

The two awarded grants, which total nearly $700,000, will allow Bao to further his research into the unique properties of quantum materials and lay the foundation for practical innovations in the decades to come.

"I am grateful for the Department of Defense's long-term support of my work, which seeks both to answer major questions in fundamental science and apply those findings to advance technology," Bao said.

The first award comes from the Army Research Office (ARO), a directorate of the U.S. Combat Capabilities Command Army Research Laboratory, which manages the Army's extramural high-risk, high-payoff research opportunities crucial for future Army capabilities. ECP awards are one of the most prestigious honors bestowed by the Army on outstanding scientists beginning their independent careers.

Bao's ARO award will support his research on superconducting materials, which have many important applications, such as in magnetic resonance imaging (MRI) and maglev trains. To be useful, superconducting materials must be cooled to super-low temperatures. Bao's project will explore ways to increase those operational temperatures and thus reduce the energy costs associated with cooling superconductors.

The second award comes from the Office of Naval Research's Defense University Research Instrumentation Program (DURIP), which awards equipment in university researchers' labs through a merit-based competition. With the DURIP award, Bao's lab will add new tools to investigate the still-mysterious nature of cavity quantum materials, which previous research has shown are able to create exotic properties not yet achieved through other approaches. These new tools will also offer valuable research and learning opportunities for undergraduate and graduate students, as well as postdoctoral scholars.

"I am grateful for the Department of Defense's long-term support of my work, which seeks both to answer major questions in fundamental science and apply those findings to advance technology," Bao said.

In 2024, RPI and IBM officially unveiled the world's first-ever IBM quantum computer on a university campus. The new IBM Quantum System One at RPI is powered by a 127-qubit IBM Quantum 'Eagle' processor, to offer RPI's network of researchers, students and partners dedicated access to a utility-scale quantum computer.

New Major proposed!

MSE took on an effort to enable a leap forward rather than by incremental enrollment improvements, by designing a prospective new major with the working title of "Computer Science + Materials Engineering."

CS+ME is planned to be a new Bachelor's Degree program that synergistically integrates computer science and materials engineering. The realization of new computing paradigms, such as neuromorphic computing, quantum computing, and photonic computing, demands new materials with unique and often unprecedented properties. At the same time, computation plays an ever-increasing role in materials research, both deepening the understanding of structure-property relations and accelerating the discovery of new materials.

This program aims to prepare the next generation of scientists and engineers to advance computing technology and materials research by ensuring they have a solid interdisciplinary background in computer science and materials engineering.

We hope to have the new major approved by Fall 2026.

DEPARTMENT HISTORY

The RPI Materials Science & Engineering department traces its origins to 1933, when it was established as the Department of Metallurgical Engineering under the leadership of Professor Matthew A. Hunter, who in 1910 was the first to develop a process to purify titanium. The Hunter Process, a method to produce 99.9% pure titanium was not just an achievement in chemical engineering, it was a transformative milestone in RPI's 200 year history of innovation. Titanium's unique strength-to-weight ratio opened new horizons in aerospace, medicine and beyond. Some of his early experiments were carried out in the institute's football field!

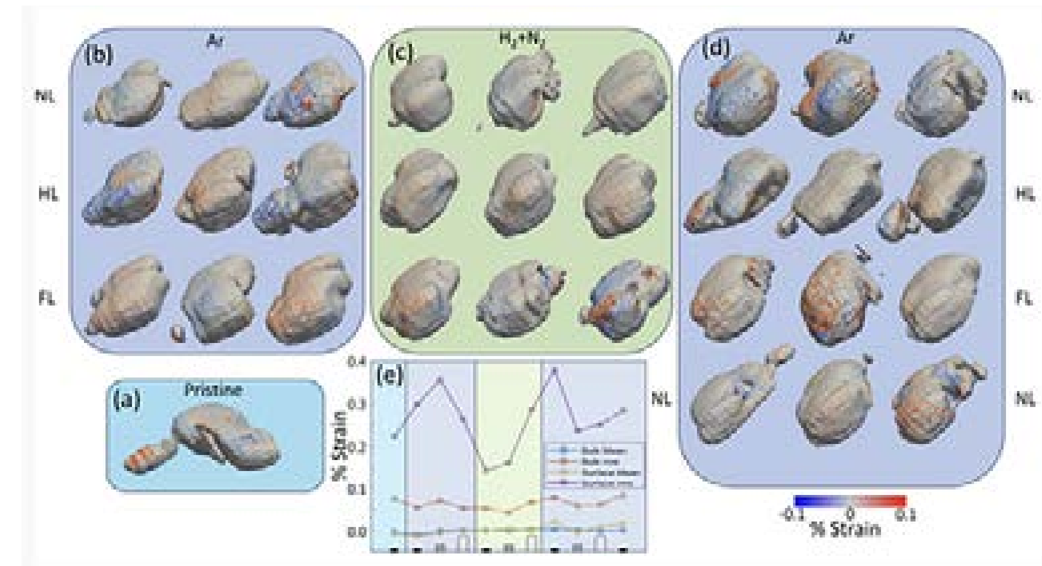
From the very beginning materials research conducted at RPI was at the forefront of scientific and technological innovation, and rapidly became known for its leadership in various fields of metallurgical engineering. In the post-war years the department built exceptional programs in welding, powder processing, mechanical metallurgy, solidification and corrosion. In the 1960s and 1970s the department diversified to build programs focused on non-metallic materials; glasses, ceramics and polymers, laying the foundation for the department's leadership role in composites and electronic materials in the 1980s and 1990s.

