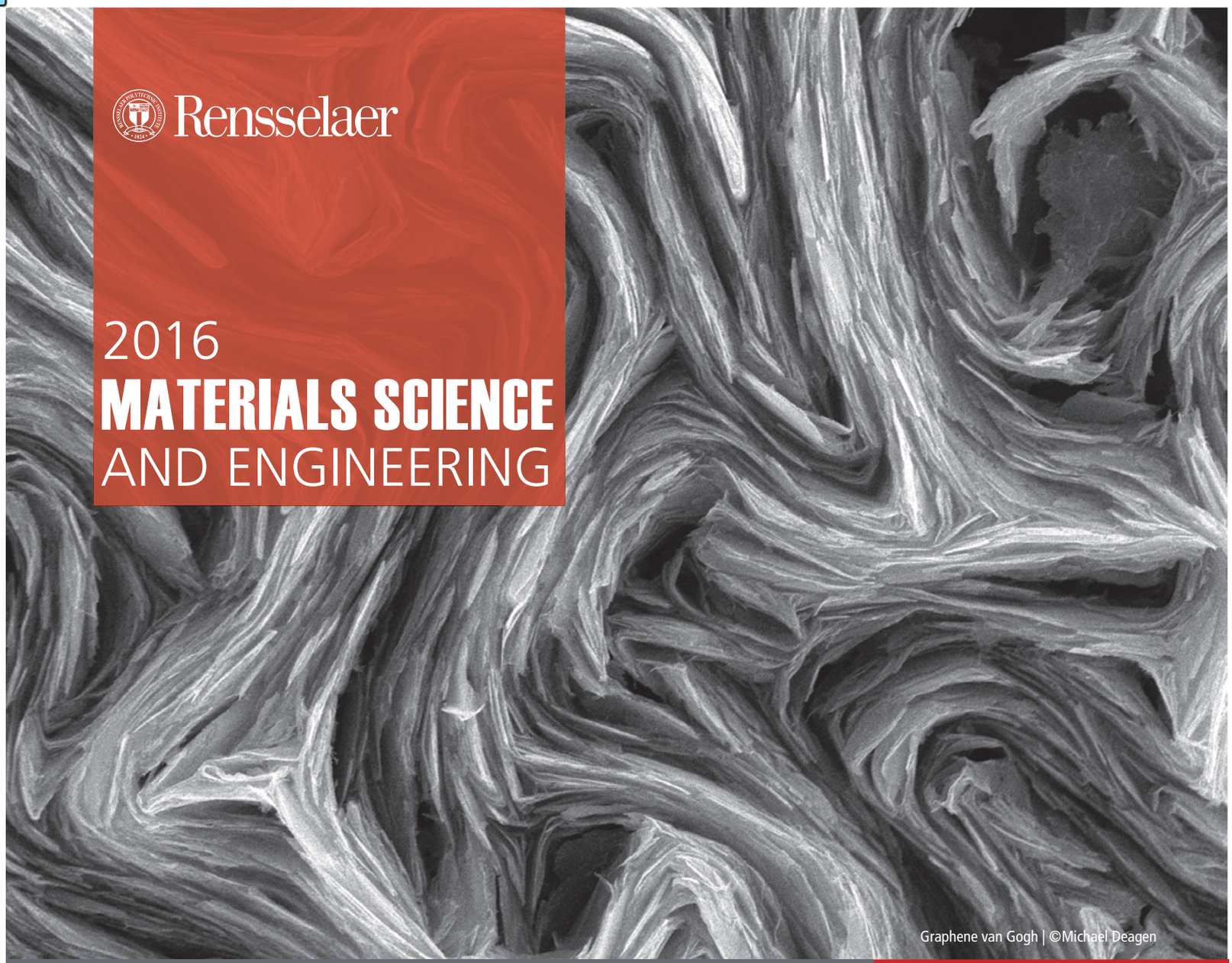
Rensselaer

2016 MATERIALS SCIENCE AND ENGINEERING



Graphene van Gogh | ©Michael Deagen

Pawel Keblinski

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

WELCOME

I AM DELIGHTED TO SHARE MY EXCITEMENT WITH YOU ABOUT THE EDUCATIONAL, RESEARCH AND COMMUNITY SERVICE ACTIVITIES THAT ARE ONGOING IN THE DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING AT RENSSELAER.

My enthusiasm is reinforced by the awareness that our success is a collective endeavor involving contributions from faculty, staff, students and alumni. In this issue of *MSE News*, you'll find many highlights of our recent achievements and developments within MSE community at Rensselaer.

Now in my second year leading the department, my appreciation for multiple aspects of the MSE community at Rensselaer has grown. I've throughly enjoyed working together to advance excellence and career

03 Excellence in Electronic Materials

09 Alumni

11 Faculty

13 Student

17 In Memoriam

mse.rpi.edu

WELCOME [CONT.]

opportunities for our students, creating opportunities for our faculty and staff, and fostering an integrated environment for work and social interactions. For example, inspired by the excellence in our ***Materials Advantage Chapter***, driven mostly by our undergraduates, I worked with our graduate students to formally develop the ***Materials Science Graduate Society.*** The new society provides a platform for professional development, student body representation, better communication between students and faculty, and community building efforts. Now in its formative stages, the society has already launched a successful monthly social event followed by student research presentations, and culminated with outdoor social activities for the whole MSE community. The society is working with faculty, introducing new pathways for student success at Rensselaer and beyond, including a student-student mentorship program mirroring our very successful faculty-faculty mentoring program.

In this issue of the MSE News, you will find many exciting stories. We will introduce our newest faculty member, Professor Ravishankar Sundararaman, who is working in the area of electronic structure calculations of solids and liquids with a focus on energy conversion applications.

And we also report on successes of our four existing assistant professors who are forging a path to advance the vibrancy, and research and educational prominence of our department. Our feature story is on electronic materials research, a traditional area of strength with a long history of excellence, now bolstering the future via the early successes of our junior faculty. We describe the ongoing successes of our research teams, including various awards and honors, external funding, and publications in top-notch journals.

You will also find inspiring stories about students and alumni. Tapan Desai, one of my past PhD advisees, shares his experiences with R&D development in the US and his recent move to India, where together with his wife and brother-in-law (both Rensselaer alumni), now lead a top global supplier of nickel based alloys. An MSE senior, Haoxue Yan, Chair of the Rensselaer Materials Advantage, shares her long list of achievements, which she secured just few years after she arrived alone from China to attend high school in the US.

Please enjoy these stories and feel free to share any thoughts, ideas and your own successes with us. As we celebrate the accomplishments of this past year, we look forward to many more years of excellence yet to come.

