

## **Materials Processing Center**

The [Materials Processing Center](#) (MPC) was established as an interdisciplinary center within the School of Engineering in response to a recognized national need to improve the materials processing knowledge base and to streamline the process of translating materials research results into industrial innovations and applications. MPC is now in its 34th year.

Following a science-to-systems approach, MPC works with faculty to assemble resources and leverage existing knowledge to help companies and federal agencies address fundamental challenges through research and create opportunities through technology transfer. MPC supports about 60 faculty and senior research staff with proposals for research and post-award program management. In addition, we provide administration services and liaison support with industry contacts outside of MIT. MPC also organizes events for the broader materials research community at MIT, which includes more than 150 faculty.

MPC's research volume over the past year was about \$15.8 million, a decrease of 8% from the previous year. This continues a drop from a high of about \$20 million in FY2012, but it is still significantly above the approximately \$8 million low of FY2009. A significant portion of this decrease can be attributed to the ending of stimulus funding and departure of senior faculty from MIT. MPC continued to support its two subcenters—the Solid State Solar Thermal Energy Conversion Center and the Microphotonics Center—as well as professor Harry Tuller's large multi-faculty program in Chemomechanics of Far-From-Equilibrium Interfaces and the Low Energy Electronics Systems IRG of the Singapore-MIT Alliance for Research and Technology. New programs include the Skoltech Center for Electrochemical Energy and professor Raymond Ashoori's Center for Integrated Quantum Coherent Materials.

### **Industry Collegium and External Advisory Board**

The MPC Industry Collegium consists of eight companies that provide direct financial support for the center's discretionary activities through annual donations. Representatives from these companies work with MPC throughout the year to identify opportunities for collaboration and they participate in MPC's annual Materials Day symposium and poster session. Current collegium members are Agoria-Belgium Consortium, Ishikawajima-Harimi Heavy Industries, Merck KGaA, Michelin, POSCO, Raytheon, Siam Cement Group, and Applied Materials-Variation Semiconductor Equipment Associates. Growth of Industry Collegium membership is a high priority for MPC.

MPC's external advisory board meets for a full day after the Materials Day event each year. At that meeting, MPC's director and staff report on the prior year's activities and present on planned initiatives and goals for subsequent years. Some of the new faculty present their planned research for the year, and senior faculty discuss major new initiatives. The external advisory board provides valuable advice on program development and management and assists in identifying opportunities for interactions with industry. The board meeting culminates in an oral and written report to the dean

of the School of Engineering or a designated representative. Current board members represent 3M, Applied Materials-Varian Semiconductor, Boston University, Charles Stark Draper Laboratory, Compaq, General Motors, Harmonic Inc., Lockheed Martin, LORD Corporation, EMC, Novartis Pharmaceuticals, Saint-Gobain Corporation, Sandia National Laboratories, and Solvay Advanced Polymers.

New faculty members who spoke at this year's board meeting included professor Adam Willard (Chemistry), professor Michael Short (Nuclear Science and Engineering), professor Yogesh Surendranath (Chemistry), and professor John Hart (Mechanical Engineering).

### **Center for Electrochemical Energy**

A new international research program, the [Center for Electrochemical Energy](#) (CEE), was initiated within the MPC this year. The CEE was selected to be one of the first three Centers for Research, Education and Innovation (CREIs) affiliated with the new [Skolkovo University of Science and Technology](#) in Russia. The CREI program is supported by the Russian government through the Skolkovo Foundation. CREIs are based on three-way collaborations among an international university, an established Russian university, and Skoltech. The CEE's Russian partner institution is Moscow State University (MSU), widely considered to be the best university in Russia. The CEE research program involves seven faculty members at MIT and a comparable number of faculty at MSU, and it eventually will involve a comparable number of faculty at Skoltech. The expected steady-state annual funding level at MIT for this five-year program will be \$2.5 million.

Research in the CEE will be focused in three areas: advanced metal-ion batteries, rechargeable metal-air batteries, and fuel and electrolysis cells. Advances in electrochemical energy storage technology will provide new routes for efficient use of fossil fuels through grid-level power shaping and time shifting and through energy buffering for intermittent alternative energy sources. Advances in energy storage technology will also provide improvements needed for widespread use of electric vehicles and enable development of mobile devices with new functionalities and improved performance.

