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 36th 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. The 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. The center also organizes events for the broader materials research community at MIT, which includes more than 150 faculty.

The MPC staff went through a transition this year. Long-time employee Jonathan Bartels, who was the administrative officer, had been with MPC for 32 years before his retirement on January 31, 2016. Jon joined MIT 39 years ago, starting in the Office of Sponsored Programs, where he worked for seven years. Gil Cordova has been promoted to administrative officer, replacing Jon in his position. Heidi Kendig was hired to replace Gil in his former role as senior financial administrator.

Industry Collegium and External Advisory Board

The MPC Industry Collegium consists of 10 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 participate in MPC's annual Materials Day symposium and poster session. Current collegium members include the Agoria-Belgium Consortium, Applied Materials, Ishikawajima-Harimi Heavy Industries, Merck KGaA, Michelin, Raytheon, Shanghai Banzan Macromolecule Materials, Siam Cement Group, Stanley Black & Decker, and SunEdison Semiconductor.

The MPC external advisory board meets for a full day after the Materials Day event each year. MPC's director and staff report on the prior year's activities and present on planned initiatives and goals for subsequent years. In addition, 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. It also 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 Corporate Research Laboratory, Applied Materials, Boston University, Compaq Computer Corporation, General Motors, Lockheed Martin Corporation, Lord Corporation, Midrange Systems EMC, Novartis Pharmaceuticals, Saint-Gobain Corporation, Sandia National Laboratories, Solvay Advanced Polymers, SunEdison Semiconductor, and Westinghouse Electric Company.

Faculty members who spoke at this year's board meeting included Professor and Associate Dean for Innovation Vladimir Bulović (School of Engineering), Professor Krystyn Van Vliet (Materials Science and Engineering), Professor Lionel C. Kimerling (Materials Science and Engineering), Assistant Professor Robert Macfarlane (Materials Science and Engineering), Assistant Professor Joseph Checkelsky (Physics), Assistant Professor Luqiao Liu (Electrical Engineering and Computer Science), and Professor Benedetto Marelli (Civil and Environmental Engineering).

Center for Electrochemical Energy Storage

The Center for Electrochemical Energy Storage (CEES) continued into its third year in 2016. CEES is one of approximately 10 centers for research, education, and innovation (CREIs) that provide the primary support for research and teaching at the Skolkovo Institute of Science and Technology (Skoltech). Skoltech is a new university founded in close collaboration with MIT through the MIT Skoltech Initiative. Each of the original CREIs is based on collaborations among Skoltech, a Russian university (Moscow State University in the case of CEES), and an international university (MIT in the case of CEES). The expected steady-state annual funding level at MIT for this five-year program was $2.5 million. However, CEES receives its funding in Russian rubles, and, due to a decrease in the value of the ruble, 2016 funding dropped to approximately $1 million, as compared with $1.3 million in 2015.

The CEES team is highly interdisciplinary and involves faculty from the MIT Departments of Mechanical Engineering, Chemical Engineering, Materials Science and Engineering (DMSE), and Chemistry as well as faculty from the Departments of Physics and Chemistry at Moscow State University. As of the end of FY2015, a total of five faculty were involved in CEES at Skoltech, including the center director.

Research in CEES is focused on three areas—advanced metal-ion batteries, rechargeable metal-air batteries, and fuel and electrolysis cells—chosen to target the technologies that will replace the current Li-ion battery technology. The center is also conducting a project addressing general methods for systems-level analyses. Research on advanced metal-ion batteries focuses on electrode and electrolyte materials for earth-abundant ions such as Na^+ as replacements for more expensive Li^+ ions, as well as on improved materials for Li-ion batteries such as dual electronic and ionic conducting polymer materials. Activity was initiated this year on the development of new metaphosphate compounds for redox flow batteries. Research on reversible metal-air batteries included mechanistic studies of the effects of electrolyte solvents on discharge product morphologies that lead to high volumetric capacities in both Li-air and Na-air batteries. Modeling and experimental studies also focused on catalytic materials for oxide reduction reactions, which are important in metal-air batteries as well as electrolysis. Other research directed toward coupled solid oxide fuel and electrolysis cells included an investigation of materials with mixed ionic and electronic conduction to enable high performance of solid oxide fuel cells that operate at reduced temperatures.

