Greetings from the Chair,

2013 was an active year in the department on many fronts. We hired a new faculty member with a broad interest in glass science to build on that important research area and to continue the strong tradition of collaboration with Corning Incorporated. President Barchi completed his first year at Rutgers and his strategic planning effort produced a recently issued plan that outlines future directions for Rutgers. Within MSE our External Advisory Board met and provided strategic direction to the department as we glow in the success of our ABET accreditation. Many research successes occurred this year, including yet another R&D 100 Award, this year for Professor Riman’s work on carbon sequestering structural materials. Two such awards (Professor Nosker won last year) to a single academic department is unprecedented and speaks to the innovative character of MSE. The new Nion advanced transmission electron microscopy (Professors Batson and Cosandey) came on-line during the year and is in final check-out phases. Our student body is at an ideal size, 150 UG and 75 graduate students. The students are excellent academically, involved in research, and populate numerous active student organization. Come to the MGM Symposium on April 4! Wishing all of you success in 2014! — RLL
Friday, April 4th 2014.

Mark your calendars!

Further information is at the link below. To register, e-mail us NOW!

Professor Rick Lehman serves as the department contact-point (rllehman@rutgers.edu).

More information here: http://canj.rutgers.edu

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2014 MGM Lecture Symposium

You are Invited!!

Our spring 2014 event is happening VERY soon. We will be honoring our colleague from Johns Hopkins University, Professor K. T. Ramesh (pictured here) as the distinguished speaker at the upcoming McLaren Lecture-ship and symposium, which will be held on the afternoon and evening of April 4th. See details in the blue box.

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McLaren Symposium

The principal technical and social event for the department is the Malcolm G. McLaren Symposium when we honor a distinguished member of our community with the "McLaren Lectureship". Last spring we honored Dr. Gary Calabrese of Corning Inc. (pictured here) with the McLaren Lectureship. His lecture was entitled: "Inventing the Future with New Materials". The McLaren Symposium featured three other talks covering a range of nano and materials topics: Dr. Glenn Amatucci ("The Enabling Battery – The complexity behind your daily frustration and what is being done about it."), our own Professor Philip Batson ("The Nion UltraSTEM with 10 meV electron energy loss spectroscopy") and Dr. Chris Heckle Director of Crystalline Materials Research at Corning ("Novel uses for cellular ceramics").

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2014 MGM Symposium

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More information here: http://canj.rutgers.edu
Corning Glass Laboratory

The Corning Glass Laboratory continues to grow and to become a major integral part of the MSE department. The Laboratory was officially opened on April 12, 2013 when Dr. Gary Calabrese performed the ribbon cutting with Dean Farris. Let the melting begin!! This great success was only made possible through a $500,000 grant from Corning to Rutgers and through the repeated visits and design assistance provided by Corning AMPL personnel such as Pat Gill, Josh Snyder, Dennis Barney, and many others. From the Rutgers side, Professor Lehman and Bob Horvath provided additional design elements and coordinated the effort.

On January 1 our newest professor, Ashutosh Goel, joined the department to add to the department’s historically strong emphasis on glass and optical materials. Partially funded by Corning, Dr. Goel has diverse interests in glass and has already in just two months begun establishing a strong program focused on the new glass laboratory.
Department News

Paul Kim was selected to participate in the 2013 Science of Signatures Advanced Studies Scholars Program, a multi-disciplinary program at Los Alamos National Labs, in NM.

Professor Richard Riman co-organized the International Hydrothermal Solvothermal Association Meeting, January 13-16, 2013 at UT, Austin with Brian Korgel. The conference offers opportunities for exchanging information and ideas among scientists worldwide working on Hydrothermal and Solvothermal research and to promote the processing of advanced materials for the environment.

Vishnu Vijayakumar mentored a team of students who took First Place in the ECE Senior Design Contest (Project Title: “Photovoltaic and Thermal Systems”, Jonghyun Bae, Dan Cox, Eric Greendyk, Todd Katz).

Moiz Rauf, Joe Woo, and Matthew Lu (right side of group photo) won First Place in the 2013 Rutgers Energy Institute Contest, with a project entitled “Reducing Utility Consumption via Incentives (RUCVI)”

Professor Adrian Mann gave invited talks on Multiscale Structure and Nanomechanics of Healthy and Diseased Dental Enamel at the 2013 MRS Spring Meeting, San Francisco, and on Experimental and Modeling Studies of Dental Enamel Mechanics at the 2013 MRS Fall Meeting, Boston.


