INSTITUTE FOR MATERIALS RESEARCH

The gateway to materials research at The Ohio State University

Fiscal Year 2009 – 2010

Annual Report

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Institute for Materials Research Annual Report
FY 2009-2010

Introduction

The cumulative impact and influence of the IMR on the Ohio State materials community has been profoundly positive to date, and this year has been no exception. As will be seen in this report, this impact can be measured in many ways, whether it be that OSU is now part of an elite group of universities with currently funded NSF MRSEC and NSEC programs, arguably the two most competitive and highly acknowledged block programs in materials, or whether it be we have successfully recruited some of the best and brightest young faculty members in several areas and colleges who have acknowledged that without the role of the IMR and the move of OSU toward pre-eminence in materials in the last few years *as an institution*, they would not have joined our faculty, or whether it be that the IMR is enabling total coordination of facilities leading toward reduced duplication of investment and thus increased support of these vital, and expensive laboratories around campus that all materials researchers have access to, or whether it be that due to IMR's active role, OSU has taken on the mantle of leadership in a key statewide materials program to hire endowed chair faculty members in areas of strategic importance to the State to establish it as the "go-to" state in advanced materials, or whether it be that we have formally launched a new industry partnership program with joint seed funding.

The past year of IMR activity has witnessed several important accomplishments, including new externally funded awards, newly hired faculty members in areas of exquisite strength and strategic importance, development of new, shared facilities, starting of our industrial match funding program, hiring additional technical staff, expanding the network of IMR-managed facilities for campus-wide access, and even incorporating the largest shared laboratory/building in the materials community at OSU – the Nanotech West Lab, formerly as part of IMR. Some of the specific accomplishments, in no particular order, from the past year include:

- Establishment of OSU as a Center of Excellence in Materials by the State of Ohio
- Addition of 6 companies to the IMR's Wright Center on Solar Energy
- Funding of new awards from NSF, DoD, DOE and industry
- Awarding of a new NSF I/UCRC (Industry/University Cooperative Research Center) in materials joining
- Awarding of two DoD MURI programs, in thermoelectric materials and in advanced electronic and dielectric materials
- Initial industry challenge grants awarded
- Transfer of entire Nanotech West Laboratory administration, operation and unit reporting from Engineering to IMR

- Hiring of first Ohio Research Scholar endowed chair professors in the Technology-Enabling and Emergent Materials Statewide Cluster
- Multiple major equipment acquisitions supporting research in energy materials, electronic materials, magnetic materials and characterization
- Creation of a new IMR user facility in the Chemistry Department and hiring of our 4th IMR Member of Technical Staff
- 2nd Annual Materials Week conference
- First activities via IMR-Spain collaboration on electronic materials
- Expanding the involvement of OSU in energy funding opportunities via DOE
- Moving two labs onto our new Integrated Laboratory Management database platform
- NSF NSEC renewed for its phase II program
- New funded projects starting in FY2010 exceeded $57,000,000 in awarded funds

This annual report that follows, provide more detail into many of these accomplishments, and in general summarizes progress and current status of the IMR within its broad mission to advance and support the University's materials-allied research enterprise..

Overview of the Institute for Materials Research

The Ohio State University Institute for Materials Research (IMR) is an interdisciplinary organization established in 2006 with the purpose of facilitating, promoting and coordinating research activities and infrastructure related to the science and engineering of materials throughout the University. IMR serves as the gateway to the materials research enterprise at The Ohio State University.

> **IMR VISION**: A multidisciplinary research institute that propels OSU to the recognized international forefront of materials-allied research and scholarship
>
> **IMR MISSION**: To nurture, grow and support research groups leading to small, large and center-level awards; to provide strategic planning, resources, infrastructure, and educational/outreach activities; to coordinate, support and assist with management of campus-wide materials-allied research and related resources

In 2005, a Materials Vision Committee of 13 OSU faculty from a broad range of departments involved in materials research from the Colleges of Engineering, Math & Physical Sciences and Medicine was formed by the OSU Senior Vice President for Research to develop a compelling and strategic vision for materials-allied research at OSU. This Committee's mission was to assess OSU's materials community and its activities and make recommendations designed to propel OSU to worldwide leadership in materials research. In September 2005, the Materials Vision Committee submitted its report, and based on critical assessments of the status, assets, needs and unique strengths of materials research across the University with respect to international trends and future opportunities, the Committee recommended formation of a strong and vibrant Institute for Materials Research (IMR).

IMR Members

The OSU materials community is made up of a diverse and distinguished group of faculty researchers. Members of the materials community at Ohio State include 5 National Academy members, 7 Ohio Eminent Scholars, 5 Distinguished University Professors, and dozens of Fellows at various professional associations such as AAAS and IEEE. IMR's membership includes over 140 faculty members and research staff representing 20 departments and 6 colleges. IMR members are faculty from the Colleges of Engineering; Arts and Sciences (Division of Natural and Mathematical Sciences); Food, Agricultural and Environmental Sciences; Medicine; Pharmacy; and Veterinary Medicine.

An ISI literature search of IMR members' publications that likely include conference proceedings, books and chapters and other forms of citable scholarship published during the reporting period (July 1, 2009 – June 30, 2010) found that these 141 faculty members authored 2,617 papers per faculty member over the last year. Those 141 faculty members' publications also received 13,499 citations during that same 12-month period, for an average of 95.7 citations per faculty member this year. The Ohio State Office of Sponsored Programs tabulated the current research activities of all faculty members within the IMR materials community, and found that during the same 12-month period of June 1, 2009 – May 31, 2010, IMR members served as investigators for research projects with awarded budgets totaling $101,799,425 in external research funding. New projects with project start dates of June 1, 2009 or later accounted for $57,310,252 of that amount, meaning a full 56% of the active research projects over the last 12 months were newly funded by external sponsors.

IMR Committees

The Institute for Materials Research reports to a single Executive Committee and is advised by two other committees, the Faculty Science Advisory Committee (FSAC) and the External Advisory Board. This organizational structure was created by the original vision committee, and has proved to be an effective way to obtain a wide range of guidance from university, industry, and national laboratory leadership. **Figure 1** shows the organization chart depicting the placement and role of these committees and their membership.

IMR has over 140 members representing 20 departments and 6 colleges at The Ohio State University.

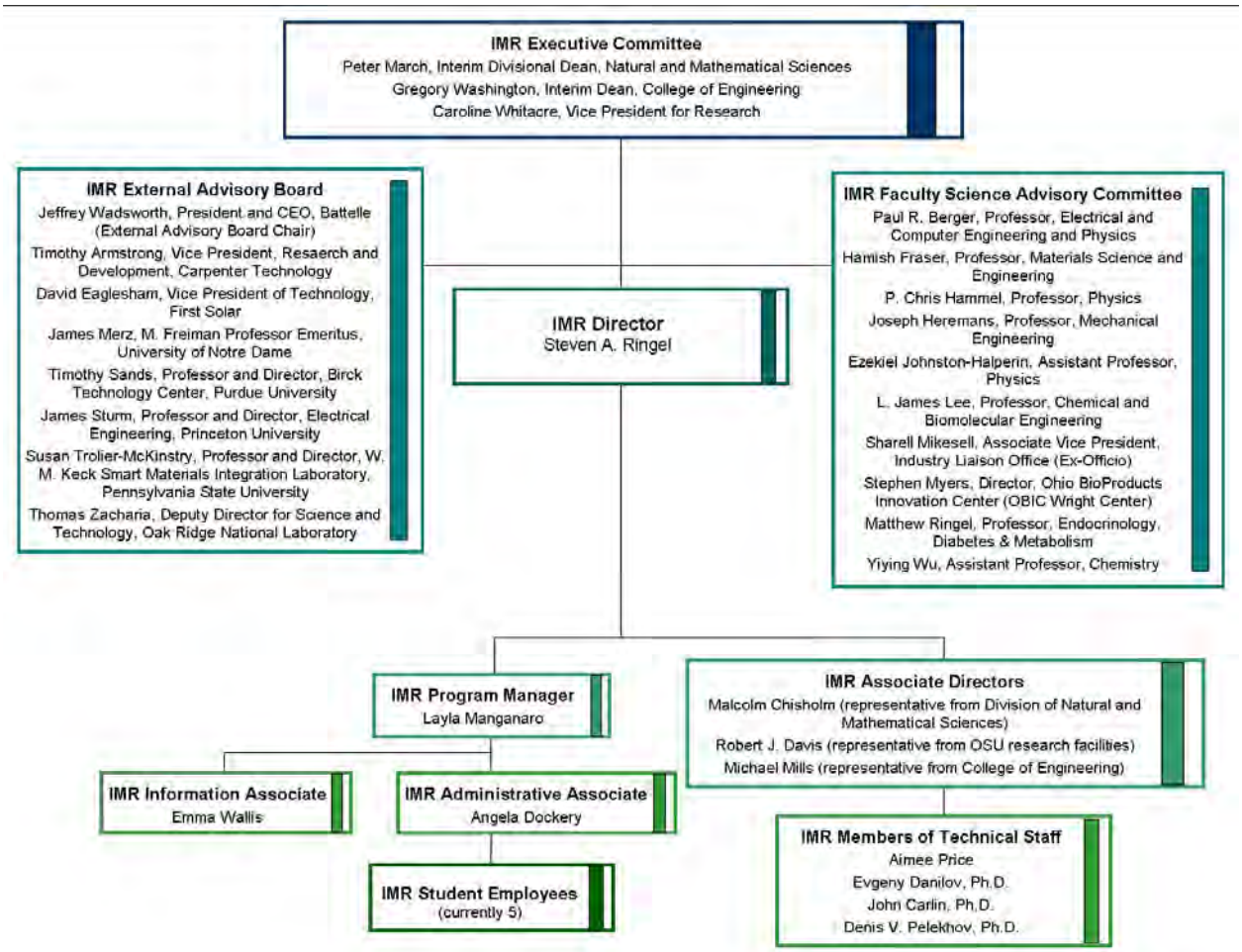


Figure 1. Institute for Materials Research organizational chart

IMR Executive Committee

The IMR Executive Committee is made up of Ohio State leaders from the three units of the university that provide direct operational funding for IMR: OSU's Office of Research, College of Engineering, and the Division of Natural and Mathematical Sciences of the College of Arts and Sciences. This committee meets two to three times each year with the IMR Director to review IMR activities, finances, and future plans, and in turn provides oversight and guidance regarding IMR's strategic planning and ensures that IMR activities are aligned with college priorities in materials and are in the best interests of the colleges supporting IMR. The balance in this committee between equivalent financial stakeholders is critical and has allowed IMR to assist in creating unique college-to-college interactions that leverages the strengths of each.

IMR Faculty Science Advisory Committee

The IMR Faculty Science Advisory Committee (FSAC) is made up of Ohio State faculty representatives of the entire university materials community. The Faculty Science Advisory Committee meets quarterly to advise the IMR Director and Associate Directors regarding near and long-term strategies, important

external opportunities for funding and collaboration, decisions on priority areas for IMR Research Enhancement Support, and issues related to facility clusters. The Advisory Committee provides representation of faculty associated with their own departments and colleges to the IMR. The composition is balanced as follows: 4 members from the College of Engineering, 4 members from the Division of Natural and Mathematical Sciences of the College of Arts and Sciences and 2 at large members from other colleges (currently Agriculture and Medicine). The Associate Vice President and Director of the OSU Industry Liaison Office is an ex-officio member. Currently there are 10 FSAC members, representing three OSU colleges and two Ohio Wright Centers of Innovation.

IMR External Advisory Board

The IMR External Advisory Board (EAB) was formed in 2009 with the purpose to provide IMR leadership with non-OSU perspectives and experience-driven advice from other universities, industry and federal laboratories, to help ensure the success and relevance of IMR activities moving forward. An important goal for the EAB is to assist IMR in maximizing its impact and to enhance its collaborations with partners from the industrial and non-profit sectors, including federal laboratories, by providing advice on both technical directions and mechanisms for interactions with external organizations. The EAB meets annually with IMR leadership to review and discuss IMR research activities, directions, facilities and programs and provide a written assessment and recommendations for future success.

IMR Administration and Management

IMR employs a small but strategically important staff comprised of technically-oriented and administrative employees to sustain IMR in is mission to advance materials research and community at OSU. Below is a brief overview of IMR's employees and their roles within the Institute.

IMR Director: Steven A. Ringel, Ph.D.

Dr. Steven A. Ringel has served as the Director of IMR since its inception. Dr. Ringel is a Professor in the Department of Electrical and Computer Engineering, where he also holds the Neal A. Smith Endowed Chair in Electrical Engineering. He also holds courtesy appointments as a Professor of Physics and a Professor of Materials Science and Engineering. Dr. Ringel's research program is internationally recognized and is focused on electronic materials, devices, photovoltaics and defect science with a particular interest in integrating basic science and engineering issues to create new device technologies.

The IMR Director is appointed by the Vice President for Research, with the advice and recommendation of the Executive Committee, and serves 50% of his time as the chief administrative officer of the IMR. He is responsible for the external and internal leadership, vision, overall direction, general welfare and progress of the IMR. The Director is also responsible for the accomplishment of IMR's programs, financing and staffing, and serves as the linkage for the IMR community to OSU central administration, and to state and federal government and external agencies as may be appropriate.

IMR Associate Directors: Malcolm Chisholm, Ph.D., Robert J. Davis, Ph.D., Michael Mills, Ph.D.

Dr. Bob Davis, Director of Nanotech West Laboratory and IMR Associate Director, represented The Ohio State University at the Alternative Energy Supply Chain Reception at the Governor's Mansion, August 12, 2009

IMR's three Associate Directors are representative of the OSU materials community, with one Associate Director with a home department in the College of Engineering, one Associate Director with a home department in the Division of Natural and Mathematical Sciences of the College of Arts and Sciences, and a third Associate Director who represents leadership from OSU's materials-allied research facilities on our west campus research park, emphasizing large facilities and industry interactions. Each Associate Director assists with the leadership and planning of IMR, and serves as a formal liaison between his/her college or unit constituency and the IMR. The Associate Directors more generally help to plan and participate in major IMR events and coordinate and review IMR Members of Technical Staff. They meet with the IMR Director at least monthly to consult with and provide advice regarding strategic decisions that include research priorities, facility planning, modifying and proposing new plans, and related issues. They create and recommend review processes regarding allocation decisions to the Director for funding of programs and support of technical staff through its Research Enhancement Program.

IMR Administrative Staff

The IMR has an administrative staff of 2.5 FTEs, which includes a full-time Program Manager, a full-time Administrative Associate, and a part-time Information Associate. IMR administrative staff is responsible not only for the entire financial administration of IMR and major externally funded research programs, but also has key leadership within the Institute for activities such as proposal development, management of our large internal research funding program, the annual Materials Week conference, marketing and communications, and seminar series. In addition, each quarter the IMR hires several undergraduate students to provide a wide range of support services for our organization, including driving the IMR shuttle van, assisting our Members of Technical Staff with laboratory maintenance, and supporting our administrative staff with general clerical duties.

The diagram in **Figure 2** shows how IMR interfaces with the materials community as an umbrella institute providing overall support in a variety of ways.

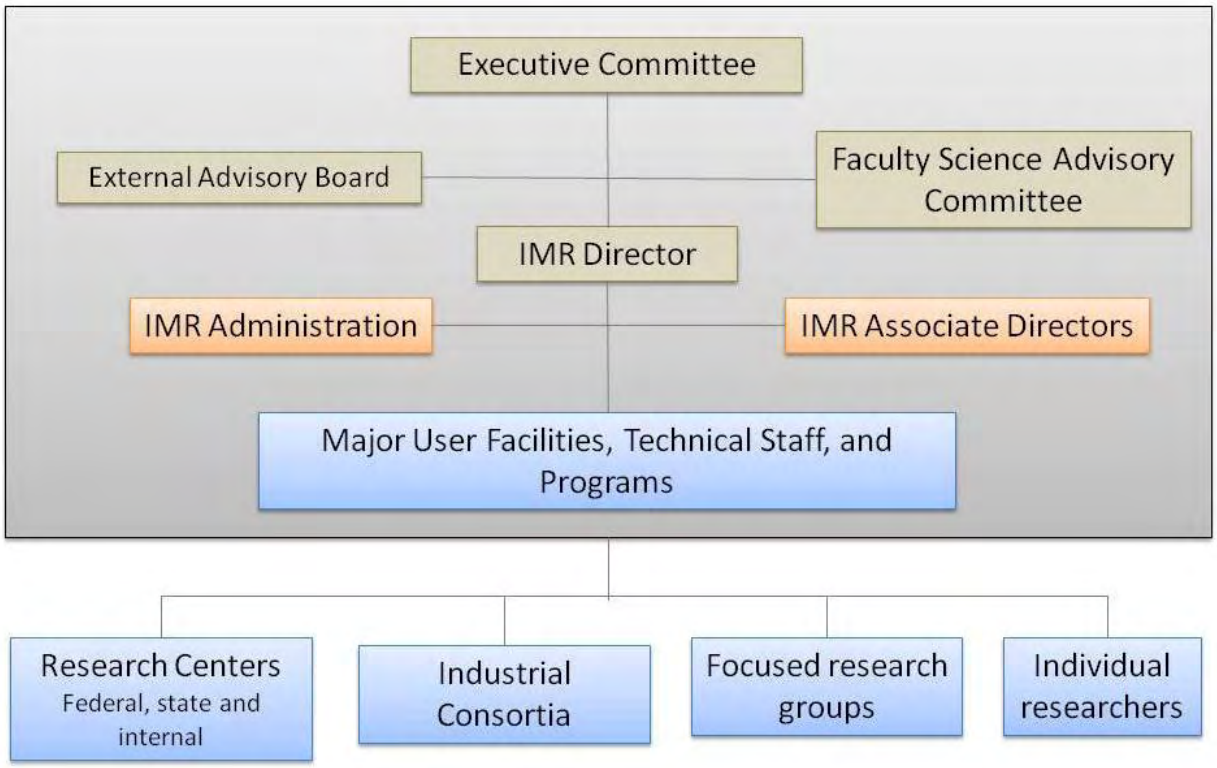


Figure 2. The interface between IMR and the OSU materials community, showing some of the organizational structure of IMR and how it serves as an umbrella organization with resources available to research centers, groups, and individuals.

IMR Members of Technical Staff

One of the most important recommendations from the 2005 OSU Materials Vision Committee that recommended the creation of the IMR was the need for a layer of highly skilled staff engineers/scientists to maintain large facilities at peak conditions, perform experiments and sometimes full-blown research, always enable access to users, provide training and generally be available to assist with research programs from various sources. Importantly, a layer of such individuals, each of whom would be assigned primarily to one major facility, would themselves create a human interface that would network between the many laboratories across colleges. In other words, the creation of the IMR Members of Technical Staff (MTS) would become glue for enabling cross-disciplinary research, assist in the avoidance of redundant lab development and at the same time provide engineering and scientific support on any number of projects. Generally speaking, MTS employees serve as laboratory coordinators to enable access by researchers not only from OSU but also from outside the university. In addition to dealing with all aspects of maintaining complex instrumentation, including scheduling, data management and financial responsibilities, MTS employees are encouraged to develop research programs and contracts depending upon their own level of expertise and education.