The CEE team is highly interdisciplinary in nature, involving faculty from the departments of Mechanical Engineering, Chemical Engineering, Materials Science and Engineering, and Chemistry at MIT, as well as faculty from the departments of Physics and Chemistry at MSU. Academic programs at Skoltech are built around five research themes, one of which is energy. It is expected that Skoltech CEE faculty will be primarily associated with the energy theme.

### **Solid State Solar Thermal Energy Conversion Center**

MPC completed its fifth year supporting the [Solid State Solar Thermal Energy Conversion Center](#) (S<sup>3</sup>TEC), a US Department of Energy (DOE) Basic Energy Sciences-sponsored Energy Frontier Research Center (EFRC). Led by professor Gang Chen (Mechanical Engineering), S<sup>3</sup>TEC is a multidisciplinary effort that includes leading researchers from physics, chemistry, materials science, and electrical and mechanical

engineering. The goals of the research center are to enable highly efficient harvesting of heat energy from multiple high-temperature processes, such as power plants, chemical plants, and engines (e.g., turbines and automobiles), in addition to realizing more efficient collection of the full solar energy spectrum into usable, sustainable green energy. Its research focus in basic science on energy transportation in nanostructured materials and devices has applications in conversion of thermal energy to useful electrical energy from heat sources including solar.

Research is based on three major areas: (1) the study and control of photons for solar thermoelectric and thermophotovoltaics, (2) the understanding of electron and phonon transport, and (3) high-temperature reliability. The core activities of the center are focused on the investigation and development of thermoelectric materials, the collection and conversion of heat energy into electrical energy, and thermophotovoltaics for high-efficiency energy conversion of solar energy into electricity. Key to the energy conversion process is the ability to understand phonon transport processes in these materials, combined with the design and fabrication of highly selective surfaces to serve as efficient photon emitters in the case of thermophotovoltaic systems. Investigation of the material systems requires use of unique and adapted characterization tools, such as thermorefectance, acoustic wave, and phonon tomography.

The S<sup>3</sup>TEC researchers have achieved several fundamental advances that are enabling them to fabricate thermoelectric devices with significantly increased efficiency and to create spectrally selective surfaces critical to high-performance thermophotovoltaic systems. The researchers' combined efforts have resulted in over 165 published journal papers and book chapters, 25 patent applications, and one startup company.

Based at MIT, S<sup>3</sup>TEC supports the research efforts of 12 principal investigators, multiple academic disciplines, and student and postdoctoral members assigned from their research teams. Co-principal investigators include professors Millie Dresselhaus, Eugene Fitzgerald, John Joannopoulos, Sang-Gook Kim, Keith A. Nelson, Yang Shao-Horn, Chris Schuh, Marin Soljacic, and Evelyn Wang. Partnerships and collaborating organizations include professor C.P. Opeil from Boston College, professors Theodore Borca-Tasciuc and Ganpati Ramanath from Rensselaer Polytechnic Institute, Dr. David Singh and Dr. Olivier Delaire from Oak Ridge National Laboratory, and professor Zhifeng Ren from the University of Houston. The management structure for S<sup>3</sup>TEC was updated to include the appointment of professor Evelyn Wang as associate director for the center.

The center was officially launched in August 2009 for a five-year period, based on meeting annual reporting requirements. S<sup>3</sup>TEC has submitted a proposal for renewal based on carrying forward its core research activities addressing direct heat-to-electricity conversion, but with newer elements that will consider challenges of mesoscale science, multi-scale computational simulations, and experimental approaches. The support of a renewed S<sup>3</sup>TEC EFRC program will be transferred from MPC to the Department of Mechanical Engineering effective with anticipated renewal date of August 2014.

## Microphotonics Center

The [Microphotonics Center](#) (MPhC) was established in 1999 based on research on silicon photonic device integration and applications to support the demand for exponential growth in communication bandwidth that has enabled the information age.