Glenn Lockwood received the 'Outstanding Graduate Student Award' from the School of Engineering in May 2013.

Arya Tewatia received First Place Poster Paper Award at ANTEC 2013. Kevin Lucero and Marissa Tierno also presented a poster at this national meeting.

Professor Thomas Tsakalakos and Koray Akdogan filed a US patent application for “Methods for Producing Low Porosity Ceramics”, describing their invention burst mode densification of ceramics, a process for sintering of ceramics at 1/3 of the melting temperatures in 3 minutes to >95% density.

Dr. Thomas F. McNulty (Ph.D. 1999) was elevated to a Principal Scientist at GE Global Research.

Dr. Farhad Mohammadi (Ph.D. 2001) was promoted to Chief Technical Officer of Advanced Cerametronics Inc. (ACI).

Spencer Ferguson took 3rd place in the 2013 MS&T student speaking contest. His talk was entitled: “Advanced Cement Materials with Reduced Environmental Impact.”

George Celler filed a patent application (assigned to Rutgers) for a concept developed under the funding from Semiconductors Research Corp. that is expected to achieve electronic quality thin SiC substrates at a significantly reduced cost, aimed for applications such as: photovoltaic power inverters, electric vehicles, and other power electronics.

Voshadhi Amarasinghe (advisor George Celler) obtained a Rutgers travel grant to attend the International Conference on Silicon Carbide and Related Materials, in Japan last September, where he presented the results on “4H-SiC layer exfoliation for monolithic integration of SiC devices with Si circuits and for reduced cost device-quality SiC substrates”.

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Gary Cheung - Received a New Jersey Space Grant Consortium Undergraduate Academic Fellowship.

Professor Deirdre O’Carroll gave an invited talk entitled: “Light management approaches in nanostructured organic semiconductor thin films” at SPIE Optics+Photonics, San Diego.

Mahsa Sina (Advisor – Fred Cosandey) received the 2013 Presidential Scholar award from Microscopy Society of America for her work entitled: “STEM/EELS and diffraction study of phase transformation in FeO₀.7F₁.3/C nanocomposites after lithiation/delithiation.”

Sheel Sanghvi won a Rutgers Energy Institute Summer Internship for 2013. He worked with Professor Glenn Amatucci and Dr. Nathalie Pereira of the Energy Storage Research Group.

Catrice Carter (Advisor – D. O’Carroll), Raymond Fullon (Advisor – M. Chhowalla), and Shawn Ward (Advisor – A. Mann) are GAANN (Graduate Assistance in Areas of National Need, Dept. of Education) Fellows.

Alumna Dr. Asha Hall (2006, Advisor - Safari) was named “Outstanding Woman of the Year” at the Aberdeen Proving Grounds. She is with the Ground Vehicle Technology Directorate, Army Research Labs (ARL)

Alumnus Dr. Emrah Unalan (2006, Advisor – Chhowalla), Middle East Technical University, Dept. Metallurgical and Materials Engineering, Ankara, Turkey received the Parlar Foundation Faculty-Promotion Award for his work on nanowires and nanotubes in electronic devices.

Dr. Yusuke Daiko was honored as the 2013 Ulrich Award and the Sol-Gel Science meeting in Madrid. He is presently working as an assistant professor at the Nagoya Institute of Technology, Japan.

Dr. Saquib Ahmed (Advisor – D. Birnie) was honored by INTEL with a Divisional Excellence Award for 2013. With this honor he has been promoted into their “Pathfinding” group, helping develop future generation technologies for IC processing.

Dr. Glenn Lockwood, (Advisor – S. Garofalini), who is now at the San Diego Supercomputer Center (SDSC) received kudos in the “HPC Wire” that covers the world’s fastest computers in high performance computing. They said: “When it comes to data-intensive computing and Hadoop’s potential role in HPC, [Glenn] is one of the key sources for information about specific challenges and opportunities.