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

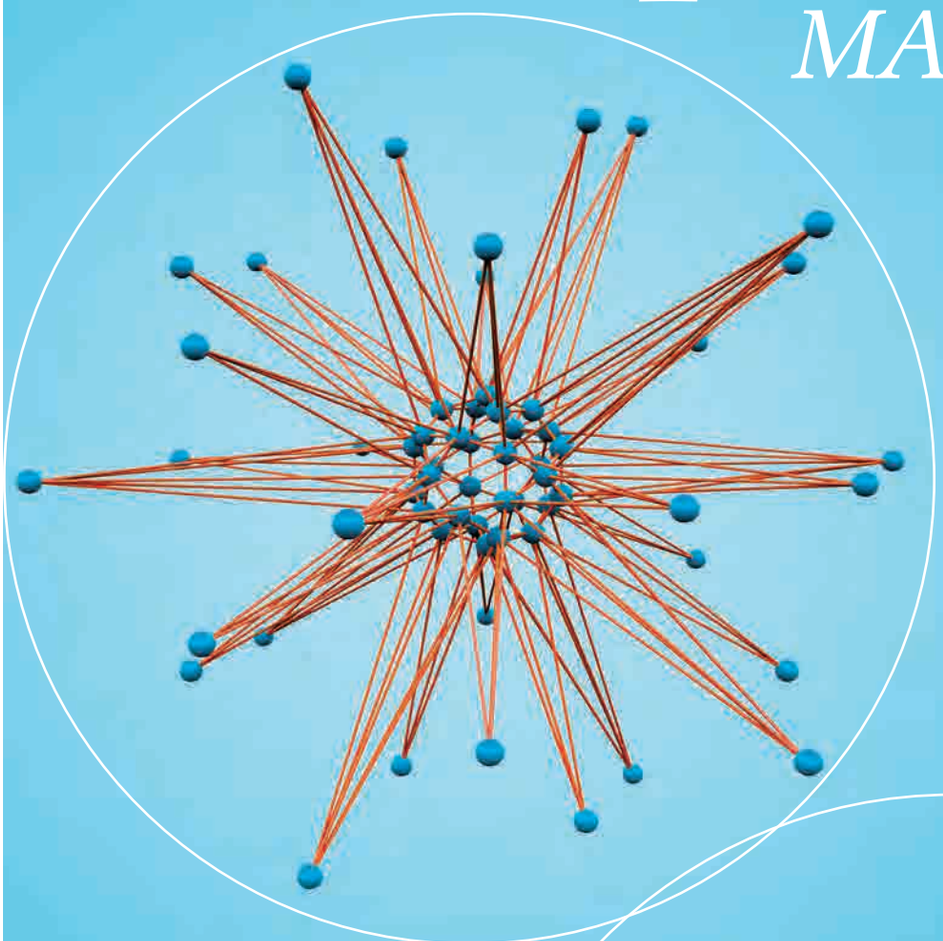
On the Cover. The beautiful image by graduate student Michael Deagen earned first place in the **2015 Artistic Microscopy International Metallographic Contest** sponsored by the International Metallographic Society. The image of rolled graphene was taken on our Versa Scanning Electron Microscope at 5000× magnification under a 20 kV beam. The image is strikingly evocative of the brushstrokes of a van Gogh painting.

CLASS OF 2016

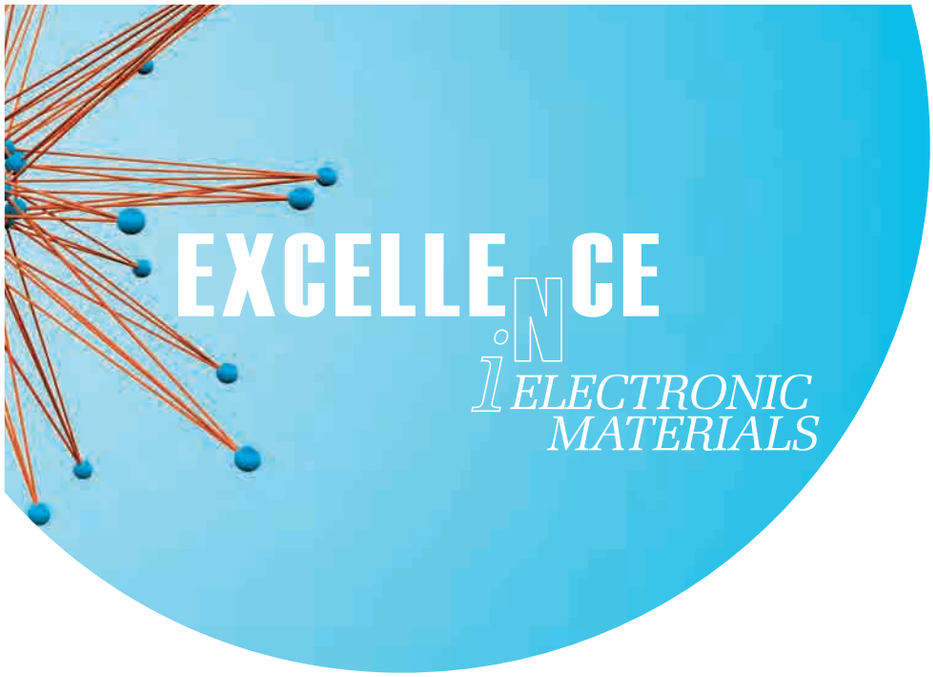
We wish the very best to our class of 2016! Students are bound for graduate school (Northwestern, Tufts, Columbia, University of Michigan, and University of Madison-Wisconsin) and industry (Exxon Mobil, Pratt & Whitney, Honda, Global Foundries, and many others).

Awards. Andrew Ehlers and Thomas Rebbecchi won the Matthew Albert Hunter Prize, for outstanding academic work. Sarah Straub won the Scott Mackay Prize, for time and effort in the service of others. Erin Evke won the Messler Design Award for her capstone project.

EXCELLENCE *in* ELECTRONIC MATERIALS



PAST, PRESENT, & FUTURE.



EXCELLENCE IN ELECTRONIC MATERIALS

PAST PRESENT & FUTURE

Rensselaer has a long history in research of electronic materials. From the early 1970's Professors Ghandi, Hickok and Gutmann of the ECSE Department were working on the processing of III-V semiconductor compounds in the MRC. While some work was being performed in this period by Professor Roger Wright on the development and processing of super-conductor wires and by Professor Robert MacCrone on the electronic properties of glasses and ceramics, it was not until 1980, with the establishment of the Center for Integrated Electronics (CIE) that Rensselaer became a major player in the field of electronic materials. Shortly after the establishment of the CIE the Department was fortunate in recruiting Shyam Murarka from Bell Labs in 1984, a leading authority in the area of on-chip interconnect technology. Professor Murarka was instrumental in recruiting Christoph Steinbruchel in 1989, an expert on dielectric compounds, and eventually in establishing and heading the Center for Interconnect Science and Technology (CAIST). That Center was co-founded with SUNY Albany and housed at Rensselaer, with major funding from the Semiconductor Research Corporation (SRC) , New York State, and a number of industrial partners including IBM. Professor Murarka is credited with being one of the early proponents of the replacement of aluminum interconnects with copper, a major breakthrough in increasing the speed of modern computational platforms. The establishment of CAIST led to increased MSE departmental electronic materials activities with Professor Duquette, working on chemical mechanical planarization and electrodeposition of copper interconnects, becoming the Associate Director of the Center and eventually Co-Director with Professor Lu of the Physics Department. In the late 1990's and early 2000's a significant increase in departmental activity in the electronic materials area occurred with the addition of Professors Keblinski, Gall, Lewis, Huang, Hull and Ramanath to the faculty, all of whom are working on some aspect of electronic materials science and engineering from first principle calculations to the processing of lead free solders for back-end connections.

PAST **PRESENT** & FUTURE

Today, our Department continues to advance the frontiers of understanding and controlling the electronic structure and property of new materials. Robert Hull, the Henry Burlage Professor of MSE and Director of the cMDIS, says "Advancing the field of electronic materials – whether to extend the almost miraculous progress of conventional microelectronics, or to enable entirely new systems and functionalities – has long been a focus of excellence at RPI and in the MSE Department." Approximately 30 professors from five Departments at Rensselaer focus their research primarily on electronic materials, encompassing faculty from Materials Science, Physics, Electrical Computer and Systems Engineering, Chemical Engineering, Mechanical Aerospace and Nuclear Engineering.

