Department of Materials Science and Engineering

This past year has been eventful for the Department of Materials Science and Engineering (DMSE), with many personnel changes, curriculum redesigns, and construction projects. The coming months and years will be an exciting time of transition and evolution for DMSE.

Professor Edwin L. Thomas has accepted a position as the dean of engineering at Rice University, and a broad-based search for the next department head will include candidates from outside the Institute. Carl V. Thompson, Stavros Salapatas professor of materials science and engineering and director of the Materials Processing Center, has agreed to serve as interim department head during the search. The Department Head Search Advisory Committee has begun to meet with department constituents and aims to make recommendations to the dean of engineering by August 2011. The committee members are professors Lorna J. Gibson (chair), Alfredo Alexander-Katz, Samuel M. Allen, Angela Belcher, Mary Boyce (head of the Department of Mechanical Engineering), Darrell J. Irvine, Caroline A. Ross, Michael F. Rubner, and Krystyn J. Van Vliet.

The department has maintained its first-in-the-nation ranking from *US News and World Report* and was also ranked first by QS World University Ranking (metallurgy and materials). While proud of this ranking, our faculty continue to assess and adapt our undergraduate and graduate curricula to address new developments in our field and the changing needs of our world, and our admissions committee is re-evaluating how we choose our students and assess their success.

Construction has begun on the Laboratory for Engineering Materials (LEM). The LEM will be located on the first floor of Building 4, with access from the Undergraduate Teaching Lab on the Infinite Corridor, and will house prototyping and fabrication equipment for the use of faculty, students, and staff. Construction, including asbestos abatement, began after Commencement; in the meantime, major steps have been made to clean out the space, finding new homes for underutilized equipment and disposing of obsolete machinery. As part of the renovation, the Undergraduate Teaching Lab will be expanded to include more fume hoods specifically for corrosion labs. Phase 1 of construction will be finished by September 1, 2011, and the project will be completed in January 2012.

A generous gift from the Dow Chemical Company has established the Dow-MIT Outreach Program to support and encourage underrepresented minorities and women as they pursue careers in science and engineering. The gift established a Dow graduate fellowship for outstanding women or minority first-year graduate students in DMSE. The gift also expanded the Dow-MIT ACCESS program, which was started in the Department of Chemical Engineering but now also involves DMSE and the Department of Chemistry. This program serves to introduce underrepresented minority undergraduates to the benefits afforded by a graduate degree. This fall, some 60 undergraduates from across the country will visit MIT for a weekend to learn about graduate education in chemical engineering, chemistry, and materials science and engineering.

We are deeply saddened to report on the deaths of two good friends and colleagues: Professor Anne M. Mayes passed away at her home in Mustang, OK, in January, and Joseph M. Dhosi, long-serving administrative officer and director of the Course 3 Internship Program, passed away in April. Colleagues, students, and friends will celebrate Professor Mayes' life and career at MIT on October 29, 2011. At commencement, the DMSE Outstanding Internship Report Award was renamed in honor of Mr. Dhosi, who administered and championed the program from its inception in the 1970s.

Research Initiatives

DMSE research volume continues to be strong, and our faculty and students continue to innovate in many diverse areas with wide application, affecting all aspects of modern life. The recent White House initiative to "discover, develop, manufacture, and deploy advanced materials" is called the Materials Genome, a name coined by Gerbrand Ceder, R.P. Simmons professor of materials science and engineering. Energy research is prominent at this point, with the drive to make batteries smaller, faster charging, less expensive, and with longer lives. Innovations are coming from professors Angela Belcher, W. Craig Carter, Gerbrand Ceder, Yet-Ming Chiang, Jeffrey C. Grossman, Yang Shao-Horn, Donald R. Sadoway, Carl V. Thompson, and others.