A number of important milestones were achieved this year. In 2015, 18 journal articles based on CEES research with MIT coauthors were published. Included among these articles is the first paper based on joint Skoltech and MIT research, which was published

in *Nature Communications*. Now that the number of CEES-related faculty has increased to five, the number of joint papers is expected to rapidly increase. MIT faculty also participated in the second annual "Electrochemical Energy Storage: Challenges and Prospects" workshop, held for the first time at Skoltech's new facilities. In addition, in fall 2015, CEES faculty at MIT hosted Skoltech students in their research groups for the first time. These and other interactions are expected to continue next year.

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.

MPhC performs research and technology supply chain studies that are released periodically in the form of the MIT Communication Technology Roadmap (CTR). The CTR is coordinated by the center's industry consortium, and reports are written by faculty and by industry-led technology working groups (TWGs). The purpose of the CTR is to define difficult challenges and identify potential solutions. CTR releases thus far are as follows:

- CTR I (2000–2005) focused on industry trends and areas for technology development such as electronic-photonic synergy, integration, standardization, and cross-market platforms.
- CTR II (2005–2009) identified market opportunities for electronic-photonic convergence and technology targets (cost, power efficiency, bandwidth density).
- CTR III (annual releases) focused on scaling energy (2010), scaling copper (2011), short-reach and board-level optical interconnections (2013), and open architecture system optimization (2014).

MPhC's activities are supported by 28 companies, 12 academic affiliates, 7 roadmap organizations and national labs, and more than 100 participating roadmap study organizations. Its membership meets twice each year to review silicon microphotonics research in the fall and the CTR in the spring. The fall and spring meetings include members, invited speakers, and guests. Interest in the center's activities has grown significantly over the past five years, as represented by the number of individuals and organizations in attendance. More than 100 organizations—representing industry, government, and university groups—participated in the fall 2015 and spring 2016 meetings. Contributing members over the past year have included 3M, Acacia Communications, Alcatel-Lucent, Analog Devices, Boston University, Cisco, Dow Corning, Facebook, Hewlett Packard, Intel Corporation, Luceda Photonics, Luxtera, McMaster University, the MIT Materials Systems Laboratory, Palomar Technologies, SABIC Innovative Plastics, SiFotonics Technologies, the University of Arizona, the University of Southampton, and Waseda University.

The Microphotonics Center and the International Electronics Manufacturing Initiative (iNEMI) were awarded a grant from the National Institute of Standards and Technology (NIST) to address the technology gaps and challenges that are limiting the advance of hardware technology for integrated photonic system manufacturing. A consortium of

academics, technologists, and companies was formed and, working together through TWGs, has prepared the first version of an integrated photonic technology roadmap. The roadmap seeks to bring together the fragmented, customization-focused photonics industry to enable collaborative engagement that supports the development of high-volume mass-manufacturing, assembly, and packaging technologies with processes that are reliable and cost-effective. The TWGs associated with the roadmap include groups focusing on circuit backplanes and connectors, assembly and testing, monolithic integration, photonic component packaging, and packaging of electronic photonic systems.

American Institute for Manufacturing Integrated Photonics

MPC, working with the Research Laboratory of Electronics and the MIT administration, supported lead professors Lionel Kimerling and Michael Watts in the development of a major proposal for the creation and funding of the American Institute for Manufacturing Integrated Photonics (AIM Photonics) in response to the US government's call for an integrated photonics institute for manufacturing innovation (IP-IMI). On July 27, 2015, the Obama administration announced that the IP-IMI had been awarded to AIM Photonics. This $600 million public-private partnership, which will help strengthen high-tech US-based manufacturing, brings government, industry, and academia together to advance domestic capabilities in integrated photonic technology. The lead institution in this partnership is the University of New York Polytechnic Institute (SUNY Poly). The AIM Photonics executive management team includes Professor Michael Watts as chief technology officer and Professor Lionel Kimerling as education, workforce development, and roadmap executive.