The MPhC performs research and technology supply chain studies that are released periodically as the MIT Communication Technology Roadmap (CTR). The purpose of the CTR—coordinated by the center’s industry consortium and written by lead faculty and industry-led technology working groups—is to define the difficult challenges and identify potential solutions. The following CTR releases have been issued thus far:

- CTR I - Survival (2000–2005): Identified industry trends and areas for technology development as electronic-photonic synergy, integration, standardization, and cross-market platform
- CTR II - Performance (2005–2009): Identified market opportunities for high volume and electronic-photonic convergence and technology targets to be cost, power efficiency, and bandwidth density
- CTR III - Scalability (Annual Releases):
  - “Scaling Energy” (2010)
  - “Scaling Copper” (2011)
  - “Short Reach and Board-Level Optical Interconnection” (2013)
  - “Open Architecture System Optimization” (2014)

The CTR III addresses a growing constituency with a new structure for engagement and work products that address industry concerns for scalability and the performance limits of integrated photonics. Consortium members work to form a consensus on identifying the parameters, needs, and distinctions between short-term and long-term communication functions that impact both research requirements and the industry supply chain. CTR III is publishing on a shorter timeline to better match the industry cadence and product cycles. The latest report from the Open Architecture System Optimization technology working group noted the critical need to address packaging requirements for integrated photonic-electronic devices.

The National Institute of Standards and Technology has awarded the MIT Microphotonics Center and the International Electronics Manufacturing Initiative (iNEMI) a grant to address the technology gaps and challenges that are limiting the advance of hardware technology for integrated photonic system manufacturing. The effort will establish a consortium of academics, technologists, and companies that will create an Integrated Photonic Technology Roadmap; bring together the fragmented, customization-focused photonics industry to engage collaboratively in developing a common roadmap; support development of high-volume mass-manufacturing, assembly, and packaging technologies and processes that are reliable and cost-effective; and include CTR III integration to develop dynamic models of supply-chain function and interaction as the transition to integrated photonics occurs to inform how the industry should implement technologies, and to develop technology-based models for the cost and environmental implications of a transition to integrated photonics.

MPhC's activities are supported by 28 companies, 12 academic affiliates, seven roadmap organizations and national labs, and more than 100 participating roadmap study organizations. Its membership meets twice each year to review silicon microphotronics research in the fall and the CTR in the spring. MPhC's Industry Consortium Board commissions technology working groups that meet twice monthly to perform the CTR studies and issue its releases. The most recently established technology working group on open architecture system optimization was established in October 2013 and published its first interim report in April 2014.

The fall and spring MPhC meetings at MIT include members, invited speakers, and guests. Interest in MPhC's activities has grown significantly over the past four years, as represented by the number of individuals and organizations present at the meetings. More than 100 organizations representing industry, government, and university groups participated in the fall and spring meetings in 2013–2014. Contributing members over the past year have included Alcatel-Lucent, Analog Devices, Corning, Hewlett-Packard, IBM, Intel, Mellanox (formerly Kotura), Molex, NEL America (NTT), Nippon Electronics, Photonic Controls LLC, Promex Industries, SABIC Innovative Plastics, SOITEC - Silicon on Insulator Technologies, and TECIP – Institute of Communication, Information and Perception Technologies.

### **SMART Low Energy Electronic Systems**

The Singapore-MIT Alliance for Research and Technology (SMART) Low Energy Electronic Systems (LEES) interdisciplinary research group, directed by professor Eugene Fitzgerald and managed through the Materials Processing Center, is now in its third year. This program has an MIT/MPC research volume of \$1.7 million per year, with a corresponding Singapore volume of about three times that. The program aims to identify new integrated circuit technologies that reduce energy per function, reduce power consumption, and increase system performance, based on the use of current silicon IC wafer processing infrastructure and integration of compound semiconductor device technology. A major research facility for this program has been constructed in Singapore, with two state-of-the-art metal organic chemical vapor deposition systems, and a wafer bonding and chemical mechanical polishing system. Coupled with other facilities available through collaborations with the Nanyang Technical University (NTU) and the National University of Singapore (NUS), full capabilities for III-V device processing on silicon substrates are now available. Collaboration with Global Foundries in Singapore has also been established for silicon CMOS wafer processing, establishing the ability to create novel monolithic III-V and silicon CMOS using foundry design platforms.