Departments or centers receiving an IMR MTS to support their activities execute a Memorandum of Understanding with IMR that details specifics of the agreement regarding MTS supervision, salary

support, and expectations for the arrangement. Success metrics are jointly agreed upon between the faculty member or senior staff member in charge of the particular facility and the MTS, with approval by the IMR Director. MTS may be reassigned by the IMR Director in consultation with the Associate Directors to another research area based on university demands, needs and history of performance. It is understood that any facility that is supported by an MTS must become itself an "earnings" center so that the facility can be accessible to users throughout the IMR community, irrespective of home department, via a fee-for-use model. We currently have four Members of Technical Staff employed by IMR, to assist researchers at the Nanotech West Laboratory, the ENCOMM NanoSystems Laboratory, and the Center for Chemical and Biophysical Dynamics, the latter of whom was hired in the past year in our continuing expansion of networked, multi-college facilities.

IMR-Supported Externally Funded Research Centers and Programs

A primary goal in the establishment of the IMR was to develop and secure major block research grants, since the creation of teamed efforts leads to scholarly activity and impact that is greater than the sum of their parts. To that end, cumulatively in the first 4 years of operations, the IMR has resulted in extraordinary success, achieving its initial target goals of developing, and winning, major and competitive block center grants. The Center for Emergent Materials (CEM), OSU's first NSF MRSEC award (Nitin Padture, P.I.), granted in 2008, is arguably the award from NSF that truly signifies an elite materials research program. Taken together with the NSF Nanoscale Science and Engineering Center (NSEC), another similarly prestigious and competitive program that is directed by Prof. L. James Lee that was successfully renewed for another 5 years, with IMR support, in FY2010, *OSU is one of a handful of universities that have active NSEC and MRSEC programs simultaneously*. IMR, in its role as the university-wide entity for nurturing and advancing large scale materials research, supports both centers with a variety of seed grants, facility support programs, technical staff, laboratory space and outreach and engagement activities. Additionally, IMR is the lead organization for a state-wide materials program funded by the State – the Ohio Research Scholars Cluster Program – entitled Technology-Enabling and Emergent Materials, with a total of 5 endowed chairs being created in 3 universities (3 at OSU), with IMR Director Steven A. Ringel as the P.I. In FY10, excellent progress toward filling all of these positions has been achieved in a coordinated trans-institutional fashion. Adding to these three major center efforts is the IMR's current Wright Center in solar energy (Wright Center for Photovoltaics Innovation and Commercialization - PVIC), which is co-directed by IMR (IMR Associate Director Bob Davis is the PI) with the University of Toledo, and its importance in making Ohio the nation's leading producer of solar power and connecting university research to that strategic asset. PVIC added several new company members this year, and was responsible for several millions of dollars in secondary funding targeting key collaborations between OSU faculty and industry partners in advanced energy materials.

In its first 3 years of operations, IMR helped obtain over $46 million in new block center awards to the OSU materials community.

In FY10 important advances were made in each of these centers and a key role of IMR support has been to support the continued growth and success of these centers so that they thrive for many years to come. The following sections provide progress reports and FY10 status for these major externally-funded research centers that are a direct result of the Institute for Materials Research through proposal development, operational support, technical support, administrative support and infrastructure support, and for one other smaller but very strategic program that was initiated in the past year.. Please note that while IMR now supports the NSEC program, especially with its winning of phase II support in this past FY, the phase I NSEC program in fact predates IMR. However, NSEC is almost entirely housed in, and serviced by, the IMR Nanotech West Laboratory and staff, so this relationship has grown to be very important.

- NSEC – Nanoscale Science and Engineering Center for Affordable, Nanoengineering of Polymer Biomedical Devices, National Science Foundation, PI: L. James Lee, Co-PIs: Jeffrey Chalmers, Terrence Conlisk, John Lannutti, Robert J. Lee, Susan Olesik and Barbara Wyslouzil, 9/1/2004 – 9/30/2014, $25,716,460 (Phase II renewal began 9/1/2010)
- MRSEC: Center for Emergent Materials, National Science Foundation, PI: Nitin Padture, Co-PIs: Leonard Brillson, P. Chris Hammel, Ezekiel Johnston-Halperin, Patrick Woodward, 9/1/2008 – 8/1/2014, $10.8 million
- Wright Center for Photovoltaic Innovation and Commercialization (PVIC), Ohio Department of Development (Subcontract through University of Toledo), PI: Robert J. Davis, Co-PIs: Paul Berger, Malcolm Chisholm, Arthur Epstein, Joseph Heremans, Nitin Padture, Steven Ringel, 2/16/2007 – 2/15/2011, $18.6 million total ($6.9 million to Ohio State)
- Ohio Research Scholars Program: Technology-Enabling and Emergent Materials, Ohio Department of Development, PI: Steven Ringel, Co-PIs: Jeffery McNeal, Steven Slack, Greg Washington, Stephen Cheng (U. Akron), Charles Browning (U. Dayton) 8/18/2009 – 8/17/2013, $18,153,846 ($8,953,846 to Ohio State)
- MRI: Acquisition of a Hybrid Diamond/III-N Synthesis Cluster Tool, National Science Foundation Major Research Instrumentation Program, PI: Ezekiel Johnston-Halperin, Co-PIs: Harris Kagan, Steven Ringel, Siddharth Rajan, Fengyuan Yang, Roberto Myers, 8/1/2009 – 7/31/2011, $601,890 ($421,323 from NSF plus $180,576 cost share from The Ohio State University and Ohio Board of Regents Action Funds)

The following pages contain specific progress for each of these large programs. Due to the very different nature and goals of these programs, the format for each summary varies as appropriate to their specific missions.

Center for Emergent Materials

Funding Agency: National Science Foundation - Materials Research Science and Engineering Center (MRSEC) Program

Principal Investigators: PI: Nitin Padture, Co-PIs: Leonard Brillson, P. Chris Hammel, Ezekiel Johnston-Halperin, Patrick Woodward, with 14 senior investigators

Duration: 9/1/2008 – 8/1/2014

Amount: $10.8 million + $6.8 million cost share, including more than $1M from IMR

Description: The CEM (Center for Emergent Materials), a NSF Materials Research Science and Engineering Center (MRSEC), was established at OSU on September 1, 2008. Its development was achieved over the course of several years of prior internal planning in internal processes led by IMR, in conjunction with the ENCOMM initiative and Prof. Nitin Padture, who became the CEM Principal Investigator and ultimately, it's Director. Details of this process were provided in the 2009 IMR Annual Report. The CEM brings to bear the combined expertise of 22 core faculty members and 8 other faculty investigators drawn from 6 different disciplines and 3 universities on cutting-edge materials research and education. The current research focus of CEM is magnetoelectronics. Interdisciplinary teams of faculty, graduate students and postdoctoral scholars are addressing complex scientific issues in this area by integrating materials synthesis/growth, characterization and theory/modeling. The long term vision of the CEM is to become the key enabler of future spintronics through exploration and discovery of emergent materials and phenomena, and to foster excellence in materials research and education. The scientific mission of the CEM is to lay the foundation for creating new opportunities and directions in spintronics. The scientific foundation is in the form of innovation in synthesis/growth of emergent materials, in probes used to understand emergent phenomena, and in predictive theory/modeling. This could enable building both future oxide-based electronic devices that can perform multiple functions and energy-efficient, fast computers that have integrated memory and logic. The CEM has two Interdisciplinary Research Groups (IRGs), a Theory Cluster, a Seed program, which has substantial support form IMR as a cross-over with the IMRG core IMR seed program, and a substantial education and outreach program that is required for all MRSECs, which is also supported by IMR. This report summarizes research progress of CEM, which is now emerging from its start-up phase as the second funded year has just been completed.

Highlights and Accomplishments of CEM for FY 2010:

Overall, CEM in only its second year of existence has made remarkable strides forward. A total of 24 refereed journal papers were published by CEM in FY2010 and one patent application was filed. There are current 19 graduate student fellows supported by CEM and 3 PhD students graduated in this period. Publications are included in the appendix of this report. The outreach activities are included in the appropriate section later in this report.

IRG-1 Towards Spin-Preserving, Heterogeneous Spin Networks

IRG-1 comprises 12 core faculty members, 14 graduate students, 3 post-doctoral scholars, and several undergraduates.

Spin Transport in Graphene: Tunneling Spin Injection Across MgO Barriers:
Experiments show that graphene is a superior material for lateral spin transport. For example, graphene was the first material to exhibit gate tunable spin transport at room temperature. Recently, we have

achieved tunneling spin injection into SLG using Ti-seeded MgO tunnel barriers, leading to world record values for a non-local spin signal.

Au-Doping of Graphene Channels: Graphene has potentially very long spin lifetimes at room temperature (μs regime theoretically) due to low intrinsic spin-orbit coupling and a weak hyperfine interaction. However, experimental studies have measured short spin lifetimes of ~100 ps. This discrepancy is a central mystery of graphene spintronics and understanding its origin will be crucial for improving the spin lifetime and further enhancing the non-local spin signals. To investigate the role of charged impurities on spin scattering in graphene, we utilized MBE to deposit charged impurities (Au adatoms) onto the surface of graphene spin valves and measured their effect on spin lifetime through *in situ* spin precession measurements. The surprising result is that the spin lifetime does not decrease even though the mobility decreases considerably. This clearly shows that the charged impurities are not the main source of spin relaxation.

Active Organic Spintronics: As carbon-based material, organic systems have the same potential advantages for spintronics as described above for graphene (low spin-orbit coupling and low Z leading to long spin lifetimes). In addition, organic spintronics is positioned to exploit the same advantages that have propelled the field of organic light-emitting diodes (OLEDs) and organic thin-film transistors (OTFTs), including low cost, robust fabrication (low temperature, ambient pressure) and chemical tuning of material properties. We have demonstrated spin injection and transport in ferromagnet/organic semiconductor/ ferromagnet (FM/OSC/FM) heterojunctions using rubrene, $C_{42}H_{28}$, as an organic semiconductor spacer. Both tunneling magnetoresistance (TMR), and giant magnetoresistance (GMR) were studied by varying the thickness of the rubrene layer, 5–30 nm. A thorough study of the device characteristics reveals spin-polarized carrier injection into, and subsequent transport through, the OSC layer.

Hybrid Spin-LED: The spin light-emitting diode (spin-LED) is a well-established platform for demonstrating electrical spin injection from a magnetically ordered material into a semiconductor. We reported the first experimental demonstration of spin injection *from* an organic-based magnet *into* an inorganic semiconducting channel (GaAs). The development of this hybrid device provides the opportunity to both "bootstrap" organic spintronics using existing inorganic systems and develop hybrid spintronic devices in their own right. The latter have the potential to combine *both* the arsenals of synthetic chemistry and solid-state materials synthesis to overcome critical challenges in spintronics, including room temperature and active operation.

Single-Molecule TCNE: Charge transfer at organic/inorganic interfaces plays a critical role in determining charge and spin transport, and is inherently sensitive to atomic-scale coordination between metal contact and molecules. By combining scanning tunneling microscopy (STM) experimental results with density functional theory (DFT) calculations, we have developed an improved understanding of atomic scale mechanisms that determine this process. These methods will be extended to study charge transfer at the TCNE/GaAs interface relevant for our spin-LED efforts.

IRG-2 Double Perovskite Interfaces and Heterostructures

The IRG-2 team comprises 9 core faculty members, 1 faculty affiliate, 11 graduate students, 5 post-doctoral scholars, and several undergraduates.

$A_2BB'O_6$ double perovskites (DPs) are the central focus of IRG-2 activities, particularly half-metallic DPs, such as Sr_2FeMoO_6 (SFMO). The promise of injecting carriers with a high degree of spin polarization makes half-metals attractive components in nearly all spintronic devices. Unfortunately the list of materials that exhibit (a) a half-metallic band structure, (b) a Curie temperature, T_c, well above room temperature, and (c) metallic conductivity is restricted largely to two families of compounds: double perovskites and Heusler alloys. The use of these compounds in spintronic devices has been limited by the fact that both families are chemically complex which makes them prone to non-stoichiometry and chemical disorder.

<u>*Theoretical and Computational Modeling*</u> Our modeling activities involve both density functional theory (DFT) calculations and the use of model Hamiltonians. The DFT calculations use the VASP package with a GGA+*U* approach to account for the strong Coulombic correlation present in the localized 3*d* orbitals. The model Hamiltonian approach treats core spins on the B sites (*e.g.* Fe) classically and the itinerant B′ (e.g. Mo) electrons quantum mechanically. The full problem of classical spins coupled to quantum electrons has been solved using a very general Exact Diagonalization plus Monte Carlo (EDMC) formulation that permits calculation of the magnetic and electronic properties of the material as a function of temperature. In addition, we have derived an effective Hamiltonian for the core spins, generalizing the classic Anderson-Hasegawa (AH) analysis to double perovskites. Our DFT modeling reveals that point defects arising from disorder and non-stoichiometry affect the properties of SFMO in the following ways:

- Fe_{Mo} antisites lead to a systematic decrease in M_s due to the fact that Fe_{Mo} antisites couples antiferromagnetically to neighbors.
- Mo_{Fe} antisites create states in the gap of the majority spin channel leading to a decrease of spin polarization from 100% for $x \geq -0.125$ to 0 at $x \sim -0.75$.
- M_s decreases linearly with increasing Fe/Mo antisite disorder in good agreement with experimental studies. P decreases rapidly as antisite disorder increases.

<u>Growth and Characterization of Double Perovskite Films</u>: Over the past year, we have made great strides in understanding and optimizing growth conditions for DP film growth. Controlling stoichiometry, phase purity, and Fe/Mo antisite disorder are challenges that must be overcome before half-metallic DP films can be used in spintronic devices. We are close to realizing that goal in SFMO using off-axis sputtering. Much to our surprise the M ~ T curve of the SFMO (111) film reveals that T_c > 500 K, significantly higher than the best bulk samples (T_c = 430 K). Another intriguing feature of these new films is the observation of magnetic hysteresis loops that exhibit distinctive and different shape anisotropy than seen for the $Sr_2Fe_{0.94}Mo_{1.06}O_6$ films. The properties of the new SFMO films raise interesting questions. The prospect of pushing T_c to temperatures well above 500°C is an exciting development, but the mechanism driving such behavior is not yet understood. Magnetic impurity phases, like Fe_3O_4 and metallic Fe, cannot be the cause of this behavior because the M_s value is more than double the value expected for such phases.

<u>*Novel Properties in Bulk Double Perovskites:*</u> Our efforts in this area have largely focused on A_2MnRuO_6 DP phases. These phases are the first examples of ferrimagnetism in an oxide where two

different transition metal ions are highly disordered. These phases are of great interest for several reasons. Ferrimagnetism in a disordered transition metal oxide whose electrical transport can be varied from metallic to insulating by electron doping is unheard of. Understanding this behavior may provide strategies for using chemical substitution to maintain high T_c values in the presence of chemical disorder in the half-metallic double perovskite like SFMO.

Wright Center for Photovoltaic Innovation and Commercialization (PVIC)

Funding Agency: Ohio Department of Development

Principal Investigators: PI: Robert J. Davis, Co-PIs: Paul Berger, Malcolm Chisholm, Arthur Epstein, Joseph Heremans, Nitin Padture, Steven Ringel

Duration: 2/16/2007 – 2/15/2012

Amount: $18.3 million total ($6.8 million to Ohio State) and $30M in cost sharing from Ohio industries and participating universities

Description: IMR's first major sponsored project award created the current Wright Center in solar energy – the Wright Center for Photovoltaics Innovation and Commercialization - which is co-directed with the University of Toledo. PVIC was established in early 2007 through an $18.6 million award from the Ohio Department of Development, along with matching contributions of $30 million from universities, federal agencies, and industrial collaborators. PVIC is a scientific partnership of the University of Toledo, Bowling Green State University, and The Ohio State University, and more than 25 Ohio-based companies engaged in various aspects of photovoltaics technology. PVIC has a primary goal of enabling Ohio to become the nation's leader in photovoltaics research, development and commercialization. The overall PVIC mission is to accelerate the photovoltaic (PV) industry in Ohio by reducing solar costs, improving technologies, and transferring these new techniques from the laboratory to the production line. The OSU/IMR node of PVIC has a specific focus on so-called 3rd generation photovoltaics, which inherently involves advanced materials and nanotechnology using both inorganic and organic materials. Primary thrust areas are multijunction solar cells, heterogeneous integration of high efficiency PV with low cost platforms, nanostructured solar cells, polymer photovoltaics and basic optical-thermal processes. IMR administers the Ohio State University PVIC site and IMR Associate Director Dr. Robert J. Davis serves as the Principal Investigator of the OSU PVIC site.

Highlights and Accomplishments of PVIC for FY2010

The Ohio Wright Center for Photovoltaics Innovation and Commercialization entered its third year in FY10. Nine IMR faculty members are funded by, and performing research within PVIC through direct research support. A much larger number are impacted daily by the capital investment component of PVIC funding (most of this investment has occurred for shared facilities housed at the OSU Nanotech West Lab) and by the continued fostering of academic-industrial collaborations in the photovoltaics arena. A strong feature of the PVIC-OSU effort is the technological range of 3rd generation PV activities it includes, ranging from compound semiconductors (Steven A. Ringel, Bob Davis, John Carlin, Siddharth Rajan, Roberto Myers) to polymeric photovoltaics (Malcolm Chisholm, Arthur Epstein, Paul Berger, Terry Gustafson), through novel and nanostructured materials (Nitin Padture, Joseph Heremans), a span that ranges from Electrical Engineering, Materials Science and Engineering, and Mechanical Engineering, to Chemistry and Physics.

Nanotech West Laboratory staff member Paul Steffen and the new 6-pocket CHA SOLUTION™ System electron gun evaporation system purchased with PVIC funds.

PVIC/IMR especially enjoyed the results of the Ohio Third Frontier Program Advanced Photovoltaics Program competition in late December 2009, when it was announced that two of the three proposals it co-developed as collaborators with industrial partners had won two of the six total awarded by the State. A collaboration of Ferro, Inc. (Cleveland, OH), StrateNexus Inc. (Columbus, OH), the Edison Welding Institute (Columbus, OH) and Ohio State (Prof. Paul Berger, Department of Electrical and Computer Engineering) won $1.0M (0.25M to OSU) / 2 years in support of their proposed effort to develop new encapsulant materials for a wide variety of photovoltaic devices. This project was a direct result of seed grant support in the form of an IMR Interdisciplinary Materials Research Grant to Prof. Berger in 2008-09 (the IMRG program is described later). Likewise, a collaboration of Replex Plastics (Mt. Vernon, OH), Dovetail Solar and Wind (Athens, OH), and Ohio State (through Dr. Robert Davis, PVIC Co-Director, Nanotech West Director, and IMR Associate Director) won $1.258M / 2 years for their program on low-cost, low-concentration photovoltaics, of which $358k goes to OSU. This program intimately involves silicon photovoltaics work at OSU Nanotech West Lab and includes hiring and locating a Replex engineering technician full-time at Nanotech West, which has already occurred.