In the fall, we launched the new BP-MIT Corrosion Center. Direct sponsorship from BP created this virtual center as the home for three new interdisciplinary research projects in fundamental aspects of materials characterization and design: (1) metal hydride formation, (2) metal sulfide film formation and stability, and (3) metal microstructural design to minimize grain boundary corrosion. The first two projects require integration of advanced computational modeling and simulation, as well as new in situ materials characterization techniques under extreme chemical environments. The third project pivots on theoretical calculations that will be tested in subsequent years through materials manufacturing methods developed at MIT. To date, the team has made impressive progress on this nascent effort, with six full-time students and postdocs working on these interrelated projects.

This program also facilitated renovation of new teaching space in DMSE for undergraduate lab modules related to corrosion science. Related closely to this center funding, BP also offered two graduate fellowships that were used to sponsor PhD candidates working on flagship research projects.

The key founding faculty of the center include Michael Demkowicz, Silvija Gradečak, Chris Schuh, and Krystyn Van Vliet (DMSE), as well as Bilge Yildiz and Sidney Yip (Department of Nuclear Science and Engineering). Professor Van Vliet serves as PI of the BP-MIT Corrosion Center.

BP executives and research scientists have visited the group twice. As interim department head, Professor Thompson now serves on BP's executive board and In this capacity, they attended a BP review and planning meeting in Edinburgh, Scotland, in June, and met

potential collaborators from BP and the University of Manchester. Expansion of the BP-MIT Center's research portfolio and funding levels is expected in AY2012.

Undergraduate Education

The incoming sophomore class of 52 students brings DMSE's undergraduate enrollment to 153 students (an 8.5% increase from last year), with 57% women, 28.8% underrepresented minorities, and 3.2% international students. Twenty students are designated Course 3-A (a flexible degree program often taken by students intending to study medicine, business, or law) and two students are designated Course 3-C (archaeological materials science). The internship program continues to attract many DMSE undergraduates; 41 DMSE rising seniors and juniors are working at 35 host institutions for summer 2010, including 15 at overseas institutions.

Departmental advisors and core instructors continue to assess the undergraduate curriculum, last revised in AY2003, to ensure that the growing enrollment is accommodated in our facilities and that students are well prepared for further academic study or for careers in established corporations, start-up companies, or government. As MIT's academic courses evolve to include more students with double majors or minors, DMSE academic staff and student advisors are taking steps to establish procedures for working with these students to ensure that they are able to meet their degree requirements in a timely manner.

Graduate Education

The department's graduate enrollment remains healthy, numbering 193 in fall 2010. Approximately 25% of the graduate students are women and 4.1% are underrepresented minorities. Ten DMSE students participate in the Program in Polymer Science and Technology. For fall 2011, we anticipate an incoming class of 40, approximately 25% of whom are women and 7.5% of whom are underrepresented minorities.

The department has reaffirmed its commitment to support all doctoral-track students in their first year with fellowships and research assistantships, thereby allowing them to focus on their core subjects rather than acting as teaching assistants.

After an assessment that reviewed qualifying procedures across MIT and across materials science and engineering departments at other universities, professor Christine Ortiz worked with the faculty to develop a new qualifying procedure for our students. The written qualifying exam will continue to focus on the first-year core courses. Now, however, rather than focusing on post-core courses in one of six panel areas, the oral exam will be merged with the thesis proposal presentation and include questions that are related to the proposed research, as well as broader questions. The examination will test the student's fundamental understanding of the literature in the field (historical and current); the basic vocabulary/language of the field; the context and implications of the proposed research within this body of literature; the application, integration, synthesis of core knowledge to the proposed research; and aspects of research design (e.g., methods, analysis, proposed aims, etc.).

Student Organizations

We greatly value our student organizations and recognize the efforts they make to help students support one another in their MIT careers and to be good ambassadors for our department and for our field. During the open house celebrating MIT's 150th anniversary, the student volunteers designed and set up demonstrations for school-age and younger children, welcoming over 1,000 visitors to the Undergraduate Teaching Lab and serving more than 500 samples of liquid nitrogen ice cream.