The SMART program involves eight MIT faculty, one MIT senior research scientist, as well as their students and postdocs based at MIT. Thirteen faculty from NTU and NUS are also involved in collaborative research. Seventeen MIT staff and postdocs are now supported in Singapore for research based there. A number of NTU and NUS students supported by SMA3 graduate fellowships are also involved in the program.

### **Selected New Programs with Industry**

MPC continues to support faculty research efforts with industry collaboration over a wide range of materials science-based applications, from metallurgical coatings for

strength and corrosion resistance to integrated photonics, solar cells, and batteries. MPC supports many ongoing research programs with faculty, including professor Christopher Schuh's research with Mitsubishi Materials and POSCO, professor Lionel Kimerling's programs with iNEMI, professor Antoine Allanore's program with Terrativa, professor Donald Sadoway's research with NorCo, and Dr. Randy Kirchain's research with Hydro Aluminum. A new program awarded to Dr. Jurgen Michel by ARPA-E for research on spectrum splitting for high-efficiency photovoltaic and thermal energy generation will seek to engage with individual companies for further development of the research.

The MPC also supports faculty with the establishment and operation of consortium research programs with industry. Two ongoing programs in 2013 include the Materials Systems Laboratory, directed by professor Joel Clark, and the Microphotonics Center, directed by Professor Kimerling.

The MPC partners with officers of MIT's Industrial Liaison Program (ILP) in support of company inquiry and ILP members' interests associated with the faculty research that MPC supports. In addition to coordination with faculty for meetings, MPC also provides technical briefings and seminars by MPC's director and associate director. Significant company meetings coordinated with ILP officers throughout the year were provided to senior executives and researchers from Applied Materials-Varian SEA, Embraer, Huawei Manufacturing, IHI Corporation, LG Corporation, Michelin, Merck, PTT, Sabic Innovative Plastics, and Siam Cement Group. All are members of ILP and/or participants in the MPC Collegium or Microphotonics Center Consortium. The MPC also supports other major ILP-sponsored events, including research and development conferences in Japan and at MIT.

### **Promotions and Selected Honors and Awards**

MPC faculty received numerous awards and honors, as individually reported in the reports of their home academic departments. The following are of special note.

Lionel C. Kimerling, the Thomas Lord professor of materials science and engineering, received a grant for the Consortium for Integrated Photonic Systems Manufacturing (CIPSM), a partnership between iNEMI and the Microphotonics Center. The \$539,990, 19-month grant is one of 19 awards totaling \$9 million to develop technology roadmaps aimed at strengthening US manufacturing. Elsa A. Olivetti, the Thomas Lord assistant professor of materials science and engineering at MIT, and Randolph Kirchain, a principal research scientist in the engineering systems division, will conduct process-based, cost modeling analyses of the economics of integrated photonics manufacturing. CIPSM will look at costs of both packaging and chip manufacturing as well as scaling up to high-volume manufacturing and standardization. The work will involve five to ten faculty at MIT associated with the Microphotonics Center as well as about 30 of its Industry Consortium companies. Funding began June 1, 2014.

Physics professor Raymond C. Ashoori and a team of MIT researchers will be a part of the Center for Integrated Quantum Materials, led by Harvard University and funded with a \$20 million, five-year Science and Technology Center program award from the

National Science Foundation. The team will work with graphene, a one-atom thick form of carbon; topological insulators, a class of materials on which electrons move on surfaces in directions that are determined by their individual electronic spins; and nitrogen vacancy centers in diamond, which can act as a site to store a bit of quantum information and be readily probed optically. MIT will receive about \$1 million a year for five years. Also involved in the research will be physics faculty Pablo Jarillo-Herrero, Nuh Gedik, Liang Fu, Leonid S. Levitov, and Jagadeesh Moodera (senior scientist), and electrical engineering and computer science faculty Tomás Palacios and Jing Kong. The researchers' proposal to NSF was one of three selected from a national competition that started with more than 250 pre-proposals. Begun on October 1, 2013, the project is based at the Harvard School of Engineering and Applied Sciences and also includes a network of four-year colleges—including Wellesley College, Gallaudet University, Olin College, and Mount Holyoke College—and six community colleges, including Bunker Hill Community College.

