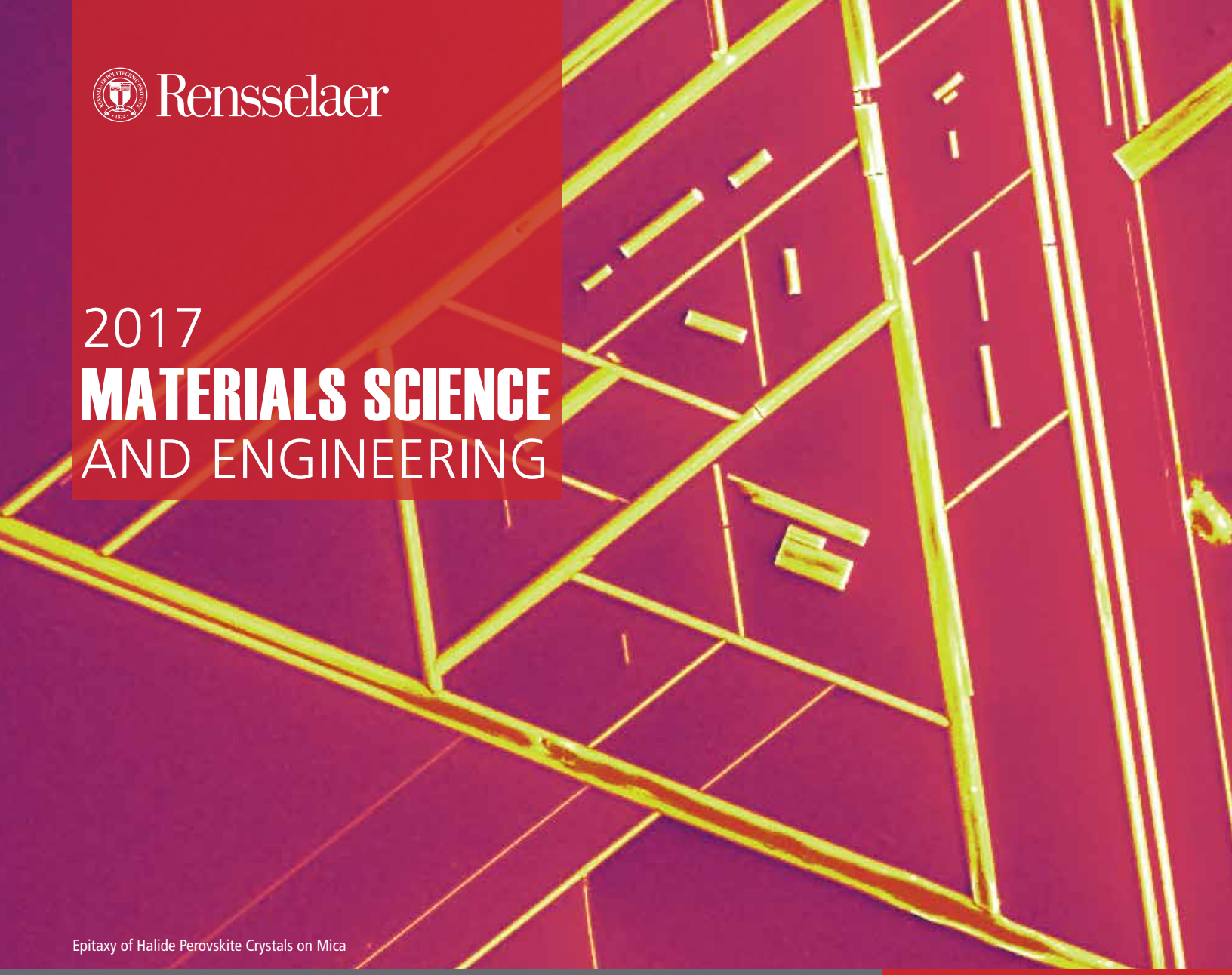
Rensselaer

2017 MATERIALS SCIENCE AND ENGINEERING



Epitaxy of Halide Perovskite Crystals on Mica

Pawel Keblinski

Professor and Department Head, Materials Science and Engineering

WELCOME

IN MY THIRD YEAR AS DEPARTMENT HEAD, I AM CONSTANTLY INSPIRED BY THE ACHIEVEMENTS AND IDEAS OF OUR FACULTY, STAFF, STUDENTS, AND ALUMNI. I AM EXCITED TO SHARE THEM WITH YOU IN THIS EDITION OF MSE NEWS.

In this issue of MSE News, you will find many highlights of our recent achievements and developments within MSE at Rensselaer. Every year I lead the department, I realize more and more my appreciation for multiple aspects of our community, and you will find many reasons why in this newsletter. The feature story describes our ***Excellence in Computational Materials Science & Engineering***. This aspect of the Department experienced perhaps the most significant transformation during my

WELCOME [CONT.]

20-year tenure at Rensselaer, and now is on par with the experimental component of our research program. Throughout this issue you will also find inspiring stories about students and alumni, and faculty achievements and distinctions. In our *Alumni Hall of Fame* section you will learn about Dr. David Krashes, who started his undergraduate education at Rensselaer in 1940s and completed his degree in Physics after serving in the US Army during the height of WWII. He later completed PhD in Metallurgy at RPI, and went to have distinguished career in academia and later as an entrepreneur and creator of an R&D company. Our Materials Advantage Chapter was named the best in country. Our graduate student Yiping Wang (Jian Shi group) has won a Presidential Graduate Research Fellowship. Amazingly, Yiping has co-authored 17 publications in just 3 years of his PhD thus far. We are extremely proud that two of our assistant professors, Ed Palermo and Chaitanya Ullal, received prestigious NSF CAREER awards. Quite remarkably, Prof. Ullal also led a successful NSF Materials Research Instrumentation (MRI) proposal to establish super-resolution optical microscopy capabilities in the region. Successes of our senior faculty include two new multi-investigator NSF Design Materials to Revolutionize our Future (DMREF) programs lead by Prof. Linda Schadler and Prof. Robert Hull, and American Physical Society fellowship of Prof. Ramanath. We will also introduce two new Professor of Practice Faculty: Prof. Kathryn Dannemann, our alumna, rejoined Rensselaer as the Director of the Multidisciplinary Design Laboratory, and Prof. John Lagraff, Professor of Practice, will focus on development of laboratory components of undergraduate materials courses.

Pawel Keblinski, Professor and Department Head, Materials Science and Engineering

GRADUATING CLASS OF 2017

CONGRATULATIONS AND BEST OF LUCK!

Our freshly-minted graduates are bound for further study (Stanford, MIT, Cornell, Northwestern, University of Washington, University of Pennsylvania, Carnegie Mellon and UCLA) and industrial positions (Ecovative Design, Raytheon, Corning Inc., Accenture, and many others.)