The officers of the Society of Undergraduate Materials Scientists for 2011–2012 will be Jaclyn Schein and Connie Park, co-presidents; Claudia Richardson and Stephanie Moran, social chairs; Ester Lomeli, career development chair; Marisa Jasso, recruitment chair; Garrett Lau, secretary/historian/publicity chair.

The Graduate Materials Council officers for 2011–12 will be Jordan Chesin, president; Max Solar, vice president; Vivek Singh, secretary; Jocelyn Newhouse, treasurer; Satoru Emori and Kunal Mukherjee, academic committee; Kevin Spencer, Sema Ermez, Nancy Twu, and Alan Lai, social chairs; Nick Thompson, Niel Patel, and Adam Jandl, representatives to the departmental Committee on Graduate Students; Kevin Gotrik, publicity chair; Tim Milakovich, athletics chair; Eric Jones and Ami Yaacobi, outreach chairs; Denis Loginov and William Woodford, alumni relations committee; and Neel Monoj Bardhan, Ryan Iutzi, and Dan Harris, Graduate Student Council representatives.

Beginning in summer 2011, the Graduate Materials Council Academics Committee initiated a Student-Faculty Lunch Summer Series, allowing graduate students to sit down with professors in the department for an informal lunch and discussion. Five students attend each of the lunches, which are held weekly through July. Participating faculty include professors Alfredo Alexander-Katz, Michael Demkowicz, Edwin Thomas, Christopher Schuh, Polina Anikeeva, and Yang Shao-Horn.

Personnel

Polina Anikeeva will join this department as the AMAX assistant professor in materials science and engineering in July. Dr. Anikeeva holds a BS in biophysics from St. Petersburg State Polytechnic University (2003) and a PhD from DMSE (2009). Her PhD thesis focused on the physical properties and design of light-emitting devices based on organic materials and nanoparticles, working under the supervision of professor Vladimir Bulović. She subsequently held the Dean's Postdoctoral Fellowship in the School of Medicine at Stanford University. Her current research is centered on the development of new non-invasive methods for in vivo neural stimulation and design of opto-electronic devices for simultaneous recording and stimulation of neural circuits.

Effective July 1, 2011, Yoel Fink and Christopher Schuh will be promoted to full professor. Professor Fink joined the MIT faculty in 2000, after receiving a BSc (1994) and a BA from the Technion (1995) and a PhD from this department (2000). Dr. Schuh, Danae and Vasilios Salapatas professor of metallurgy, came to MIT in 2002; he holds a BS from the University of Illinois at Urbana-Champaign (1997) and a PhD from Northwestern University (2001).

Jeffrey C. Grossman, Carl Richard Soderberg associate professor of power engineering, and Krystyn J. Van Vliet, Paul M. Cook career development associate professor of materials science and engineering, will receive tenure, effective July 1, 2011. Professor Grossman joined the MIT faculty in fall 2009, coming from the University of California, Berkeley; he holds a BA from Johns Hopkins University (1991) and an MS (1992) and PhD (1996) from the University of Illinois at Urbana-Champaign. Professor Van Vliet holds an ScB from Brown University (1998) and a PhD from this department (2002); she joined the MIT faculty in 2004.

Professors David K. Roylance and Bernhardt J. Wuensch retired from MIT after 35 and 46 years on the faculty, respectively. They were honored at the annual faculty dinner, at which colleagues shared experiences they had had with Dave and Bernie over their long history of service in DMSE.

Professor Nicola Marzari has spent the past three semesters at Oxford University; beginning in September of this year, he will leave the Institute and take a position at École Polytechnique Fédérale de Lausanne. Subra Suresh, Vannevar Bush professor of engineering, has taken a leave of absence to assume leadership of the National Science Foundation. Effective July 1, 2011, Edwin L. Thomas, department head and Morris Cohen professor of materials science, will leave the Institute to become dean of engineering at Rice University.

On August 1 2010, professor Christine Ortiz assumed the role of MIT dean for graduate education. Samuel M. Allen, POSCO professor of physical metallurgy, will be chair of the MIT Faculty in AY2012 and AY 2013. Lorna J. Gibson, Matoula S. Salapatas professor of materials science and engineering, was the School of Engineering chair of a study on women faculty at MIT released in March.