Henry Burlage Jr. Professor of Engineering and Director of Center for Materials, Devices, and Integrated Systems, Robert Hull

John Tod Horton Professor of Engineering, Ganpati Ramanath

John Tod Horton Professor of Engineering David J. Duquette

Associate Professor Yunfeng Shi

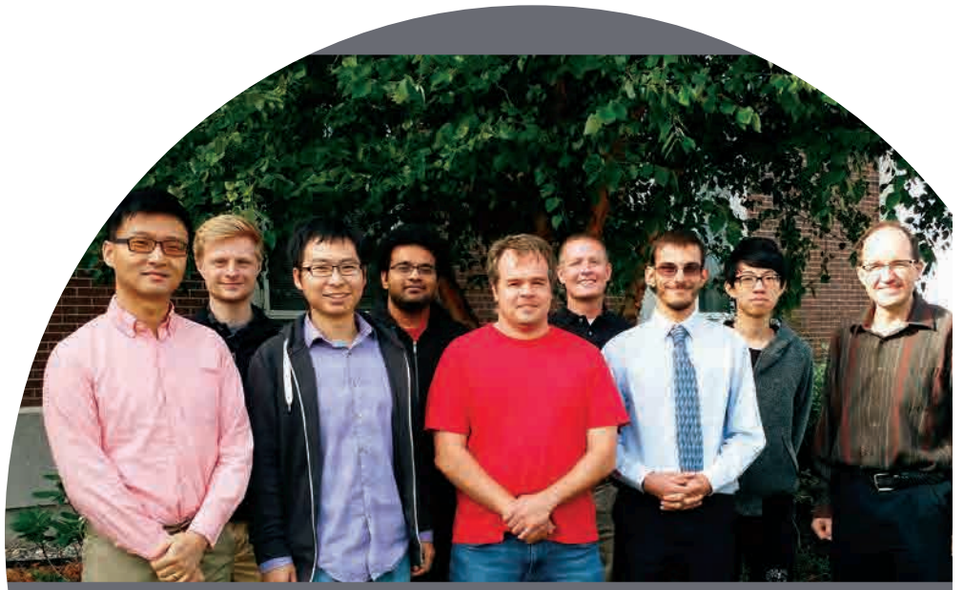
Professor Daniel Gall

One of our resident experts in electronic materials is **Professor Daniel Gall**, who joined the MSE faculty at Rensselaer in 2002. Gall has written over one hundred publications and has been recognized as a world-wide leader in the exciting fields of electron transport in metal nanowires and the electronic structure of nitrides. The Gall group develops an atomistic understanding for thin film growth and uses this expertise to create new materials with unprecedented atomic-level quality. He has discovered a new high-temperature corrosion-resistant semiconductor (scandium nitride) which is promising for switching devices inside combustion engines, a magnetic semiconductor (chromium nitride) which may reduce energy usage of future computer chips by orders of magnitude, and a piezoelectric nitride (aluminium-scandium nitride) which will allow more efficient frequency filtering in mobile devices. The Gall group also studies electron scattering in metal nanowires in order to determine the best material to replace copper as interconnect material in integrated circuits. Because of this work, he is frequently contacted by the leading semiconductor companies including Intel, IBM, Global Foundries, and Micron, who are constantly looking for a solution to the interconnect resistivity problem that limits the performance of future computer chips.

Professor Gall's research on novel transition-metal nitrides was identified as one of "the ***100 most important scientific discoveries*** during the past two and a half decades, supported by the US Department of Energy's Office of Science". He also won the 2006 Alfred H. Geisler Memorial Award for "Outstanding Contributions in Education and Thin Film Growth Research," the Faculty Early Career Development (CAREER) Award from the National Science Foundation, the 2007 Outstanding Research Award from the Rensselaer School of Engineering, the 2008 Early Career Award for "Excellence in Education and Outstanding Research in the Field of Thin Film and Nanostructure Growth," a 2008 IBM Faculty Award for research on "Post-CMOS Nanoelectronics," the 2011 NSF Ceramics Best Highlight Award, and the 2011 SPIE Thin Films IV Best Presentation Award. Professor Gall holds two US patents, has authored 3 book chapters and over 100 peer-reviewed journal articles, and has presented his research results in over 90 invited lectures in North America and Europe. His students won over 20 poster competitions, best paper awards, and best microscopy awards. Professor Gall's research is funded by the National Science Foundation, the US Department of Defense, the Semiconductor Research Corporation, the ACS Petroleum Research Fund, IBM, and the State of New York.

SELECTED PUBLICATIONS BY DANIEL GALL:

- R.P. Deng, B. Ozsdolay, P.Y. Zheng, S.V. Khare, and D. Gall, "Optical and Transport Measurement and First-Principles Determination of the ScN Band Gap," Phys. Rev. B 90, 045104 (2015).
- P.Y. Zheng, R.P. Deng, and D. Gall, "Ni Doping on Cu Surfaces: Reduced Copper Resistivity," Appl. Phys. Lett. 105, 131603 (2014).
- Mathieu Cesar, Daniel Gall, and Hong Guo, "Reducing the Grain Boundary Resistivity of Copper by Doping," Phys. Rev. Appl. 5, 054018 (2016).
- Pengyan Zheng and Daniel Gall, "Role of the Fermi Surface in the Anisotropic Size Effect of the Electrical Resistivity of Metallic Nanostructures," Phys. Rev. Appl., under review, (2016).

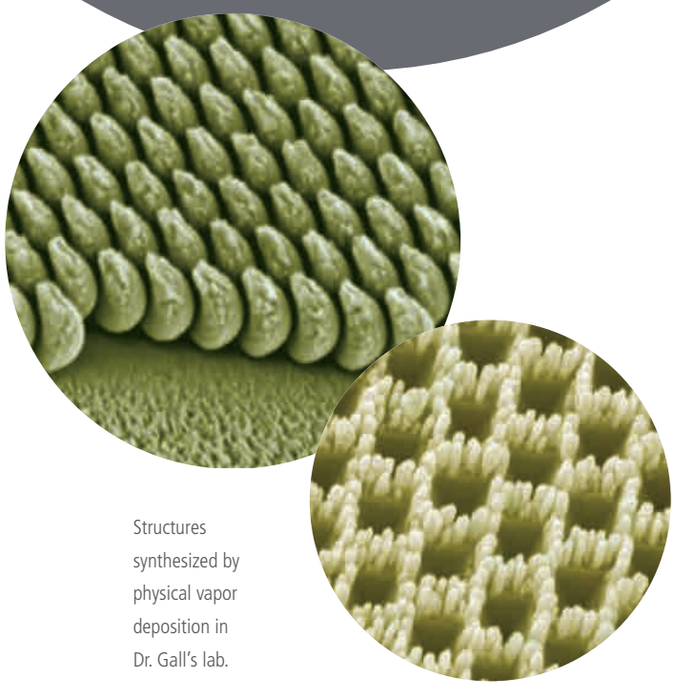


Daniel Gall received his Diploma from the University of Basel, Switzerland, in 1994, and his Ph.D. from the University of Illinois at Urbana-Champaign in 2000. He was a Visiting Scientist at the Frederick Seitz Materials Research Laboratory, Illinois, and a Visiting Professor at the Ecole Polytechnic Federal Lausanne. He has served as Assistant Editor and Editorial Board Member for Thin Solid Films, as Associate Editor for J. Vacuum Sci. Tech. A, as chair for the AVS Advanced Surface Engineering Division, as proceedings editor, session chair, symposium chair, and program chair for the AVS International Symposium and the International Conference for Metallurgical Coatings and Thin Films.

TOTAL NUMBER OF STUDENT AWARDS IS 34

SLECTED AWARDS

- P. Zheng, AVS Thin Film Division Graduate Student Award. This includes being a finalist for the James Harper Award Competition, Award presentation at the AVS Symposium, San Jose, CA, October 19, 2015.
- P. Zheng, Rensselaer's Founders Award for Excellence, Creativity, Discovery, and Leadership, October 24, 2015.
- Best Presentation Award, P. Zheng und D. Gall, "Ni and Ti Doping on Cu Surfaces: Reduced Metal Resistivity," AVS Hudson Mohawk Spring Meeting, Malta, NY, April 28, 2014.
- Best Paper Award, P. Zheng and D. Gall, "Ni and Ti Doping on Cu Surfaces: Reduced Metal Resistivity," Techcon 2014, Austin, TX, September 7-9, 2014.
- Best Paper Award, R.P. Deng and D. Gall, "Novel Al1-xScxN Alloy: A Study on Structure and Bandgap", Hudson-Mohawk AVS Fall Meeting, Albany NY, October 14, 2013.



Structures synthesized by physical vapor deposition in Dr. Gall's lab.