On the Cover. Epitaxy of Halide Perovskite Crystals on Mica by Assistant Professor **Jian Shi**. Since joining RPI in 2014, the Shi group has been extraordinarily productive, with 22 publications in such journals as *Nature, Advanced Materials,* and *Nano Letters*. Jian has a current h-index of 24 with nearly 2000 citations, which is very impressive performance for a young faculty member. Thus far, he has had three NSF grant proposals funded as the PI, as well as a contract from IBM, in just three years. Wow!

EXCELLENCE
IN COMPUTATIONAL MATERIALS SCIENCE & ENGINEERING

TOOLS OF THE TRADE

RPI's Advanced Multiprocessing Optimized System (AMOS) is a five-rack IBM BlueGene/Q Supercomputer. With a top peak processing speed of 1048.6 teraflops, it is ranked 1st among supercomputers at private US schools and 43rd on the worldwide top-500 list.

In 2013, IBM announced that it would provide a modified version of an IBM Watson system to RPI, making ours the first University in the world with such capability. Best known for it's performance on Jeopardy!, Watson features the unique DeepQA architecture.

EXCELLENCE

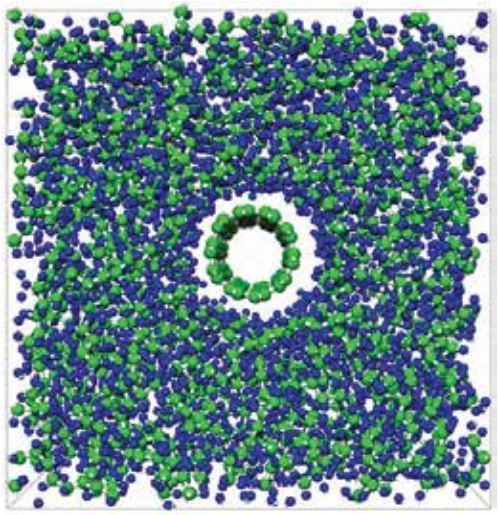
IN COMPUTATIONAL MATERIALS SCIENCE & ENGINEERING

PART 1 RESEARCH IN COMPUTATIONAL MSE

Our department has enjoyed a long tradition of simulation and modeling as an important component of research and education. Professor Martin Glicksman, a RPI alumnus who had a long and distinguished career at RPI, made seminal contributions to the field of kinetics of solidification, phase coarsening, atomic diffusion, and grain growth, using a combination of experimental and modeling work. Professor Emeritus Roger Wright, who taught at RPI from 1974 to 2011, distinguished himself by numerous contributions to the modeling and finite-element simulations of metal processing.

Professor Pawel Keblinski

The arrival of **Professor Pawel Keblinski** (PennState PhD '95) in the late 1990s marked the beginning of a new chapter in modeling and simulations within our department. He is the first MSE faculty with a research program that is fully dedicated to modeling, theory and simulations. His main interest is in atomic-level simulations of structure-property relationships, most notably in interfacial and nanoscale materials. His focus is on modeling of interfacial heat flow, i.e., investigation of role of interfaces in thermal conduction processes. His earlier notable contributions were in the area of heat flow in nanoparticle/nanofiber colloidal suspensions (nanofluids) and polymer nanocomposites, exposing the rather detrimental role of interfaces of thermal conductivity in these materials. In recent years, along with continued interest in interfacial thermal



conductions, Professor Keblinski uses molecular-level simulations to investigate evaporation-condensation processes at the liquid vapor interface. These processes are of key importance in many areas, including plants evaporation, cooling of high power microelectronics, and vapor bubble cavitation dynamics. His recent publication[1] on evaporation topic "…represents the first actual test of the Schrage theory and is an outstanding contribution to the field of evaporation and condensation", according to a peer review. Just as Pawel's pioneering program has flourished, quite a few faculty in our department, from the well established to the new hires, use computational and simulation methods as a major component of their research efforts.

Professor Daniel Gall

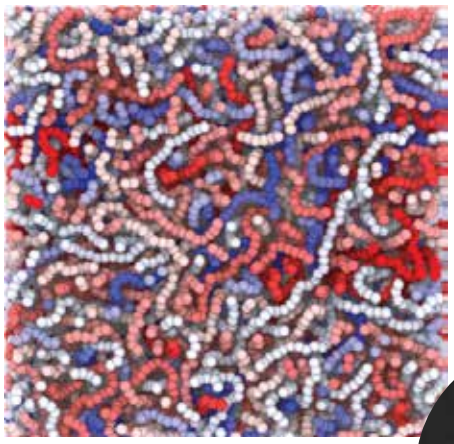
Professor **Daniel Gall** (UIUC PhD, '00) started his independent career at RPI in 2002, focusing on thin film and nanostructure

[1] Molecular Simulation of Steady-state Evaporation and Condensation: Validity of the Schrage Relationships, Z. Liang. B. Thierry and P. Keblinski, Inter. J. Heat and Mass Transfer 114, 105–114 (2017)

growth from the vapor phase and on electronic, optical, and mechanical properties of materials. Gall predicts electronic, optical, and mechanical properties of new materials using first-principles density functional methods. One major effort is on the prediction of the electrical resistivity of metals at the nanoscale, which is of key importance for the further downscaling of integrated circuits. Daniel's recent paper on nanoscale conductivity in *J. Appl. Phys.* was one of the "most-read" articles of 2016. See page 9 for a detailed description of that work. Other simulations focus on discovering new nitride phases, and predicting their mechanical properties, with the goal to design new self-healing super-tough hard coating material systems.

Professor Dan Lewis

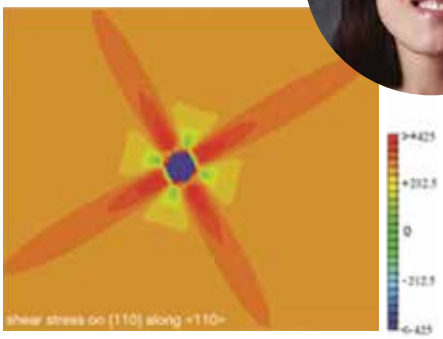
Professor **Dan Lewis** (Lehigh PhD '01) joined the MSE department at RPI in 2006, following appointments at GE Global Research and NIST. His research program focuses on the science of microstructure development in materials. His research uses experimental characterization as well as modeling and simulation tools to understand the forces that create and evolve material structures at the micrometer scale. He is currently working on the development of phase field models for grain growth and solid-state phase transformations. His group currently manages the development of the Mesoscale Microstructure Simulation Project that provides a simple data structure that scales up to multiprocessor systems like **Rensslaer's Blue Gene/Q supercomputer.**



Professor Yunfeng Shi

In 2008, two new faculty were added to our roster, both of whom devote a substantial fraction of their research and teaching efforts to computational materials science. Professors **Yunfeng Shi** (U Michigan PhD '06) and **Liping Huang** (UIUC PhD '04) came to RPI following postdoctoral work at Michigan and NC State. Known as our "power couple", the pair has had a major impact on the direction and growth of computational MSE at RPI. Yunfeng uses molecular simulation methods to elucidate molecular-level mechanisms in advanced materials systems. Areas of interests include glassy solids, anode materials in Li-ion batteries, molecular motors, nanoporous materials, nanotribology, and active self-assembly. Liping's group, using computational techniques at the electronic and molecular level, significantly advances the fundamental understanding of the structure – property relationships in amorphous/porous materials at the atomic level. Liping's computational studies also provide guidelines in rational design of these materials with tailored properties, such as glasses with improved damage resistance for active display or hierarchical nanostructured porous materials with both mesopores and micropores for efficient energy conversion or storage. In recognition of their outstanding contributions to glass science, the duo both received the ***Inaugural Gordon S. Fulcher Distinguished Scholar*** fellowships from Corning Incorporated.