Matt Humbert joined DMSE as a technical instructor in the Laboratory for Advanced Materials and for undergraduate laboratory subjects. Mr. Humbert is a 2008 graduate from the Department of Mechanical Engineering; he previously worked at Schlumberger in Prudhoe Bay, Alaska.

Research Highlights

In this year's report, the department is profiling exciting research from four of its faculty members.

Professor Silvija Gradečak's group uses an interdisciplinary approach to study semiconductor materials and low-dimensional systems for applications in optoelectronics, energy harvesting, and energy conversion. Freestanding materials with confined dimensions have unique properties that are distinct from their bulk counterparts, and Professor Gradečak combines a set of unique synthesis and characterization techniques recently developed in her laboratory to precisely control structural properties of nanostructured materials, their size uniformity, and dopant distribution at the atomic level. In the past year, they have focused on controlled growth and doping of one- and two-dimensional nanomaterials through detailed understanding of the fundamental growth mechanisms. In two papers published in *Physical Chemistry*

Letters and one published in *Nano Letters*, they investigated the role of gold particles, used as nanowire growth seeds, on optical and electrical properties of ZnO and GaAs nanowires. They demonstrated that gold is critically linked to the nanowire growth mechanism and corresponding growth rate and that its presence modifies nanowire optical properties. Based on this knowledge, they demonstrated n-type doping in GaAs nanowires for the first time, a critical step toward development of nanowire high-electron mobility transistors.

In a related study published in *Nano Letters*, the Gradečak group worked on development of organic-inorganic hybrid bulk heterojunction solar cells with increased power-conversion efficiencies. In collaboration with the Bulović group, they developed organic-inorganic solar cell devices by blending uniformly sized GaAs nanowires with a conjugated polymer in a single solvent. This approach takes advantage of the high aspect ratios, high electron mobility, and photon absorption of GaAs nanowires, while preserving solution processability of the polymer. By increasing the concentration of the nanowires in the active region of the device, polymer ordering and nanowire alignment were controlled, thus enhancing both electron and hole transport. Understanding of the role of structural ordering in the device performance forms the basis of several ongoing projects in the Gradečak group.

In the past year, professor Darrell Irvine's group made a major advance in engineering the immune system to combat cancer. The Irvine group demonstrated an approach for engineering the surfaces of living cells with synthetic drug-carrier nanoparticles, endowing individual cells with the ability to release drugs that either promote the cells' own native functions or to deliver drugs to their environment in vivo. T-cells carrying drug-loaded nanoparticles, dubbed "pharmacytes," were shown to traffic into tumors and receive self-supporting drugs from their surface-bound drug reservoir. Using this approach, the Irvine lab demonstrated that a single injection of cytokine-carrying antitumor T-cells can eliminate established lung tumor metastases in a mouse model of melanoma, leading to complete cure of all treated animals under conditions where control animals treated with T-cells alone all die within 30 days. The first major results from these studies were published in *Nature Medicine*.

In a second major area of research, the Irvine group recently developed a new class of phospholipid vesicles, termed interbilayer-crosslinked multilamellar vesicles (ICMVs). These nanocapsules are formed by fusing liposomes into multilamellar structures, then "stapling" apposed lipid bilayers in the vesicle walls by way of membrane-permeable crosslinkers, which covalently bridge headgroups of one bilayer to the surface of the adjoining bilayer. These novel structures have greatly increased stability relative to traditional liposomes. By embedding immunostimulatory molecules into the vesicle walls and entrapping protein antigens in the aqueous core, the Irvine group found these stabilized ICMV structures could be used to prime immune responses following vaccination with strengths comparable to those of live viral vectors, the strongest known vaccine vectors. However, ICMVs offer many potential advantages over existing viral vectors in terms of ease of manufacturing, safety, and the ability to be administered repeatedly to boost the immune response. These results were published in *Nature Materials*.