Through MPhC, MPC will support important activities related to education and workforce development as well as research. The MPhC roadmap efforts supported under NIST, which extended to manufacturing, packaging, and testing in collaboration with iNEMI, ended as of May 2016; however, these efforts have transitioned and will be supported and further developed through AIM Photonics. The AIM Photonics Academy has been established under the leadership of Professor Kimerling as the organization leading the development of education, workforce development, and roadmap materials and services. The academy leadership team includes participating members from iNEMI, SUNY Poly, the University of Rochester, the Rochester Institute of Technology, the University of Arizona, and the University of California, Santa Barbara. The academy has produced several new course modules for education and workforce programs and has launched two new technology working groups for the roadmap: the electronic-photonic design analysis TWG and the photonic sensors TWG. The AIM Photonics Academy leverages and builds on the ongoing success of the Microphotonics Center and the CTR program through its participating members from industry, academia, and government and semiannual meetings held at MIT.

Singapore-MIT Alliance for Research and Technology 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 A. Fitzgerald and managed through MPC, is now in the fifth and final year of

its phase 1 activity. This program has an MIT/MPC research volume of approximately $1.3 million per year, with a corresponding Singapore volume of about three times that amount. A proposal for additional funding for five years in phase 2 is under review. A decision on renewal is expected in late summer or early fall 2016.

The goal of the LEES program is to demonstrate a research paradigm in which specialists in materials processing, device and circuit design, and systems architecture work in close concert to develop new integrated circuit technologies that will enable new applications. The key feature of this process is that these specialists work jointly in the iterative process that leads to innovation with impact. Toward achieving its goals, in phase 1 LEES developed a 200-mm wafer processing facility in Singapore that includes two state-of-the art metal organic chemical vapor deposition systems as well as other components such as wafer bonding, chemical mechanical polishing tools, and tools for materials and device characterization. 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 have been developed. Collaborations with two semiconductor integrated circuit foundries have also been established. Through these collaborations, LEES compound semiconductor devices and circuits have been integrated with silicon complementary metal-oxide-semiconductor circuits to produce new circuit architectures for new functionalities.

Key features of the new platform developed by LEES include the following:

- Seamless integration with Si foundry processes
- Core III-V and Si integration-enabling process technologies
- Heterogeneous III-V and Si process design kits for circuit designers
- Initial demonstrations of integration possibilities
- Advanced material options and complementary technologies for optical/electrical/wireless integrated circuits

In addition, advanced research on photovoltaic devices, microbatteries, and thermal management systems is under development for future integration into the LEES platform.

The SMART program involves seven MIT faculty and one MIT senior research scientist, as well as their students and postdocs based at the Institute. Eleven faculty from NTU and NUS are also involved in collaborative research. Twenty-four MIT staff and postdocs are now supported in Singapore for research based there. A number of NTU and NUS graduate and undergraduate students supported by fellowships are also involved in the program.

Center for Integrated Quantum Materials

Entering its fourth year, the Center for Integrated Quantum Materials (CIQM) is a National Science Foundation (NSF) science technology center led by Harvard University, with principal partners at MIT, Boston's Museum of Science, and Howard

University. The center focuses on discovering new quantum materials that will transform signal processing and computation. MIT's CIQM effort pulls together nine principal investigators (PIs) in various fields including quantum materials, quantum electronics and photonics, and atomic scale networks and provides support to nine graduate students and five postdoctoral associates.