Title	PIs	Agency	Duration	Amount	Relation to IMR
Sealing Systems for Solar Cells	Steven Florio (Ferro Inc.); Paul Berger (OSU)	Ohio Dept. of Development	2 years; start 3/10	$1.0M total ($250k to OSU)	Based on earlier IMRG seed grant from TIE funds; Leverages PVIC program
Low-Cost Low-Concentration Photovoltaic Systems for Mid-Northern Latitudes	Mark Shuetz (Replex Plastics); Robert J. Davis (OSU)	Ohio Dept. of Development	2 years; start 3/10	$1.258M total ($358 to OSU)	Leverages Nanotech West Laboratory and PVIC program supported by TIE

Table 1. External Research Funding Awarded Through PVIC During FY 2010

In January 2010 the Ohio Department of Development granted the PVIC program a no-cost extension (NCE), through the end of February 2011, and due to expenditure delays at one of our partner universities in PVIC, this is being extended again until 02/12. The NCE was especially important to the OSU site, since the program subcontract from the University of Toledo took several months to put in place, delaying OSU expenditures of both operational and capital PVIC dollars. IMR has already

developed a plan to continue activities once the PVIC funds are fully expended, and this is part of an MOU between IMR, Engineering and the Office of Research that was signed in March, 2010.

Joining Companies

Several new companies joined PVIC in FY10, many of whom have their primary interaction with the Ohio State site, and who have designated the bulk of their PVIC membership dollars to PVIC-OSU. These six new companies are:

- Energy Focus, Solon, OH
- Ferro, Inc., Cleveland, OH
- Plaskolite, Columbus, OH
- Replex Plastics, Mt. Vernon, OH
- StrateNexus, Columbus, OH
- Tosoh SMD, Columbus, OH

As of June 2010, 34 companies and 3 not-for-profits are now PVIC members, more than doubling the original number of participating companies from the original proposal. Also, in this time period, First Solar (Perrysburg, OH), the largest US manufacturer of photovoltaics, joined PVIC, but as of June 2010 has not yet designated its membership fee distribution.

Sylvain Marsillac, University of Toledo; Steve Ringel, IMR; Ryne Raffaelle, National Renewable Energy Laboratory; Bob Davis, Nanotech West Laboratory and IMR at the semi-annual meeting of the Wright Center for Photovoltaics Innovation and Commercialization (PVIC) on April 22, 2010.

Meetings

The semi-annual spring meeting held in April attracted approximately 70 participants. PVIC was honored to host Dr. Ryne Raffaelle, newly installed Director of the National Center for Photovoltaics at the National Renewable Energy Laboratory (NREL) in Golden, CO, as its plenary speaker. Dr. Raffaelle was also a speaker at the Ohio Innovation Summit the day before in a session on Photovoltaics that was arranged by IMR and PVIC. We are actively cultivating a special arrangement with NREL via Dr. Raffaelle's close tie with Battelle and Ohio State.

Major Capital Investments

As of early June 2010, PVIC/IMR has invested $2.96M in capital equipment at Ohio State, predominantly at the OSU Nanotech West Lab. While these investments have been made with photovoltaics foremost in mind, however, they have also always been made in consideration of the support of a wide spectrum of materials-related technologies and programs, and that strategy has been extremely successful. All of the equipment items noted below are used by multiple groups across all of IMR. The operation, maintenance and training of these complex pieces of equipment are provided by the IMR members of technical staff. The table below lists the main PVIC-funded capital investments made at Nanotech West during the program, their direct utility to photovoltaic device fabrication, and also examples of uses of the tools by other technologies.

Capability	PV Uses	Other Uses (examples)
Picosun® SunALE R-150 atomic layer deposition tool	Deposition of electrical passivation and anti-reflective coatings	Passivation of high-speed transistors, depositions of gate dielectrics and spin-tunneling devices
Zeiss® Ultra 55 Plus field emission scanning electron microscope	Imaging of nanostructured materials for PV and DSSC devices	Imaging of nanostructures for electronics, optics, biology, and materials science
Aixtron® 3x2" metalorganic chemical vapor deposition system	Growth of single, tandem, and triple-junction solar cells based on III-V materials	Growth of epitaxial III-V structures for visible and IR photodetectors, high-speed transistors, solar cells and nanowires for basic sciences
AJA International® 5-gun RF/DC sputter deposition system	Deposition of high-quality metallization for ohmic contacts	Sputter deposition of metallization for magnetic and non-magnetic devices, dielectric depositions for optical waveguides and MEMs
CHA® Solution Systems 6-pocket electron gun evaporator	High-quality ohmic contacts to crystalline PV cells	High-quality contacts to transistors, semiconductor photodetectors, sensors, solar cells and lasers
Plasma-Therm SLR770 inductively-coupled plasma reactive ion etcher	Mesa etching for silicon and III-V compound semiconductor photovoltaics	Low-damage dry etching for III-V and III-N electronics and electrooptics, dielectric optical waveguides, and materials test structures

Table 2. Major PVIC Tool Investments at Nanotech West

Selection of Key PVIC Scientific Highlights

Some OSU research technical highlights from the PVIC program include:

- Demonstration of advanced polymeric photovoltaic devices based on P3HT:PCBM materials and with silver nanodot-enhanced absorption (Berger research group)
- Development and demonstration of 1.7 eV bandgap GaAsP solar cells on silicon that are promising systems for low-cost and ultra-efficient multijuction photovoltaic devices (Ringel research group)

- Development of high direct bandgap (1.95 – 2.2 eV), Ga-rich GaInP materials that are Al-free and N-free, using lattice engineering, for ideal 2.1/1.55.1.0 multijunction cells on active, integrated Si cells (Ringel research group)
- Determination of lifetime limiting traps and their correlation with oxygen in AlGaInP 1.95 eV solar cells for 4 junction stacks on Ge (Ringel research group)
- Development of metalorganic polymer materials based on Mo, W, and Ti that have absorption across the entire visible solar spectrum (Chisholm research group)
- Development of new thallium-doped PbTe thermoelectric materials that double thermoelectric response compared to their undoped counterparts (Heremans research group)
- Observation of anomalous magnetoresistance in polymeric materials that may be beneficial to future photovoltaic devices (Epstein research group)

Nanoscale Science and Engineering Center for Affordable Nanoengineering of Polymer Biomedical Devices - CANPBD

Funding Agency: National Science Foundation – NSEC (Nanoscale Science and Engineering Center) Program

Principal Investigators: PI: L. James Lee, Co-PIs: Jeffrey Chalmers, Terrence Conlisk, John Lannutti, Robert J. Lee, Susan Olesik and Barbara Wyslouzil

Duration: 09/01/2004 – 09/30/2014

Amount: $25,716,460

Description. The primary goal of the Center for Affordable Nanoengineering of Polymeric Biomedical Devices (CANPBD) is to develop polymer-based, low-cost nanomaterials and nanoengineering technology to produce advanced medical diagnostic devices, cell-based devices, and multifunctional polymer-nanoparticle-biomolecule nanostructures for next-generation medical and pharmaceutical applications. Although challenging, this goal provides opportunities for scientific breakthroughs, cutting edge technologies and novel interdisciplinary system integration. Fundamental science and engineering is one of the major foci of our center. In Phase I, which ended in 2009, many useful nanotechnologies, devices and nanoconstructs have been developed. Each has specific merits and value-added capabilities providing for near-term applications. Following this success, a nanotechnology pipeline for Phase II has been initiated to address the need for (1) ‘up-stream’ fundamental science, (2) high risk technologies meeting long-term research objectives, and (3) ‘down-stream’ devices and nanoconstructs requiring integrated system-level effort. In addition to NSF NSEC funding, we will also pursue leverage grants from NSF SBIR/STTR, other funding agencies (e.g. NIH, Ohio Third Frontier Program), and industry through joint proposals and CANPBD spin-off companies. Joint industry/academia/government opportunities provide not only commercialization pathways but also a ‘blueprint’ for a business plan providing center sustainability after Phase II funding ends.

Highlights and Accomplishments of CANPBD for FY2010

The interconnections among fundamental sciences, technology innovations and medical applications of our research plan were carried out in six interdisciplinary Core Technology Platforms and three Testbeds in Phase I. The six Core Technology Platforms were identified based on the center's expertise and the demands of CANPBD's goals. They include: (1) Affordable Nanomanufacturing, (2) Self and Dynamic Assembly, (3) Micro/Nanofluidics, (4) Nanomanipulation, (5) Nanofiber Synthesis, and (6) Super/Subcritical Fluids (SCFs). We have successfully established a comprehensive nanomaterial and nanotechnology 'tool box' in the aforementioned areas in Phase I. They are being applied to a large scale nanofactory system and will also be used in a smaller nanofactory system in Phase II. The three Testbeds were: (A) Biosensors/chips for Medical Diagnostics, (B) Micro/Nanofluidics and Nanoparticle-based Drug/Gene Delivery, and (C) Cell-based Devices and Constructs. Instead of many small-scale nanoconstructs and devices developed in Phase I, our Phase II research program will focus on two highly integrated nanofactory assembly (or disassembly) systems to develop personalized nanomedicine. They are (i) Automated Cell to Biomolecule Analysis (ACBA) System currently being developed, and (ii) Multifunctional Nanoparticle Design and Synthesis (MNDS) System to be developed in the future. Both systems share many similar nanotechnologies. To realize this goal, many system level challenges and technical barriers will be addressed though team efforts using a well-known SIMILAR system integration process.

The Center's research team has completed a very productive year. Our faculty and students published 123 technical papers. In addition, 9 patents were filed, 2 patents were awarded, and 8 inventions were disclosed. Two postdoctoral researchers, 11 PhD students, and 1 MS student completed their studies in the past 12 months and are now working for our industrial collaborators, other companies, and academia. Our research program and industrial collaboration are strongly enhanced by $4.2M in federal grants, $2.3M in research and commercialization grants from the Ohio Department of Development, industry, and SBIR Phase II grants. More than $8M in state-of-the-art equipment items in nanomachining, nanoscale polymer processing, nanobio characterization and manipulation, and micro/nanofluidic analysis are now fully installed in the CANPBD's central labs, Nanotech West. The "supply chain" linking CANPBD with nearby national laboratories such as Cleveland Clinic and Battelle, major medical centers at OSU such as the Comprehensive Cancer Center (CCC), the Davis Heart and Lung Research Institute, the Center for Entrepreneurship at OSU's Fisher College of Business, and the biotech industry is enhanced through guidance from an Industry Advisory Board, a Medical Advisory and Evaluation Board, and an External Scientific Evaluation Board.

We have also made good progress in teaching, training, outreach and diversity in the past year. Twenty-six courses were taught over the past year that featured CANPBD research themes as part or all of the content, reaching over 700 undergraduate and graduate students. The graduate fellows of CANPBD continued the student organization (CONGS) to better integrate the student researchers and provide a social fabric for the center. Although our REU proposal did not get funded, we hosted 7 underrepresented minority students in Center labs. Outreach to K-12 students and teachers reached over 370 students and 26 teachers in the past year through visits to center laboratories, workshops, and activities in discovery-based labs in local high school science classrooms. We saw significant improvements in the number of diverse faculty and student participants in the past year. Many outreach and collaboration activities took place with industry and medical doctors, and external advisors are now

an integral part of most graduate students' advisory teams. Finally, our international programs further expanded this past year in Asia, Europe, and Australia.

Research Scholars Cluster on Technology-Enabling and Emergent Materials

Funding Agency: Ohio Department of Development

Principal Investigators: PI: Steven Ringel, Co-PIs: Jeffery McNeal, Steven Slack, Gregory Washington

Duration: 8/18/2009 – 8/17/2013

Amount: $18,153,846 ($8,953,846 to Ohio State) and cost share of $17.2 million

Description: IMR is the lead organization for a state-wide materials program funded by the State – the $18.1M Ohio Research Scholars Program (ORSP) award entitled Technology-Enabling and Emergent Materials. This award creates a university coalition consisting of The Ohio State University, the University of Akron and the University of Dayton and funds are for creation and support of five endowed chairs with the title of Ohio Research Scholar – three at OSU and one each at the University of Akron and the University of Dayton. IMR Director Steven Ringel serves as that award's Principal Investigator and IMR performs all program management and research administration for the award.

The technical goal of this program through targeted faculty hiring is to pioneer revolutionary approaches to accelerate the development of materials for technological impact, by evaluating emergent materials at an early stage through the application of advanced characterization and predictive modeling. By targeting the Scholars positions toward advanced microscopy, including applications toward biomaterials, chemical synthesis from bio-based sources, and scalable processing based on nanostructure-enhanced composite and also bio-based materials, this unique cluster aims to build upon and coordinate strategic strengths existing at the partnered universities in areas of international impact. A prime area of focus is the exploration and development of innovative materials that possess tailored functionalities and are derived from nontraditional (including bio-based) sources, with the state's universities and industries being the prime beneficiaries. IMR has established a *Materials Innovation Council* that includes leaders at each of the three state universities and a wide range of industry leaders and other state-supported industrial consortia, in order to maintain alignment and communications up and down the value-chain from basic science to commercialization, which is chaired by the project P.I., Steven A. Ringel, IMR Director.

Highlights and Accomplishments of the ORSP for FY2010

This project kicked into high gear in FY10, after funding arrived and was dispersed in the latter part of FY09. As mentioned, the ORSP team consists of Ohio State, the University of Akron and the University of Dayton. The Scholars program has a specific funding structure and mandate as set forth by the Ohio Department of Development, with funds for endowed chair faculty members, capital expenses and operating expenses. The goal is to create a single, but trans-institutional research cluster led by the endowed chairs in collaboration across not just traditional disciplines and colleges within universities, but between 3 universities too.

Figure 3 shows the descriptions of the positions, their primary focus areas and how they are integrated. The Materials Innovation Council has a key role in not only ensuring collaborations between the

Scholars across the universities (in part by virtue of its control of a special fund for collaborative research), but also its very important role in bringing industry connections, perspectives and collaborations to fulfill one of the State's strategic goals of connecting basic university research to industrial adoption, expansion, commercialization and job growth of the future.

The status of the Scholars hiring is on target, especially when considering the difficulty in recruiting distinguished senior researchers. Each department awarded with a position is responsible for conducting their own searches and the composition of each search committee is required to include a member from each of the other universities, and an IMR representative. We felt it was very important to inform the candidates at their interviews, of the special, trans-institutional opportunity being offered, as our goal is to hire only those candidates that are both eminent in their scholarly activities and are also naturally collaborative in the broadest sense. Only the OSU searches will be described here, but we note that the

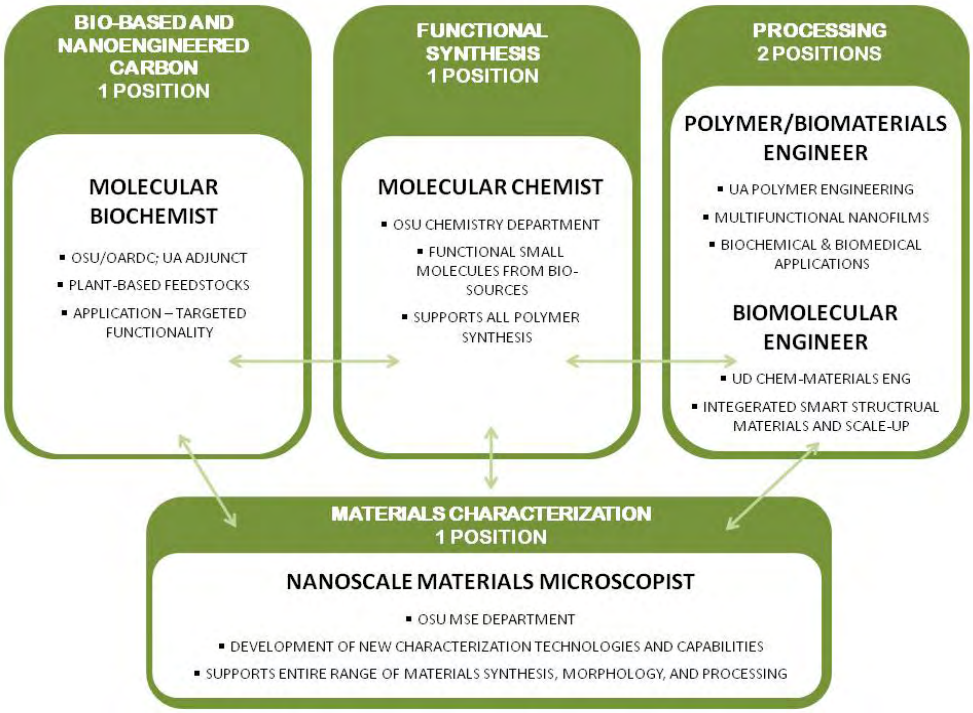


Figure 3. Description of ORSP Scholar positions by area with universities and status indicated. Each position carries approximately $2.5M of startup in capital and operative expenses. The team is integrated via the Materials Innovation Council headed by IMR and including representatives from participating industries and universities.

University Akron is in the final stages of recruiting their Scholar, and the University of Dayton has successfully completed their recruitment in early FY11.

The position in materials characterization in the MSE Department conducted extensive searches in the past year, ultimately making two offers. Unfortunately, neither accepted due in one case to family issues and another case due to the candidate's current institution generated a truly remarkable counter offer and the position went unfilled. The search was re-tooled and the MSE department is interviewing an outstanding candidate in November, 2010, from which we anticipate a successful recruitment.

The position in synthetic chemistry in the Chemistry department was delayed in receiving its funding from the State due to the State's economic situation. However, in FY10, Chemistry moved quickly once funding arrived, and has already conducted a very thorough search, resulting in several interviews that are ongoing at the time of this writing.

The position in bio-based materials is moving the quickest of all. In FY10 an extensive search was undertaken. Two very strong candidates were interviewed in December, 2009 with one offer being made. The candidate of choice, Dr. Katrina Cornish, recently accepted the offer and joined OSU officially July 1, 2010. Professor Cornish is a world leader in bio-based chemistry through her research at the USDA, she is Fellow of AAAS and she is a recipient of many research awards. She is also a highly successful entrepreneur. Her recruitment also is notable as an under-represented group member. More on Professor Cornish's background can be found later in this report, under the Faculty Hiring section. Overall we are confident that the remaining positions will be filled during FY11.