Today, our programs encompass an even greater scope of materials not only cutting across materials classes, but across disciplines under the umbrella of nanoscience and nanotechnology. The Materials program portfolio now included nanocomposites, nanoelectronics, biomaterials, and a variety of applications in energy generation and storage. The Materials Science and Engineering department is uniquely positioned at the cusp of many fields of science, engineering and technology!

Professor Matthew A. Hunter , who in 1910 was the first to develop a process to purify titanium.

Edwin Fohtung and Moussa N'Gom illuminate previously unseen properties of materials

Researchers with the schools of science and engineering at RPI are exploring new ways to manipulate matter with light to unlock a new generation of computer chips, photovoltaic cells and other advanced materials.



Visualization of strain and cracking in a bismuth tungstate nanoparticle under various environmental conditions. (Fohtung et al., Real-Time Tracking of Nanoscale Morphology and Strain Evolution in Bi2WO6 via Operando Coherent X-Ray Imaging, Advanced Materials 2025)

Physics professor Moussa N'Gom, Ph.D., and materials science professor Edwin Fohtung, Ph.D., have brought together their respective areas of expertise — optics and materials science — to illuminate previously unknown properties of the materials that will build the next generation of consumer, industrial and scientific devices.

"We can use almost the entire spectrum of light, from visible to x-ray, to manipulate and study materials," Fohtung said. "We can interrogate any system, from hard condensed matter to soft biological tissue."

Two of their findings, which explore how structured light can be used to alter and control material properties, were recently published in the journal Advanced Materials with the help of colleagues from RPI and Argonne National Laboratory.

In one of the papers, the researchers demonstrated that they can modulate the polarization of certain ferroelectric materials using light that has been "twisted," or given a spiral waveform. They found that this gives them a great deal of control over the internal polarization of the material.

"We often think of light photons like a hammer, striking down on a material to switch its polarization on or off," N'Gom said. "With this technique, however, we are using the photons more like a wrench: we can target a given set of atoms or ions in a crystal and manipulate the magnitude and configurations of the material's internal electric field."

They were able to capture detailed images of those manipulations using x-ray imaging. "The optical photons allow us to manipulate and form out-of-equilibrium configurations of the polarization textures, while the x-ray photons help us to capture three-dimensional images of the material's internal structure," Fohtung said.

It's a proof-of-concept for new classes of non-volatile ferroelectric random-access memory (FeRAM) devices, similar in construction to the magnetic dynamic random-access memory (DRAM) devices used in conventional electronics. FeRAM devices could enable more information to be stored more efficiently in the same amount of space.

"Everybody wants their devices to be smaller, faster, store more information and be more secure," Fohtung said. "We can do all those things with the method that we came up with. Using twisted light — light beams carrying orbital angular momentum (OAM) — to manipulate polarization textures represents a powerful, emerging strategy for designing FeRAM devices."

In the second paper, taking a major step forward for clean energy and materials design, a research team led by N'gom and Fohtung captured, for the first time, real-time 3D images

continued on next page

of structural atomic changes inside individual nanocrystals as they react to heat, gases, and light.