This year the MPC Materials Day symposium focused on quantum materials and featured invited speakers from the CIQM program, with an added invitation for all Materials Day attendees to attend the CIQM annual program review meeting held on the following day. Among the CIQM speakers at Materials Day were MIT professors Nuh Gedik (Physics), Pablo Jarillo-Herrerro (Physics), and Tomas Palacios (Electrical Engineering and Computer Science); Dr. Amir Yacoby of Harvard University; and Professor Gary Harris of Howard University. The primary research topics covered by the speakers included topological insulators, quantum transport and optoelectronics with van der Waals heterostructures, and system-level applications of two-dimensional materials.

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 ORMCO, Professor Lionel Kimerling's programs with iNEMI and AIM Photonics, Professor Antoine Allanore's program with Tavarua, Professor Donald Sadoway's research with NorCo, Dr. Randy Kirchain's research with the Hangzhou Jinjiang Group and Rio Tinto, Professor Elsa Olivetti's program with Advanced Micro Devices, and Dr. Jurgen Michel's programs with Futurewei and the Advanced Research Projects Agency-Energy. MPC, working with faculty, will seek to engage individual companies for future development of research.

MPC also supports faculty with the establishment and operation of consortium research programs with industry. Two ongoing programs for 2015 and 2016 include the Materials Systems Laboratory (Professor Joel Clark and Dr. Randolph Kirchain) and the Microphotonics Center (Professor Lionel Kimerling, director).

MPC partners with MIT Industrial Liaison Program (ILP) officers in support of company inquiries and ILP members' interests in faculty research. MPC support includes coordination with ILP officers and faculty for meetings as well as technical briefings and seminars offered by the MPC director and associate director. Significant company meetings coordinated with ILP officers throughout the year were held for senior executives and researchers from Analog Devices, Applied Materials, Breca Group, Haitian Plastics, Huawei, Kobelco (Kobe Steel), Metalsa, Michelin, Nanjing Fiberglass, Ningbo Hi-Tech, Sabic Innovative Plastics, Saertex, Shanhai Banzan Macromolecule Materials, Siam Cement Group, SNCF Group, and Swedish Defense Materials. All are either members of ILP or participate in the MPC Industry Collegium or Microphotonics Center Consortium. MPC also supports other major events sponsored by ILP, including its research and development conferences in Japan and at MIT.

Promotions and Selected Grants, Honors, and Awards

MPC faculty received numerous awards and honors, as individually described in the reports of their home academic departments. Some highlights are listed below.

Seed fund grants were awarded to nine established and new faculty in the amount of $150,000 each to support early-stage innovative research across the energy spectrum. One of the faculty members receiving funds was Bilge Yildiz, associate professor of nuclear science and engineering. His project, "Metal-Oxide Surfaces to Enable Fast Oxygen Exchange in Fuel Cells," seeks to significantly improve the performance of perovskite oxides functioning in extreme environments.

Donald Sadoway, professor of materials science and engineering, received a seed fund grant to support early-stage innovative research for his project "Aluminum Polymer Battery for Automobile Propulsion."

Tonio Buonassisi, associate professor of mechanical engineering, was awarded a grant for his project "Cost-Optimizing Solar Power Systems for Water Desalination." Buonassisi was also one of the recipients of the Presidential Early Career Award for Scientists and Engineers (PECASE). PECASE awardees are selected for their pursuit of innovative research at the frontiers of science and technology and their commitment to community service, as demonstrated through scientific leadership, public education, or community outreach.

Tomas Palacios was promoted to full professor of electrical engineering and computer science this year. Palacios has made groundbreaking contributions to electron devices through the use of new materials and nanotechnology. His work includes advancing the design, fabrication, and application of semiconductors such as gallium nitride, ubiquitous in today's solid-state lighting and power electronics, as well as developing some of the first device concepts and applications of graphene and other two-dimensional materials. Palacios also received seed funding from the MIT International Science and Technology Initiatives (MISTI) for his project "Automatic Transfer of 2D Materials to Flexible Substrates and Benchmarking as Chemical Sensors."