MRI: Acquisition of a Hybrid Diamond/III-N Synthesis Cluster Tool

Funding Agency: National Science Foundation

Principal Investigators: PI: Ezekiel Johnston-Halperin, Co-PIs: Siddharth Rajan, Roberto Myers, Harris Kagan, Steven A. Ringel, Fengyuan Yang

Duration: 08/01/2009 – 07/31/2011

Amount: $601,890 ($421,323 from NSF plus $180,576 cost share from The Ohio State University and Ohio Board of Regents Action Funds)

Though not officially a block grant, we are including this $601,890 NSF Major Research Instrumentation (MRI) award due to its strategic nature to acquire several state of the art experimental capabilities to be jointly located in both the College of Natural and Mathematical Sciences and Engineering laboratories, and because it is a collaboration that includes 3 of the young, outstanding faculty members who were hired as part of the IMR's strategic faculty cluster hires in Materials Science and Engineering, Electrical and Computer Engineering and Physics.

Figure 4 shows a conceptual diagram of the combined facility for synthesis of diamond and III-nitride materials and how it is designed to interface in multiple areas of AMI support. The goal of this project is to push the state of the art in new materials synthesis, which requires a synergistic approach combining physics, materials, electrical engineering and chemistry. The facilities are due to arrive in mid FY11 and will be reported on further in next year's report. The location of the facilities in the ENCOMM Nanosystems Lab (ENSL) and in the Semiconductor Epitaxy and Analysis Lab (SEAL), both of which are IMR Major User Facilities, is strategic for their long-term prosperity as core infrastructure resources. This is because the acquisition enables a strong path forward for future collaborative and externally funded projects through a unique coupling of materials systems that many in the field are only now realizing may be possible. Hence, the IMR provided significant funding for lab renovation so that the necessary equipment integration could be achieved, it provided cash in cost sharing for some of the equipment, and IMR is providing the necessary administration of all aspects of

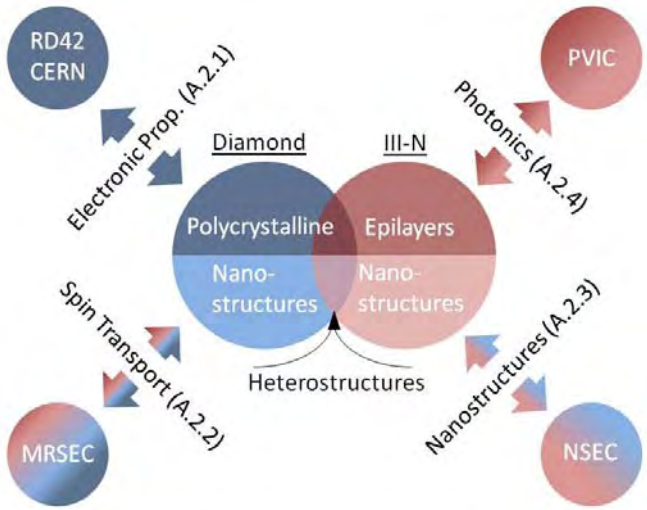


Figure 4. Diagram of how the new MRI facility integrates across various traditional disciplines and other interdisciplinary centers within the IMR purview, in addition to international collaborations.

the grant itself. Importantly, this leverages prior IMR commitments toward the capital expenditures of the start-up packages for 2 of the faculty members in this team, in addition to renovation costs to expand the lab resources to accommodate the influx of new equipment. IMR looks to this effort to be a key path forward for OSU leadership in the next generation of materials research.

The Advanced Materials Initiative – A Targeted Investment in Excellence Award

Funding Institution: Ohio State University Office of the Provost

Principal Investigators: PI: Steven A. Ringel (Director, IMR), Co-PIs: P. Chris Hammel (Physics), W. "Bud" Baeslack (former Dean of Engineering), Richard Freeman (former Dean of MAPS)

Duration: 7/1/2006 – 6/30/2011

Amount: $9.7 million (split between IMR, Colleges of MAPS and Engineering; $2.1M to IMR core) plus 1:1 matching from IMR, MAPS and COE

Description: In 2006 the OSU Office of the Provost conducted a unique internal competition designed to provide targeted funds to areas of existing excellence at the University, with the goal of making those areas to be the pre-eminent programs of research in their fields. The program is called the Targeted Investment in Excellence, or TIE, and the response to the call for proposals yielded approximately 100 proposals from across the entire University, of which 9 were awarded. The IMR, collaborating with the College of Engineering and the College of MAPS teamed to develop the "Advanced Materials Initiative," which received the largest total sum of funds from the competition. The funds were split into three sub-areas, one for each of the two colleges, and one for IMR to enhance its core programs, but all integrated via IMR's overarching, multi-college mission. The entire program has been coordinated and with funds being used strategically for support of new faculty hiring and their start up packages, outfitting core laboratories with major shared instrumentation, team building exercises that contributed to the creation of both successful IRGs of the recent MRSEC award via the creation of the

interdisciplinary ENCOMM group that is centered in the Department of Physics. For the IMR core, funds assisted in procuring some limited ($418k) strategic equipment, but most of the award went toward creating and supporting teams of researchers through our Research Enhancement Program, increasing the breadth of technical staff being distributed to various major facilities, and supporting the two joint faculty hires in Electronic Materials and in Photovoltaics that were awarded to the Department of Electrical Engineering and the Department of Materials Science and Engineering. Details of progress in the use of the TIE funds are distributed in the annual report.
**Note: this is not an external grant; however the scope and magnitude of the program demanded its inclusion here.*

Major Multi-Investigator and Multi-Disciplinary Proposal Development in FY10

During the FY10 fiscal year, IMR worked with research teams to develop major, multi-investigator proposals to NSF, Department of Energy, the Keck Foundation, the Department of Defense, and the Ohio Department of Development, in addition to developing smaller but highly strategic programs with select, targeted private companies involved with particular faculty groups and IMR Facilities. This section highlights only the larger, multi-group efforts developed with substantial IMR involvement in FY2010. The private-public projects are listed elsewhere as the relate to the IMR Industry Challenge Grant program, contract work with the IMR Nanotech West Facility, and through the various Wright Centers that are supported by IMR. Our goal is to create the most competitive teams and proposals possible for these opportunities, and thus we always note that there are many factors that go into final selection of awards, that are not generally in the control of the PIs. By simply having these teams form around opportunities greatly increases their likelihood of competing for other programs, whether funded or not.

Note also that we have chosen to not list the even larger number of proposals created with IMR support that were submitted through the participating colleges, since we desire to explicitly focus on those activities that are particularly significant in a multi-college sense, having a large number of investigators, consistent with the mission of IMR. Working with the lead PIs and their teams, IMR has either facilitated or is leading the coordination and response of each proposal listed below this fiscal year to date:

Title: Center of Excellence in Materials, Manufacturing Technologies and Nanotechnology
Agency: State of Ohio Board of Regents
PI: Steven A. Ringel (Director, Institute for Materials Research)
Amount: N/A
Status: Awarded
****Description of Center of Excellence.** In the past fiscal year, the Ohio Board of Regents called for universities to propose State-acknowledged Centers of Excellence in many key areas. IMR, at the request of OSU central administration, created a proposal for this designation. While no direct funding results from this designation, its importance may be substantial in future years, especially as budgetary issues continue to come to light. The State looks not only for research prominence, but also for

economic benefit from such prominence in the form of company spinoffs, technology transfer, training of highly skilled workers, and so on. The fact that OSU and IMR are fortunate to have an elite faculty and student cohort in materials, and highly recognized federal and public-private centers of research, innovation and commercialization, made this proposal very strong. In April 2010, this proposal was selected as a winner, thus officially declaring OSU, through its IMR interface, to be an Ohio Center of Excellence in Advanced Materials.

Title: Low-Cost Low-Concentration Photovoltaics with Replex Plastics: An Ohio Third Frontier Proposal Submission
Agency: Ohio Third Frontier Program, Ohio Department of Development (Submitted September 2009 through Replex Plastics proposal)
PI: Robert Davis (Institute for Materials Research)
Amount: $100,000
Status: Funded

Title: Dielectric Enhancements For Innovative Nitride Electronics - DEFINE
Agency: Office of Naval Research MURI program (submitted through Univ. California at Santa Barbara as prime)
PI: Steven A. Ringel (Electrical and Computer Engineering, Institute for Materials Research)
Co-PIs: Siddharth Rajan (Electrical and Computer Engineering; Materials Science and Engineering)
Amount: $1,250,000 (7,500,000 total for 11 investigators from 7 universities)
Status: Pending (Funded as of 10/1/10)

Title: Cryogenic Peltier Cooling
Agency: Air Force Office of Scientific Research, Multidisciplinary University Research Initiative (MURI) Program
PI: Joseph Heremans (Mechanical and Aerospace Engineering)
Amount: $7,500,000
Status: Pending (Funded as of 10/1/10)

Title: I/UCRC Center for Integrative Materials Joining Science for Energy Applications
Agency: National Science Foundation, Industry/University Cooperative Research Center (I/UCRC) Program
PI: Sudarsarnam Suresh Babu (Materials Science and Engineering)
Co-PIs: Avraham Benatar (Materials Science and Engineering), Glenn Daehn (Materials Science and Engineering), Dave Farson (Materials Science and Engineering), John Lippold (Materials Science and Engineering)
Amount: $2,130,000 over 5 years ($655,000 from NSF, $1,475,000 from industry collaborators)
Status: Pending (Funded as of 10/1/10)

Title: Photovoltaic Characterization Consortium - PVCC
Agency: Department of Energy Photovoltaics Manufacturing Initiative (submitted through George Washington University as prime)
PI: Steven A. Ringel
Amount: $25,000,000 over 5 years
Status: Pending

Title: Focused Ion Beam/Analytical Scanning Transmission Electron Microscope for Nanoscale Imaging and Characterization of Biological Materials
Agency: W. M. Keck Foundation
PI: Hamish Fraser (Materials Science and Engineering)
Co-PIs: Michael Paulaitis (Chemical and Biomolecular Engineering), Richard Burry (Neuroscience), P. Chris Hammel (Physics), L. James Lee (Chemical and Biomolecular Engineering), Michael Mills (Materials Science and Engineering), Matthew Ringel (Endocrinology and Oncology), Steven Ringel (Electrical and Computer Engineering)
Amount: $1,000,000
Status: Not funded (made it to second round; farthest ever by OSU entry)
Note: IMR has focused in the past year on bridging the gap between materials characterization and medical research. This was our first real exercise toward that goal.

Title: Solar Harvesting - Photovoltaics, Photocatalysis and Energy Storage
Agency: National Science Foundation Integrative Graduate Education and Research Traineeship Program (IGERT)
PI: Malcolm Chisholm (Chemistry)
Co-PIs: Paul Berger (Electrical and Computer Engineering), Claudia Turro (Chemistry), Chiu-Yen Kao (Mathematics), Avner Friedman (Mathematics), Arthur Epstein (Physics), Joseph Heremans (Mechanical Engineering), Terry Gustafson (Chemistry), Patrick Woodward (Chemistry), Steve Ringel (Electrical and Computer Engineering), Yiying Wu (Chemistry), Anne Co (Chemistry), Siddharth Rajan (Electrical and Computer Engineering), Prabir Dutta (Chemistry), Roberto Myers (Material Science and Engineering)
Amount: $3,000,000
Status: Not funded (did not make it to final round)

Title: Exploration and Traineeship in Research and Engineering of Materials for Extreme Environments (EXTREME)
Agency: National Science Foundation Integrative Graduate Education and Research Traineeship Program (IGERT)
PI: Katharine Flores (Materials Science and Engineering)
Co-PIs: Thomas Blue (Mechanical Engineering), Roberto Myers (Materials Science and Engineering), Wolfgang Windl (Materials Science and Engineering), S. Michael Camp (Fisher College Center for Entrepreneurship), Anand Desai (John Glenn School of Public Affairs), Leonard Brillson (Electrical and Computer Engineering), Hamish Fraser

(Materials Science and Engineering), P. Chris Hammel (Physics), Ezekiel Johnston-Halperin (Physics), Thomas Lemberger (Physics), Michael Mills (Materials Science and Engineering), Patricia Morris (Materials Science and Engineering), Nitin Padture (Materials Science and Engineering), Siddharth Rajan (Electrical and Computer Engineering), Steven Ringel (Electrical and Computer Engineering), Giorgio Rizzoni (Mechanical Engineering), Yunzhi Wang (Materials Science and Engineering), John Wilkins (Physics), Patrick Woodward (Chemistry)

Amount: $3,000,000

Status: Not funded (but did make it to final round)

Title: High Efficiency, Radiation Hard, Quantum Dot Enhanced Solar Cells for Space Applications

Agency: Department of Defense Missile Defense Agency Small Business Technology Transfer (STTR) Program (Submitted September 2009 through NewCyte, Inc. proposal)

PI: John Carlin (Institute for Materials Research)

Amount: $30,500

Status: Not Funded

Title: Off-Grid SSL/Solar Wall Pack

Agency: Ohio Third Frontier Program, Ohio Department of Development

PI: Steven A. Ringel (Electrical and Computer Engineering and IMR)

Co-PIs: John Carlin (Institute for Materials Research), Bob Davis (Institute for Materials Research), Siddharth Rajan (Electrical and Computer Engineering)

Amount: $2,500,000

Status: Not Funded

Note: The proposal was ranked 7/25 and the top 6 were awarded. ODOD encouraged a resubmission in FY11, which was done.

Title: Concentrating Photovoltaics Diffusion Technology Support for Greenfield Solar

Agency: Ohio Third Frontier Program, Ohio Department of Development (Submitted September 2009 through Greenfield Solar proposal)

PI: Robert Davis (Institute for Materials Research)

Co-PIs: John Carlin (Institute for Materials Research), Bob Davis (Institute for Materials Research), Siddharth Rajan (Electrical and Computer Engineering)

Amount: $30,000

Status: Not Funded

Title: Sunlight to Fuels Energy Innovation Hub

Agency: U.S. Department of Energy, Solar Fuels Hub (Submitted through Pennsylvania State University as prime)

PI: Robert Davis (Institute for Materials Research)

Co-PIs: Steven Ringel (Electrical and Computer Engineering), Leonard Brillson (Electrical and Computer Engineering), Siddharth Rajan (Electrical and Computer Engineering), John Carlin (Institute for Materials Research)
Amount: $3,472,282
Status: Not funded

Unsuccessful ARPA-E white papers. IMR assisted multiple teams to respond to the initial ARPA-E call for proposals. None were successful in this extremely competitive competition. However, while funding was an ultimate goal, perhaps more important was the creation of these teams who are now well positioned to focus toward additional energy related materials research program opportunities.

Title: Low-Cost Low-Concentration Photovoltaic (LC2PV) Systems for Mid-Northern Latitudes
PI: Robert Davis (Institute for Materials Research) through Replex Plastics as prime
Co-PIs: Steve Ringel (Electrical and Computer Engineering), John Carlin (Institute for Materials Research)
Amount: $1,200,000

Title: Viable CO2 Membrane Separation
PI: Hendrik Verweij (Materials Science and Engineering)
Co-PIs: Prabir Dutta (Chemistry), W.S. Winston Ho (Chemical and Biomolecular Engineering)
Amount: $4,700,000

Title: 50% Efficient III-V Solar Cell at Low Cost Using Existing Silicon Infrastructure
PI: Steven Ringel (Electrical and Computer Engineering and IMR)
Co-PIs: Siddharth Rajan (Electrical and Computer Engineering), John Carlin (Institute for Materials Research), Roberto Myers (Materials Science and Engineering), Robert Davis (Institute for Materials Research)
Amount: $3,800,000

Title: Accelerating the Pathway Toward Polycrystalline Multijunction Solar Cells
PI: Leonard Brillson (Electrical and Computer Engineering)
Co-PIs: Steven Ringel (Electrical and Computer Engineering), Roberto Myers (Materials Science and Engineering)
Amount: $3,496,907

Title: New Smart Materials for Next-Generation Diesel Fuel Injectors
PI: Marcelo Dapino (Mechanical Engineering)
Co-PIs: Joseph Heremans (Mechanical Engineering), Stephen Bechtel (Mechanical Engineering)
Amount: $850,000

Title: Durable and High Efficiency Thin-Film Energy Devices
PI: Paul Berger (Electrical and Computer Engineering
Amount: $5,250,000

Note that this list above does NOT count the many proposals developed by the individual IMR faculty or groups that are also directly benefitting from the Research Enhancement Program. These projects are tabulated in the appendices based on self-reported information.

Interdisciplinary Faculty Cluster Hiring

The IMR has an active role in working with colleges and departments to support strategic faculty hiring. Typically this means a focus on interdisciplinary aspects of materials research such that IMR can aid departments in collaborating across traditional boundaries. IMR is achieving this in two ways, first through the Advanced Materials Initiative Targeted Investment in Excellence Award, and second through the Ohio Research Scholars Program in Technology Enabling and Emergent Materials. Both of these funded programs were described earlier in the report.

As part of the Advanced Materials Initiative TIE award led by IMR and its Director as PI, IMR coordinates the recruitment and selection of faculty in targeted hiring areas to further strengthen the OSU materials community. IMR initiated and coordinated a unique approach to hire faculty members via a "cluster hiring' process, in which topical areas defined the positions, and not academic departments, to ensure that a focus on interdisciplinary hiring could be achieved. As candidates applied, appropriate departments were identified in order to position each candidate in the correct tenure-initiating unit and in some cases appointments were shared between two departments. The primary focus of the process was applied to two areas, Computational Multiscale Materials Modeling and Electronic Materials, the latter of which was augmented via a designed overlap with the Energy TIE in the area of Photovoltaics. Significant amounts of the startup funds for each position were provided to each of these positions via the Advanced Materials TIE award. During FY09, the modeling cluster was broadened somewhat to augment and complement the successful hires made in FY08, and now includes biomaterials and validation/verification computation methods to reflect the ever evolving nature of advanced materials. To date 6 faculty members have joined the materials community through the cluster hiring process, and each have contributed substantially to furthering the scholarly quality and quantity of our community in various ways.

Through the Research Scholars award, IMR received ~ $18,000,000 in funds to hire 5 endowed chair faculty members, 3 at OSU and 1 each at the University of Dayton and the University of Akron. Each faculty line includes generous capital and operating start up funds. At OSU, one Ohio Research Scholar has recently joined, and the two remaining positions are pending to be filled. This research cluster has a primary focus on acceleration and innovation of material from basic science to application, via coordinated characterization, predictive modeling and synthesis. A particular emphasis is on nanomaterials, soft materials and materials from renewable and sustainable resources. To that end, Professor Katrina Cornish is ideally suited. Details of Professor Cornish's background and interests can be found in recent press releases on the IMR website, www.imr.osu.edu.