Professor Lionel Kimerling's group addresses three research areas: silicon microphotonics, imaging and sensing, and thin film photovoltaics. The Kimerling group, in collaboration with senior research associate Jurgen Michel, proposed the physical concept of a germanium laser and has developed advanced device designs and demonstrated the first prototype performance. Germanium, an indirect gap semiconductor material, was engineered to provide optical gain using tensile strain and n-type doping. The laser provides a new architectural paradigm for information transport and processing. Photonic signal transport can provide much higher energy efficiency and connectivity than traditional electronic signal transport on metal wires. Germanium is monolithically compatible with the industry standard, silicon complementary metal-oxide-semiconductor chips, and efficient data broadcast by on-chip laser networks can facilitate scaling of parallel programming and performance to thousands of computer nodes. Future multicore chip design, fabrication, and programmability are being studied in new collaborations with professors Li-Shiuan Peh, Armando Solar-Lezama, and Vladimir Stojanovic and the CSAIL Angstrom Project led by Anant Agarwal (Course 6). The group developed the design principles for athermal photonic circuits and demonstrated zero thermo-optic drift using polymer/dielectric composites. Athermal performance enables monolithic electronic-photonic integration on chips where temperatures can fluctuate within 80°C.

During the past year the group was granted nine US patents in the area of microphotonics, and published an invited review in *Nature Photonics* of principles for materials selection and waveguide integration for Ge-on-Si photodetectors. This industry-university consortium, which Kimerling chairs, published the first release of Communication Technology Roadmap III, entitled "Scaling and Energy."

Professor Kimerling's research with Dr. Anu Agarwal studies mid-infrared materials and devices for a microphotonic platform to enable on-chip imaging and sensing. In 2010, the team demonstrated a multispectral pixel for simultaneous 1550-nm and 3600-nm detection. The pixel consists of coupled optical microcavities with a sensing material of polycrystalline PbTe. The cavities enhance thin film absorption while maintaining low dark current, thereby allowing high-detectivity performance without cryogenics. The team developed a novel glass-on-silicon technology for monolithic integration of biological/chemical sensors on silicon readout integrated circuits. They have demonstrated (1) a full process flow, (2) high Q-ring resonators, (3) integration with microfluidic flow cells, (4) world-best detection levels for various analytes, and (5) a prostate-specific antigen test.

The Kimerling solar energy team introduced total photonic design for performance optimization of thin film solar cells. After showing that a 3-D photonic crystal backside can guide light in the plane of the cell and enhance absorption, they demonstrated self-assembled prototype devices to support manufacturability. These devices use a distributed Bragg reflector behind a 2-D grating based on porous anodic oxidation of aluminum followed by deposition of silicon in the pores. The self-assembled, pseudoperiodic structures performed better than perfect periodicity. To generalize this design approach, they considered a variety of texture designs, such as simple periodic gratings and commercial random textures, and they examined arbitrary irregular

periodic textures designed by multiparameter optimization. Dimensionally deep and high-index-contrast textures exhibit strong anisotropic light scattering that is outside the regime of validity of the Lambertian models commonly used to describe texture-induced absorption enhancement for normal incidence. In collaboration with professor Steven Johnson (Course 18), they created a texture optimization algorithm and showed that, over a 900–1100 nm wavelength range, surface texture in two dimensions can enhance solar energy conversion by a factor of $2.7\pi n$, considerably larger than the original πn Lambertian result. Using the same principles, the team improved the light extraction efficiency of light-emitting diodes. With numerical simulations, they systematically investigated the influence of materials selection and structure on the performance of light-emitting diodes (LEDs). They demonstrated a 27% improvement in emission intensity for a GaAs LED. This technique provides a low-cost method for design and fabrication of high efficiency LEDs.