Prof. Ahmad Safari gave these invited and plenary talks at international conferences: “Pb-Free piezoelectric ceramics, Transducers and Thin Films, International Meeting on Ferroelectricity, Krakow, Poland; "Advances in Pb-Free Piezoelectric Ceramics, Thin Films and Transducers”, International Workshop on Pb-Free Piezoelectric Materials, Shanghai, China; and “Development of Pb-Free piezoelectric ceramics for medical imaging applications”, Center for Biomedical Imaging, Shenzhen, China.
2013 – Joint UFFC, EFTF and PFM Symposium, Prague

Professor Ahmad Safari organized and chaired The 2013 Joint IEEE-Ultrasonic Ferroelectrics and Frequency Control (UFFC) Symposium at the Prague Convention Center, Prague, Czech Republic on July 21-25. The joint Symposia were to celebrate the 60th anniversary of the UFFC society. The conference was able to host the European Frequency and Time Forum (EFTF) as well as the Piezoresponse Force Microscopy (PFM) workshop.

The conference was highly successful on all accounts. Over 300 society volunteers helped Professor Safari for almost two years to put together outstanding technical and social programs.

Over 2000 scientists from 49 countries participated in the joint conference. Technical program was consisting of four plenary, 144 oral, and 10 poster sessions for four days. There were six plenary speakers, 77 invited talks, 1,625 contributed talks and 48 industrial exhibits. Rut Rivera and Greg Yesner graduate students from Rutgers participated and gave talks in the conference. Professor Safari presented Elaheh Taghados and Mehdi Hejazi contributions at the conferences.

Professor Leonard Feldman Elevated to Fellow of Materials Research Society

Professor Feldman is currently the Director of Rutgers Institute for Advanced Materials, Devices and Nanotechnology; Professor of Materials Science and Engineering; and Vice President, Physical Science and Engineering Partnerships. Dr. Feldman has been named a 2014 MRS Fellow "For innovative applications of ion beam analysis; seminal contributions to the elucidation of surface and interface structures; and distinguished service to the materials community."

MRS Fellowships are awarded to "outstanding members whose sustained and distinguished contributions to the advancement of materials research are internationally recognized." Dr. Feldman has published over 400 research papers, been awarded 20 patents and authored four books on thin film science, some of them translated into Chinese and Russian. Congratulations Len!
Innovation with Materials

YOU INNOVATE!

In this issue we feature a patent from Hrishikesh Keshavan who received his PhD in 2006 studying with Professor Roger Cannon. Hrishi is one member of the team at GE – Global Research who helped develop a low-cost ceramic membrane based technology to separate Hydrogen from a syngas stream. The separated Hydrogen will be used to upgrade bitumen (produced in the oil sands region in Alberta) and the separated CO₂ will be sequestered. This project was performed in collaboration with the University of Alberta and with Alberta Innovates & was funded through the Climate Change and Emissions Management Corporation in Alberta (CCEMC). The membrane developed is a naturally occurring zeolite (molecular sieve) called Clinoptilolite. It’s mined in a rather pure form and therefore is a lower cost solution than many synthetic zeolites. These zeolite grains were fused together at relatively low temperature by reactive inorganic binder as shown in the figure. Their patent is number 8,647,997 and is entitled “Zeolite membrane and methods for making the same”.

WE INNOVATE!

On the faculty side, we pay tribute to one of our former faculty members’ inventions: Daniel J. Shanefield (who we recently learned, sadly, had passed at the age of 83) – was here on the department faculty from 1986 until his retirement in 2001. Before joining the Rutgers faculty Dr. Shanefield had worked at ITT Laboratories in Nutley, N.J. and then at Western Electric (later Bell Laboratories) in Hopewell. While at the Hopewell laboratory, Dr. Shanefield’s many inventions with coworkers included a ceramic insulator for microcircuits later sold worldwide by Western Electric and installed in almost every telephone line in the United States. He developed 38 patents and wrote textbooks on ceramic engineering and industrial electronics (two of which are featured at right). One of his patents related to formulations and compositions advantageous for tape casting, a technology that he develop with his colleague Richard Mistler. The figure above is from patent 5,002,710, “Composition useful for producing thin ceramic sheets”. The tape casting process continues to be a workhorse method for making thin membranes for fuel cells, batteries, capacitors and other high-value devices in microelectronics. We honor Dan’s memory and his contributions to our field and department.

Send us YOUR stories of invention, patenting and innovation.