The seven faculty members recruited by IMR to date in conjunction with the appropriate departments, according to the programs just summarized, are listed here:

- **Ezekiel Johnston-Halperin**, Assistant Professor, Physics, October 2006
  - Magnetic and electronic materials, spintronics and nanostructures
- **Sudarsanam Suresh Babu,** Associate Professor, Industrial, Welding and Systems Engineering Department, October 2007
  - Materials joining, non-equilibrium processing, modeling and manufacturing
- **Ji-Cheng (J.C.) Zhao,** Associate Professor, Materials Science and Engineering Department, January 2008
  - Computational thermodynamics, phase diagrams, diffusion, materials property microscopy tools, and materials design
- **Siddharth Rajan**, Assistant Professor, Electrical and Computer Engineering (80%) and Materials Science and Engineering (20%) departments, October 2008
  - High-performance semiconductor devices and materials applied to electronics, energy devices and optoelectronics
- **Roberto Myers**, Assistant Professor, Materials Science and Engineering (80%) and Electrical and Computer Engineering (20%) departments, October 2008
  - Electronic materials, nanostructures, optoelectronic properties and magnetoelectrics
- **David Wood**, Professor, Chemical and Biomolecular Engineering in October 2009.
  - Biomaterials and the application of the techniques of molecular biology to the development of new material systems for bioseparations.
- **Katrina Cornish,** Professor and Ohio Research Scholar Endowed Chair in Bio-based Emergent Materials, Horticulture and Crop Science and Food, Agricultural and Biological Engineering departments, July, 2010
  - Bioemergent materials, alternative natural rubber production, natural rubber biosynthesis, materials and products from plant-based sources

Dr. Katrina Cornish, OSU's new Ohio Research Scholar in Bio-Based Emergent Materials

IMR Research Enhancement Program

An important goal of the IMR is to expand our ability to provide competitively-awarded early-stage funding to OSU researchers, allowing them to explore cutting-edge materials-allied research in anticipation that these activities lead toward major, externally-supported interdisciplinary research groups and centers, as well as nurturing very futuristic research that lays the seeds for areas where OSU can claim pre-eminence by defining new waves of research in materials-allied areas such as energy, computational materials, renewable materials, nanotechnology, and so on. IMR developed and manages a large Research Enhancement Program which provides internal research funding to Ohio State materials researchers using three distinct award programs, interdisciplinary materials research grants (IMRGs), Facility Grants and IMR Industry Challenge Grants.

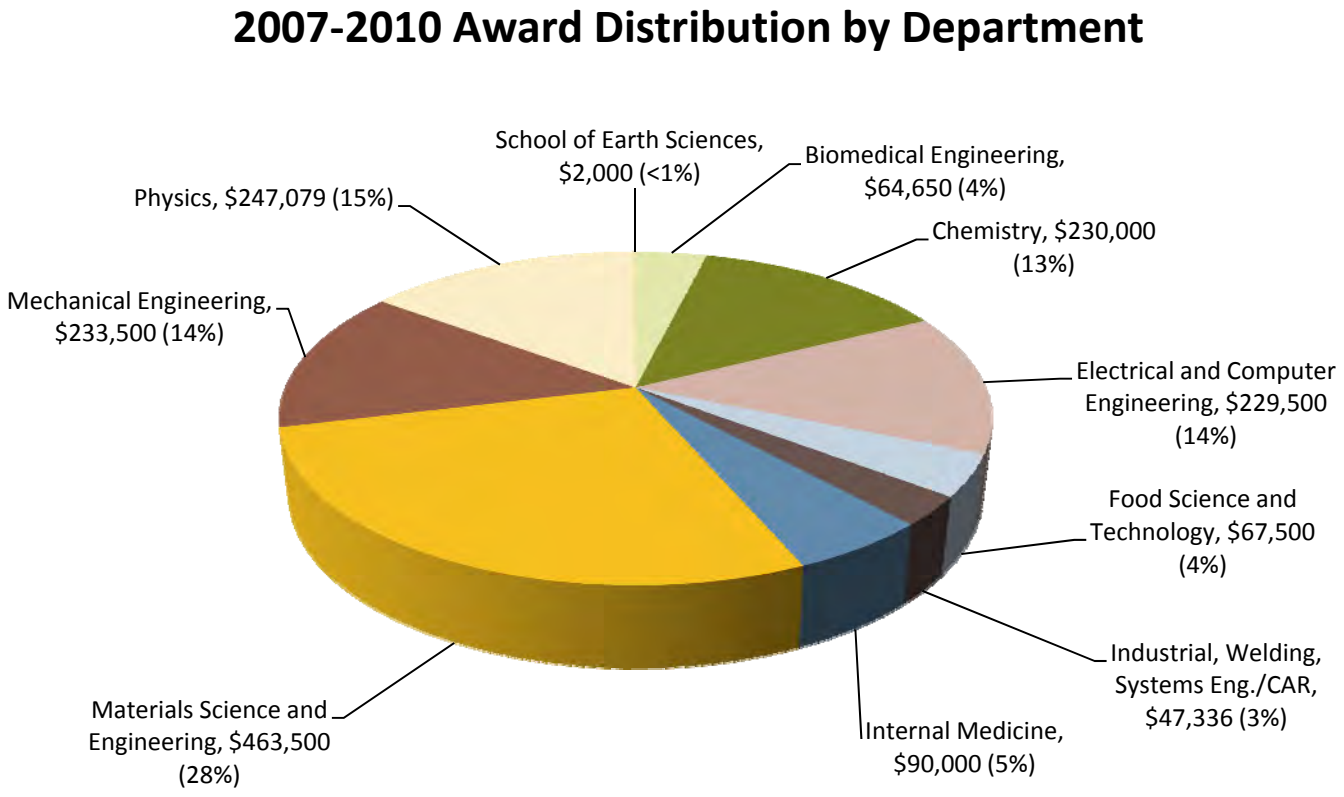


Figure 5. IMR Research Enhancement Program funding between 2007 and 2010, shown by distribution to lead PIs' departments, total dollars and percentage of total awards given.

Since the inception of this program in February 2007, IMR has invested $1,675,065 in internal research awards, supporting 194 OSU researchers representing 16 departments from 5 colleges. **Figures 5 and 6** show the distribution of these awards between 2007 and 2010 by department. We list the self-reporting of publications, new proposals and awards from recipients of this support in the Appendices.

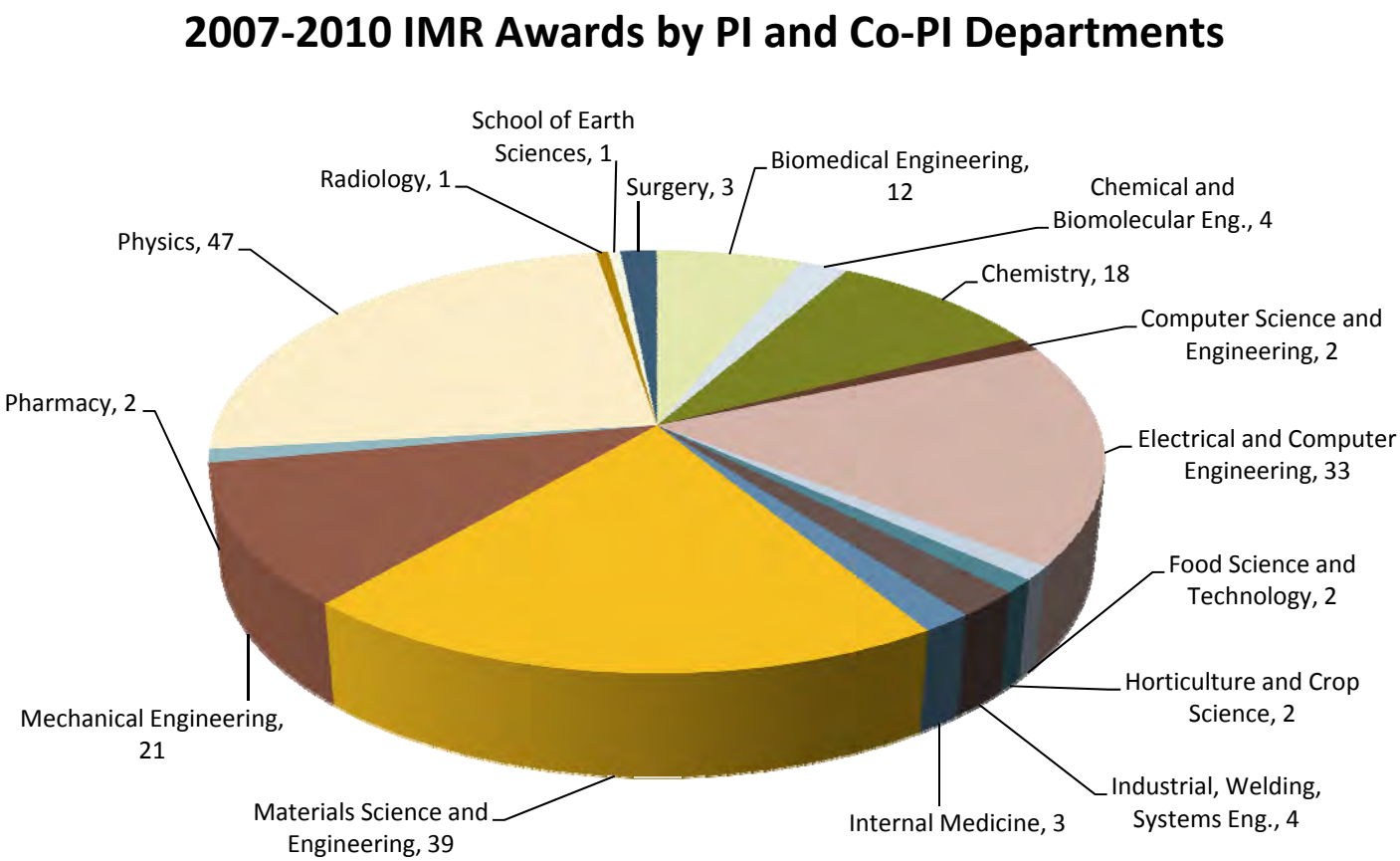


Figure 6. IMR Research Enhancement Program award distribution between 2007 and 2010, distributed to all Investigators' departments for all awards. Numbers show the sum of all researchers per department on funded research teams. Hence certain individuals will be counted more than once if they are on more than one award.

IMR Interdisciplinary Materials Research Grants

The **Interdisciplinary Materials Research Grant** (IMRG) awards provide seed funding to support pioneering interdisciplinary research in materials-allied fields with the goal of generating highly competitive external grant proposals that target large, multi-investigator and center-level opportunities. Grants up to $45,000 are competitively awarded and may be renewable for a second year.

To date we have awarded 26 IMRGs totaling $1,492,149 to support the research of 64 IMR members from 5 colleges and 16 academic departments. In 2010 IMR funded 8 IMRG awards for a total of $355,000 in IMRG funding. Statistics for the distribution of IMRG awards in 2010 are as follows:

<u>2010 IMR Interdisciplinary Materials Research Grants:</u>

- $355,000 total awarded to 9 interdisciplinary teams (approx. $45,000 each) from 7 departments and 5 colleges
  - $215,631 of the awards was budgeted for student support (stipend, tuition, fringe)

- $139,369 of the awards was budgeted for "other direct costs" (lab fees, supplies, materials, staff salary and support)

FY 2010 IMR Interdisciplinary Materials Research Grant (IMRG) Awards

Title: Multi-Scale Characterization of Battery Materials for Improved Performance
Investigators: Sudarsanam Suresh Babu (PI); Bharat Bhushan; Yann Guezennec; Giorgio Rizzoni; Shrikant C. Nagpure
Amount: $45,000

Title: Metamaterials with Smart Reconfiguration for Broadband RF Antennas
Investigators: Marcelo Dapino (PI); Suresh Babu; John Volakis
Amount: $45,000

Title: Structure-Property Relationships in Novel Structural Materials
Investigators: Katherine Flores (PI)
Amount: $40,000

Title: Economical Platforms for FET-based Protein Detection to Support Sensor Clinical Translation
Investigators: Stephen C. Lee (PI); Paul Berger
Amount: $22,500

Title: Use of Electrospun Biomaterials as Carriers of Bone Marrow Derived Stem/Progenitor Cells to Stimulate Tissue Neovascularization
Investigators: Nicanor I. Moldovan (PI); John J. Lannuti
Amount: $45,000

Title: Exploring Electrically Tunable Magnetism in Gd-doped Nitride Quantum Structures
Investigators: Roberto C. Myers (PI); Ezekiel Johnston-Halperin; Michael Mills
Amount: $45,000

Title: Experimental and Computational Study of ALD-grown Dielectrics on III-Nitrides
Investigators: Siddharth Rajan (PI); Wolfgang Windl
Amount: $45,000

Title: Assessing the physico-chemical properties of bio-based PLA-PEG films for food packaging applications
Investigators: Yael Vodovotz (PI); Kurt Koelling
Amount: $22,500

Title: Synthesis of III-V Semiconductor Nanowire Heterostructures Using Metalorganic Chemical Vapor
Investigators: Fengyuan Yang (PI); Ezekiel Johnston-Halperin; Roberto C. Myers
Amount: $45,000

IMR Facility Grants

IMR Facility Grants provide up to $2,000 to assist OSU faculty with facility user access fees and related minor charges associated with conducting innovative materials-allied research. To date IMR has awarded 73 Facility Grants to support the research of 58 IMR members from 3 colleges and 9 academic departments. In fiscal year 2010, IMR has funded 19 Facility Grants for a total of $38,000:

FY 2010 Facility Grant Awards:

- $38,000 total awarded to 19 projects ($2,000 each) from 6 departments and 2 colleges

FY 2010 IMR Facility Grant Awards

Title: Lithium-ion Batteries, LiFePO4, Aging, High Resolution Characterization
Investigators: Sudarsanam Suresh Babu (PI)
Amount: $2,000

Title: Steep Sub-Threshold Quantum Tunneling Transistors
Investigators: Paul R. Berger (PI)
Amount: $2,000

Title: Characterization of Protein-Block Copolymer Interactions for Biomaterials Development
Investigators: Bharat Bhushan (PI); Scott R. Schricker; Manuel Palacio
Amount: $2,000

Title: Fabrication and Characterization of Biomimetic Superoleophobic Surfaces
Investigators: Bharat Bhushan (PI)
Amount: $2,000

Title: Research on Spintronic Phenomena in Organic-Based Materials and Organic-Based Biosensors
Investigators: Arthur Epstein (PI)
Amount: $2,000

Title: Mechanically and Biochemically Compatible Tissue Constructs to Improve Cardiac Function
Investigators: Jianjun Guan (PI)
Amount: $2,000

Title: Surface and Tip Enhanced Single Molecule Spectroscopy for Energy Applications
Investigators: Jay Gupta (PI)
Amount: $2,000

Title: Soft Microelectrode Arrays for Individual Cortical Column Potential Measurements
Investigators: Derek J. Hansford(PI)
Amount: $2,000
Title: FIB Characterization of MFM Probes

Investigators: P. Chris Hammel (PI); Gunjan Agarwal; Michael Page
Amount: $2,000

Title: Raman Microscopy of Poly-Diamond Films and Nanostructures
Investigators: Ezekiel Johnston-Halperin (PI)
Amount: $2,000

Title: Radiation Damage and Disorder in Magnetic Multilayers
Investigators: Ezekiel Johnston-Halperin (PI)
Amount: $2,000

Title: XPS and Liquid AFM Facility Support for MIG Chemical Bonding and Conjugation on AlGaN Biosensors
Investigators: Stephen Lee (PI); Leonard Brillson
Amount: $2,000

Title: High Performance III-Nitride High Electron Mobility Transistors for Power Electronics
Investigators: Wu Lu (PI)
Amount: $2,000

Title: Ultra High-Pressure Metallurgy
Investigators: Wendy Panero (PI)
Amount: $2,000

Title: Development of low work function metal “end-on” contacts to Si nanowires with high-quality Si/SiO2 interfaces
Investigators: Jonathan Pelz (PI)
Amount: $2,000

Title: Composite Natural-Synthetic Polymer Fibers: Interfacial Control
Investigators: Heather Powell (PI)
Amount: $2,000

Title: Materials Science of Electron Beam Induced Reliefs in Germanium Selenium Glasses
Investigators: Ronald M Reano (PI)
Amount: $2,000

Title: Mobile Magnetic Traps for Cell Manipulation and Sorting
Investigators: R. Sooryakumar (PI); Jeff Chalmers
Amount: $2,000

Title: Micropatterning of Polymer Nanofibers for Functional Tissue Engineering
Investigators: Yi Zhao (PI)
Amount: $2,000

IMR Industry Challenge Grants

The newest funding opportunity is the **IMR Industry Challenge Grants**, which are intended to strengthen collaboration between OSU researchers and private industry partners in materials-allied research. These grants provide one-to-one matching funds up to $20,000 per year to allow OSU researchers to conduct research in collaboration with private industry partners that will lead to major external proposal development. IMR Industry Challenge Grants are eligible for renewal for a second year of funding. This third grant program was announced in March 2009 and IMR funded its very first $20,000 Industry Challenge Grant in September 2009 to Dr. Dennis Bong, Assistant Professor of the Department of Chemistry, and a key industrial partner. Since then, interest has ramped dramatically. During summer of 2010 (first quarter of FY11 by OSU's calendar) IMR has received several more proposals and is likely to support 2 during FY11. This activity will grow over time due to the role of the ORSP program with industry, and the rapidly increasing number of private-public collaborations through several centers and facilities.

Facility and Infrastructure Updates

Introduction

Materials research, especially at the cutting edge, requires an enormous infrastructure, specialized equipment that can be prohibitively expensive, and need complex operations that require highly skilled technical staff. A world-class research program in materials must figure out a way in which the necessary capabilities are available and can be operated at the state of the art. Since the price tag on high end tools can reach in the millions of dollars and major laboratories like a semiconductor cleanroom can run into the tens of millions of dollars, with million dollar plus annual operating costs and service contracts that can be 10's to 100's of thousands of dollars per year per tool, an infrastructure operation where shared facilities are the rule rather than the exception is needed. Also, available space and plans to integrate new tools over time is essential. Prior to the creation of IMR, this type of environment, with a few notable exceptions (such as the Campus Electron Optics Facility), did generally not exist at OSU and lab development, maintenance and access were generally handled by individual departments or individual faculty. Many departments whose faculty are engaged in materials research either are not able to support or do not understand

IMR's free daily shuttle service averages 150 passengers per month, or 1,770 passengers over the last year.

how to support state of the art materials research capabilities. Therefore, a very important goal of IMR has been and continues to be the development and implementation of a comprehensive infrastructure plan that would create a network of shared facilities operating at peak condition, which would be open to the community. Complementary capabilities at each facility would be coordinated and users would be trained on an as-needed basis. In fact, these are the primary reasons for the presence of the IMR Members of Technical Staff. The expectation is that through a coordinated effort, resources could be optimally applied across the various laboratories, state-of-the-art equipment operation would be uniformly achieved, and interdisciplinary interactions would prosper. It is totally reasonable to expect that such a network of facilities can and should simultaneously support multiple research centers as well as individual and small group research efforts.