Professor Caroline Ross's group works in spintronic and magneto-optical materials and devices and in templated self-assembly of block copolymers and other systems that can generate nanoscale structures spontaneously. In the area of spintronics, they are investigating the fabrication and magnetic properties of nonvolatile, programmable magnetic logic and memory devices from multilayer magnetoresistive thin films, based on the manipulation of magnetic domain walls. The devices are written and read back using electric current and can be concatenated to perform complex tasks such as a full adder. Professor Ross's group has also worked on magnetooptical materials for optical communications devices. They showed how magnetic substitution into strontium titanate could produce a transparent magnetic material and demonstrated the importance of strain on the magnetic properties. They have experimentally demonstrated a monolithically integrated ultracompact optical isolator on silicon. This device uses a different design strategy from any other previously reported optical isolators, which allows a significant device footprint reduction from the centimeter or millimeter scale down to the tens-of-micrometers level. As a monolithic nonreciprocal optical component on silicon, this device can also be developed into a variety of integrated nonreciprocal photonic devices, including optical circulators, modulators, and switches, which opens a new dimension of functionality for silicon photonics.

Professor Ross's work on the self-assembly of block copolymers within lithographically-defined templates to create patterns with long-range order has attracted considerable attention as a method for extending lithography beyond the limits of optical lithography, enabling fabrication of smaller microelectronic devices. Block copolymer self-assembly has the advantages of cost-effectiveness, large area coverage, and compatibility with pre-established top-down patterning technologies. Block copolymers self-assemble to form microdomains whose size and geometry depend on the molecular weights of the constituent blocks and their interaction. Professor Ross's group has shown that poly(styrene-b-dimethylsiloxane) block copolymers are excellent candidates for nanolithography because of their large interaction parameter and a high etch contrast between two blocks, and they have templated these materials using an array of nanoscale topographical posts that act as surrogates for the minority domains of the block copolymer. Recently, they showed that aperiodic nanoscale patterns can be generated by combining the self-assembly of block copolymer thin films with minimal

top-down templating, providing the necessary junctions, bends, and other geometries for device fabrication at sub-10-nm lengthscales.

Awards and Honors

Professor W. Craig Carter received second place in the annual Institute Screw Competition for his role in 3.016 Mathematical Methods for Materials Scientists and Engineers.

Professor Michael Cima was elected to the National Academy of Engineering.

Professor Yet-Ming Chiang was named a member of the US Department of Energy's Energy Efficiency and Renewable Energy Advisory Committee. Professor Chiang was the keynote speaker at "Breaking the Glass Ceiling: How to be an Asian Leader in the Corporate World," an all-day workshop presented by the MIT and Cornell Society of Asian Scientists and Engineers. He presented the plenary lecture, "Materials, Systems, and Manufacturing Challenges for Electrochemical Storage at Transportation and Grid Scales," at the Spring Materials Research Society (MRS) meeting. He also addressed the Technology Innovation Forum.

Professor Michael Demkowicz received honorable mention for TMS(The Minerals, Metals, and Materials Society) 2011 Early Career Faculty Fellow Award.

Professor Eugene Fitzgerald was a co-recipient of the Institute of Electrical and Electronics Engineers (IEEE) Andrew S. Grove Award for his "seminal contributions to the demonstration of Si/Ge lattice mismatch strain engineering for enhanced carrier transport properties in MOSFET devices."

Professor Kimerling was elected a fellow of the School of Engineering at the University of Tokyo.

Thomson Reuters has released data identifying the world's top 100 materials scientists and top 100 chemists, ranked by the highest citation impact scores for articles and reviews published since January 2000. Impact is a weighted measure of influence that seeks to reveal consistently superior performance. In the Top 100 Chemists was professor Michael Rubner, at number 40. In the Top 100 Materials Scientists were Professor Suresh, number 28; Professor Chiang, number 66; and Professor Ross, number 86.

Professor Schuh is one of the 2011 MacVicar Faculty Fellows. He received the Ralph R. Teetor Educational Award from the Society of Automotive Engineers (SAE). The SAE Ralph R. Teetor Educational Fund brings younger engineering educators together with practicing engineers to exchange views on techniques, challenges, and future possibilities.