EXCELLENCE in ELECTRONIC MATERIALS

PAST PRESENT & FUTURE

We envision a very bright future for research in electronic materials within our department, fueled by the outstanding productivity of our young faculty. Particularly, we are excited about the work of our new **Assistant Professor Jian Shi.**

Encompassing a broad range of topics in in materials science, the Shi group focuses on developing a fundamental understanding of atomic scale symmetry, the science and engineering of low-dimensional electronic and optical materials and their structure-property relationships, adaptive electronics and optics, and materials engineering for energy transformation. The Shi group is pioneering vapor phase epitaxy of halide perovskites - an emerging material system that is extremely promising for the optoelectronics industry. The Shi group has also advanced the forefront of elastic strain engineering of soft inorganic thin films and low-dimensional semiconductor materials lacking inversion symmetry. These emerging materials exhibit very exotic physical properties. The Shi group has made seminal contributions to the field of proton doping of strongly correlated nickelates and their applications in neuromorphic computing and solid electrolytes.

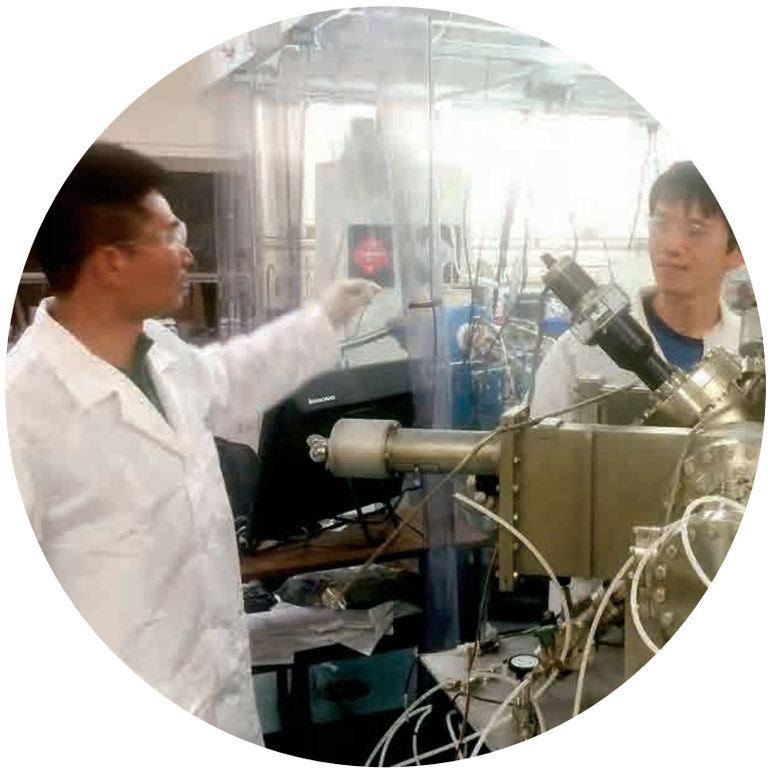
As a rising-star on campus and beyond, Jian has already published eleven journal articles in just two years since joining our ranks. Research from his independent career has appeared in such journals as *Advanced Materials, Nature, Nano Letters* and *Applied Physical Letters*. Jian's cutting-edge research has already attracted major financial investments from the National Science Foundation (already received two NSF grants as a PI), a clear endorsement of his emerging research program. Jian currently serves as a guest editor on *Journal of Materials Research*. For more information, please visit Jian Shi's group website: http://homepages.rpi.edu/~shij4/index.html

Assistant Professor Jian Shi

Dr. Jian Shi was a postdoctoral research fellow at Harvard University from 2013 to 2014. Supervised by Professor Shriram Ramanathan at Harvard, J. Shi's research focus was studying the electron doping properties f strongly correlated compounds and applying the understanding for neuromorphic computing. He received his Ph.D. degree in Materials Science at the University of Wisconsin at Madison in 2012, his M.S. degree in Mechanical Engineering at the University of Missouri at Columbia in 2008 and his B.S. degree in Materials Science and Engineering at Xi'an Jiaotong University in 2006.

"MSE researchers have helped established Rensselaer as a major force in this exciting and dynamic field. This has been recognized by multiple federal funding agencies, by New York State who have sustained a Focus Center at Rensselaer in this field for many years, and by major industrial partners, such as IBM who recently supported a major gift program to advance the field of electronic packaging at Rensselaer. Electronic materials is also a key focus of the new Rensselaer Center for Materials, Devices and Interdisciplinary Systems (CMDIS), which manages our state-of-art cleanroom and characterization facilities that help our faculty and students bring their ideas to fruition. With brilliant faculty like Jian Shi, Daniel Gall and their students, we look for a continuing stream of advances, discoveries and inventions."

—Robert Hull



SHI GROUP'S RECENT PUBLICATIONS:

- Wang Y, Seewald L, Sun Y-Y, Keblinski P, Sun X, Zhang S, Lu T-M, Johnson J, Hwang J, Shi J, Nonlinear Electron-Lattice Interactions in a Wurzite Semiconductor Enabled Via Strongly Correlated Oxide. Adv. Mater. 2016,in press.

- Wang Y, Shi Y, Xin G, Lian J, Shi J. Two-Dimensional Van der Waals Epitaxy Kinetics in a Three-Dimensional Perovskite Halide. Crystal Growth & Design 2015, 15, 4741.

- Wang Y, Sun Y, Zhang S, Lu TM, Shi J. Band Gap Engineering of a Soft Inorganic Compound PbI2 by Incommensurate Van der Waals Epitaxy. Applied Physics Letters 2016, 108, 013105.

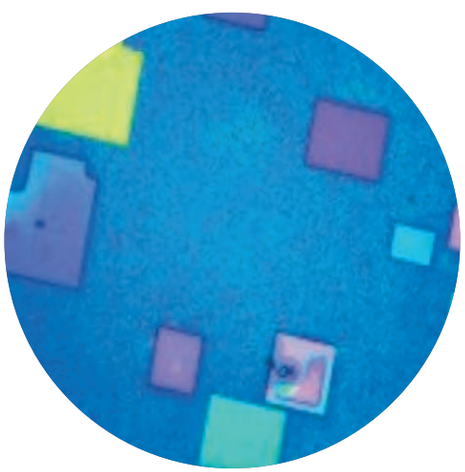
- Zhou Y, Guan X, Zhou H, Ramadoss K, Adam S, Liu H, Lee S, Shi J, Tsuchiya M, Fong DD, Ramanathan S. Strongly Correlated Perovskite Fuel Cells. Nature 2016, in press.

STUDENT AWARDS WON BY J SHI STUDENTS:

- Yiping Wang, Presidential Graduate Research Fellowship Program (PI: Jian Shi, Co-PI: Shengbai Zhang), RPI, 2016.

- Yiping Wang, Best Poster Award, Eastern NY ASM Meeting, NY, 2016.

- Yiping Wang, CFES Best Poster Award, Troy, NY, 2015.



Van der Waals epitaxy of halide perovskites synthesized in Dr. Shi's lab.

ALUMNI NEWS

ALUMNI
SPOTLIGHT
TAPAN DESAI'05

ACADEMICS, GOVERNMENT, AND INDUSTRY RESEARCH – DESAI DOES IT ALL!

Tapan Desai graduated from Rensselaer in 2005 with a Ph.D. in Materials Science and Engineering. His work focused on developing a fundamental understanding of polymer dynamics in nanocomposites using molecular-level computational simulations, under the guidance of Professor Pawel Keblinski. After graduation, he studied ionic liquids at Argonne National Laboratory and nuclear fuel materials at Idaho National Laboratory (INL). For 3 years at INL, he performed simulations based on scalable first principles molecular-dynamics (MD) models to predict how fuel and cladding materials will behave in the core of a nuclear reactor. Later, he joined a defense contractor company, Advanced Cooling Technologies, Inc., in Lancaster, PA as a Research Engineer. Within first 6 months of his joining the company, he received grants on his innovative proposals on "Ablative Materials Development for Heat Shields in Space Vehicles" by NASA SBIR (Small Business Innovative Research) and for Insulation Materials in Rocket Motor Engines by NAVAIR STTR (Small Business Technology Transfer Research). In the following years, he received funding to perform research in different areas such as software development for semiconductors, thermoelectric heat recovery systems, novel low-cost solar collectors for water heaters, hybrid solar coal gasification systems, nanoscale corrosion resistant coatings, nanofuels, pumped two-phase cooling for high energy laser systems, etc. from Army, Navy, Air Force, DOE, DARPA and NSF. He quickly rose through the ranks to Lead Engineer and then to R&D Manager within 4 years of his joining date. He was responsible for generating external R&D funding of around $5 million every year. In addition to performing research, he also commercialized several R&D technologies that are currently being incorporated by Advanced Cooling Technologies' customers.