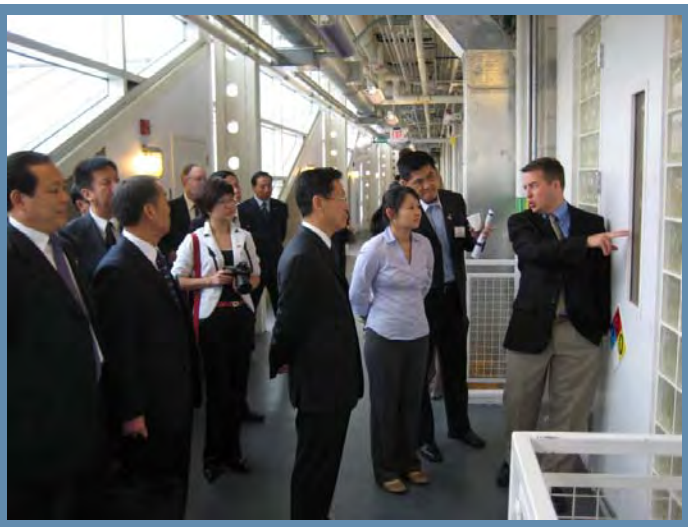
IMR funds have been used to acquire and sustain key infrastructure facilities now in four major user facilities, Nanotech West in the OSU research park on Kinnear Road, the ENCOMM Nanosystems Lab (ENSL) in the Physics Research Building, the Campus Electronic Optics Facility (CEOF) in Watts Hall, and the Nanomaterials Processing Center (NanoMPC) in Dreese Lab. IMR supports Members of Technical Staff who provide state of the art experimentation and sustainability in these facilities and also in the Center for Chemical and Biophysical Dynamics (CCBD) lab in the department of Chemistry, the newest member of the IMR network of major user facilities. Support is used to provide transportation and "barrier-lowering" between all facilities, regardless of physical proximity. In prior reports we provided significant detail on infrastructure coordination, including a description of shared office space for students, faculty and collaborators at Nanotech West, the move of the nanopatterning electron beam lithography facility from central to west campus, a new shuttle connecting central and west campus materials facilities and the role of IMR's Wright Center – PVIC, in this mix. Here we provide a status report of those facilities as of the end of FY10, their impact and describe our already successful operational structure that is enabling a sustaining operation now and into the future.

IMR Members of Technical Staff (IMR-MTS)

- Aimee Bross, Senior Research Associate in the IMR Nanotech West Laboratory, specializes in electron beam lithography, scanning electron microscopy, various metrologies and device fabrication
- John Carlin, Ph.D., Research Scientist in the IMR Nanotech West Laboratory, specializes in metal organic chemical vapor deposition (MOCVD), atomic layer deposition (ALD), device processing and overall cleanroom-based fabrication
- Denis V. Pelekhov, Ph.D., Research Scientist, in the ENCOMM Nanosystems Laboratory (ENSL), specializes in focused ion beam/scanning electron microscopy, x-ray diffractometry, and SQUID magnetometry, and is the ENSL lab manager
- Evgeny Danilov, Ph.D., Senior Research Associate, in the Center for Chemical and Biophysical Dynamics Laboratory (CCBD), for which he is the lab manager and supports research on ultrafast laser spectroscopy in biological, chemical, physical, and materials systems. Dr. Danilov joined IMR in January, 2010.

As described earlier, IMR Members of Technical Staff (MTS) are vital to support the massive materials research infrastructure, particularly for expensive, one-of-a-kind pieces of instrumentation that are open to many users, and to support the large laboratories that house such instrumentation. Hence, their accomplishments, particularly those accounted for in this past FY10, are included here in this section on infrastructure accomplishments, since the relevance is made more obvious. More details of their overall activities can be found in the Appendix section.

Every top materials program in the U.S. has some form of this support and until the creation of the IMR, OSU had not supported this new class of research personnel in a centralized way with multi-department and multi-college access outside of one or two examples. During FY10, the 3 MTS individuals - Ms. Aimee Bross, Dr. John Carlin and Dr. Denis Pelekhov - have all been vital and outstanding performers in their MTS mission. Bross now directly interacts with more than 60 PIs and other researchers in FY10. Significantly, this includes a growing number of users from industry, national labs and other universities. Dr. Carlin has been enabling various companies to work with NTWest particularly in the solar area (he is partially supported by PVIC) and is leading the development of both the ALD and MOCVD capabilities and creating NTWest as the home for solar cell fabrication in an outsourced model, all of which have been his primary areas focus in FY10. In FY10, the ALD tool came on-line and Dr. Carlin has been enabling the research and training users for ALD deposition of ZnO, TiO_2, SiO_2 and other oxide materials. The MOCVD facility is just about completing its acceptance and should be completed in early summer 2010. The MOCVD is anticipated to be of extraordinary impact for OSU materials researchers in a variety of fields. Dr. Pelekhov has been directly interacting with and supporting 27 research groups in the ENSL, a brand new facility. ENSL activities have generated over $100,000 in user fee billing in this FY. All three have been working closely together and have successfully realized IMR's vision of a layer of highly skilled research scientists/engineers who collaborate across all boundaries to connect the various major user facilities and building for the greater community.



On October 29, 2009 Nanotech West Laboratory was honored to host a visit from a Chinese delegation representing Hubei Province, a sister-state to Ohio since 1979 and home of Wuhan University. Dr. John Carlin, Research Scientist and IMR Member of Technical Staff, provided an overview of the photovoltaics research taking place at Ohio State and the broad research capabilities of OSU's Nanotech West Laboratory. Dr. Carlin was joined by Dr. Yun Wu, a Postdoctoral Researcher at OSU's NSEC program, who is originally from Hubei Province.

This year we entered into an agreement with the Chemistry department to cost share a fourth MTS individual to provide state of the art support for the Center for Chemical and Biophysical Dynamics (CCBD). The CCBD is an ultrafast laser spectroscopy laboratory located in the Newman and Wolfrom Laboratory building. The facility provides researchers with access to time-resolved spectral measurements on subpicosecond time scales over a wide wavelength

range. Dr. Evgeny Danilov joined the staff in January 2010 as an IMR Member of Technical Staff assigned to CCBD, where he assists users with time-resolved optical spectroscopy. Dr. Danilov trains users to conduct their own ultrafast laser experiments, assists them with the interpretation of research data, works with potential CCBD users to identify the most suitable experimental approach to study spectral dynamics, and develops new instrumentation appropriate for new and emerging materials and molecular systems. Dr. Danilov comes to us from the University of Texas at Dallas, where he was a Senior Research Scientist for the Department of Physics and Alan G. MacDiarmid NanoTech Institute. He has a Ph.D. in Laser Physics, and previously worked at Bowling Green State University as Research Coordinator for the Ohio Laboratory for Kinetic Spectrometry.

Nanotech West Laboratory Accomplishments for FY10 and Overview

Open to both academic and industrial users, Nanotech West Laboratory's state-of-the-art facilities include a 6,000 square foot biohybrid laboratory and a 6,000 square foot class 100 cleanroom specializing in micro and nanoscale fabrication and material synthesis with a full-flow 100mm process capability. Nanotech West includes a wide array of major facilities, all staffed, coordinated and serviced by research scientists, engineers and technicians. As a result, Nanotech has now become a central facility for wide areas of materials research. A partial list of primary capabilities at Nanotech West, not including the extensive bio-hybrid space but updated from last year to include the arrival of several key new tools in FY10 is provided here:

- Electron beam lithography [Vistec® EBPG-5000]
- Metalorganic chemical vapor deposition [Aixtron / Swan® 3x2]
- Atomic layer deposition [Picosun SunALE® R-150B]
- Field-emission scanning electron microscopy [Carl Zeiss Ultra 55 Plus]
- ICP-RIE, inductively coupled plasma reactive ion etching [Plasma-Therm SLR 770] and several other plasma etch tools
- Five-gun RF/DF sputter deposition system (AJA International)
- Semiconductor PCD lifetime measurement system (Sinton)
- Six-pocket electron gun evaporator (CHA) Wafer bonding and micro– and nanoimprint lithography [EVG 520HE]
- I-V, C-V, L-I-V, microfluidic, and solar device testing
- Atomic force microscopy [Veeco 3100, NanoInk, Asylum BioAFM]
- Full-flow 100 mm process capability including photolithography, wet/dry etching, deposition, oxidation, metrology
- 6,000 square foot class 100 cleanroom
- 10 full-time equivalent engineering and administrative staff

An impressive way to summarize the current state of Nanotech West is that as of this writing Nanotech West is the physical home to 3 very large (>$15M each) interdisciplinary materials centers – The NSF

Nanoscale Science and Engineering Center, the Wright Center for Photovoltaics Innovation and Commercialization, and the Wright Center for Multifunctional Polymer Nanomaterials and Devices, and is a primary user facility that serves the NSF Materials Research Science and Engineering Center - CEM. Additionally, Nanotech West is now the primary location for university-industry interactions in advanced materials (at least 50 company users). In summary, Nanotech West has been completely

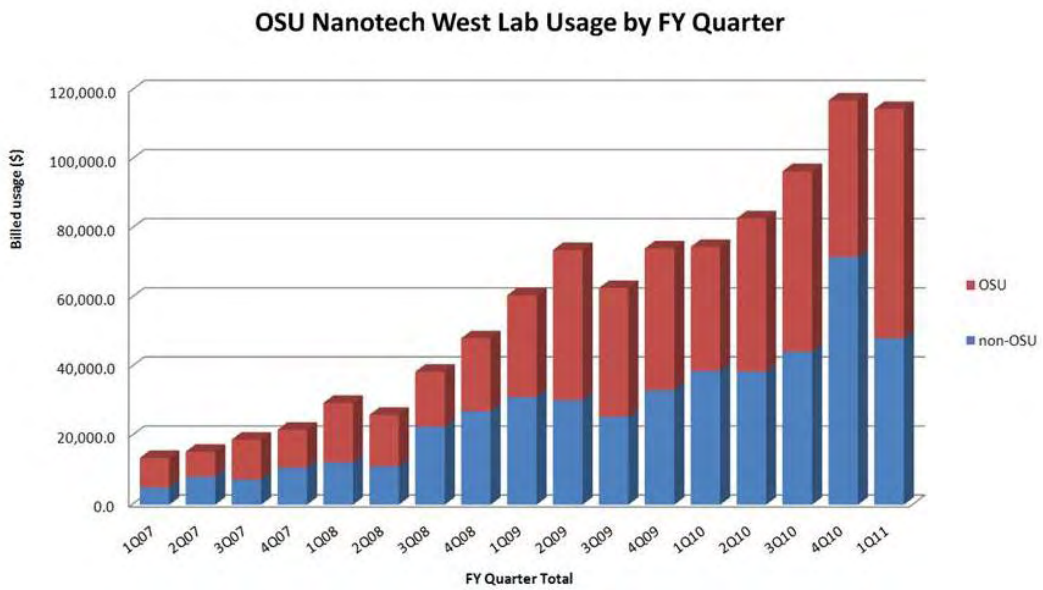


Figure 7. Chart showing substantial growth in user fee income that tracks growth in facility usage after AMI stimulation and support of the Lab and its facilities. Final FY10 user fee income alone, not counting direct grant support to the lab, is $371k.

upgraded a level that is approaching that of comparable facilities at the very elite universities in this field. As the primary IMR location on OSU's west campus, it has become a centerpiece for collaborative research in OSU's materials community.

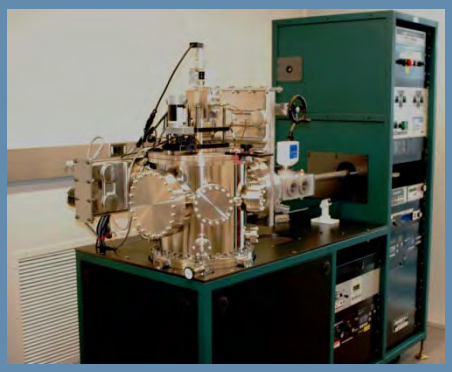
During the reporting period, and as a result of several years of planning and discussions, in March 2010 a memorandum of understanding (MOU) was signed at Ohio State that administratively moved Nanotech West to become an organization within IMR, from its historical line of report to the College of Engineering. This reflects the impact of the Lab on research across the OSU campus, and is in line with one of the several IMR primary missions - the support of shared materials-related research facilities on campus. Details of the administrative change will begin to take effect in June 2010.

Year in Review

Turning specifically to the time period being reported upon here, FY10 was once again a time of major user activity growth for Nanotech West and included the above-mentioned administrative change for the Lab. User activity continued its steady growth in this period, total activity growing approximately 40% over the previous year as measured by total user fee billings (see **Figure 7** for usage trend as compared to 1Q FY07). Very notable during this time period is the fact that in FY10, non-OSU use of Nanotech West accounted for 52% of user fee income. While this somewhat reflects the fact that industry pays

higher user fee rates, it also is indicative of the importance of Nanotech West in the central Ohio high-tech area. Nearly 30 companies used Nanotech West in FY10, all but three of them from inside the state.

In FY10 Nanotech West Lab capabilities were also key to program wins by local companies such as a $6.43M DARPA award to Srico, Inc. (Columbus, OH, to develop high-speed electro-optic modulators) and a $1.257M Third Frontier Program award to Replex Plastics (Mt. Vernon, OH, to develop low-concentration photovoltaic systems). Replex, for example, now has a newly-hired full-time employee at Nanotech West, joining seven other employees from other companies that spend the majority of their weekly time there.



Nanotech West Laboratory recently acquired this Orion-8 sputtering system from AJA International, Inc.

Major Tool Acquisitions / Installations

FY10 was also a very active time of tool and instrument acquisitions for Nanotech West, most but not all originating from the Wright Center for Photovoltaics Innovation and Commercialization (PVIC). During this time period the new **Aixtron 3x2" close-coupled showerhead (CCS) metalorganic chemical vapor deposition (MO-CVD) system** was installed and most of its qualification completed. Vendor-related hardware changes have delayed final acceptance, but that acceptance is expected by July 2010. These include modifications to the tool exhaust, improvements in the reactor quartzware, and installation of a double-dilution source delivery system. The tool, which can grow III-V compound semiconductor phosphides and arsenides, was bought with PVIC funds will be the source of a major growth of activity at Nanotech West in FY11. Targeted technologies are advanced III-V photovoltaics, III-V/Si integration for high-speed electronics, optoelectronic device technologies, nanowires and quantum dot physics and applications, to name several. To our knowledge, this is one of only a handful of openly accessible MOCVD facilities in the U.S.

During FY10, other equipment installations included:

- An AJA International five-gun RF/DC sputter deposition system, which became operational in November of 2009, and is being used in a variety of user projects require deposition of metals and dielectrics;
- A Sinton Consulting semiconductor lifetime measurement system, arriving in late summer 2009, enabling users to measure semiconductor material quality, especially for photovoltaics;
- A CHA Solutions System 6-pocket electron gun evaporator, which arrived at Nanotech West in May 2010 and will become operational by the start of FY11.A GCA 6300 series optical step-and repeat system was donated by the Wright-Patterson Air Force Base in Dayton, OH, and enables high-speed photolithographic patterning down to approximately 0.70 microns.
- A Spectrolab X-10 solar simulator was donated by Spectrolab, Inc. (wholly owned subsidiary of Boeing Inc.), which will allow spectrum-matched solar measurements of photovoltaics and other devices.

The combined value of the two noted donations is in excess of approximately $250k and each is a significant capability to add to Nanotech West's already extensive list of shared equipment. A summary of all recently-placed major equipment at IMR Nanotech West is listed in **Table 3**, below.

Equipment	Source	Approx. Value
Carl Zeiss Ultra 55 Plus Field-emission scanning electron microscope	PVIC	$490k
Plasma-Therm SLR770 inductively coupled reactive ion etcher	PVIC	$350k
AJA International Orion 5-gun RF/DC sputter deposition tool	PVIC	$260k
Aixtron 3x2" metalorganic chemical vapor deposition system	PVIC	$1.75M (total installation including on-site hydrogen generation system)
CHA Solutions System 6-pocket electron gun evaporator	PVIC	$200k
Sinton Consulting WCT-120 contactless lifetime measurement system	PVIC	$25k
Nikon IC-66 optical microscopes (2)	PVIC	$14k
Oriel solar simulator and support electronics	PVIC	$16k
GCA 6300-series optical step-and-repeat photolithography system	WPAFB donation	$200k
Boeing Spectrolab X-1 solar simulator	Boeing donation	$50k
Total approximate PVIC-related capital investment at Nanotech West		**$3.355M**

Table 3. Recent major equipment acquisitions at Nanotech West Laboratory through PVIC-related capital investments.

ENCOMM Nanosystems Laboratory (ENSL) Accomplishments for FY10 and Overview

ENCOMM NanoSystems Laboratory (ENSL) is an established OSU user facility located on the Columbus Campus of The Ohio State University in the Physics Research Building. The facility is open to all academic and industrial customers on a user fee basis. A primary ENSL goal is to provide users with access to advanced material characterization and fabrication tools for research and development applications. We have simplified user access to the equipment and enabled transparent, after-hours access for experienced users. ENSL is fully up and running with a diverse suite of research instrumentation including items acquired using TIE funding such as FEI Helios Nanolab Dual Beam Focused Ion Beam/Scanning Electron Microscope (FIB/SEM), Bruker-AXS D8 Discover X-ray diffractometer and NIMA Technology Model 612D Langmuir-Blodgett Trough (LBT). ENSL is one of the research infrastructure facilities falling under the IMR umbrella and the ENSL Director is an IMR technical staff member.

Research capabilities available at ENSL include focused ion beam/scanning electron microscopy, e-beam lithography, nanomanipulation, EDS X-ray microanalysis, X-ray diffractometry, SQUID magnetometry, atomic force/magnetic force microscopy, Langmuir-Blodgett trough monolayer deposition and a capability for Low-Temperature Magnetotransport measurements.

During the reporting period covered by this report ENSL has supported 27 research groups, including one external, with 108 users. ENSL has provided services bringing in a total of $127,140 with 55 funded research projects/awards benefiting from ENSL use.

ENSL staff expansion

User demand at ENSL has grown rapidly since its inception in 2007 (ENSL user fees came to over $100,000 this FY). The increased demand for use of the scientific instruments has generated corresponding demand training and instrument maintenance. In response, ENSL staff has been expanded with two new staff members, and is now staffed at the level of 2.5 FTEs.