Pablo Jarillo-Herrero, professor of physics, was also a recipient of a seed grant from MISTI for his project "Quantum Optoelectronics with 2D Materials." MISTI funds enable participating teams to collaborate with international peers, either at MIT or abroad, with the aim of developing and launching joint research projects.

Liang Fu, assistant professor of physics, received the New Horizons in Physics Prize, which is awarded to promising junior researchers who have already produced important work in fundamental physics. Fu works on theories of topological insulators—a new class of materials whose surfaces can freely conduct electrons even though their interiors are electrical insulators—and topological superconductors. These materials may provide insight into quantum physics, and they have possible applications in creating transistors based on the spin of particles rather than their charge.

Paula Hammond, the David H. Koch Professor in Engineering, was named the head of the Department of Chemical Engineering. She is the first woman and the first person of color appointed to the post. Hammond's research group focuses on biomaterials and drug delivery. The core of her work is the use of electrostatics and other complementary interactions to generate functional materials with highly controlled architectures, including the development of new biomaterials and electrochemical energy devices.

Communications and Outreach

The increasing shift to online information transfer has catalyzed a more focused initiative utilizing 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. The website is updated regularly and highlights the latest news stories generated for our e-newsletter, as well as related news from the MIT News Office. Each month a faculty member is highlighted along with the research activities of his or her graduate students and postdocs. Faculty profiles in 2015–2016 included Joseph G. Checkelsky, Liang Fu, Nuh Gedik, Ibrahim Cissé, Jagadeesh S. Moodera, and Alexie M. Kolpak. This year 40 original articles were written and photographed for the e-newsletter, and 29 of those articles were picked up by the MIT News Office for use on its own website. DMSE, the MIT Energy Initiative (MITEI), the School of Science, and the School of Engineering also picked up several articles for use on their websites.

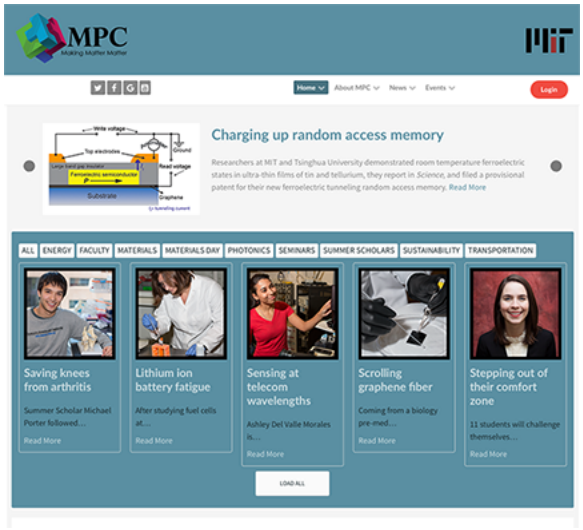

Figure 1. Screen capture of the MPC website homepage featuring a news and announcements segment that can be sorted by topic.

We continue to use social media (Twitter, Facebook, and Google+) to communicate with and expand our audience. As a result, we have grown our following by almost double from last year, and now other MIT organizations are sharing our Twitter posts with their followers.

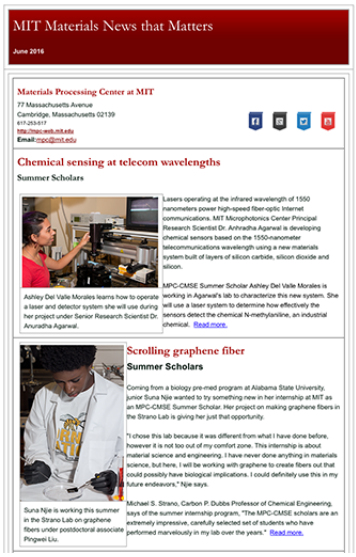

Figure 2: The monthly MPC e-newsletter.