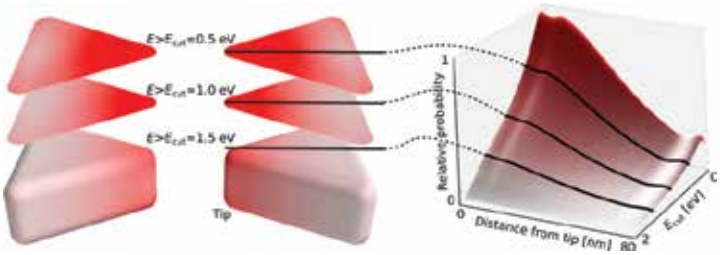
Professor Ying Chen



Professor **Ying Chen** (MIT PhD '08) joined our faculty in 2012, following positions as a postdoc at the Institute for Soldier Nanotechnologies at MIT and at GE Global Research. Her group studies microstructure evolution and mechanical properties in polycrystalline metals by atomistic and mesoscale models, with a focus on grain boundary effects. The

Chen group is particularly interested in coarse-grained modelling of collective atomic processes. For example, she recently developed a coupled Kinetic Monte Carlo-Finite Element model for stress-induced martensitic transformation. Another project studies the effect of grain boundary solute segregation on microstructure evolution in nanocrystalline alloys by an Atomistic Lattice Monte Carlo model.

Professor Ravishankar Sundararaman



Nature Commun. 8, 14880 (2017)

Most recently, our 2016 hire of Professor **Ravishankar Sundararaman** (Cornell PhD '13), a DFT methods developer, has moved our department into new and exciting directions. Following a postdoc at Caltech, Shankar began his independent career to develop "*ab initio* multi-physics" methods: techniques to quantitatively predict the properties of nanoscale systems starting from quantum simulations of electrons in materials. He uses these methods to design nanoscale materials with properties inaccessible in conventional materials for applications including electronic devices, sensing, energy conversion and storage. A key research direction in the group is designing metallic nanostructures and two-dimensional material heterostructures to harvest non-equilibrium excited electrons for efficient solar cell and photo-detector applications. Additionally, he develops computational models and an electronic-structure software called JDFTx for efficient quantum simulations of and materials design for solid-liquid interfaces and electrochemical systems.

Shankar is off to a great start in the short time he has been at RPI. His publications from 2017 have appeared in *Nature Communications, Advanced Optical Materials* and the *Journal of Chemical Physics,* the latter of which will be featured as a "2017 Highlight" published in early 2018. He is also a part of the newly funded NSF DMREF with Prof. Linda Schadler (see page 11).

Professor Liping Huang

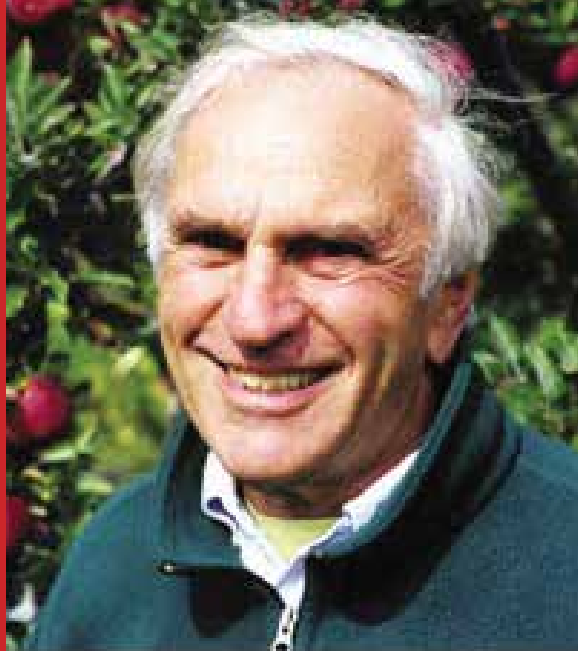
PART 2 EDUCATIONAL INNOVATION IN COMPUTATIONAL MSE

Professor Liping Huang developed an upper-level undergraduate core course: MTLE 4500 *"Computational Materials Design"*. This course provides the background and a set of examples of how computational methods can be applied to design of materials with desired structure and properties. Computational methods span multi-length and time scales, including continuum level modeling, molecular dynamics simulations, stochastic methods for optimization and sampling, and first-principles approaches. Lectures are complemented by ten computer labs with hands-on exercises using publicly available or commercial software packages such as OOF2 on nanoHUB, ABAQUS, LAMMPS and PWSCF.

Professor Dan Lewis has developed the Mesoscale Microstructure Simulation Project (MMSP) to provide a simple, consistent, and extensible programming interface for all grid and mesh based microstructure evolution methods. Dan also developed an undergraduate course that applies mathematical techniques to understand materials engineering topics such as materials structure, symmetry, diffusion, mechanics and physics of solids. The class uses examples from the materials science and engineering core courses to introduce mathematical concepts and materials-related problem solving skills.

ALUMNI NEWS

ALUMNI SPOTLIGHT
DAVID KRASHES '58 PH.D.



MSE ALUMNI *HALL OF FAME* – DR. DAVID KRASHES (PH.D. 1958)

"IT'S NOT ALWAYS THE BRIGHTEST PERSON WHO SUCCEEDS, BUT THE PERSON WHO STICKS TO WHAT THEY DO."
—Dr. David Krashes

In the 1940s, a young David Krashes left his undergraduate textbooks behind at Ohio State to serve in the *U.S. Army 99th combat infantry division* at the height of World War II. His unit crossed the border from Belgium into Germany, fighting in the *Battle of the Bulge* along the way.

After the War, Krashes resumed his studies at RPI, pursuing a B.S. in physics, due in part to his fascination with the Manhattan Project. As a student, he played football and lacrosse, in addition to Lambda Chi Alpha membership. In his senior year, he became interested in metallurgy, in particular the topic of fatigue, and chose to pursue an M.S. degree, and later a Ph.D., in the materials engineering department (as it was then known). During his doctoral studies, Krashes worked at ***Nuclear Metals*** in Cambridge, MA, the metallurgy research and design arm of the Manhattan Project, where he studied uranium processing. Krashes witnessed many groundbreaking experiments during his time at Nuclear Metals and he returned to the RPI campus to complete his PhD in Metallurgy in 1958.