Using a cutting-edge technique called Bragg Coherent Diffractive Imaging (BCDI), the team observed how bismuth tungstate (Bi_2WO_6) nanoflakes — materials widely explored for photocatalysis and solar-driven chemical reactions — change their internal shape, stress, and structure under realistic operating conditions. “It’s like having X-ray vision into the heart of a single nanocrystal while it’s working,” Fohtung said.

This work overcomes a long-standing barrier in catalysis and energy materials: the inability to directly observe how single particles behave under real-world conditions. “These insights help us understand what drives performance — and failure — at the nanoscale,” Fohtung explained. “That means we can design smarter, more efficient materials from the ground up.”

In an experiment, the researchers found that exposure to intense light caused bismuth tungstate to break down, increasing the amount of surface area available to facilitate chemical interactions. They also found that the light could be used to induce a phase change in the catalyst from a metallic to a semiconducting state, effectively allowing them to switch the catalytic process on or off.

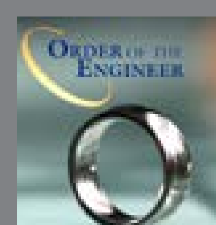
“Photocatalytic materials are significant for their unique capability to harness light energy to drive chemical reactions,” N’Gom said. “This collaborative work aims to show that structured light can be employed to enhance their activity under visible light and to control their physical properties such as recombination of charge carriers, thereby improving overall efficiency.”

“This work is a testament to the interdisciplinary nature of the research done at RPI, and to the creativity and inventiveness of our scholars,” said Gyorgy Korniss, Professor and Head of RPI’s Physics, Applied Physics and Astronomy department. “Advanced imaging techniques not only provide incredible tools to probe fundamental properties of materials and living cells, but also pave the way for the development of new computer chips, memory storage units, and other advanced devices and materials that will make all of our lives better in the coming decades.”

The work was supported by the U.S. Department of Energy, the U.S. Department of Defense, the National Science Foundation, the PAIR UP Imaging Science Program, and other sources.

Pawel Keblinski Inducted into the Order of the Engineer

Pawel Keblinski



Pawel Keblinski, John Tod Horton ’52 Professor of Materials Engineering and Department Head, was inducted into the Order of the Engineer on October 15, 2025.

He joined more than 240 graduating engineering students as they took the Oath of Obligation, and affirmed our shared commitment to ethics, dignity, and professionalism while inspiring the next generation of RPI engineers.

He was presented with the Engineer’s Ring during the ceremony.

The Order of Engineers welcomes faculty and professionals who embody the values of ethics, dignity, and professionalism in engineering.

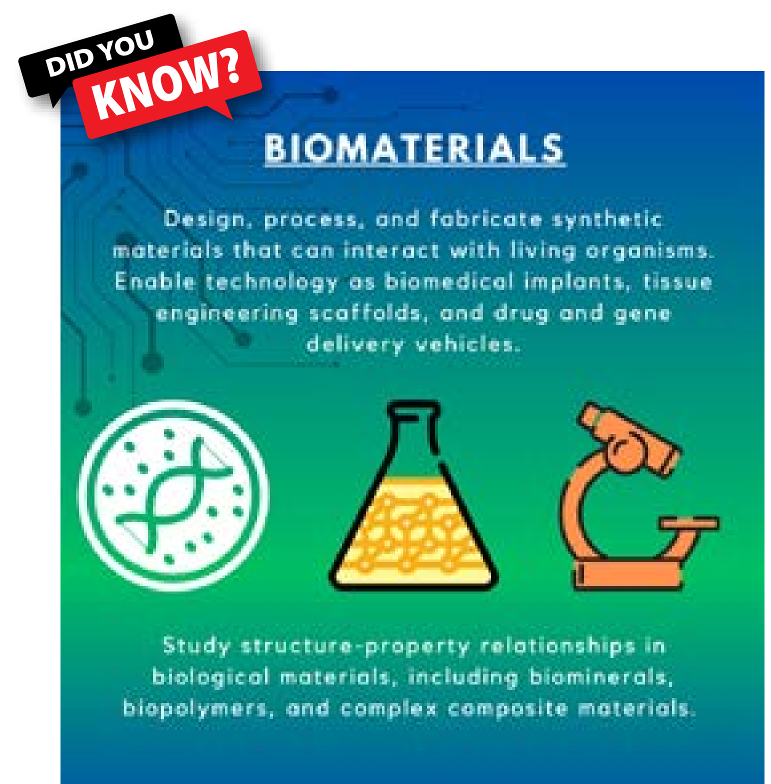
Timothy M. Gross

Timothy M. Gross, an alumni of the RPI MSE PhD program, has been awarded the Stookey Lecture of Discovery, named in honor of materials pioneer Dr. S. Donald Stookey.