Tomás Palacios, associate professor of electrical engineering, was awarded the Agustin de Betancourt Award, the most prestigious award given in Spain to an engineer younger than 36 years old. Presented by the Spanish Royal Academy of Engineering, the award recognized Professor Palacios's work on nanotechnologies applied to high-frequency electronic devices based on GaN and graphene.

Professor of materials science and engineering Eugene Fitzgerald's SMART Low Energy Electronics Systems Lab (designed by Dr. Mayank Bulsara) is located on Singapore's Campus for Research Excellence and Technological Enterprise. The lab, built to attract the world's top researchers, was named *R&D Magazine's* 2013 Laboratory of the Year, an award that recognizes excellence in research laboratory design, planning, and construction.

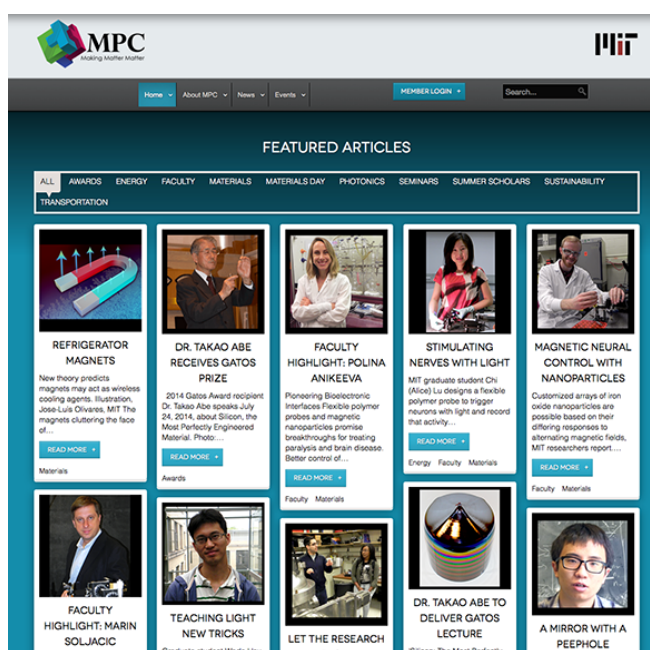
Harry Tuller, professor of materials science and engineering, was elected vice president/president-elect of the International Society of Solid State Ionics (ISSI). Elections were held for new officers at the 19th meeting of the International Meeting on Solid State Ionics, which was held in Kyoto, Japan, and attended by nearly 900 participants. The stated goals of the ISSI are "to promote science and technology related to ionic transport in solids" and to "provide an international and interdisciplinary forum for scientists in this field."

### **Communications and Outreach**

The increasing shift to online information transfer has created a more focused initiative using the website as a campus-wide materials reporting resource. The MPC website has become a highly successful portal for materials news and events within the MIT community. Updated regularly, the website highlights the latest news stories for our e-newsletter, as well as related news from the MIT News Office. Each month a faculty member is highlighted, as well as their graduate students' and postdocs' research activities. Faculty profiles in 2013–2014 included Brian Wardle, Silvijia Gradecak, Caroline Ross, Evelyn Wang, Katharina Ribbeck, Keith Nelson, A. John Hart, Raymond Ashoori, Antoine Allanore, Jeff Gore, Paula Hammond, and Marin Soljacic. The faculty highlight on Professor Ribbeck was featured by the MIT News Office in its "Top Stories

of the Week” email, sent to all MIT community members. This year 55 original articles were generated for the e-newsletter, and 35 of those were picked up by the News Office. The MIT Energy Initiative and the MIT Edgerton Center also picked up several of the articles for use on their websites. MPC’s faculty highlight on Evelyn Wang was picked up by the website [www.womeninnano.org](http://www.womeninnano.org), and the online newsletter [phys.org](http://phys.org) picked up reporting and photos on potassium research conducted by MIT postdoc associates Taisiya Skorina and Davide Ciceri. The School of Engineering featured on its home page MPC coverage of Professor Kimerling’s joint photonics consortium award and the MPC-CMSE 2014 Summer Scholars program.

We continue to use social media (Twitter, Facebook, and Google+) to communicate and expand our audience. This year, other MIT organizations started shared our Twitter posts with their followers, and *Nature* magazine and *Nature Reviews Cancer* online have shared our posts with their followers, who number in the thousands.