Krashes began his career as a Professor of Metallurgy (and lacrosse coach) at Worchester Polytechnic Institute (WPI). He proposed many changes to how metallurgy was being taught and spearheaded the creation of a processing and metallurgy laboratory for students. After teaching at WPI for some years, he recognized the need for a private company to offer metallurgical analysis to local manufacturing companies. Thus he created a new venture, in 1961, the ***Massachusetts Materials Research Group*** (MMR) (http://www.massmaterials.com). MMR is still a thriving business today. In the early days, Krashes boldly invested in a TEM and an SEM, which enabled his team to understand fracture. *"We could do stuff nobody else could do…that's what made us,"* Krashes said recently. From his time at MMR, Krashes learned the value of thinking like a businessman. When considering the investment of expensive electron microscopes, Krashes evaluated the costs and expenditures of purchasing the product while his business advisor simply stated *"If it's going to make your business better, get it!"* Furthermore, Krashes expressed the importance of adapting. He stated, "We were willing to change" and this was one of the many reasons his company is still standing 56 years later.

Krashes emphasizes the importance of membership and participation in ASM as a way to foster the careers of young students. Krashes was once President of ASM, he was among the first 100 fellows of ASM chosen in 1970, served as Treasurer, and later as an Honorary Member. When asked what his fondest memory was of RPI, Krashes says "the people". After nine years at RPI, and a lifetime of memories, Krashes remembers RPI for its people. Their ambition, drive, and thirst to change the world created a lasting impression. Krashes stated, "It's not always the brightest person who succeeds, but the person who sticks to what they do."

*This article was written by **Anahit Hovhannisyan** and **Justin Weinstein**, both MSE undergraduates, who interviewed Dr. Krashes in person at his home in Princeton, MA.*

ALUMNI HIGHLIGHTS

DR. TIMOTHY GROSS OF CORNING WAS RECENTLY NAMED A RESEARCH FELLOW – WHICH IS THE HIGHEST TECHNICAL RANK THAT A SCIENTIST CAN ACHIEVE WITHIN CORNING

Tim has a Ph.D. in Materials Science and Engineering from Rensselaer Polytechnic Institute, where he worked under Professor Tomozawa. He joined Corning in 2008 as a research scientist in the Characterization Sciences directorate. He is an outstanding scientist who has demonstrated a successful track record of impactful technology delivery. Since joining Corning, he has contributed significantly to the growth of the company's glass technology including the evolution of Corning® Gorilla® Glass family of products and several emerging applications including ultra-thin bendable glass and antimicrobial glass technologies.

Tim holds 25 granted U.S. patents, 57 pending patent applications, 71 invention disclosures, and 20 internal technical reports. He has authored 17 external publications, including two book chapters that are currently in press. He received the Corning's Stookey Award for outstanding exploratory research in 2012, and has presented and chaired several external technical conference sessions. He is also a reviewer for several scientific journals and proceedings. In 2016, he presented an American Chemical Society webinar on chemically strengthened glass that was recorded with one of their highest number of participants.

MOLECULARLIUM RELEASES NEW SMARTPHONE APP

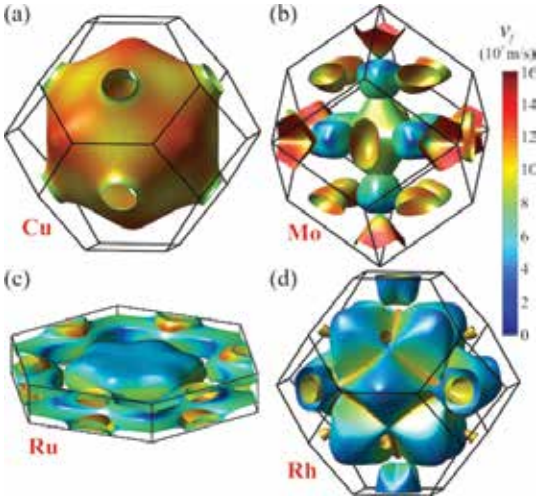
The Molecularium Project (www.molecularium.com) was created in 2001 by Professors Richard W. Siegel, Director of the Rensselaer Nanotechnology Center, Linda S. Schadler, and SoE Dean Shekhar Garde. The Project's mission is to expand science literacy and awareness. The goal is to excite audiences of all ages to explore and understand the molecular nature of the world around them. This is accomplished through compelling stories, experiential learning and unprecedented visualizations in immersive andinteractive media. The project has already produced such animated musical hits as *Riding Snowflakes* for digital-dome theaters and *Molecules to the MAX!* for IMAX® and other giant-screen theaters, as well as the award-winning online educational amusement park *NanoSpace*. DVD and Blu-ray versions of *Molecules to the MAX!* are also widely available.

Now, 16 years since its inception, the project is releasing its latest creation, a fun new educational molecule-building game app, ***My Molecularium***. The game will be available for free download from either Apple App Store or Google Play onto any smartphone or tablet after its release in early October 2017.

FACULTY NEWS

DANIEL GALL'S **"MOST-READ PAPER"** OF 2016

The *Journal of Applied Physics* announced that the paper "Electron mean free path in elemental metals" by **Professor Daniel Gall** is one of the most read papers in 2016. The article is the result from extensive calculations on **RPI's IBM BlueGene/Q** Supercomputer to determine the mean free path of the twenty most conductive metals. They show that some metals are more than twice as conductive as copper, in the limit of narrow wires. The results are very important for the semiconductor industry, as they indicate which metals are most promising for future interconnect wires. Currently used copper wires become too resistive to be used in future integrated circuits where the wires will be less than 10 nanometers wide. This research is funded by SRC, MARCO, and DARPA through the FAME STARnet center.



The calculated Fermi surfaces of copper, molybdenum, ruthenium, and rhodium. The colors indicate the Fermi velocity v_F. Such quantitative data of the most energetic electrons in each metal are key to predict their conduction at the nanoscale.

STAFF SPOTLIGHT
MEELI CHEW LEITH

Meeli Chew Leith joined the Department as an administrative coordinator in the spring of 2014. She began her career at Rensselaer in 1985 as a senior secretary in the ECSE department. She then worked in the Chemistry Department at RPI with Prof. Len Interrante, founding Editor-In-Chief of *Chemistry of Materials*, as Editorial Office Manager from 1988 to 2013.

Meeli oversees the day-to-day operations of the administration office. She introduced the celebrations of both Chinese New Year and Diwali in 2015 and initiated the first international holiday potluck party which has been celebrated before the final exams. She coordinates with the Materials Students Graduate Society and the Material Advantage group. She also reaches out to female students to meet with the department's female seminar speakers and has established our "Women in Engineering" seminar sessions. Her initiative led to two new, and funded, undergraduate awards.

Meeli enjoys cooking, travelling, hiking and photographing people. Next spring, she looks forward to not only planning the annual commencement dinner, but also celebrating the occasion with her son who is expected to graduate in materials engineering.