Summer Research Internship Program

MPC does not limit its educational outreach to the MIT community. For more than 30 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 is an NSF Research Experiences for Undergraduates program. The program brings the best science and engineering students in the country to MIT for graduate-level materials research in the 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.

The 2016 nine-week program ran from June 8 to August 6 and involved 11 faculty and 11 students from schools including Florida State University, Montana State University, Pennsylvania State University, the University of Puerto Rico-Mayaguez, the Johns Hopkins University, the Polytechnic University of Puerto Rico, Alabama State University, the University of Massachusetts Amherst, Rutgers University, and Vanderbilt University.

Figure 3. 2015 summer scholars.

Materials Day

Sharing knowledge and insight with others in the materials science and engineering field can lead to new ideas, collaborations, and breakthroughs. Once a year, the materials community is invited 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. The Materials Day 2015 symposium focused on quantum materials and was a joint collaboration with CIQM at Harvard. Seven presentations were offered over the course of the day, by both faculty and industry professionals, drawing a crowd of more than 140 attendees.

Invited speakers (and the titles of their talks) included Professor Nuh Gedik of MIT ("Shining Light on Topological Insulators"), Dr. George Bourianoff of Intel ("Novel Materials and Condensed Matter Phenomena for Cognitive Information Processing"), Professor Pablo Jarillo-Herrero of MIT ("Quantum Transport and Optoelectronics with van der Waals Heterostructures"), Professor Tomas Palacios of MIT ("System-Level Applications of Two-Dimensional Materials: Challenges and Opportunities"), Dr. Daniel Twitchen of Element Six ("The Battle to Control Diamond"), Dr. Amir Yacoby of Harvard University ("Exploring Condensed Matter Physics Using Nitrogen Vacancy Center Based Nano-Scale Magnetometry"), Dr. Gary Harris of Howard University ("Diamond, a Quantum Material: You Have Come a Long Way Baby, BUT!"), and MPC director Carl V. Thompson, who led the opening welcome presentation.

The poster session that followed panel presentations and discussions included over 65 posters presented by graduate students and postdoctoral associates from departments such as 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 of representatives from industry as well as members of the MPC advisory board. Winners received award certificates and $500 prizes. Poster session winners were as follows:

> Sophie Liu, Lionel C.H. Moh, Alexander R. Petty, and Graham T. Sazama, Chemistry: "Metalloporphyrin-Functionalized Carbon Nanotubes in Gas Sensors." Faculty advisor: Professor Timothy M. Swager
>
> Brian Pearson, Mechanical Engineering: "Crystalline Ge on Amorphous Substrates for Electronic-Photonic Integration." Faculty advisors: Professors Lionel C. Kimerling and Jurgen Michel
>
> Lan Li, DMSE: "Integrated 3D Flexible Glass Photonics." Faculty advisor: Professor Juejun Hu

Materials Day 2016 is scheduled for October 18, 2016, and the workshop will focus on advances in materials for energy storage.

Research Volume

Total expenditures under MPC totaled $17.5 million in FY2016. Major program expenditures included the Low Energy Electronic Systems program within SMART, led by Professor Eugene Fitzgerald and eight co-PIs; the Skoltech Center for Electrochemical Energy Storage, led by Professor Carl V. Thompson and seven co-PIs; the Chemomechanics of Far-From-Equilibrium Interfaces (COFFEI) program, supported by the Department of Energy (DOE) and led by Professor Harry Tuller and five co-PIs; the NSF-supported Center for Integrated Quantum Materials, in collaboration with Harvard University and led by Professor Raymond Ashoori and seven co-PIs; and the American Institute for Manufacturing Integrated Photonics (in collaboration with the State University of New York Research Foundation), supported by the Department of Defense (DOD) and led by Professor Lionel Kimerling and 6 co-PIs. Other significant faculty research groups included those of Associate Professor Pablo Jarillo-Herrero, Assistant Professor Ibrahim Cisse, Associate Professor Jeffrey Gore, Associate Professor Nuh Gedik, Assistant Professor Antoine Allanore, and Professor Donald Sadoway.