Dr. Camelia Marginean has joined ENSL as a Technical Staff Member in April 2010. Dr. Marginean is a recent graduate of The Ohio State University department of Physics, and her thesis focused on studies of charge transport through metal/molecular layer/semiconductor and metal/quantum dot structures using Ballistic Electron Emission Microscopy (Advisor: Professor J. Pelz). Dr. Marginean is now the primary contact at ENSL for training and operation of the Veeco Dimension 3000 Scanning Probe Microscope, Quantum Design MPMS-5 SQUID magnetometer, electrical two-probe measurements using nanomanipulators and various instruments in the photolithography laboratory.

Ms. Stephanie Arend has joined ENSL in September 2009 as a Research Aide. Ms. Arend is a recent graduate of The Ohio State University with a major in History and a minor in Business. At ENSL her responsibilities include, but not limited to, equipment maintenance, chemical waste disposal, supplies inventory maintenance, web design, database support and financial management. She is 50% supported by IMR through an MOU with the Physics Department as technical support staff for ENSL and Dr. Pelekhov.

New equipment

During the past year ENSL has added two new major research capabilities. A pair of Kleindiek nanomanipulators has been installed in the vacuum chamber of the existing dual beam FEI FIB/SEM thus transforming the instrument into a hands-on tool for nanomanipulation and electrical measurements. Nano/micro objects can be manipulated in situ while observing the process with SEM. In addition, the same manipulators can be used for 2-probe electrical measurements on nanoscale devices and structures.

A new low-temperature magneto-transport measurement system was designed and constructed and recently commissioned. This instrument can measure electrical properties of materials and devices over a temperature range of 5 K–300 K and in magnetic fields as high as 2.3 T. The system is equipped with a Janis Research flow cryostat and a GMW electro magnet. It can be used for magneto transport measurements in 4 or 5-probe configuration including measurements of magnetoresistance, non-local spin transport, Hall voltage and differential conductance. The instrument was designed to minimize liquid helium use in order to reduce costs for users. The instrument was purchased using funds provided jointly by the OSU MRSEC and the ENCOMM TIE.

Center for Chemical and Biophysical Dynamics (CCBD)

The Center for Chemical and Biophysical Dynamics (CCBD) was formed by several investigators within the Department of Chemistry using resources obtained from the National Science Foundation, the State of Ohio Board of Regents' Action fund, and the State of Ohio Hayes Fund. Through a partnership between the Chemistry department and IMR, the CCBD has in this reporting period become an open user lab available to OSU faculty and their research groups, as well as external users. The mission of the CCBD is to provide users with access to laser spectrometry instrumentation, including all the equipment necessary to measure transient UV/Vis, fluorescence, infrared, and stimulated Raman spectra on femto-, pico-, and nanosecond time scale. Researchers use CCBD instrumentation to perform several forms of ultrafast laser spectrometry to reveal the complex evolution of light quanta absorbed by matter. By measuring with high temporal precision the changes in characteristic spectral signatures of photogenerated intermediates, the sequence of individual events can be discerned, the information which otherwise is smeared and integrated over time. The evolution steps provide a rich harvest of knowledge about the energy flow and mechanisms of transformations in biological, chemical, physical, and materials systems. This knowledge is invaluable for learning how photoreactive systems work in Nature as well as for optimizing the energy transfer and eliminating energy losses in artificial systems and materials.

A highlight of the lab is a million-dollar ultrafast laser system. It consists of 35 femtosecond 800 nm Coherent Ti:Sapphire seed lasers and high energy regenerative amplifiers. Regenerative amplifiers pump optical parametric amplifiers to generate fs pulses at a variety of wavelengths (from ~240 nm to ~12 microns) using nonlinear frequency conversion. The wavelength diversity allows one to select specifically the excitation and detection characteristic for the system under study. The detection systems include single-wavelength and array detectors. For picosecond fluorescence lifetime measurements, a mode-locked Nd:YLF laser – pumped dye laser is used as a source for a time correlated single photon counting (TCSPC) apparatus that facilitates measurements with a time resolution of *ca.* 40 ps.

The CCBD is also equipped with a nanosecond time-resolved dispersive infrared spectrometer with a 50 ns-response MCT detector. The excitation is provided by a ns Nd:YAG laser source tunable from ~410 to 690 nm and from ~210 to 340 nm. More details can be found on the CCBD website at http://www.chemistry.ohio-state.edu/ ~gustafso/ ccbd.html.
Major instrumentation at CCBD is functionally divided into several time-resolved spectrometers:

- Femtosecond transient Ultraviolet / Visible absorption spectrometer
- Femtosecond time-resolved infrared spectrometer
- Femtosecond stimulated Raman spectrometer
- Femtosecond kinetic measurement setup
- Time-correlated single photon counting emission spectrometer
- Nanosecond time-resolved infrared spectrometer

Accomplishments for FY10 and Overview

All instruments are accessible for members of research groups after appropriate training and serve equally as scientific and educational resource. A highly qualified Research Scientist was hired in a position of a CCBD Manager to oversee day-to day operations, ensure technical support and training, provide liaisons and establish collaboration between the CCBD and materials research community.

As with all IMR supported facilities of this nature, CCBD is now run as an open facility for internal and external users. The capabilities within CCBD are for optical characterization and their inclusion within the IMR family of facilities and facility centers (eg. NTWest and is various core labs, CEOF, ENSL, SEAL, NanoMPC) complements the capabilities of each facility. This also assists in integrating Chemistry more obviously into the materials community, greatly assisting the various Chemistry faculty members currently conducting funded materials research through IMR, NSF and DOE programs.

All the IMR-MTS are vital for any external materials center, such as the Ohio Scholars, WCI-PVIC or the NSF MRSEC, and thus part of their support is included as cost share to those programs as they greatly leverage any externally funded program that uses our facilities. In January 2010, Dr. Evgeny Danilov joined the staff of Ohio State's Department of Chemistry as a Senior Research Associate, becoming the fourth IMR Member of Technical Staff on campus to provide high-level technical support for materials researchers on campus. Dr. Danilov now manages the CCBD operations and he has been tasked with taking this multi-user research facility and turning it into a facility open to the entire materials community.

Other Facility Development and Infrastructure Optimization

In the current reporting period, IMR financial support enhanced several other open facilities in the Nano-Materials Processing Center (Nano-MPC) located in Dreese Laboratory. Already described were funds in support of the NSF-MRI award for an ammonia-based MBE growth system for GaN coupled with a diamond CVD system. Substantial support was provided to develop this sophisticated facility, and to expand resources for their integration into existing space within the Semiconductor Epitaxy and Analysis (SEAL) and ENSL labs. This included more targeted purchases of smaller components to increase the efficient use of the SEAL facility to accommodate the presence of Profs. Rajan and Myers, who as two of our recent faculty hires in the electronic materials and photovoltaics cluster, described earlier, are sharing a lab. Of particular note was the procurement and installation of a new liquid nitrogen delivery system ($120k) so that additional MBE systems could be installed into that laboratory and to achieve a higher level of integration between several groups to share the complex MBE systems (each runs approximately $1M). It is noteworthy that the $120k spent for this new delivery system is saving that lab approximately $40k/year, meaning that this investment will pay for itself in three years.

IMR Integrated Laboratory Management

An important activity that commenced in FY10 is IMR's development of a system for Integrated Laboratory Management. This is essential for addressing proper cost recovery issues and to unburden the IMR Members of Technical Staff from wasting time on separately developed billing and tracking systems. Furthermore, a standard approach for tracking enables much simpler and easily provided reports on usage, impact, multidisciplinary involvement, industry involvement and so on. By working initially with the IMR-supported ENCOMM Nanosystems Laboratory (ENSL) we have worked to create a comprehensive tracking database data-entry software suite that tracks all forms of major facility use, and allows for timely and accurate billing and invoicing. The software was developed by one of our MTS scientists – Dr. Denis Pelekhov, and once it was beta-tested at ENSL, Dr. Pelekhov worked with IMR staff (Ms. Emma Wallis) to adapt the software for other IMR-enhanced and operated labs, including the Semiconductor Epitaxy and Analysis Lab (SEAL) in Electrical Engineering. In FY10 the IMR initiated a contract with the Ohio Supercomputer Center to house a platform that could work with and between the various department level computer firewalls and security systems to enable sharing of data between IMR and the various labs housed in different departments and colleges. At the time of this writing both ENSL and SEAL have adopted the ILM program. The next year we plan to bring it to Nanotech West and CCBD. As a function of time, each IMR-supported facility cluster will house an IMR student employee to run the Integrated Laboratory Management program on behalf of each facility and IMR MTS, handle data entry, report generation and invoicing. This will be fully operational in FY11.

Communication, Outreach and Engagement

A new plasma-assisted molecular beam epitaxy (MBE) system for producing state-of-the-art III-Nitride heterostructures was installed with the Semiconductor Epitaxy and Analysis Laboratory (SEAL) with support from IMR.

New International Collaborations

In FY2010, IMR and the Universidad Politecnica de Madrid (UPM) entered into a formal MOU to establish research collaborations jointly between the two institutions. The primary motivation is to engage in personnel exchange between research labs leading to an effective international experience for students and postdocs, to establish faculty sabbatical-style visitations and to create opportunities for attracting third party support for research activities that can bring additional prestige to both universities in creating a higher degree of global impact. Tying the OSU materials community with the top technology university in Spain can also create special opportunities in several strategic areas, not

only electronics but also photovoltaics, an area of substantial focus for IMR. We note here for instance that the largest company in Europe (if not the world) in the field of concentrating solar cells, Isofoton, which spun out of UPM some years ago, announced in September 2010 the development of an Isofoton solar plant to be located around 50 miles east of Columbus, and to build the largest PV array in the U.S. east of the Mississippi river at the same location, near Zanesville, OH. Having this close connection may thus lead to unusual opportunities for IMR and OSU in the future and IMR will pursue this carefully. Hence, building on a linkage established between the IMR Director Steve Ringel and several faculty colleagues at UPM to jump-start this collaboration and make it real, the first "annex" of this MOU was agreed upon to establish a collaboration in the area of electronic materials, semiconductor physics and novel oxide materials for optical detector applications. In the past year, IMR was host to a female graduate student, Ms. Gema Taberas, from UPM for 3 months, who performed research on oxide materials. Her advisor, Prof. Adrian Hierro is planning a 2 week stay at IMR in January of 2011 to follow up and recently a proposal to the European Office of Naval Research was submitted by UPM and OSU researchers to find our first external support. This small start is anticipated to expand in the next year or 2 to several other groups at both universities.

Materials Week Conference

IMR successfully hosted the second annual **IMR Materials Week** from August 31 – September 3, 2009 at the Blackwell Inn and Conference Center. This conference showcases the extraordinary research ongoing in materials-allied fields at Ohio State and beyond, and also fosters community building internally. Due to the success of the inaugural event in 2008, the 2009 Materials Week was expanded to cover four full days of seminars, poster sessions, meetings, and receptions. In September 2010, Materials Week was be co-hosted by the Center for Emergent Materials, OSU's MRSEC program, and will be reported on in the next annual report.

Details on the 2009 IMR Materials Week and the preliminary agenda for 2010 OSU Materials Week can be found on the IMR website. Highlights of the 2009 IMR Materials Week included:

- Keynote Address by Randall M. Feenstra of Carnegie Mellon University titled "Surfaces and Interfaces of Compound Semiconductors"
- Seven 3-hour long scientific symposia, featuring ten Ohio State faculty and 19 researchers from other universities, government labs, and private industry. Topics covered in these technical sessions represented the depth and breadth of materials research. Symposia titles are listed below:
    - Moving the Silicon Roadmap and Visioning Beyond: Scaling, Integration and New Materials
    - Magnetoelectronics and Nanostructures
    - Advances in Energy Storage: New Materials, Challenges and Opportunities
    - Photovoltaic Materials and Technology: State of the Art and State of the Future in Solar Energy Conversion
    - Nitrides and Diamond: Wide Bandgap Materials for New Functionalities

- Materials By Design: Computational Materials
- Biosensors: Materials, Devices and Challenges

- Two student poster sessions demonstrating the research of 90 OSU undergraduate and graduate students, including 54 student posters at a general materials research poster session and 36 student posters at a second poster session open to fellows of the Center for Emergent Materials
- The first External Advisory Board meeting and NSF center review of the Center for Emergent Materials, the NSF Materials Science Research and Engineering Center at Ohio State
- The IMR External Advisory Board's inaugural meeting and external review
- An evening reception at COSI, with private viewing of special exhibit "Lost Egypt: Ancient Secrets, Modern Science"

A total of 248 individuals attended 2009 IMR Materials Week (which was surpassed at the 2010 Materials Week event with 330 attendees), including OSU students, faculty and staff and scientists from national laboratories, private industry, and other Ohio universities. The continued success of this high-profile conference is another way to bring Ohio State to the forefront of materials-allied research nationally. A very helpful side benefit of this type of professional scientific conference at OSU is to train staff and faculty to host significant conferences in materials at OSU, and we have informal information that such discussions are already occurring.

Nitin Padture, Director of the Center for Emergent Materials MRSEC Program, Gordon Gee, President of The Ohio State University, and Subra Suresh, MIT

Dr. Subra Suresh, Dean of Engineering and Vannevar Bush Professor of Massachusetts Institute of Technology, was the guest speaker for the final presentation of the 2009-2010 IMR Colloquia Series. Dr. Suresh's talk, ***Engineering the Future of Human Health,*** was well attended by approximately 250 OSU faculty, staff, and students. Soon after his visit, Dr. Suresh was named the next Director of the National Science Foundation.

IMR Colloquia Series

The materials community is fortunate to enjoy numerous seminar series run through the many academic departments that participate in materials research, in addition to seminar speakers visiting various centers such as CEM, CANPBD, PVIC and others. As a result, IMR chooses to run a very high level Colloquium Series in which 3 – 4 internationally prominent researchers and innovators are highlighted each year. The 2009-2010 IMR Colloquium Series brought three high-profile international experts in areas of strategic interest to the IMR community to Ohio State's campus this academic year:

2009-2010 IMR Colloquia Series

- *Engineering the Future of Human Health*, Subra Suresh, Dean of Engineering and Vannevar Bush Professor of Engineering, Massachusetts Institute of Technology, May 5, 2010 (note – Prof. Suresh is now the Director of the National Science Foundation)
- *Integrated Computational Materials Design*, Gregory B. Olson, Wilson-Cook Chaired Professor in Engineering Design, Materials Science and Engineering, Northwestern University and Chief Science Officer, QuesTek Innovations LLC, February 9, 2010
- *Toward Higher Performance Permanent Magnets for Automotive Applications*, Kazuhiro Hono, Managing Director, Magnetic Materials Center, National Institute for Materials Science (NIMS) and Professor, Graduate School of Pure and Applied Sciences, University of Tsukuba (Japan), October 29, 2009

IMR Quarterly Newsletter

Beginning Spring 2009, the Institute for Materials Research created and began to distribute a **quarterly newsletter** with technical articles highlighting materials-allied research, and newsworthy information relevant to materials at The Ohio State University, *IMR Quarterly*. IMR staff members collect information from various subject matter experts throughout campus for each newsletter, including activities within the many federal, state and industry supported materials research and innovation centers, updates on research funded by IMR grants, facility updates, recently awarded grants, and other materials research news. The publication highlights one or two IMR members per issue as well. Each quarterly newsletter is available online at IMR's website and is distributed by mail to approximately 2,000 readers on campus and at national labs, other universities, and industry partners.

Support for OSU Participation at Other Conferences

An important role for the IMR is to support participation in strategic conferences, especially those that, while making sense for our faculty, tend to be outside of the traditional support structure provided by research grants. This includes meetings with industrial orientations, as well as travel grants to access facilities in federal laboratories.

For the fourth year in a row, IMR has sponsored Ohio State students to attend the **Ohio Innovation Summit** (formerly the Ohio Nanotechnology Summit) held April 20-21, 2010. This year's sponsorship covered registration fees for 32 Ohio State students representing 13 departments and 4 colleges at the university. IMR's support allowed those students to attend the conference and its many talks and panel discussions, and we required that each sponsored student present a scientific poster at a Summit poster session. The 2010 Summit was run as a collaboration between The University Clean Energy Alliance of Ohio (UCEAO) and the Wright Center for Multifunctional Polymer Nanomaterials and Devices (CMPND), and the focus was Materials and Energy: The Building Blocks for Ohio's Economic Future. In addition, the IMR participated as a panelist (Steve Ringel) on the topic of Photovoltaics – Now and Future.

IMR also supported the **2009 North American Solid State Chemistry Conference** held June 17, 2009 at OSU, by covering OSU student attendance. This biennial national conference features undergraduate chemistry students' research projects from across the United States and is another excellent opportunity for OSU students to learn and network with leading experts in their fields. Speakers from Los Alamos National Laboratory, Oak Ridge National Laboratory, and numerous universities across the country presented abstracts and conducted workshops and tutorials related to solid state chemistry.

Membership in the Institute for Complex Adaptive Matter

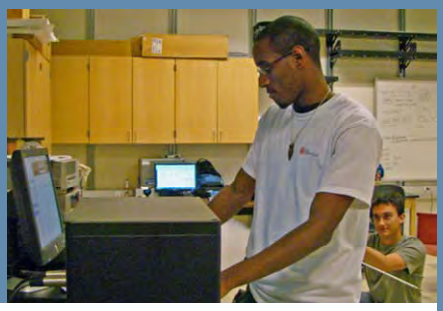
The IMR, ENCOMM and Center for Emergent Materials together cover the annual membership fees for The Ohio State University to **ICAM, the Institute for Complex Adaptive Matter.** ICAM is a distributed experiment-based multi-institutional partnership whose purpose is to identify major new research themes in complex adaptive matter—the search for an understanding of emergent behavior in hard, soft, and living matter. Its open and dynamic scientific programs include exploratory workshops, frontiers symposia, fellowships and travel awards. ICAM links 84 leading centers of complex materials research worldwide, including 31 in the US. Through its branches in the US, Europe, Asia, South America, the Middle East and Australia, it nucleates and conducts collaborative research and scientific training that links together scientists in different fields and different institutions, and draws from chemical, physical and biological viewpoints on its research themes. Its outreach and educational programs seek to convey to a broad cross-disciplinary audience an appreciation of the scientific excitement and challenges in carrying out the search for an understanding of emergent behavior in matter. As a result of OSU's membership, the university has benefited from ICAM membership to the tune of nearly $70,000 in academic year 2008-2009. ICAM contributed $30,000 to support a workshop on Recent Progress in Many Body Theories at OSU from July 27-31, 2009. ICAM financial support also provided educational and scientific collaboration opportunities, including a long term collaborator from Japan; a postdoctoral researcher shared with a group in Dresden, Germany; student travel expenses; and support for the annual Festival of Physics at Columbus' Center of Science and Industry (COSI).