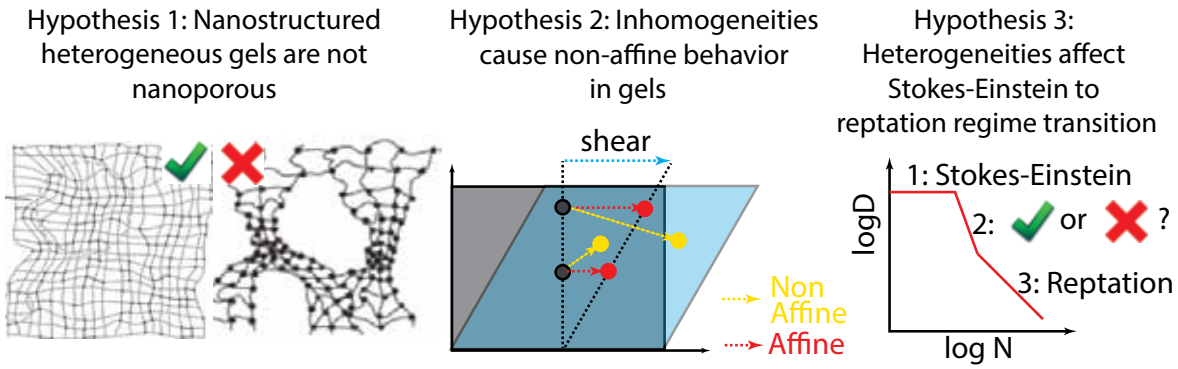
CHAITANYA ULLAL WINS THE NSF CAREER AWARD

Chaitanya Ullal has received a Faculty Early Career Development Award (CAREER) from the National Science Foundation (NSF), DMR-Polymers division. He will use the five-year, $556,091 award to study the structure of hydrogels.

Ullal uses advanced imaging techniques such as Stimulated Depletion Emissions Microscopy (STED), an optical microscopy technique with resolution on a scale of tens of nanometers, to characterize the structure of hydrogels. "We can't fully explain the mechanics of hydrogels with the assumptions that we have now," said Ullal, an expert in organization of polymers at the nanoscale. "With accurate descriptions of how hydrogels are structured, we will be able to develop new materials with desirable properties and put these remarkable materials to use."

The resolution of conventional optical microscopes is limited to about 250 nanometers, insufficient for viewing crosslinks at the molecular scale. STED microscopy, developed in the 1990s, circumvents the so-called diffraction barrier. Ullal worked as a postdoctoral researcher in the laboratory of Stefan W. Hell, who was awarded the 2014 Nobel Prize in Chemistry for the invention of STED. Ullal's CAREER proposal is titled "*Resolving and mapping of nanoscale heterogeneities in polymer gels and determination of their impact on properties.*" The grant includes an educational component, a particular interest of Ullal, who serves on the board of director's for Iridescent Learning, a nonprofit devoted to STEM education for underserved girls, children, and their families. Outreach through the grant could include hands-on learning activities, mentoring, and videos, such as the video on "making metamaterials" Iridescent created with Ullal. He joined the Rensselaer faculty in 2013, after a B.S. in technology from the IIT Bombay, and a PhD in materials science and engineering from MIT.

In 2016, Ullal was a recipient of the American Chemical Society Petroleum Research Fund Doctoral New Investigator Award. Also in 2016, he received an NSF Division of Chemistry Macromolecular, Supramolecular and Nanochemistry grant for "Photochromic Switching for Nanostructured Polymer Gels," in collaboration with Ed Palermo. In 2017, he led a team that won an MRI grant from the NSF, which will bring a state-of-the-art commercial STED microscope to Rensselaer.



ED PALERMO WINS THE NSF CAREER AWARD

Edmund F. Palermo has won a Faculty Early Career Development Award (CAREER) from the National Science Foundation (NSF), DMR-BMAT division. He will use the five-year, $539,177 award to study "*Biomimetic Macromolecules at the Materials-Microbe Interface.*"

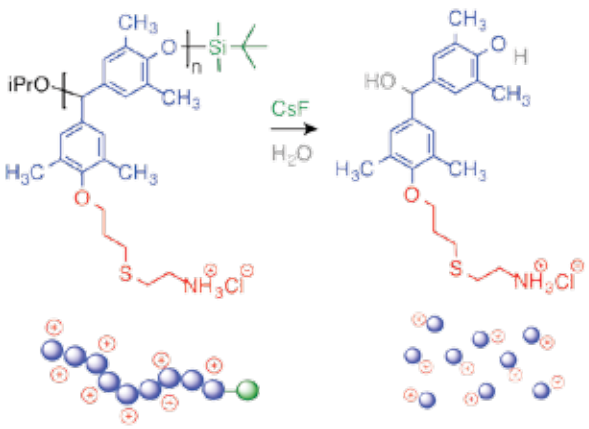
Palermo's research lies at the intersection of functional polymer synthesis, microbiology and biophysics. Palermo is developing materials that combat infectious pathogens, inhibit biofilm formation, and act as components in new medical diagnostic tools. To do this, he is taking inspiration from design features of natural biological materials and translating those to design novel man-made materials in a process known as "biomimicry."

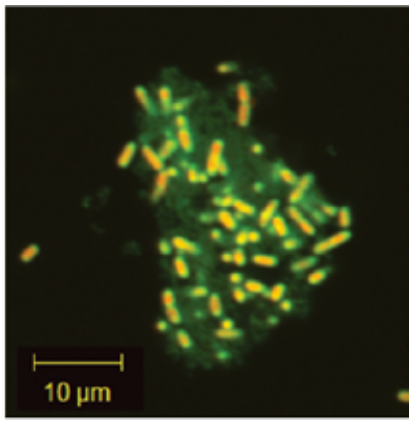
"The complexity and sophistication of biological materials design in nature has always been the envy of humankind," said Palermo. "Today, materials scientists can leverage these design principles – from the macroscopic down to the molecular level – and apply them to the remarkably diverse pallet of synthetic materials. The ultimate goal is to vastly broaden our scope of capabilities in a broad range of high-performance technologies."

The NSF award will support research designed to enable human control over the interaction between plastics and harmful bacteria to create surface coatings that kill germs on contact and prevent the accumulation of harmful biofilms on surfaces. Applications of these new materials could include self-cleaning ship hull coatings to reduce drag, pipe-flow inner linings to prevent biologically induced corrosion, and infection-preventing catheter devices for use in hospitals.

Involving graduate and undergraduate students in the research is an integral part of the grant. Palermo also has created a program for middle and high school students to visit campus, learn concepts in biology and materials science, and share their knowledge on social media.

Palermo joined the Rensselaer faculty in 2014. He earned his B.S. in mechanical engineering at Cornell University in 2006 and his Ph.D. in macromolecular science and engineering at the University of Michigan in 2011. He was a postdoctoral researcher in the Chemistry Department, also at Michigan, before coming to Rensselaer. In 2016, Palermo won a 3M Nontenured Faculty Award (NTFA) and an NSF grant (CHE-MSN) for "Photochromic Switching for Nanostructured Polymer Gels," in collaboration with Chaitanya Ullal. In 2017, he also received a Doctoral New Investigator Award from the American Chemical Society Petroleum Research Fund (ACS PRF).