Professor Suresh was awarded the Padma Shri by the president of the Republic of India in recognition of his distinguished work in science and engineering.

Professor Harry Tuller presented the Israel Pollak Distinguished Lecture Series at the Department of Materials Engineering, Technion, in December. His talks were on "Electroceramics—Strategic Materials in the Quest to Solve the Energy Crisis" and "Nano-Structured Materials for Next Generation Fuel Cells and Sensors."

Research scientist Xiaoman Duan was awarded an Honorary Professorship at the XIAN Institute of Optics and Precision Mechanics at the Chinese Academy of Science. This honor recognized Dr. Duan's and the Kimerling group's achievements on "High Efficiency Solar Cells with Textured Photonic Crystal Backside Reflectors," which was presented at an invited talk at the academy in Shanghai.

Undergraduate Awards

Course 3 seniors who have been awarded the 2011 NSF Fellowship are Kathleen Alexander (attending MIT in fall 2012), Mahati Chintapalli (attending UC Berkeley), Daniel Montana Fernandez (attending MIT), and Denys Zhou (attending Stanford).

Christopher Francis '12, received one of MIT's Ronald E. McNair Scholarship Awards.

Phi Beta Kappa inductees for the class of 2011 include Lina Garcia and Christina Jaworsky.

Daniel Montana Fernandez '11 has been awarded the Merage American Dream Fellowship. The Merage Foundation for the American Dream honors outstanding immigrants who display significant leadership and academic achievements. Merage Fellows receive a two-year $20,000 stipend that may be used for formal study, travel for research, and professional opportunities. Mr. Fernandez also received DMSE's Outstanding Senior Thesis Award for "Magnetic Microparticle Trapping and Mechanical Excitation using Domain Walls in Magnetic Microstructures."

Anjali Thakkar '12, a double major in biology and materials science and engineering, received one of the 2011 Harry S. Truman Scholarships. These prestigious scholarships recognize college juniors who are committed to careers in public service. Ms. Thakkar's plans are for medical school, with a focus on the study of diabetes, hoping to work with Partners in Health.

Jason Douglas '11 received the Joseph M. Dhosi Outstanding Internship Report for "Considerations for Solid Oxide Membrane Electrolysis in Primary Metal Production."

Brienne Kugler '11 received the Horace A. Lubin Award for Outstanding Service.

The Outstanding Seniors, Class of 2011, were Lina Garcia and Ian Matts. Graham Van Schaik was named Outstanding Junior, Class of 2012, and Michael Gibson was named Outstanding Sophomore, Class of 2013.

Graduate Awards

Several DMSE students are recipients of an NSF Graduate Research Fellowship: Brian Albert, David Cohen-Tanugi, Daniel Harris, and Oliver Johnson.

Marco Bernardi has been awarded a Corporate Intel PhD Fellowship for the 2011–2012 academic year. The award covers tuition, a stipend, and a travel allowance for attending the Intel PhD Fellowship Forum in August.

Oliver Johnson received the National Defense Science and Engineering Graduate research fellowship.

Joaquin Rodriguez Nieva received the Roberto Rocca Fellowship. These fellowships are open to citizens of Argentina, Colombia, Brazil, Indonesia, Mexico, Romania, and Venezuela who are pursuing a PhD outside their country. Rocca Fellows are enrolled in programs studying materials science or mechanical, metallurgical, or petroleum engineering, and their research offers potential benefits to the steel industry. The fellowships honor the late Roberto Rocca ScD '51, who was president of Organizacion TECHINT in Buenos Aires.

Xing Sheng received the MIT Energy Initiative Martin Fellowship. He also received the Best Poster Award (runner-up) in the 35th IEEE Photovoltaic Specialists Conference, 2010; the poster title was "Efficient Light Trapping Structure in Thin Film Silicon Solar Cells."

David Cohen-Tanugi also received a Fellowship from the Office of the Dean for Graduate Education.