We want to continue to feature our alumni in future newsletter issues.
NSF ICORPS Program Sparks Innovation in Solar

As we feature in many articles, Innovation permeates our department. Another recent example was enabled through a program sponsored by NSF called “ICORPS”, an innovation and business startup development program aimed specifically at ideas that were originally generated through earlier NSF support. In this case, the key invention had been developed by Brian Viezbicke under support from the NSF IGERT program. For the recent ICORPS training, current graduate student Josh Epstein was the “Entrepreneurial Lead”, with Marcus Crews of the Rutgers Office of Technology Commercialization was the “Industry Mentor” and Professor Dunbar Birnie was the Faculty PI. The core idea we were examining was the development of an Earth Abundant and Environmentally friendly method for making solar absorber thin films.

The ICORPS training was based on the Lean-Launchpad entrepreneurial training and was hosted by our neighbors at CUNY, the home of the NYCRIN (New York City Regional Innovation Network). A core part of the training was intensive outreach to customers to understand what the market forces are and how to position a new product. It really was an intensive program!
Concrete is the second most utilized substance on Earth, after water. More than 30 billion tons of concrete are manufactured each year, and Portland cement (PC) is the primary binder used in the production of concrete. However, regulatory pressure is forcing significant reductions in carbon dioxide emissions from the concrete industry. Process steps result in emissions of approximately 800 kg of carbon dioxide for each metric tonne of cement produced.

Solidia Cement, a replacement for traditional Portland cement, from Solidia Technologies Inc., is intended to reduce these emissions through the use of calcium metasilicate that can either be naturally mined or synthesized by solid-state reaction at lower temperatures than traditional methods. Research in Professor Richard Riman’s lab provided the foundation for mineral carbonation, and supported the theoretical work in developing the process for synthesizing this mineral in a Portland Cement kiln. The reduced emissions associated with Solidia Cement production and the carbon dioxide sequestration associated with Solidia Concrete curing combine to reduce the lifecycle emissions of concrete by 60%. Keep up the great work, Rik!

**Solar-2-Vehicle Project**

Supported by the Rutgers Energy Institute (REI) and the Rutgers EcoComplex, Professor Dunbar Birnie has been measuring the effectiveness of using plug-in vehicles for round-trip electric commuting/travel – subject to the aspiration that the plugged-in electrical source should be associated with solar photovoltaic power generation. Year 1 of the Solar-2-Vehicle Project has been completed and the mountain of data has been crunched: approximately 80% of the full-year’s round-trip transit mileage has been provided by electricity even when limiting plug-in to daytime and at on-campus available plug-in spots. Meanwhile the data show a strong increase in interest by other users for on-campus workplace charging: several days the four plugs by the engineering complex have been in simultaneous charging use by electric and hybrid vehicles! Work is underway to encourage further infrastructure investment and visible growth/outreach to expand electric transportation in our region.

Dr. Birnie’s studies serve to highlight the importance of solar power generation – and how materials research on batteries and solar cells can be transformative for products in this sector.
Organizations

Society of Plastics Engineers

Sony Wonder Tech. Lab.

MSE has an active chapter of the Society of Plastics Engineers and meetings and off-site trips are held monthly. On May 16th, 2013 the group traveled to New York City to experience the Sony Wonder Technology Laboratory where amazing effects are generated with materials and electronics. Not to miss out on opportunities for fun, the group (some members shown here in Central Park) discovered 57 Napoli Pizza e Vino, a great Pizza place and a good place to relax after an exhausting day in the world of plastics.

ANTEC

The annual technical conference of the Society of Plastics Engineers [ANTEC] was held in Cincinnati in 2013 and Professor Lehman led a group of three students to present papers at the meeting. Shown lower left boarding our plane to Cincinnati on May 21 are Arya Tewatia, Marissa Tierno, and Kevin Lucero. All the papers were well received, but we are especially proud of Arya for winning the Best Poster Paper Award for his paper, “Characterization of Novel One-Step Processes FG-PTT Composites.”

Graduate Student Open Mic Night

The graduate students organized their annual Open Mic Night on December 11th in the Fiber Optics Auditorium. All were invited to attend
and to show off their skills. It is amazing the excellent quality of performance exhibited by the graduate students and faculty, again demonstrating that Materials Scientists and Engineers are particularly well-rounded! In this photo, Kevin Lucero jams ad-lib with Professor Tsakalakos. Sounded GREAT!