Tapan joined the Materials Department of Rensselaer after B.S. and M.S. in Chemical Engineering with a desire to learn something new. He had to audit and take a lot of undergraduate courses to prepare for the Ph.D. qualifying examination. He also clearly remembers the help and support received from the other Ph.D. students. These interactions built camaraderie that was helpful throughout his Ph.D. and later, for technical and personal brainstorming. In addition to students, many professors were generous to help by conducting personal mock oral examinations. This creates an open environment between all students and professors, where innovative solutions are sought by understanding the governing fundamentals, deriving hypothesis and then performing simulations and experiments. Tapan believes Rensselaer education promotes its students to be free, innovative thinkers and remove the words "Not Possible" from the dictionary (as long as thermodynamics and kinetics say "Possible"). At Rensselaer,

TAPAN CREDITS HIS INNOVATIVE RESEARCH AND TECHNICAL WRITING SKILL TO HIS RENSSELAER MENTORS

he started publishing his articles in high profile peer-reviewed research journals. He continued publishing in his subsequent positions and now has over 50 publications in different research focused journals such as *Physical Review Letters, Applied Physics Letters, Scripta Materialia,* and many others. He has received about 1,000 citations for his research articles in renowned journals, including *Nature* and *Science*. He credits the training required for all these publications, which includes performing innovative research and good technical writing skills, to the mentorship received at Rensselaer.

Currently, Tapan is the Director at JLC Electromet (JLC) developing high performance nickel-based alloys for lighting, heating, soft magnetic, automotive, electronics, and welding industries. JLC is one of the world's leading manufacturers of nickel-based alloys in wire and strip forms, from melting stage, with a product line covering hundreds of alloys. He considers himself fortunate as throughout his career he has been associated with varied areas of Materials Science and Engineering such as polymers, nuclear fuel, metals, ceramics, and semiconductors. He has been able to apply his Rensselaer education on a daily basis throughout his professional career. At JLC Electromet, the other Company Directors are also Rensselaer Materials Alumni, his wife Chitra Baid (B.S. '02 and M.S. '04) and his brother-in-law, Naveen Baid (B.S. '97 and M.E. '98). JLC Electromet is currently exporting to 50+ countries and the next goal for this Rensselaer Materials alumni team is to take JLC Electromet to become one of the top 3 companies in the world for nickel alloys.

What does the future hold for Tapan and his family of business-owners? One can only speculate, but we know that he stands on a solid foundation of skills and knowledge in materials science, gleaned from his training at Rensselaer and beyond. We know that he will continue to do what needs to be done in any given environment!

FACULTY NEWS

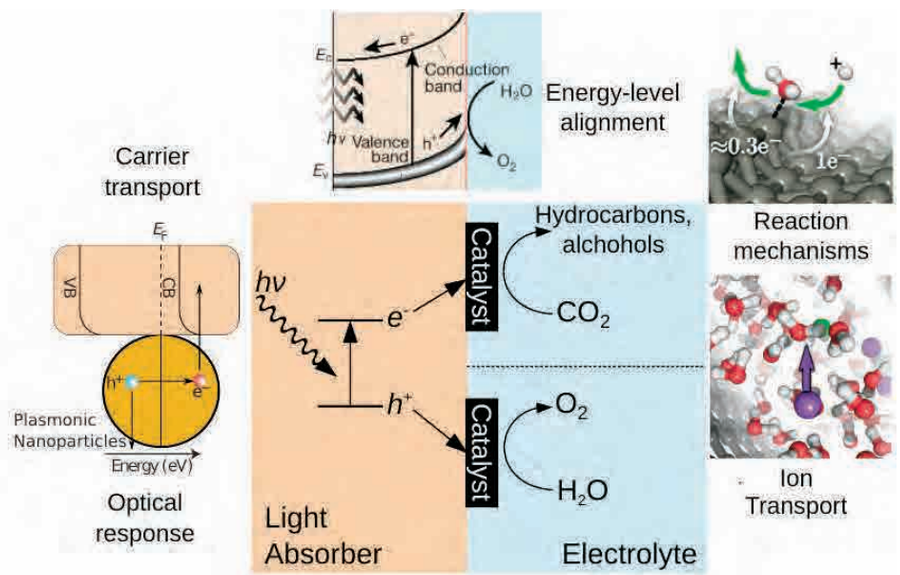
We are enormously pleased to welcome our newest tenure-track faculty member, Assistant Professor Ravishankar Sundararaman ("Shankar" for short) to MSE at Rensselaer. He is now the fifth young faculty member to join the department in five years, underscoring the rapid expansion of our vibrant interdisciplinary team of faculty members.

After growing up in crowded Mumbai, Shankar got exposed to the great outdoors only during his graduate studies at Cornell in upstate New York. He spent most of his summer weekends bicycling around the lakes in the finger lakes region, and later in the mountains of Southern California. He also enjoys hiking and plans to resume the pursuit of becoming an Adirondack 46er, now that he has moved back to this region. Additionally, Shankar dabbles in bread making and classical piano.

Shankar received his Ph.D. in Physics from Cornell University in 2013, where he worked with Professor Tomas Arias on the development of computational methods based on density-functional theory (DFT) to predict properties of electronic materials in liquid environments, with applications to battery and fuel cell materials. As a postdoctoral scholar at the Joint Center for Artificial Photosynthesis, a collaboration between California Institute of Technology and Lawrence Berkeley Laboratory, he worked with Professor William Goddard III and Professor Harry Atwater on using DFT-based calculations to predict light-matter interactions and electronic transport in photo-electrochemical and plasmonic systems for solar energy conversion. He has co-authored 25 peer-reviewed publications in premier journals such as *Nature Communications, Nano Letters,* and the *Journal of the American Chemical Society.* Outside of the lab, Shankar dabbles in bicycling, baking and piano.

Shankar's research group at Rensselaer will develop "ab initio multi-physics" methods: techniques to quantitatively predict the properties of nanoscale systems starting from quantum simulations of electrons in materials, and use these methods to design nanoscale materials with properties inaccessible in conventional materials for applications including electronic devices, sensing, energy conversion and storage. Initial research directions will include the capture of non-equilibrium excited electrons in metallic nanostructures for efficient plasmonic solar energy conversion, manipulation of ion transport and electron transfer in nanoconfined liquids for super-capacitors, and new DFT methods that are simultaneously accurate and efficient for nanoscale systems.

Shankar is now actively recruiting talented graduate students and postdoctoral scholars who are motivated to combine fundamental physics and chemistry with high-performance computing to solve challenges in nanoscale material science. For more information, contact Shankar at sundar@rpi.edu, check the group website at http://abinitiomp.org or the website http://jdftx.org of the open-source DFT software project led by this group.



HONORS & AWARDS

Pawel Keblinski

Pawel Keblinski was named Associate Editor of the *Journal of Applied Physics*.

Linda Schadler

Linda Schadler, was elected to the Class of 2016 Materials Research Society (MRS) Fellows, "for seminal research in the field of polymer nanocomposites and for leadership in materials education".

Richard Siegel

Richard Siegel was elected Fellow of the American Institute for Medical and Biological Engineering (AIMBE).

Minoru Tomozawa

Minoru Tomozawa received the Samuel R. Scholes Memorial Lecture Award at Alfred University, College of Ceramics and Inamori School of Engineering.

YOUNG FACULTY MAKING THEIR MARKS.