MPC researchers are sponsored not only by a variety of companies but also by nearly every major federal research sponsoring agency, including NSF, DOE, the National Institutes of Health, and multiple DOD agencies.

Overview and Outlook

Research volume for FY2016 was approximately $15.8 million, an increase of 12% from FY2015. This is still below our 10-year high of $20 million in FY2012 but significantly above the 10-year low of $8 million in FY2009. About one third of the total research volume is derived from large multi-investigator programs (CIQM, SMART/LEES, CEES, AIM Photonics, and COFFEI), and the remainder flows from smaller single-investigator or small-team programs. This distribution is comparable to that from the preceding year.

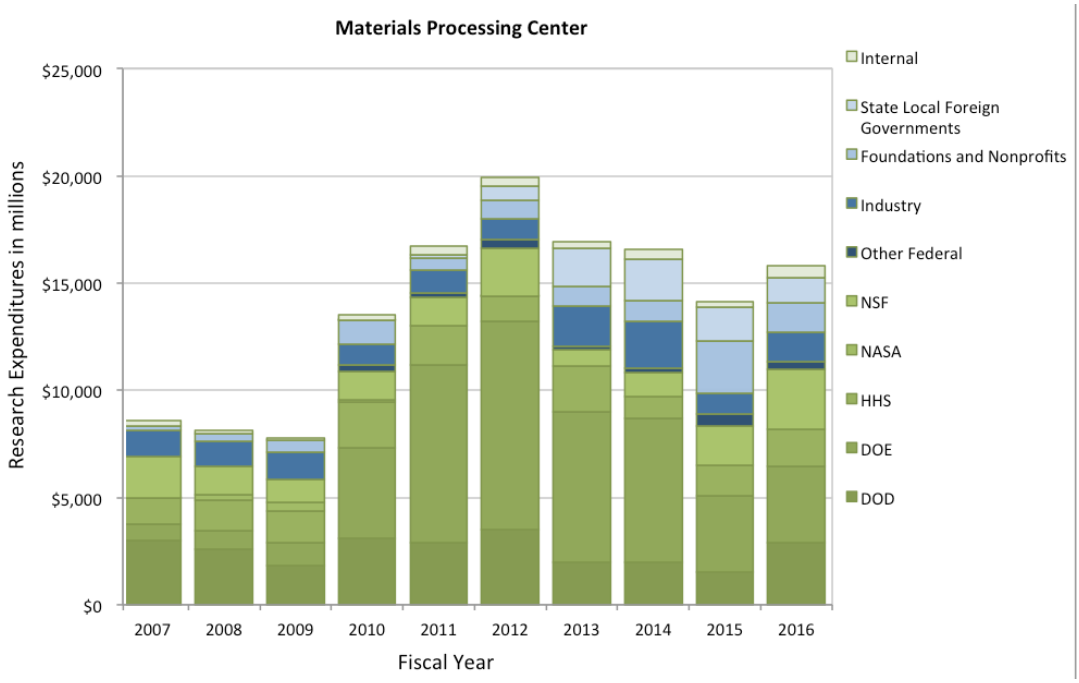

Figure 4. MPC sponsored research volume, FY2004–2016

We anticipate that our research volume will not significantly change or may increase slightly in FY2017. This year COFFEI was renewed for three years. The SMART/LEES program is likely to be renewed for five years this fall, although the funding level is not certain. The Skoltech Center for Electrochemical Energy Storage is budgeted for continuation with level funding (in rubles), and Skoltech has expressed strong support for the center. However, Skoltech's budget is itself subject to some uncertainty, leading to the possibility of changes in MPC research from this source. Research volume associated with the AIM Photonics program is likely to increase as this program continues to ramp up. CIQM is in the third year of a five-year funding cycle. Relatively new faculty in materials science (Antoine Allanore, Elsa Olivetti, and J.J. Hu) and physics (Liang Fu, Jeremy England, Joseph Checkelsky, and Ibrahim Cisse) have rapidly growing research programs, and MPC-affiliated senior faculty members remain active in seeking continued and expanded funding.