**Glass Laboratory Student Group**

Already, in its short existence, the Corning Laboratory has attracted a lot of student interest, and Professor Lehman directs a range of studies in glass melting and compositional topics. On November 20th, he hosted a gathering of students at his home, inviting the glass laboratory and the AMIPP polymer laboratory students and faculty. In this picture, Professor Nosker gives a festive seasonal look to the group gathered all around. *Season’s Greetings!*

**Trip to Corning**

Every two years, Corning Incorporated hosts a trip of students and faculty to visit their World Headquarters in Corning, NY. The trip is highlighted by an in depth tour of Sullivan Park where numerous research areas are shown, including, optical fibers, extrusion of environmental structures, advanced glass melters, and display technologies. We also visit a manufacturing plant, and meet with the many alums working at Corning. Of course we also discover the many good places along Market Street in this three-day event. This year, the trip is March 19 – 21. The 2012 group is shown here assembled in front of technology graphics in Sullivan Park.
Advanced Transmission Electron Microscope

One of the most advanced electron microscopes in the world neared completion in the MSE department during 2013. The $3 million project directed by Professors Phil Batson and Fred Cosandey has taken over a major part of the A-wing of the Engineering building in the lab complex that was the former home of the early optical fiber draw tower. The microscope requires an environment that is acoustically and electrically very quiet and much of the early phases of the project focused on assuring these requirements. However, late in 2013 the microscope itself arrived in what seemed like uncountable palletized crates. Thanks to the team effort, the scope is fully assembled and “has a beam.” Professor Batson and the team is presently putting the machine through a checkout phase and the materials community is enthusiastically awaiting full completion of the installation this year.

MSE/IAMDN/LSM

Over the past five or six years the MSE department has been very fortunate to have two other materials groups in close physical and topical proximity – the Institute for Advanced Materials, Devices, and Nanotechnology (IAMDN) directed by Professor Leonard Feldman; and the Laboratory for Surface Modification (LSM) represented by Professor Robert Bartynski. The three groups bring together a highly productive and synergistic mixture of chemistry, physics, and engineering. As the university moves forward with its strategic plan, the importance of this informal consortium is of increased impact in terms of combining the strengths of the materials community and promoting its strategic value within the university and beyond.
External Advisory Board

One of our principal external inputs to MSE programs and planning is the External Advisory Board. We are extremely proud of our distinguished board, which is comprised of nearly even numbers of industrial and academic members. The Board has met twice in the last two years, most recently on November 5\textsuperscript{th} here in Piscataway. This is an opportunity for the faculty to present our programs and organizational structure to the committee and receive feedback on what we are doing well and where they see areas of improvement. Over a busy 24 hour period, the board hears from the Department Officers and various faculty, reviews the curriculum and meets with graduate and undergraduate students, and has an opportunity to hear the Dean’s view of Materials Science and the overall engineering program at Rutgers. This is an invaluable opportunity for the department to get guidance and input from an excellent group of prominent materials scientists and engineers from the region and the nation.
New Jersey Industry Outreach

Always seeking to promote business in New Jersey, many faculty reach out to firms in the state when they need help. Recently Professor Lehman’s group assisted Gerresheimer Glass of Millville with a pharmaceutical container quality problem. In the photo, Technical Director Lisa McDermott explains essential details to Amanda Chin.

Undergraduate Senior Lab

Senior laboratory is incredibly popular this year and many excellent projects are underway. These range from optical properties design, to molecular dynamics modeling, to flow alignment in tape casting. A complete listing of student names and their topics can be found at our department website: http://tinyurl.com/Rutgers-MSE-2014-Senior-Lab

YOU should be interviewing and hiring these excellent materials engineers!

Stay in touch!

If you have received this as hardcopy then we don’t have your e-mail address (the alumni office won’t share with us!). It would save us printing and mailing costs if we could send the NEXT one out to you electronically! Are you moving?? → e-mail the department with your new info: MSE@rutgers.edu

Finally: bookmark the MSE Department website (http://mse.rutgers.edu) and “visit” us there for seminar announcements and other news.

Recent PhD Graduates


Yun Jiang, "Molecular Dynamic Simulations of RE$_2$O$_3$ in Silicate IGF in ß-Si$_3$N$_4$", January 2014 (Prof. Stephen Garofalini, advisor) Looking.


Rutgers Day – Open House

Every year Rutgers opens up the campus for a major open house in the spring. And, as usual, MSE was out in force! Below are some pictures of our display from last year. This year the date is: **Saturday, April 26th, 2014.**

Saturday, April 26th, 2014
Mark your calendar!

Check out the on-line program of activities and plans here:
http://rutgersday.rutgers.edu
Photography, Art, and Layout by the MSE Art Department.
Several photographs courtesy of IAMDN