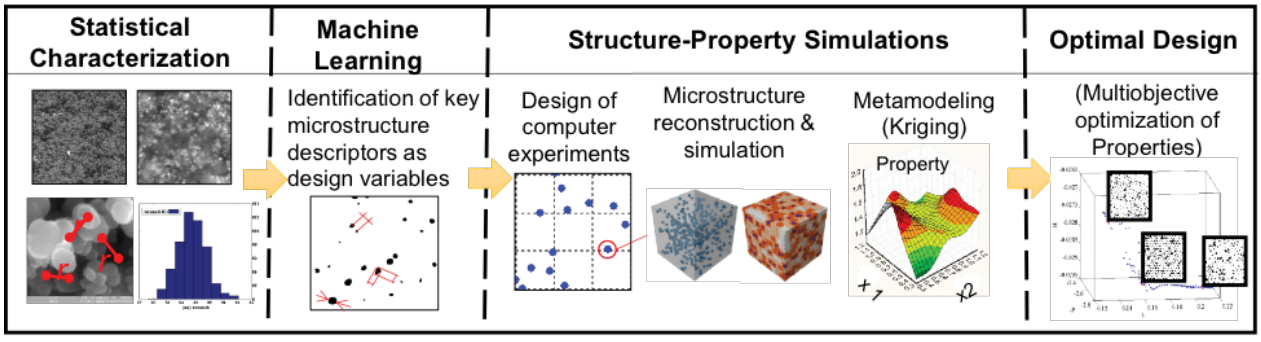
Ergene and Palermo, *Biomacromolecules*, **2017**, DOI: 10.1021/acs.biomac.7b01062

NEW RESEARCH DIRECTIONS VIA NSF DMREF

MSE faculty lead two new programs as part of the Designing Materials to Revolutionize and Engineer our Future (DMREF), funded by the National Science Foundation

Linda Schadler, Vice Provost and Dean of Undergraduate Education and the Russell Sage Professor in Materials Science and Engineering, leads DMREF program on "A Data-Centric Approach for Accelerating the Design of Future Nanostructured Polymers and Composites Systems". The program will tailor polymer nanocomposites with a data-driven design approach to simultaneously optimize for multiple properties, such as dielectric response and mechanical durability, a combination currently not achievable but necessary for high voltage electrical transmission and conversion. Co-investigators include our recently hired expert in electronic-level calculation, Prof. **Ravishankar Sundararaman**, two other RPI researchers, and collaborators from Northwestern University. The four-year effort will total $1.6 M in funded research across the two institutions.

Robert Hull, Henry Burlage Jr. Professor of Engineering and Director of Center for Materials, Devices, and Integrated Systems, leads DMREF on "*Adaptive Control of Microstructure from the Microscale to the Macroscale*". The program will develop combinations of experimental, computational and process control methods to actively control processing of advanced metals, to achieve the target microstructures that are predicted for optimized performance. The program will be enabled by synthesis of experimental characterization, process control, and microstructure simulation. MSE Prof. **Daniel Lewis** and two other RPI faculty are co-investigators on the program. The five-year effort will total $1.5 M in funded research at RPI.



Microstructural analysis and optimization Framework

FACULTY NEWS

NSF MRI GRANT ESTABLISHES SUPER-RESOLUTION CENTER AT RPI

Chaitanya Ullal is lead PI on an NSF MRI that was funded to purchase a super-resolution microscope (Leica STED) that will serve as the super-resolution center in the New York Capital Region. STED microscopy creates super-resolution images that will enable interdisciplinary research. Twenty-five investigators across four institutions will use the instrument heavily, representing fourteen different Departments/Centers. Areas of research enabled include the study of cellular adherents and cellular permeability, STEM cell research, smooth muscle cell development, intracellular molecular interactions, endothelial cell development, and functional characterization of presynaptic terminals at small central synapses.

Outreach efforts include Black Family Technology Awareness Day; the High School Summer Research Program and the LSAMP Summer Research Program; the annual Science, Technology, Arts, and Architecture at Rensselaer Program that reaches out to talented underrepresented minorities and young women.

HONORS & AWARDS

Pawel Keblinski is a recipient of the Marie Sklodowska-Curie Fellowship to support his sabbatical at the Polish Academy of Sciences at Warsaw.

Minoru Tomozawa is a recipient of the Jerome Fishbach Faculty Travel Grant to give a talk at the Turner Legacy Symposium in Sheffield, UK.

Ed Palermo was honored to serve as a visiting instructor at Nanjing University in China, summer 2017, where he taught a short course on polymers for undergraduates.

Liping Huang was appointed Secretary of the *American Ceramics Society* Glass & Optical Materials Division Executive Committee.

Rahmi Ozisik will do a sabbatical at Oden Technologies in New York City to implement artificial intelligence/machine learning.

Dan Lewis has been named as a distinguished, international academic visitor to the University of Canterbury in Christchurch, NZ.

RAMANATH NAMED FELLOW OF APS

GANPATI RAMANATH, THE JOHN TOD HORTON '52 PROFESSOR OF MSE AT RPI, HAS BEEN NAMED A FELLOW OF THE AMERICAN PHYSICAL SOCIETY (APS).

Nominated by the APS Division of Materials Physics, Ramanath was cited for "creative approaches to realize novel properties in bulk nanomaterials fabricated from nanocrystal building blocks and molecularly tailored interfaces; and uncovering atomistic and electronic structure-level mechanisms of property enhancements."

Ramanath focuses on developing a fundamental understanding of structure-processing-property relationships in nanomaterials and interfaces for applications in energy and electronics. He has published more than 160 articles in top journals including *Nature, Science, Nature Materials,* and *Advanced Materials* and holds nine U.S. patents. His work has been cited more than 7,250 times. He serves as an editor of *IEEE Transactions on Nanotechnology* and is an editorial advisory board member for the *Journal of Experimental Nanoscience*.

TWO NEW HIRES: PROFESSORS OF PRACTICE (POP)

Kathryn Danneman is pleased to return to her home state of NY and her *Alma Mater* RPI after 20 years in San Antonio, TX. In 2017, she was named Director of the O.T. *Swanson Multidisciplinary Design Laboratory* and PoP in MSE. She holds materials engineering B.S. and M.S. degrees from RPI and Ph.D. from MIT (1989). She has 35 years of industrial research experience, including as Principal Engineer at Southwest Research Institute, Staff Metallurgist at the GE Global, Lead Engineer at GE Power Systems, and Research Engineer at Bethlehem Steel Homer Research Lab.

Kathryn is President of the Society for Experimental Mechanics, and Trustee and Fellow of ASM International.

John LaGraff joins our faculty as a PoP to coordinate and develop of our Intro MSE course, ENGR-1600. John has been at RPI since 2004 as an adjunct and lab coordinator, with concurrent appointments at Sienna College.