Dr. Stookey created major life-changing inventions including photosensitive and photochromic glasses, and glass-ceramics and in 1986 was presented with the National Medal of Technology from President Ronald Reagan in recognition of his scientific achievements. This award recognizes his lifetime of innovative exploratory work or noteworthy contributions of outstanding research on new materials, phenomena, or processes involving glass, that have commercial significance or the potential for commercial impact.

Dr. Timothy M Gross has a PhD in Materials Engineering from RPI, an MS in Materials Science and Engineering from Rochester Institute of Technology, and a BS in Ceramic Engineering from Alfred University. He joined Corning in 2008 and established himself as an expert in both fracture mechanics and glass formulation.His early work focused on mechanics of ion-exchangeable glass and resulted in invention of several iterations of Corning® Gorilla® Glass. He also served as the research lead of the Corning® Bendable Glass program where he defined the solution space for use of ultra-thin, bendable glass in mobile electronic devices. Gross’ work on automotive glass resulted in several innovations including Fusion5® damage-resistant windshield glass. He also invented Guardiant® antimicrobial glass-ceramic that kills ≥ 99.9% of bacteria and viruses while maintaining long term efficacy. For his technical achievements at Corning, He was given the title of Research Fellow in 2017. He has 153 granted United States patents and 34 peer-reviewed publications. He has won numerous Corning internal awards including the 2012 Stookey Award for outstanding exploratory research and the outstanding external publication award in both 2019 and 2022.

Dr. Gross is a member of the American Ceramic Society and American Chemical Society. His current areas of research include high ionic conductivity glass-ceramics and glasses with hydration-induced stress profiles.



Congratulations to Poyen Shen from RPI on receiving the #IITC2024 S. C. Sun Best Student Poster Award.

Poyen Shen

Shen’s poster presentation, ***“Metal-metal contact resistance measurements,”*** was selected for the Best Student Poster Award by members of the North American, Asian, and European committees.

An award ceremony was held at the IITC 2025 conference in Busan, Korea, in June 2025, to celebrate their achievement.

Kamron Fazel PhD 2024

Why did you choose RPI for your studies?

I chose RPI twice – once in 2003 and again in 2020 to study Nuclear Eng BS first and then Electrical Eng/MSE PhD next. The research groups stood out in capabilities and support. As to the community of students, I enjoy belonging to a technical group that imagines what is possible and can execute the vision.

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

As an undergrad, I was in the Navy ROTC program and tennis team. As a PhD student, the research was enough with my family responsibilities.

What aspect of Materials Science are you passionate about?

Materials both enable our world to prosper and limit what is possible. Without new material capabilities and understandings our civilization will grow slower. Simulations that represent reality can accelerate new material discoveries!

What research interests you?

Connecting the domains of materials, modeling, and experiment.

How did your experience at RPI help you choose your career?

In a deep learning course at RPI, I designed a stock trading algorithm, which I developed into an app and business (fazel-alan.net) with my partner who graduated from RPI over 20 years ago with me.

Realizing the need to apply AI and materials simulations to real problems, I built a consulting company (fazel-solutions.com) to work with industry and research groups on code/AI and material simulations applications. To date I've worked with companies in finance, insurance, sports, and defense. I also took a part time job with an SBIR funded startup company (SupreMEtric) to use Raman spectroscopy and machine learning to identify bodily fluids for criminal forensics.

While these are fun, given the explosion in AI in materials simulations, I am forming a more ambitious company locally aimed at integrating material simulation and experiments for energy and aerospace applications. Please reach out if you thrive in rapidly exploring (i.e., startup mode) new domains and have experience in material characterization, synthesis, density functional theory, or molecular dynamics.

What was your favorite part of being at RPI?

Working with Professor Sundararaman and Professor Ali Tajer to learn advanced methods in material simulations and AI. Their kindness, support, and education made the experience as challenging and positive as it can be.

What is special about the Materials Science & Engineering program at RPI?

MSE is a tight and supportive community that bridges the gap between physics, chemistry, and engineering in ways that enable new research and contributions to academia and industry.