2016 was a productive year for our Assistant Professors, who have all begun to establish their research labs, generating exciting results and attracting external investments from industry, private foundations, and government agencies.

Chaitanya Ullal

Chaitanya Ullal who joined us in 2013, received a Doctoral New Investigator Award (DNI) from the American Chemical Society Petroleum Research Fund (ACS PRF) for his proposal entitled "Resolving the Impact of Mesoscopic Heterogeneities on the Mechanical and Transport Properties of Gels". Additionally, his work is supported by the National Science Foundation (CHE-MSN) and Performance Indicator LLC.

Ed Palermo

Ed Palermo, who joined us in 2014, was selected for a 3M Nontenured Faculty Award (3M NTFA) for his research project entitled "Bioresponsive Polymers as Anti-fouling Coatings". His work is also supported by the NSF (CHE-MSN) and the Army Research Office (ARO).

Jian Shi

Jian Shi, who joined us in 2014, has already published an impressive 11 peer-reviewed journal articles in the first two years of his independent career! His work on "Modification of Soft Inorganic Thin Films through the use of van der Waals Epitaxial Strain" has been supported by two recent NSF grants (CMMI).

Ying Chen

Ying Chen, came to Rensselaer from General Electric in 2012. In addition to her NSF CAREER award in 2014, she was recently awarded a Knowledge and Innovation Program (KIP) grant from RPI, for her proposal entitled "Nano-Chemo-Mechanics of Advanced Metals: An Integrated Multiscale Materials Design".

Many thanks to these Sponsors for investing in our next generation of outstanding faculty!

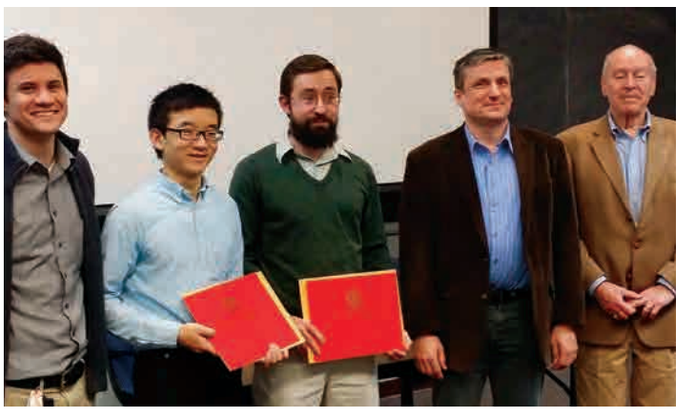
STUDENT HIGHLIGHTS

Pengyuan Zheng, a graduate student advised by Professor Daniel Gall won the 2015 American Vacuum Society (AVS) Thin Film Division Premier Student Award.

Pengyuan Zheng

Pengyuan received this award for the scientific novelty and importance of his research on electron scattering at the surface and interface of transition metals. Pengyuan has also been selected as one of the four finalists for the 2015 James Harper Award and competed in a TED-talk like contest in 2015 AVS International Symposium. Pengyuan has written six first-author publications and recently defended his Ph.D. thesis. His break-trough research demonstrated that one can lower resistivity of nanoscopic Cu lines by doping their surfaces and thus reducing electron-surface scattering. These results gained instant interest of a number of semiconductor companies, including *Micron Technology, Global Foundries, Applied Materials,* and *IBM* because of their large potential impact on integrated circuit manufacturing. After gradution Pengyuan joined continues Micron Technology as an advanced thin films implant development engineer.

2016 Norman S. Stoloff Research Excellence Award



Graduate students, Garth Scannell (advisor: Professor Liping Huang) and Yanhui Huang (advisor: Professor Linda Schadler), won the 2016 Norman S. Stoloff Research Excellence Award. The award is given annually to two MSE graduate students in recognition of outstanding research accomplishments, as evidenced by a submitted or published journal article in the past year. Each recipient receives a $500 cash prize and a certificate of the achievement.

The winners each gave a talk as part of the department spring seminar series, followed by the presentation of the awards by the committee. Yanhui presented a talk on "Understanding the Charge Dynamics in Dielectric Polymers and their Nanocomposites", and Garth disccused "Elastic Properties, Deformation Mechanisms, and Cracking Behavior of Na2O-TiO2-SiO2 Glasses".

UNDERGRAD SPOTLIGHT
HAOXUE YAN

Undergradauate materials science and engineering student Haoxue Yan won the Founders Award of Excellence at Rensselaer's 22nd Annual Honors Convocation in 2015. This honor was established in 1994 and is given to only 1% of the students who embody qualities of creativity, discovery, leadership, and the values of pride and responsibility at Rensselaer. Haoxue has a strong interest in metallurgy, with a particular emphasis on research efforts in Cu-Zn-Al shape memory alloys. In 2015, she co-authored a publication in *Scripta Materialia* under the guidance of Professor Ying Chen. As Chair of the Rensselaer Material Advantage Student Chapter, she has organized academic help sessions, industry speakers' series, and professional conferences. Haoxue has also taught K-12 students computer programming and basic materials science concepts. Haoxue also enjoys spending her weekends watching classic movies or exploring the outdoors.

RENSSELAER MATERIAL ADVANTAGE (MA) CHAPTER

Under the leadership of their executive board, the Rensselaer Material Advantage (MA) chapter continues to grow and engages students in the Materials Science and Engineering (MS&E) department by arranging networking events, offering socializing opportunities, organizing outreach in the community, holding General Body Meetings (GBM) with industrial speakers, sponsoring industry tours, and traveling to professional meetings and conferences. Rensselaer MA was rewarded with the Chapter of Excellence Award in recognition of the chapter's achievements at the 2015 MS&T conference in Columbus, OH, where 12 MA members attended. MA also thrived to reach out and recruit new students and won the Most Creative Recruitment Strategies Award for the ASM Spring Membership Challenge. Rensselaer MA also provides service and outreach to both local K-12 students and the Rensselaer campus. The goal of MA's outreach program, Material Buddies, is to spark future scientists' and engineers' interests in materials and expose undergraduate students to community service and outreach opportunities. In addition, Rensselaer MA focused on expanding MA to other majors as well as providing leadership development experiences for its members this year. Activities such as cultural celebrations, games nights, dreidel making events and the formation of a D-League hockey team brought the community together and built a causal atmosphere within the department. MA members' achievements were also recognized throughout the past year. 7 MA members were inducted into the ASM Alpha Sigma Mu Society earlier this year, while two undergraduates, Jiawei Tan and Thomas Rebbecchi, and graduate student Mark Durniak were awarded the Eastern NY ASM Chapter Academic Scholarships.

MATERIALS SCIENCE GRADUATE SOCIETY (MSGS)

For many years, our undergraduates have benefited from Materials Advantage, the premier student organization for MSE. When Department Head Pawel Keblinski took the reigns in 2015, he spearheaded the founding of a similarly successful program to meet the specific professional and social needs of the department's graduate student community.

It began in November 2015 with the introduction of the Graduate Student Seminar, a student-organized seminar series featuring presentations by graduate students across campus on topics related to their studies. For example, MS&E graduate students Yiping Wang gave a summary of his work and recent findings, while Thomas Cardinal offered a short lecture on modern vacuum technology. Through the seminar series, students have found a time and place to convene and discuss ideas with their peers.

The Materials Science Graduate Society (MSGS) was formally founded in November of 2015. The first draft of Bylaws was written and edited by graduate students Ainsley Pinkowitz, Thomas Cardinal, Timothy Krentz, and Prof. Pawel Keblinski. With the department's approval, this student group is an independent organization run entirely by the graduate students. The MSGS will coordinate social functions and professional development opportunities in conjunction with the professional societies in the department, as well as managing the Graduate Student Seminar. The MSGS bylaws were approved by vote at the department this summer. As part of an emerging summer tradition, the MSGS will host an annual summer picnic for faculty, students, and staff.