John earned his PhD in Ceramic Science from UIUC in 1992 and was a postdoc there for 5 years. He has worked at TRW Space and Defense (now Northrup Grumman) and GE Global R&D. He has co-authored 30 publications and has 8 patents.

Outside of work, he enjoys opera, running, hiking, biking, snowshoeing, power yoga and recently finished his Adirondack Winter 46r. He has three sons in college.

Kathryn Danneman

John LaGraff

STUDENT NEWS

Haoxue Yan, MSE class of 2017, is among a select few students inducted into the ***Rensselaer Phalanx Society***.

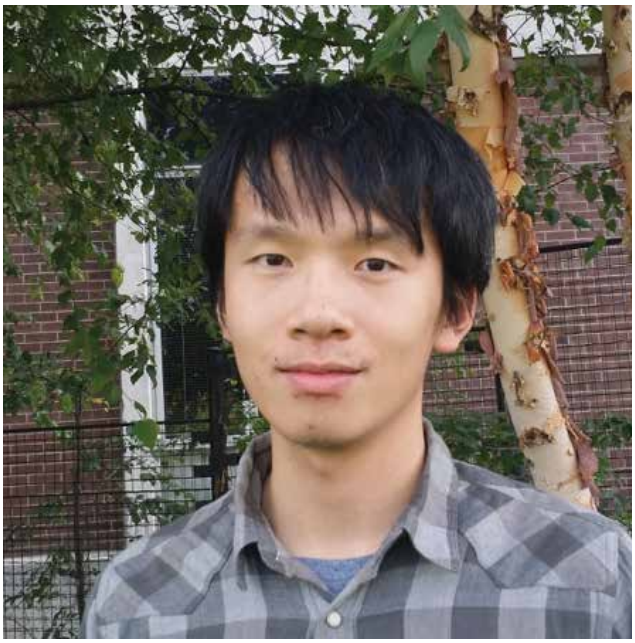
The prestigious membership is awarded to "honor and recognize leadership and dedication to improving life at Rensselaer." Haoxue was also one of seven students from the five schools at Rensselaer, who was identified to "share first person voice representing the Class of 2017" on Commencement Day in May. Her profile story is highlighted here: https://youtu.be/TJC3P-1vfIs.

From Xi'an, China, she came to RPI after an exchange program at the Laurel School in Cleveland Ohio. At Rensselaer, she achieved the highest GPA of all MSE undergraduates in her class, and she performed outstanding research in the laboratory of Prof. **Ying Chen**. She was first author on a publication in *International Journal of Fatigue* in 2017 and second author on a paper in *Scripta Materialia* in 2016.

Beyond academics, Haoxue carved out time for numerous groups on campus, including the Center for Initiatives in Pre-College Education (CIPCE), Material Advantage (MA), Center for Communication Practices (CCP), and the RPI Outing Club. During her tenure as the Chair, the RPI MA was recognized as the ***Most Outstanding Chapter*** in the nation for "overall excellence in chapter programming, career development, service, social activities, and chapter management." This fall semester, Haoxue will begin her Ph.D. studies in materials engineering at MIT and she hopes to become a professor one day!

MATERIAL ADVANTAGE
"MOST OUTSTANDING CHAPTER"

During the 2016-2017 academic year, Material Advantage continued to represent all that embodies materials science and engineering (MSE) at both RPI and the neighboring community. The RPI Material Advantage Executive Board has hosted a variety of events, touching on networking, community, outreach as areas of focus. The chapter has worked with industry speakers and professionals in the area for professional development events. In addition, social events for the community were hosted as means to relieve stress and connect with members of the MSE department as well as other departments at RPI. Outreach volunteers were trained on new demonstrations and sent out to represent RPI and teach at local events in the community, reinforcing ties with schools in the area as well as working to form new ties and create new opportunity. Further, Material Advantage has worked to ensure attendance and participation in the Materials Science and Technology conference in Salt Lake City, UT. With participation in the ASM Geodesic Domes Design Competition ("Domes Day"), the Undergraduate Student Poster Contest, and Undergraduate Student Speaking Contest, Material Advantage proudly supported RPI students. The RPI Team was awarded fourth place for their steel dome in "Domes Day", now displayed in the Fritz Lenel Lounge. Furthermore, undergraduate student Justin Weinstein received an honorable mention in the Undergraduate Student Poster Contest. Furthermore, Material Advantage proudly received the award for Most Outstanding Material Chapter among hundreds of candidates. Material Advantage hopes to continue this success in the upcoming academic school year.



YIPING WINS RPI PRESIDENTIAL GRADUATE RESEARCH FELLOWSHIP

Yiping Wang, co-advised by Professors Jian Shi and Shengbai Zhang (Physics Department), has been awarded a Rensselaer Presidential Graduate Research Fellowship for the 2016-2018 academic years. Yiping will carry out a project on "Controlling Electron-Electron Correlation in Doped Rare-Earth Nickelates for High-Performance Catalysis." The objectives of this research project are to fundamentally understand the roles of electron-electron correlation in strongly correlated complex oxides on oxygen reduction/evolution catalysis and engineer complex oxides' catalysis performance by controlling the electron-electron correlations.

Yiping joined Dr. Jian Shi's research group in August 2014 as a graduate student. He received his bachelor of engineering degree in Materials Science and Engineering at Shanghai Jiao Tong University in June 2014. Over the past three years, Yiping Wang has made significant research achievements in several research areas. At RPI, he has co-authored 17 peer-reviewed journal publications, which is already a tremendous success considering his short career as a materials science researcher. His works on the topics of elastic strain engineering and epitaxy of emerging metal halides were published (as first author) in *Advanced Materials, Nano Letters, ACS Nano, Applied Physics Letters,* and *Crystal Growth & Design.*

Litao Zhao was elected president of the Society for Asian Scientists and Engineers (SASE). He graduated from RPI in 2017 and is now at Accenture in NYC.

Matthew Rand (class of 2020) currently serves as 128th President of the Union and has won the *Charles D. Dyce Award* for scholastic ability, extracurricular activity, and leadership potential.

Genevieve Kane was recognized by the Society for Women Engineers (SWE) with an *Outstanding Collegiate Member Award*.

UNDERGRAD SPOTLIGHT

ELIZABETH VEILLETTE

Elizabeth Veillette is pursuing her BS and MS degrees concurrently, working with Prof. David Duquette's group on deleterious phase formation in stainless steel welds. Elizabeth has held internships at General Electric, the Naval Nuclear Lab, Bettis Atomic Power Lab, and Knoll's Atomic Power Lab. She is active in Alpha Gamma Delta, was President of the RPI Ski & Snowboard Club, and also helped found the RPI Weightlifting Club.

STUDENT HIGHLIGHTS

MATERIALS STUDENTS INDUCTED TO THE ALPHA SIGMA MU SOCIETY.

Inductees: Baiwei Wang, Yuwei Guo, Yanming Zhang, Taylor MacEwen, Harlan Grossman, Yumeng Yue, James Male, Scott Peters, Matthew Fields, Peter Jones, Spencer Davis, Aaron Harmon, Yvonne Marcoux, Yue Zhai, Naomi Williams, Matthew Rand. Harlan Grossman and Ainsley Pinkowitz won scholarships.