Screen shot of the new MPC website homepage featuring a news and announcements segment which can be sorted by topic.

### Summer Research Internship Program

MPC’s educational outreach extends beyond the MIT community. For 31 years, it has co-sponsored, with the Center for Materials Science and Engineering (CMSE), a [summer internship program](#) for promising undergraduate researchers from other colleges and universities nationwide. The MPC-CMSE summer internship, a National Science Foundation Research Experiences for Undergraduates program, brings some of the best science and engineering students in the country to MIT for graduate-level materials research in laboratories of participating faculty. The program culminates in a poster session held in the lobby of Building 13, where students present their research to the MIT community.



In 2014, the nine-week program ran from June 8 to August 9 and involved 14 faculty and 14 students whose home institutions included the University of California at Berkeley, University of Maryland at College Park, Columbia University, Universidad del Turabo (Puerto Rico), University of Texas, Carnegie Mellon University, University of St. Thomas, Yale University, North Carolina State University, Worcester Polytechnic Institute, University of Puerto Rico at Rio Piedras, Prairie View A&M University, Linfield College, and Rice University.



*2013 Summer Scholars.*

### **Materials Day**

Once a year, MPC invites the materials community to Materials Day, a celebration to recognize and honor the many important accomplishments and achievements of the past year and to talk about the future.

Held in the fall, Materials Day is a daylong symposium on a featured topic related to materials science and processing, followed by a graduate student/postdoctoral associate poster session. Materials Day 2013 focused on photonic materials and looked back at the 34-year legacy of MPC and how its widening focus has come to define an interdisciplinary hub of activity today. Faculty and industry professionals made seven presentations over the course of the day to a crowd of 135 attendees.

Talks included Dr. Vanita Mani, GE Global Research, "Optical Materials R&D at GE: From Science to Technology"; Professor Soljacic, MIT, "Nanophotonics for Energy-Conversion Applications"; Professor Kimerling, MIT, "From Smoke Signals to Clouds: Roadmaps, Roadblocks and Solutions"; Dr. Alice White, Boston University, "Photonic Materials for Future Exabit Networks"; Dr. Michael S. Weaver, Universal Display Corporation, "New Wave of Materials Challenges and Opportunities in the Growing Industry of Organic Light Emitting Devices"; professor Vladimir Bulovic, MIT, "Colloidal Quantum Dots in Commercialized Lightbulbs and Displays"; professor Yoel Fink, MIT, "How Can a Shirt See? The Birth of a Revolution in Fibers and Fabrics"; and an opening welcome presentation by MIT professor and MPC director Carl V. Thompson.

The poster session included more than 70 posters presented by graduate students and postdoctoral associates from departments including Chemical Engineering, Chemistry, Civil and Environmental Engineering, Electrical Engineering and Computer

Science, Aeronautics and Astronautics, Materials Science and Engineering, Mechanical Engineering, Nuclear Science and Engineering, Biological Engineering, and Physics. The posters were judged by a panel composed of representatives from industry and members of the MPC advisory board. Winners received award certificates and \$500 prizes. Poster session winners were Nisarg Shah, Chemical Engineering, “Tunable Biomedical Interfaces for Tissue Engineering” (faculty advisor Paula Hammond); Katherine Mirica, Chemistry, “Rapid Prototyping of Selective Carbon-Based Gas Sensors by Mechanical Drawing on Paper” (faculty advisor Timothy Swager); and Sakdirat Kaewunruen, Civil and Environmental Engineering, “Acoustic and Dynamic Characteristics of a Complex Urban Railway Turnout Using Fiber-Reinforced Foamed Urethane (FFU) Bearers” (faculty advisors Joseph Sussman and Herbert Einstein).

Materials Day 2014 is scheduled for October 22, 2014.