How do you want to change the world?

The challenge with our education and experience is answering this exact question. We need to know what problem is most worth solving that has industry support and how to develop a business out of it.

What was your favorite memory of your time at RPI?

Graduating a second time in the same area as 17 years later.

The first time I graduated from RPI in 2007, I was wearing my Navy ROTC dress whites ready for my naval service to begin. Katherine was beside me then (and now is my wife of 17 years). We met in 2004 at RPI in Nason Hall. She has been a huge part of my life, encouraging me to take a chance and make change.

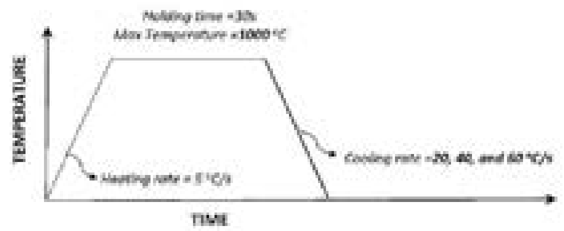
Fast-forward to 2024. I returned to the RPI commencement ceremony, this time in doctoral regalia with Katherine and our two boys – Kam and Logan. During the ceremony, I was honored to stand up as the sole graduating veteran and PhD graduate. I left RPI ready to tackle new challenges with a unique perspective and new set of tools.

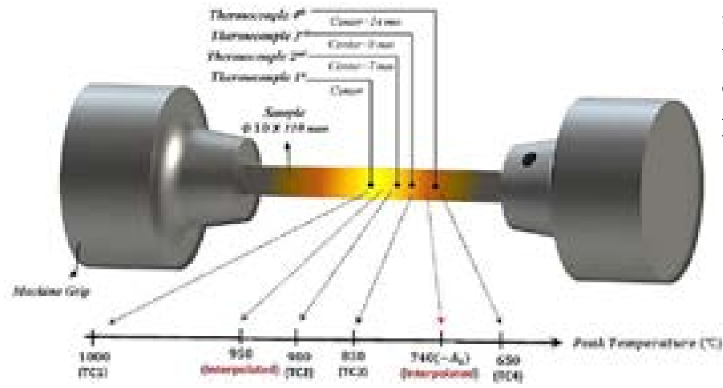
The MSE department mourns the passing this year of alumni (PhD Metallurgy 1962) Hugo S. Ferguson, who earned a bachelors degree in physics in 1956 and a Ph.D. in metallurgy in 1962 at RPI.

Hugo S. Ferguson

The MSE department mourns the passing this year of alumni (PhD Metallurgy 1962) Hugo S. Ferguson, who earned a bachelors degree in physics in 1956 and a Ph.D. in metallurgy in 1962 at RPI.

Dr. Ferguson has had a remarkable career in industry, both as a leader and innovator. His involvement in and contribution to RPI and our highly rated School of Engineering will help us to continue our goal of educating some of the best engineers in the world, and to conduct leading-edge research.





When two pieces of steel are welded together steep temperature gradients are created and because of these steep gradients the microstructure varies significantly from the fusion zone to the base material.

Ferguson is well known in the materials industry for his work in the field of thermal and mechanical testing, as well as physical simulation. Early in his career he worked closely with fellow

RPI graduates Professor Warren Savage '43 and Professor Ernest Nippes '38. Professor Hillard Huntington, published and distinguished author on "Metallic Conduction," evaluated Ferguson's thesis on "Metallic Conduction at High Current Densities" for his Ph.D. committee.

He was President of Dynamic Systems Inc, the company that invented the Gleeble thermal mechanical system and pioneered the field of physical simulation of metallurgical processes.

The Gleeble® creators wanted a machine that would allow them to simulate welding on a laboratory scale under precise control of the thermal conditions. With such a machine, they could run a sample through a thermal cycle and create a larger piece of that same microstructure that could then be examined. With a big enough piece of similar microstructure material, investigators could study the mechanical properties and perform subsequent mechanical testing on that microstructure. Furthermore the simulator could provide the researcher the ability to rapidly generate different welding cycles and examine the results under very controlled conditions.

At the time the Gleeble was unique. Nothing else could heat that fast—several thousand degrees per second—which is what happens in welding, and they also cooled very fast—which is also what happens in welding. The Gleeble proved a game changing tool for studying welding processes and developing welding improvements.

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