Many of our brightest Materials Science and Engineering (MSE) students were inducted into the ASM Alpha Sigma Mu Society, during the 2017 Eastern NY ASM chapter awards ceremony. Alpha Sigma Mu is an international professional honor society dedicated to encouraging and recognizing excellence in the materials engineering field. Members consist of students, alumni, and other professionals who have demonstrated exceptional academic and professional accomplishments. Student members are selected on the basis of scholastic standing, character and leadership. We congratulate the following students who have been inducted to the Alpha Sigma Mu Society.

2017 NORMAN S. STOLOFF AWARD

Siva Priya Jaccani (Huang group) and Matthew Kwan (Ramanath group) are the winners of the 2017 Norman S. Stoloff Research Excellence Award. The award is given annually to two MSE graduate students in recognition of outstanding research accomplishments.

Awardees with their advisers and Prof. Duquette, the award committee chairman

NEW COMMENCEMENT AWARDS

Department Head Prof. Pawel Keblinski is pleased to announce that two new commencement prizes have been established in spring 2017.

L-R: Rahmi Ozisik, Meeli Leith, Elizabeth Veillette, Amanda Moritz, Michael Moritz, Pawel Keblinski

THE ISTVAN S. MORITZ AWARD IN MATERIALS ENGINEERING (2017)

This award is given to a co-terminal M. Eng. student who has demonstrated academic excellence and outstanding service contribution. It was established by Meeli Leith, Rahmi Ozisik and the Moritz family, in memory of **Istvan S. Moritz**, a Materials Engineering co-term student who passed away unexpectedly on May 24, 2016, at the age of 22. He was scheduled to graduate on May 28, 2016 with a B.S. in Biomedical Engineering and an M.S. in Materials Engineering. The award of $ 1000 is given at the department's commencement dinner for the graduating class.

Award Recipient: ***Elizabeth Veillette*** *(B.S. Materials Eng. '17; M.Eng '17)*

THE DOREEN BALL-DIFAZIO AWARD IN MATERIALS ENGINEERING (2017)

This award is established in memory of **Doreen Ball-DiFazio**, a Materials Engineering alumnus who was also one of the first women graduates at Rensselaer to receive a Ph.D. in Materials Engineering in 1983. Through her inspiration and mentoring, her daughter, Jessica DiFazio, also graduated from Rensselaer with a B.S. and M.S. in Materials Engineering, in 2015. The annual award of $1000 is presented at the department's commencement dinner to a female senior or co-terminal student who demonstrates academic excellence and outstanding service.

Award Recipient: ***Kathryn Liotta*** *(B.S. Materials Eng. '17)*

L-R: Meeli Leith, Kathryn Liotta, Jessica DiFazio, Anthony DiFazio, Pawel Keblinski

GRADUATE **SPOTLIGHT**
YONGJIAN YANG

Yongjian Yang began his PhD at RPI in 2012, following a BS from Beihang University as well as stints at the *Arts et Metiers Paris Tech* in France and the University of Auckland, NZ. During his five years in our department, he worked with Prof. Yunfeng Shi on quantitative understanding of single-asperity contact using computational tools. He found that atomic wear is activated by mechanical agitation captured by effective temperature, in contrast to the widely-held hypothesis of thermal activation. His work has been published in Acta Materialia and he won first place for **best student poster** in the *Glass & Optical Materials Division* Annual Meeting of 2016.

IN MEMORIAM

ROBERT K. MACCRONE

Robert K. MacCrone, Professor Emeritus, passed away on October 27, 2016. He was born in 1933 and earned his B. Sc degree (Hons) in 1956 and M. Sc in Physics in 1967 both at University of the Witwatersrand in South Africa. His M. Sc. Degree advisor was Professor F.R.N. Nabarro. Professor MacCrone earned his D. Phil. Degree in Physics in 1959 at Oxford University in England. Then he came to the United States as a post-doctoral research associate at the University of Pennsylvania. His post-doctoral advisor was Professor Doris Wilsdorf. After working as an assistant professor from 1962-1967 in the Department of Metallurgy and Materials Science at the University of Pennsylvania, he moved to Rensselaer as an associate professor in 1967 and was promoted to a full professor in 1974, both at the Department of Materials Engineering of Rensselaer. He also held a joint appointment as a Professor at the Department of Physics at Rensselaer.

Professor MacCrone worked on dielectric and mechanical relaxations of various materials, including ceramics, polymers and glasses and authored over 100 publications. Also he studied magnetic properties of glasses containing transition metal ions in oxide glasses and found that transition metals are not uniformly distributed, making pairs, for example. Well known physicists such as N. Mott and H. Frolich praised his dielectric works. Professor MacCrone was also an excellent experimentalist, building various pieces of equipment, including an electron paramagnetic resonance spectrometer.

Professor MacCrone trained many Ph.D. graduate students and post-docs both at the University of Pennsylvania and Rensselaer. He retired in 1994. Even after the retirement, however, he continued as an active emeritus professor for several years. He was excellent in explaining difficult physics concept to graduate students, especially in private conversation. He was a Fellow of the *American Ceramic Society.*

WILLIAM B. HILLIG

William B. Hillig, a former Research Professor at the Department of Materials Science and Engineering of Rensselaer, passed away on September 17, 2017. He was born on October 3, 1924 and earned his BS Degree in chemistry in 1944, and his Ph.D. in Physical Chemistry in 1953 both from University of Michigan. Between the two degrees, he worked on the Manhattan Project, the Nation-wide war effort to develop an atomic bomb at both University of Chicago and MIT. From 1953 through 1989, he was a research and liaison scientist at the General Electric Corporate Research and Development Laboratory in Schenectady, NY. After his retirement from GE, he spent a year in Hamburg, Germany as an Alexander Humboldt fellow, and then joined the Department of Materials Science and Engineering of Rensselaer Polytechnic Institute as a research professor. At RPI, he spent approximately 10 years teaching and doing research on composite materials and advising some graduate students. He held 12 patents and authored more than 70 technical papers.

Professor Hillig was a world famous researcher on glasses in early part of his career and later on ceramic matrix composite materials. In particular, the Hillig-Charles theory of static fatigue of glasses by stress-corrosion mechanism was well-known since sixties and he was a fellow of the American Ceramic Society. Thus, I knew his fame, when we met for the first time in mid-eighties at an airport waiting for a connecting flight home. After a pleasant dinner together, Dr. Hillig thanked me for dining together: His good manner and humbleness impressed me immensely. Later, after he joined our Department at RPI, I found out other aspects of his character: his extreme generosity and helpfulness and careful thinking habit. Also, he came to RPI wearing an dashing bow tie in the beginning. I learned from a GE scientist that a bow tie was his trade mark at GE and at his retirement party there all the participants of the party came wearing a bow tie to express their solidarity.

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