*Materials Day 2013 Poster Session winners, from left to right: Dr. Ernest Littauer (advisory board chair), Sakdirat Kaewunruen (Civil and Environmental Engineering), Nisarg Shah (Chemical Engineering), Katherine Mirica, (Chemistry), and Carl V. Thompson (director, MPC).*

## **Research Volume**

Total expenditures under MPC were \$15.8 million in FY2013. Major program expenditures included the Solid State Solar Thermal Energy Conversion Center, the Center for Integrated Quantum Coherent Materials, the program in Chemomechanics of Far-From-Equilibrium Interfaces, the SMART Low Energy Electronic Systems IRG, and the Skoltech Center for Electrochemical Energy.

MPC researchers are sponsored not only by a variety of companies but also by nearly every major federal research sponsoring agency, including the National Science Foundation, DOE, the National Institutes of Health, Air Force Office of Scientific Research, Office of Naval Research, and US Army Research Laboratory.

## **Overview and Outlook**

The MPC has now seen a second year of falling research volume. From a high of approximately \$20 million in FY2012, research volume fell to about \$17 million in FY2013 and approximately \$15.8 million this fiscal year. However, this is still

significantly above the 10-year low of \$8 million in FY2009. This downward trend can be attributed partly to the ending of stimulus programs associated with the DOE. For example, Donald Sadoway's ARPA-E program, which has come to its natural end, resulted in a \$1.5 million decrease in MPC FY2013 research volume, and a further decrease of about \$132,000 in FY2014. In addition, professor Alexander van Oudenaarden's departure to the Hubrecht Institute resulted in a loss of about \$1.6 million in research volume in FY2013 and \$533K in FY2014.

It is anticipated that MPC research volume will be roughly unchanged in FY2015. Although FY2015 will bring the loss of Gang Chen's DOE EFRC Solid State Solar Thermal Energy Conversion Center – Professor Chen became the Department Head of Mechanical Engineering and plans to renew the S<sup>3</sup>TEC program through that department—this loss will be counterbalanced by several new activities. The new Skoltech Center for Electrochemical Energy will ramp up to its steady-state volume during FY2015, and Jurgen Michal's new ARPA-E program will start in FY2015. In addition, Professor Gore's research program has already grown to a size comparable to Professor Van Oudenaarden's former program, and new faculty in Materials Science (Allanore, Olivetti, and Hu) and Physics (Fu, England, Checkelsky, and Cissé) have growing research programs.

Over the past year, MPC has expanded services to MIT and external communities. We are providing more extensive and customized financial services to faculty, including developing tools and capabilities that provide budget projections for the entire funding portfolio of a group or program, and creating and designing new equipment-booking and billing databases and websites with collaboration tools for faculty and researchers.

MPC activities such as Materials Day and the Summer Intern Program are made possible through funds received from members of the MPC Collegium. The Collegium membership has gradually declined to a low of eight members. In the past two years, we have better defined existing benefits, developed new benefits of Collegium membership, and engaged in a rebranding process by developing new marketing materials and changing our logo. We have also developed stronger ties with the ILP, which is the source of a number of our Collegium members. While these activities led to the addition of three new Collegium members over the last two years, we also lost two members when they ended their relationship with ILP, and lost a third when they changed their allocation through the MIT Energy Initiative. Reinventing and growing of the Collegium will continue to be a high priority for the center in the coming year.

The building of MIT.nano will greatly benefit the materials research community at MIT. This is probably the most important event for the materials community in the last several decades. The MPC is working closely with the associate dean for innovation, Vladimir Bulovic, and others in developing strategies through which the activities of MPC, MIT.nano, and other centers can be integrated to optimize benefits for all members of the MIT community. This period provides an opportunity for significant evolution of the modes and mechanisms of MPC's operation.

A second MPC-specific benefit of the construction of MIT.nano has been the move of the MPC headquarters from the basement of Building 12 to the fifth floor of Building 24, a new space that was significantly upgraded and redesigned to meet the MPC's needs. While the move to Building 24 was disruptive, the new space is far better in many ways, raising morale and allowing MPC to present a better face to all who enter.

The MPC looks forward to continuing its work with individual faculty and teams of faculty to develop and support new interdisciplinary research programs. As always, the center will continue to search for new ways to interact with industry in order to create collaborations that promote the two-way exchange of expertise and lead to the development of new materials and processes that provide a sustainable improvement in the quality of life worldwide.

**Carl V. Thompson**

**Director**

**Stavros Salapatas Professor of Materials Science and Engineering**