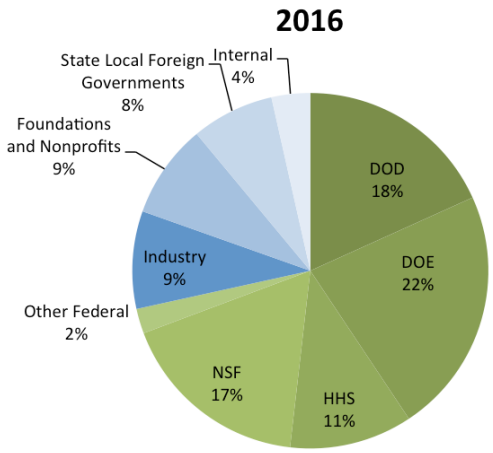

Figure 5. MPC major sponsors, 2016.

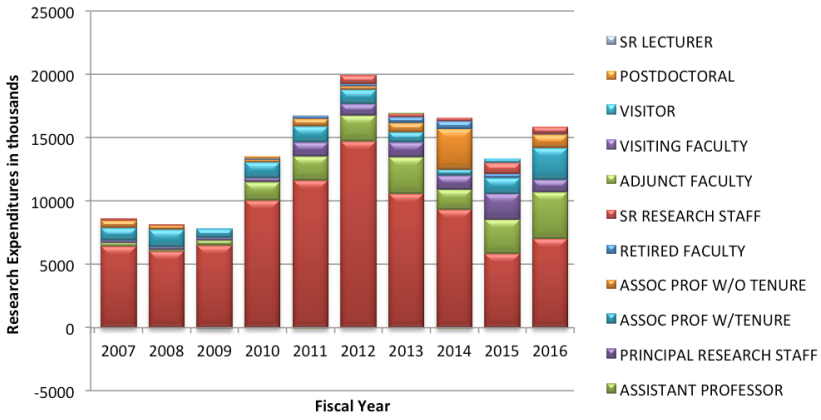

Figure 6. MPC researchers, by rank, 2016

MPC activities such as Materials Day, the summer intern program, and the e-newsletter are made possible through funds received from members of the MPC Industry Collegium. The collegium membership has held approximately steady over the past few years and currently stands at 10 companies. We continue to support strong ties with ILP, which is the source of the majority of our collegium members. Growing the collegium will continue to be a high priority for the center in the coming year.

In the past year, there have been extensive discussions regarding reorganizing MIT laboratories and centers to promote synergies between current functions and activities and new capabilities enabled by the creation of MIT.nano. Included in these discussions is a possible merger of MPC with the Center for Materials Science and Engineering to form a new laboratory with a new name. This would be a major milestone in the evolving infrastructure that supports interdisciplinary materials research at MIT. MPC and CMSE have been operating separately for more than 35 years; over time, however, their activities have become increasingly synergistic and complementary. A merger of MPC and CMSE will allow better coordination of industrial and community outreach activities as well as the development of new interdisciplinary materials research

programs enabled by, and carried out in partnership with, MIT.nano. We look forward to the outgrowth of these ongoing discussions and the changes they will produce.

In the meantime, MPC looks forward to continuing its work with individual faculty members and teams of faculty to develop and support new research programs. As always, the center will continue to promote materials research in outreach programs and to search for new ways to interact with industry in order to create collaborations that promote two-way exchanges of expertise. In these ways, MPC will support the development of new materials and processes that provide sustainable improvements in quality of life worldwide.

Carl V. Thompson
Director
Stavros Salapatas Professor of Materials Science and Engineering