DMSE was well represented at the Fall Materials Research Society (MRS) Meeting in Boston: Richard Baumer was recognized as a Best Poster winner for "Atomistic Simulations of Radiation Damage in Amorphous Metals," coauthored by T. Oppelstrup, V. Bulatov, and M.J. Demkowicz; Xiaoting Jia received the MRS Graduate Student Gold Award; and Noémie Chocat received the Graduate Student Silver Award. Sung Keun Lim won a 2011 MRS Spring Meeting Graduate Student Silver Award.

Xiaoting Jia also received the APS Division of Materials Physics Ovshinsky Student Travel Award in March.

Yi-Chun Lu won the 2010 Electrochemical Society Battery Division Student Research Award.

Jonathan P. Singer received a Best Poster Award at the 2010 COMSOL conference in Boston. "Design of Novel Lithographic Strategies through Application of Electromagnetic and Multiphysics Simulations" was co-authored by Jae-Hwang Lee, Sisi Ni, Michael A. Gibson, Steven E. Kooi, and Edwin L. Thomas.

Yoda Patta was presented with MIT's Karl Taylor Compton Prize, the highest award presented by the Institute to students and student organizations in recognition of excellent achievements in citizenship and devotion to the welfare of MIT.

David Bradwell, MEng '06 and current graduate student, was named one of the *Technology Review* 35 for his work in developing an inexpensive and reliable battery that could store renewable energy.

Sophie Ni, Jon Singer, and Clark D. Della Silva (undergraduate in Course 2) won the Lockheed Martin Prize (second place) in the Soldier Design Competition for their work on optimizing materials selection and device geometry for a flexible, modular cantilever-based inductive wind harvester that could serve as an alternative to diesel generators. In the Soldier Design Competition, teams from MIT and West Point apply creativity and engineering skills to solve the problems of the modern soldier. This year's winning team came from West Point.

Winners of the Materials Day 2010 Best Poster Awards were Rodolfo Camacho-Aguilera and Timothy W.C. Zens. Mr. Camacho-Aguilera's poster was titled, "Germanium Laser: A Bridge to the Photonic Network," and Mr. Zens' poster was titled "Resonant Cavity Enhancement of PbTe Films for IR Detectors on Si-ROICs." Timothy W.C. Zens and the Electronic Materials Research Group at MIT won best group poster for the DMSE Visiting Students Weekend.

Graduate Women at MIT (GWAMIT) received a William L. Stewart, Jr. Award. GWAMIT was founded by Megan Brewster, and many DMSE graduate women are active in the group.

Leslie Nachbar received the John Wulff Award for Excellence in Teaching for teaching excellence in an undergraduate subject. Jean-Philippe Peraud received the Graduate Student Teaching Award for teaching in a graduate subject.

Outstanding PhD Thesis Research Awards were presented to Srikanth Patala for "Topological Analysis of the Grain Boundary Space" and to Hyunjung Yi for "M13 Virus/Single-Walled Carbon Nanotubes as a Materials Platform for Energy Device and Biomedical Applications."

David Cohen-Tanugi was recognized with the 1st-Year Graduate Student Exceptional Performance Award.

Satoru Emori and William Woodford received the Graduate Student Community Service Awards.

Future Plans

Over the next months and years, DMSE will be faced with many opportunities to strengthen itself, its programs, curricula, faculty, and facilities. This time of transition is also a time of reflection, during which the department is evaluating itself through conversations with faculty, students, staff, and alumni. While we are happy that our undergraduate and graduate programs are recognized for their excellence and that our Visiting Committee was pleased with our current state of affairs, we recognize that a growing enrollment, new hires, and a new department head will require adjustments and will ultimately lead to new initiatives, new subjects, and further evolution of the department. We continue to promote and publicize our department and our field, through lectures open to the community, public display spaces, our web presence with a new website to be launched this summer, and through busy social media outlets.

Carl V. Thompson
Interim Department Head
Stavros Salapatas Professor of Materials Science and Engineering
Director, Materials Processing Center