GRADUATE SPOTLIGHT
EMILY AALDENBERG

Emily Aaldenberg, a second year graduate student in the Department of Materials Science and Engineering, has been awarded a Corning Graduate Fellowship for four years beginning Fall 2016. Corning Inc. is the leading high-tech glass supplier and values education and research on glasses conducted at Rensselaer.

Emily is pursuing her Ph.D. under the guidance of Dr. Minoru Tomozawa, Professor of Materials Science and Engineering. Her research topic is surface stress relaxation of silica glasses. It has been discovered in the Glass Laboratory at Rensselaer that the surface of glasses exhibits much faster relaxation, promoted by a trace amount of water vapor in atmosphere compared to the bulk of the same glass. This phenomenon has been used to make stronger glass fibers and to explain various mysterious phenomena of glasses. For example, cover glasses of smart phones are strengthened by the process of ion-exchange. The strength of such glass can be reduced prematurely but its origin was unknown. Also, the strength of glasses, in general, decreases with the time of static loading in moist atmosphere and this phenomenon is known as static fatigue. But after a long time, the strength reduction stops and there is a limiting stress, below which glass does not exhibit the mechanical fatigue. This limiting low stress is known as the fatigue limit. There was no convincing explanation for these phenomena. Emily's predecessors convincingly demonstrated that the surface stress relaxation causes these mysterious phenomena. The objective of Emily's research is to clarify the details of the surface stress relaxation phenomenon and to establish the origin of other mysteries involved in silica glasses by applying surface stress relaxation.

MATERIALS STUDENTS INDUCTED TO THE ALPHA SIGMA MU SOCIETY.

Many of our brightest Materials Science and Engineering (MSE) students were inducted into the ASM Alpha Sigma Mu Society, during the 2016 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.

Graduate Students: Zhizhong Chen, Chelsea Ehlert, Cansu Ergene, Ao Liu, Jihui Nie, Aditya Prasad, Varun Sarbada, Harikrishnan Vijayamohanan, Yiping Wang. Seniors: Kathryn Liotta. Juniors: Ziyu Zhou, Jiawei Tan, Haoxue Yan, Litao Zhao. Freshmen: Krista Biggs, Fangchen Liu Jiawei Tan (junior), Thomas Rebbecchi (senior) and Mark Durniak (graduate) were the scholarship winners, selected by ASM Eastern New York based on their excellence in research and high levels of achievement.

STAFF
SPOTLIGHT
DENIZ RENDE

Deniz Rende, Manager of the Nanoscale Characterization Core, Center for Materials, Devices and Integrated Systems (cMDIS), received her B.S., M.S. and Ph.D. degrees from the Department of Chemical Engineering, Bogazici University (Istanbul, Turkey). During her PhD studies, she investigated the relationships between various diseases (such as diabetes, cardiovascular disease, and Alzheimer's disease among others) by looking into the relationships between the proteins associated with these diseases via an interaction network approach. After completing her PhD, she started working as a post-doctoral research associate at Rensselaer Nanotechnology Center, Rensselaer Polytechnic Institute, in 2010. Since then, her research interests have revolved around polymer nanocomposites, supercritical carbon dioxide assisted processing of polymer nanocomposites to produce nanoporous structures and magnetic nanoparticles. She has over 10 years of experience in undergraduate level chemical engineering laboratory courses. She actively participated in establishing and coordinating various undergraduate laboratories to be used in teaching general chemistry, physical chemistry and unit operations courses at the Department of Chemical Engineering, Yeditepe University, Istanbul, Turkey. She is also the co-author of a laboratory textbook "Colloid and Surface Chemistry – Exploration of the Nano World".

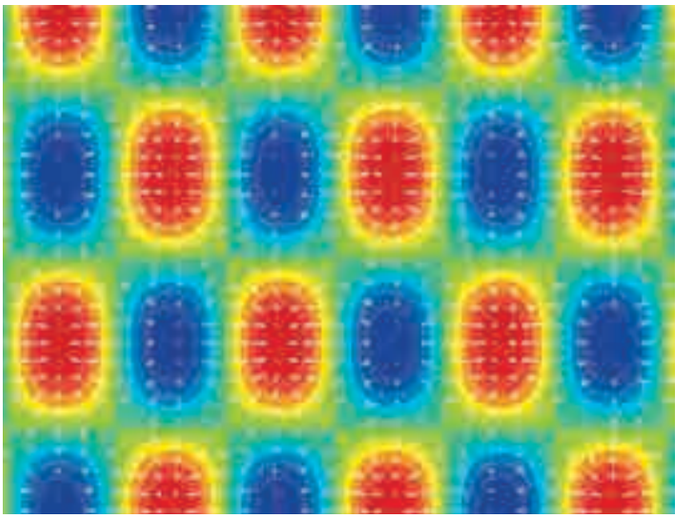
As a laboratory manager, she oversees the operations in Nanoscale Characterization Core and works with the researchers and graduate students on various surface characterization and imaging instruments: FEI Versa Dual beam SEM, Witec Confocal Raman Microscopy, Hysitron Nanoindenter, Bruker Atomic Force Microscopy. She enjoys working with researchers and participating in outreach activities that target high school students and women engineers. As a personal note, she likes to travel with her husband, Nihat Baysal (Department of Chemical Engineering) to nearby sites and art museums, to take photographs of contemporary art, to spend time with her cats and to read historical mystery. For Deniz, one has to savor life's simple pleasures, peace comes from within and art is everywhere.

COMMUNITY OUTREACH INNOVATION

MSE research is helping inspire future generations of engineers and scientists, particularly amongst students from underrepresented minorities. Professor Chaitanya Ullal is on the Board of Directors of the science education non-profit behind the "Curiosity Machine", an online learning portal, where scientists and engineers provide problem based learning and mentorship opportunities. The Curiosity Machine hosts modules that consist of household material based engineering design challenges that are suitable as activities at home; inspiration videos of scientists introducing research concepts; teacher and student guides; and questions that gauge understanding. Further active learning occurs when students submit video response to the challenges for engineering mentors to provide points, badges and interactive feedback. The modules draw on research from a number of leading universities such as Rensselaer, Yale, Duke, Stanford, UCLA, and USC, and engineering companies such as Boeing and Cummins. In 2015, 52,827 unique users spent an estimated 10,687 hours watching from the 150 videos on the site.

A family works on one of the research-based learning modules developed a RPI. The modules are widely accessible through the Curiosity Machine online portal.

CURRICULUM DEVELOPMENT



Professor Dan Lewis is deploying a new course entitled "Applied Mathematical Methods in Materials", (MTLE 4720) which will be taught in the Fall of 2016. Using examples from selected materials engineering topics, students will apply mathematical and numerical techniques, write code in Python, and develop interactive visualizations and written communication to synthesize their mathematical knowledge with their domain specific knowledge. The class uses examples from materials science and engineering core courses to introduce mathematical concepts and materials-related problem solving skills. Topics include linear algebra, eigenvalues and eigenvectors, tensor operations, symmetry operations, integral transformations, numerical methods and calculus of variations.

GRADUATE SPOTLIGHT
AINSLEY PINKOWIT

Ainsley Pinkowitz won first place in Graduate Poetry for the 2016 McKinney Writing Contest. The award was presented in conjunction with the Vollmer Fries Lecture by Pulitzer Prize winner, Steven Millhauser. Besides a $300 cash prize, Ainsley also received a special recognition for having won poetry prizes every year since she arrived at Rensselaer four years ago. She received a signed first edition copy of one of Mr. Millhauser's books. The title of Ainsley's winning submission is *It Was Easier to Love Before I Met Other Humans*. The work was a collection of seven poems focusing on a range of contemporary issues like terrorism, racism, and sexism, as well as more timeless phenomena like love, heartbreak, and nostalgia. Said Ainsley, "Suffice it to say I write from my own experiences but generally use my writing to stretch my brain outside of what I do for science, so when I get back to lab I'm feeling elastic again." Co-advised by both Dr. David Duquette and Dr. Robert Hull, Ainsley's research uses in situ liquid cell transmission electron microscopy to probe the initiation of pitting corrosion on aluminum.

IN MEMORIAM

CORNELIUS T. MOYNIHAN

Cornelius T. Moynihan, Professor Emeritus of Materials Science and Engineering, 76 years old, passed away on December 22, 2015 after a brief illness at St. Peter's Hospital. Dr. Moynihan received his B.S. in Chemistry from Santa Clara University in 1960 and both M.S. in 1962 and Ph.D. in 1965 both in Physical Chemistry from Princeton University.

Dr. Moynihan was assistant professor and associate professor in the Department of Chemistry at California State University at Los Angeles from 1964 to 1969. Then he was associate professor and professor at the Department of Materials Science and Chemistry at Catholic University of America between 1969 and 1981.

He joined Rensselaer in 1981 as professor of the Department of Materials Science and Engineering. Throughout his academic career, he specialized in amorphous materials (molten salts and inorganic glasses) and published approximately 180 scientific papers on various aspects of amorphous materials. In particular, he contributed to analyzing a complicated structural relaxation phenomenon of glasses and the most popular equations to describe the relaxation bears his name as "The Narayanaswamy-Moynihan-Tool relaxation formalism". He was a Fellow of the American Ceramic Society and was known for his high quality of research and through and rigorous teaching of thermodynamics.

Professor Moynihan is survived by his daughter, Kathleen Falls (Rensselaer '85), his son Timothy Moynihan (Rensselaer '95), his sister Sheila Moynihan Wilson, and his partner Maria Resnick. Connie loved a good joke and loved taking his children and later his grandchildren to any movie with a spaceship or an alien. He was often the center of many a party where he entertained with his guitar and repertoire that ranged from folk songs to bawdy ballads.

Minoru Tomozawa, December 2015

GEORGE W. PEARSALL

A beloved and inspirational member of our community, George W. Pearsall, passed away in February.

George was an Adjunct Professor in our Department, and a highly active member of our community, giving lectures, using our equipment, and providing generous support for a major recent acquisition, our Scanning Electron and Ion Environmental Microscope (without George the "Ion" part would not be there). He has provided a generous endowment for undergraduate research in our department. He received his BS from our department when it was the Metallurgical Engineering Department (class of '55), and re-established close contact about five years ago after he married Margaret (Peg) and started splitting his time between Troy, NY and Raleigh, NC. In one memorable early visit, George was telling me that as an undergraduate in the 50's he was in great demand for manual drawing of optical ray diagrams in microscopes, for which he had a particular talent. Sure enough on walking into the metallography laboratory, there, completely unscripted, was an early Pearsall c. 1955 depicting the optics of a light microscope, hanging on the wall (where presumably it had rested for over 50 years)!

George was internationally recognized for his work on material failure analysis and its relationship to product safety and design. After graduating from Rensselaer, he joined The Dow Chemical Company as a research engineer, before earning his doctorate at the Massachusetts Institute of Technology. He also served in the US Army in the Korean war. In 1964 he began his career at Duke, where he was twice Dean of the Pratt School of Engineering at Duke. He also helped found Duke's Program in Science, Technology, and Human Values, among many other lasting contributions. On learning of his death, university flags were lowered on the Duke Campus.

George was an outstanding engineer, an inspirational educator, a great supporter of our department, and a dear friend. We will miss him greatly, and our hearts go out to Peg for her loss.

Robert Hull, July 2016

ISTVAN S. MORITZ

It is with great sadness that we mourn the passing of one of our students. Istvan S. Moritz, of Lincoln, MA, died unexpectedly on May 24, 2016, at the age of 22. He was scheduled to graduate on May 28 with a Bachelor of Science degree in Biomedical Engineering and a Master of Engineering in Materials Engineering. Istvan was the son of Michael C. and Kathy (Lee) Moritz, and the youngest brother of siblings, Amanda, Megan and Manu. Istvan's degrees were presented to his family on May 26, 2016.

Istvan was a bright and productive student; he was interested in a variety of topics and was actively involved in research. His graduate research focused on controlling degradation of bioresorbable polymer implants via non-intrusive methods. He recently presented his research findings at the American Physical Society March Meeting in Baltimore, MD in March, 2016. He was also a member of the Phi Sigma Kappa Fraternity at Rensselaer and was actively involved in repurposing the St. Francis de Sales church on Congress Street, Troy, for use as Phi Sigma Kappa's new fraternity house.

Istvan was a valued and respected member of the Rensselaer community and will be missed by all the faculty, staff, and students who worked with him and cherished his friendship. A photo collage has been created in memory of Istvan Moritz and is displayed in the department student lounge, located in the first floor of the Materials Research Center (MRC) building.

Rahmi Ozisik, June 2016

POEM FOR ISTVAN S. MORITZ

by Ainsley Pinkowitz

I never expected to see you again.
There were three days until
two diplomas met
your single deserving hand
four handshakes ushered
your long walk across the stage.

I have the pictures
in my mind
what they should have looked like
you never updated facebook much but
I loved your whole class
you should have been there
a ghost peeking into the background
of every photograph.

You paid for an extra seat to your graduation dinner
before your own absence could be known
thirty-five dollars
one five, one ten
one twenty twisted into an origami heart
you never knew your parting gift
your tangible affection
for our community would be
an eternal memorial.

I never expected to see you again
I knew your face would peel off the board of active graduate
students your eyes squeezed against the sun
I made you face to take the picture.
I knew the student gym would be scrubbed
of every drop of salt your forehead spat.
I had accepted memories of you as archived
dissertation of our friendship.

I never expected to see you again
in person
but I have been robbed of a more believable ghost.
Some storied graduate:
my labmate would have
told me how you dodged that pine tree
as you both sleuced down Aspen's peaks.
My LinkedIn would have updated

New skills
New connections
Endorse Istvan.
I would have clicked on
Teamwork
Positive attitude
Plans ahead.

Istvan,
you could have been

But,
you aren't.

Yesterday in our department
a lab caught fire.
Smoke blossomed throughout the empty room
shrieking alarms heralded
the news of your passing
settling in the afternoon
like the dusky
scent of soot.

Today we threw the doors wide open.
All that entered
was the scent
of lilacs.

DOREEN J. BALL-DIFAZIO

Doreen J. Ball-DiFazio, 60, died Thursday, June 2, 2016 after a courageous battle with cancer. She was one of the first women graduates at Rensselaer to receive a Ph.D. in Materials Engineering in 1983. She was advised by the late Professor Ernest F. Nippes who is best remembered as the inventor of the Gleeble, a unique metallurgical tool that revolutionized materials research thermal simulations in the 1950s, and ultimately paved the way for more advanced physical simulation techniques

Doreen was the wife of Tony DiFazio, to whom she was married for 27 years. Born in Middletown, CT, she was the daughter of the late Eugene F. and Dorothy E. (Barrett) Ball. She had worked as a materials science engineer at Helix-Brooks Automation for 33 years where she made advancements in the field of cryogenic pumps. She was a member of the St. John's Choir, The Hopkinton Summer Band, and Chorus pro Musica of Boston. She served as a Girl Scout Leader for Troop 2235 and she was a boating enthusiast all her life. In addition to her husband, Tony DiFazio, she is survived by her daughters, Cristina A. DiFazio and Jessica M. DiFazio.

In addition to all of her tangible accomplishments, her greatest accomplishment was inspiring her children, Jessica and Cristina, and being a role model for others.

Jessica DiFazio, August 2016.

Statement from Jessica (Class of 2015):

My mom was the biggest role model in my life, she is the reason I became a materials engineer. As long as I can remember she would bring me to her lab and teach me how to use the SEM. Every year, she would come into my science class to do "The Cold Show" where she taught us about absolute zero, the Kelvin scale, coefficients of thermal expansion and glass transition temperatures. Seeing how much she enjoyed her job and all the knowledge she had about how things worked, inspired me to become a materials engineer at Rensselaer. I would not be the person I am today without her, and she inspired everyone she met to be better every day.

~

In addition to all of her tangible accomplishments, her greatest accomplishment was inspiring her children, Jessica and Cristina, and being a role model for others.

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