Communication, Outreach and Engagement - Nanotech West Laboratory

Nanotech West Laboratory and its staff continue to support a wide range of outreach and educational efforts as well as tours for outside visitors. Nanotech West would host approximately 20-30 separate visits and tours per month. These include tours and demonstrations for freshman honors engineering students (ENG H193 class, typically 20 students per visit), tours for graduate students in nanotechnology classes, faculty candidates, research and government visitors, high school students and such. The fact that the CANPDB NSEC program is housed at Nanotech West and under the NSF guidelines the NSEC program conducts extensive outreach activities, these numbers may be even higher.

The Nanotech West cleanroom was the site of a filming of video for an Ohio News Network (ONN) TV show for its new "Ohio Means Business" series which began in April 2010. This particular segment, which was the inaugural one, focused on alternative energy as a new business for Ohio and included shots of new equipment bought with Third Frontier funds, plus conversations with IMR Director, Steve Ringel, and IMR Associate Director, Bob Davis.

With help from an independent marketing consultant and IMR staff, Nanotech West also created a new four-page brochure during Spring of 2010. The brochure, which targets new industry users, had its first printing run of 3,000 copies in May and is now being handed out by Nanotech West and IMR staff plus Industry Liaison Officers in the Office of Research and the College of Engineering.



REU student James Mathis.

Outreach and Engagement Activities: CEM and general IMR community

Extensive outreach programs are pervasive throughout the IMR community. Both NSF funded centers, CANPDB and CEM, are required to support a wide range of programs. IMR support to these centers extends to impact these essential components. Additionally, OSU has many programs for k-12 that are tapped by our community and in certain cases individual faculty members develop their own activities in this key realm to fill our nation's pipelines of scientists and engineers. This section contains several excerpts from CEM-provide information and more general information from our IMR faculty members. CANPDB activities were summarized earlier in the report.

Summer Research Experience for Undergraduates Program

The annual Summer REU Program run by the Center for Emergent Materials focuses on providing education and research training opportunities to students from outside OSU, with particular emphasis on students from underrepresented groups. The Summer 2009 program was advertised locally and was included in the list of REU sites on the NSF website, the NSF MRSEC website, "The Nucleus" website, the AAAS' Entrypoint website for students with disabilities, the Institute for Broadening Participation website, and through flyers sent to a list of undergraduate institutions, including many minority-serving institutions. A total of 36 applications were received, and 9 students ultimately completed the summer program.

The Summer 2009 REU cohort included 2 African-American men, 1 African-American woman, 1 student from a 2-year community college (Columbus State Community College), and 1 student from a predominantly undergraduate institution (Kenyon College). The program ran June-August 2009 and was presented in conjunction with the OSU Summer Research Opportunities Program (SROP), which brings to OSU a large number of students from underrepresented groups in a wide range of fields, e.g., English, art, biology. The SROP experience was intended to make our REU students members of a larger cohort as well as provide a variety of professional development and enrichment activities, including GRE preparation, workshops on oral presentation and writing skills, how to apply to grad school, how to write a resume, how to use library resources for literature searches, etc. In addition to the SROP activities, the CEM summer program offered a workshop on machine shop skills and weekly community-building lunches. The summer culminated with poster presentations to both the SROP group and to CEM faculty and students, and submission of a final report. The Summer 2010 REU cohort included 5 women and 3 members of under-represented racial/ethnic groups. Based on feedback

received from the Summer 2009 REU students and the CEM staff involved in arranging the related programming, it was decided not to collaborate with SROP in Summer 2010. As a university-wide program, SROP includes a large contingent of non-STEM students, and many of the SROP activities were not found to be particularly beneficial to the CEM REU students. Furthermore, the tight SROP schedule hindered our ability to offer our own programming focused on STEM-specific issues. Instead, in 2010 the CEM organized its own professional development programming, which increased flexibility and enabled a better experience for the CEM Summer REU students by focusing on topics relevant to the STEM field.

Academic Year Research Experience for Undergraduate Program

To encourage OSU students to become involved in research, CEM also offered an Academic Year REU Program. Nine students, including 2 women, 1 African-American male, and 1 person with a disability, were recruited in October 2009 for the academic year 2009-10. Six of the Academic Year REU Program students were selected to present their research at the 2010 Denman Undergraduate Research Forum, a university-wide poster competition showcasing outstanding undergraduate student research. All of the students also presented at a CEM REU poster session at the end of May.

Inclusion of Materials-Related Topics in the High School Science Curriculum

IMR members support efforts to make full high-quality courses in materials science broadly available in high schools. Of particular note is Prof. Glenn Daehn of the Department of Materials Science and Engineering, who in collaboration with the Battelle Foundation and the ASM Education Foundation, developed and hosts a local ASM Materials Camps for Teachers to introduce high school teachers to the science of materials. The basic form of the camp, offered by the Education Foundation at numerous sites around the country, provides teachers with an introductory exposure to materials-related topics, including hands-on exercises and other curricular materials. In 2008, OSU initiated an “alumni” camp to provide deeper exposure and more curriculum development support to teachers interested in offering Materials Science electives at their schools. In Summer 2009, 26 teachers primarily from central Ohio attended the basic camp at OSU, and 31 teachers from 8 states and Canada attended the alumni camp. Three of the alumni attendees had already offered a materials course at their schools; 6 more did so in the 2009-10 school year. The MSE department hosted both the basic and alumni camps again in Summer 2010. The attendees at all ASM Materials Camps nationwide were able to participate in an asynchronous distance learning opportunity to earn 3 credit hours of OSU graduate credit in MSE by successfully completing OSU-produced course work, “Special Topics in Materials Science”, including an exam on the course content, and demonstrating and documenting the use of the course material in their teaching. Pre-recorded course videos are available to the registered teachers through OSU’s online course management system.

To expose K-12 students and the public to the excitement and relevance of the science of materials and improve their awareness of careers in these areas, the CEM has formed strategic partnerships with outreach programs within and outside OSU to infuse materials-related topics into existing activities and provide resources to allow the programs to expand their reach. Through these collaborations, both IMR and CEM personnel and resources are leveraged to provide more impact than each partner could provide on its own, reaching 4901 K-12 students including 2499 girls, 2218 students from underrepresented

racial/ethnic minorities and 476 students with disabilities, and well as at least 133 members of the public.

COSI/OSU Partnership

The CEM is collaborating with COSI (Center of Science and Industry), a world-renowned science museum, to produce innovative informal education outreach programs that showcase materials science. Joint efforts include:

- IMR and CEM faculty (Trivedi, Randeria, Pelz, Zhao) and students presented materials-related hands-on activities to over 4400 museum visitors before the awarding of the Feenberg Prize on 7/29/2009 as part of the International Conference on Recent Progress in Many-Body Theories at OSU.
- IMR and CEM Faculty (Gupta**)** presented "Imaging Single Atoms and Molecules with the Scanning Tunneling Microscope" on 5/7/09 and 2/26/10 to a total of 165 students in LA, OH, and Alberta as part of COSI's *Electronic Experts* program, which provides interactive videoconferencing between researchers and K-12 classrooms.

Prof. Flores working with third graders from the Columbus School for Girls.

College Access

To help increase the number of students from underrepresented groups who enter STEM fields, CEM contributes to the university's Economic Access Initiative, which helps families of first-generation college students prepare academically and financially for higher education. Joint efforts include:

- CEM staff and students described materials-related undergraduate majors and present hands-on activities to the 5th graders and their families (40 participants) for the *Blueprint:College* event at OSU on 5/15/2010.

Columbus City Schools

The Columbus City School district is the second largest in the state, serving over 55,000 students, with the majority from underrepresented racial/ethnic minorities and 78% receiving free-or reduced-price lunch. In collaboration with the university's P-12 Project, the CEM has contributed to programs that bring district students to campus to explore academic majors and encourage pursuit of higher education. Joint efforts include:

- CEM and IMR faculty members (Jay Gupta, Nitin Padture) and students presented materials-related hands-on activities to visiting 8th grade students, teachers, and parents (28 participants) on 11/3/2009 at the *Breakfast of Science Champions*, which introduces students to STEM majors and careers.
- Each May, CEM and COSI collaborate on a featured materials science demonstration for over 3,000 6th graders at *Baseball Day* (http://www.osu.edu/news/newsitem2417), which shows students the opportunities for and advantages of higher education and the importance of staying in school.

  NBC Learn : As part of a collaborative project between NBC Learn and NSF, CEM/IMR faculty (Kathy Flores) discussed the materials science of sports equipment in a series of educational videos on the *Science of the Olympic Winter Games*. The videos were shown on broadcast and cable television around the country during the 2010 Winter Olympics. The videos and related curricular materials continue to be available on-line.

Financial Report: Fiscal Year 2010 Budget and Expenses

IMR's annual internal operating budget this past fiscal year was approximately $1.3 million. In Fiscal Year 2010, IMR received $798,000 for operating expenses from three university sources in equal shares: the Office of Research, the College of Engineering, and the Division of Natural and Mathematical Sciences. In addition, IMR received $418,400 from the Targeted Investment In Excellence (TIE) program, as described earlier in this report, to make the $1.3M total. The use of these funds is detailed in **Table 4**. The expenses listed total $1.7 million, which is more than our annual budget, because it accounts for carryover expenses that were initiated or committed during FY 2009 but were expended in FY 2010.

As seen in **Figure 8**, nearly 70% of Fiscal Year 2010 expenses went directly to research-related expenses, with 24% of the annual budget covering personnel costs for technical staff in research facilities and 45% of this year's funds were distributed directly to researchers through various cost share and internal grant programs, as detailed in Table 4.

Table 4. Fiscal Year 2010 Distribution of Internal Resources (OSU General Funds and TIE Funds).

Category	Total Expenses FY 2010		Notes
			Personnel
Administrative Personnel: Salary and Fringe	$	367,687	Includes salary and fringe for staff and student employees, plus Quarter Off Duty payments for Associate Directors
Technical Personnel: Salary and Fringe	$	417,520	includes salary and fringe for Members of Technical Staff and student support
Total Personnel	**$**	**785,208**	
			Research Program Support
Research Enchancement Programs (Seed Grants)	$	435,500	Includes IMRG, Facility and Industry Challenge Grants
IMR Cash Cost and Proto-IRG support to the MRSEC	$	139,144	IMR YR 2 Cash Cost Share and YR 1 Proto-IRG to CEM
IMR Support of Dr. Johnston-Halperin's MRI	$	56,000	IMR cost support to Ezekiel Johnston-Halperin's MRI
Funds for New Faculty Hires	$	90,000	Rajan and Myers
Funds for NSEC Program Support	$	64,000	IMR Yr.4 Funding to CANPBD
Total Research Program Support	**$**	**784,644**	
			Outreach, Education & Sponsorships
General Marketing Materials	$	13,717	Includes design and printing of IMR Quarterly Newsletters, Photovoltaic Flyer, and IMR Banner and promotional items
Outreach, Education & Sponsorships	$	24,954	Includes suppport of Ohio Innovation Summit and support for OSU students to attend the International Society of Electrochemistry (ISE) Spring Meeting; ICAM Membership cost share (FY2009-2010 & FY2007)
IMR Colloquia	$	7,950	Hono, Olson, and Suresh Colloquium
IMRG Spring Symposia	$	1,152	Printing and catering expenses associated with the IMRG Spring Sympoisa
IMR 2009 Materials Week	$	84,763	2009 IMR Materials Week (all expenses inlcuding venue, catering, printing, promotional items, travel and honoria)
Business Meals and Entertainment	$	1,080	Includes Staff Appreciation Luncheon; IMR Holiday Party; Danilov Welcome Lunch and lunch with ORSP candidates
Total Outreach, Education & Sponsorships	**$**	**133,615**	
			Other Expenses
Office Supplies and Computer Equipment	$	32,955	Includes monthly phone, copier lease, vehicle service and fuel charges, software, computers, mail, etc. for IMR main offices and NTW. Also includes Scott Lab space cost for FY7-FY10; E339 Scott Lab Upgrade and New Computers for IMR Front Office
Total Other Expenses	**$**	**32,955**	
Total Expenses	**$**	**1,736,422**	

** Above listed expenses do not include personnel, operating, and capital expenses paid by external research funding such a the Wright Center for Photovoltaics Innovation and Commercialization*

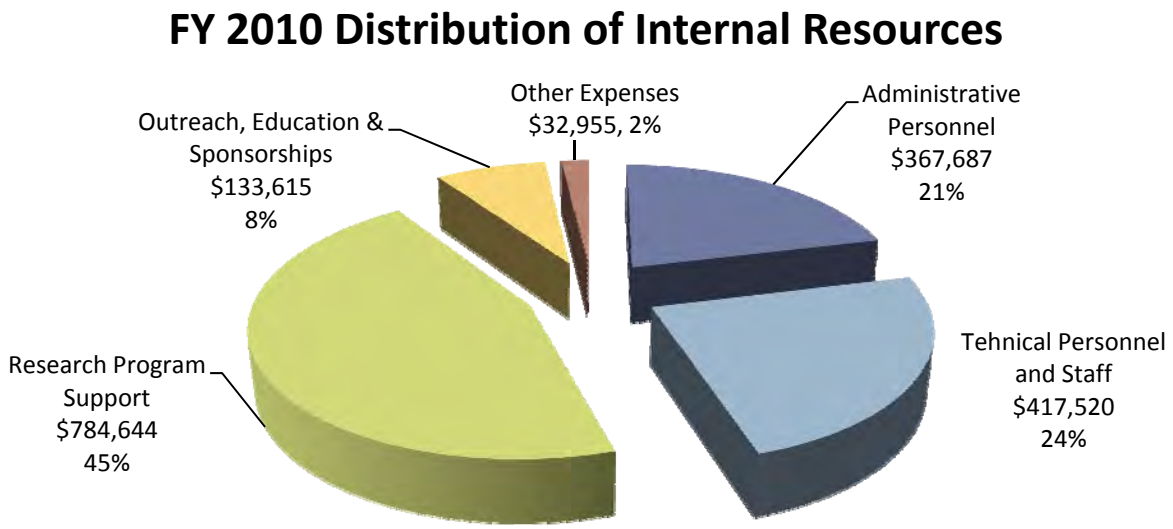


Figure 8. Distribution of internal resources by IMR during Fiscal Year 2010, by major category.

Since IMR's establishment in 2006, it has received $4.6 million in internal operational support over four fiscal years, which has translated into nearly $67 million to date in external research funding directly obtained through IMR resources and activities (see **Table 5**). Therefore, IMR was able to help obtain $14.33 in external research funding for every dollar it received in internal operating costs, an impressive return on investment by any measure.

External Research Funding Obtained Through IMR Resources and Activities FY 2007-2010*				
IMR-Led Proposal Development				
Wright Center for Photovoltaics Innovation and Commercialization (PVIC)	$	18,620,000		
Ohio Research Scholars Program: Technology Enabling and Emergent Materials (ODOD ORSP)	$	18,153,846		
Center for Emergent Materials (NSF MRSEC)	$	10,800,000		
NSF MRI	$	421,323		
Subtotal			*$*	*47,995,169*
Funding Obtained by IMR-Supported New Faculty Hires				
Sudarsanam Suresh Babu	$	853,650		
Ji-Cheng (J-C) Zhao	$	2,359,441		
David W. Wood	$	283,938		
Siddharth Rajan	$	2,979,287		
Roberto C. Myers	$	157,000		
Subtotal			*$*	*6,633,316*
External Funding Obtained by IMR Technical Staff				
John Carlin	$	150,000		
Robert J. Davis	$	2,258,000		
Subtotal			*$*	*2,408,000*
Other Research Awards Directly Resulting from Seed Grant Programs				
Awards Seeded by IMR Research Enhancement Program	$	4,758,389		
Awards Seeded by Other IMR Internal Support Programs (e.g. TIE)	$	5,148,070		
Subtotal			$	9,906,459
Total External Research Funding Obtained Through IMR Resources and Activities			**$**	**66,942,944**
Other External Research Funding Awarded to IMR Members				
Research Funding Awarded to OSU Materials Community			**$**	**131,621,623**

*See Appendix for details of all awards reported in this portion of table

Table 5. External research funding obtained directly through IMR resources and activities, and other external research funding awarded to IMR members, Fiscal Years 2007-2010.

Appendices

Appendix A: Members of the Institute for Materials Research (IMR) as of July 2010

Appendix B: Research Outputs from OSU Materials Community Directly Resulting from IMR Resources and Activities for Fiscal Year 2009-2010

- Peer-Reviewed Publications
- Professional Presentations
- Honors and Awards (includes student notable accomplishments)
- External Research Funding

Appendix C: Activities of Members of Technical Staff (MTS) for Fiscal Year 2009-2010

- Dr. John Carlin, Research Scientist, Nanotech West Laboratory
- Dr. Evgeny Danilov, Senior Research Associate, Center for Chemical and Biophysical Dynamics
- Dr. Robert J. Davis, Director, Nanotech West Laboratory and Associate Director, Institute for Materials Research
- Dr. Denis V. Pelekhov, Research Scientist, ENCOMM NanoSystems Laboratory
- Aimee Bross Price, Senior Research Associate, Nanotech West Laboratory

Appendix A

Members of the Institute for Materials Research (IMR) as of July 2010

Members of the Institute for Materials Research (IMR) as of July 2010

Gunjan Agarwal, Biomedical Engineering

Sudha Agarwal, Oral Biology

Kristy Ainslie, Pharmacy

Sheikh Akbar, Materials Science and Engineering

Boian Alexandrov, Materials Science and Engineering

Betty Lise Anderson, Electrical and Computer Engineering

Peter Anderson, Materials Science and Engineering

Sudarsanam Suresh Babu, Materials Science and Engineering

Yakup Bayram, Electroscience Lab

Thomas Bean, Food, Agricultural and Biological Engineering

Jim Beatty, Physics

Stephen Bechtel, Mechanical and Aerospace Engineering

Paul Berger, Electrical and Computer Engineering

Bharat Bhushan, Mechanical and Aerospace Engineering

Thomas Blue, Mechanical and Aerospace Engineering

Dennis Bong, Chemistry

Leonard Brillson, Electrical and Computer Engineering

Rudy Buchheit, Materials Science and Engineering

Ralf Bundschuh, Physics

Lei Cao, Mechanical and Aerospace Engineering

John Carlin, Institute for Materials Research

Malcolm Chisholm, Chemistry

William Clark, Materials Science and Engineering

James Coe, Chemistry

Edward Collings, Materials Science and Engineering

Terry Conlisk, Mechanical and Aerospace Engineering

Stuart Cooper, Chemical and Biomolecular Engineering

Katrina Cornish, Horticulture and Crop Science

Glen Daehn, Materials Science and Engineering

Marcelo Dapino, Mechanical and Aerospace Engineering

Robert Davis, Institute for Materials Research

Suliman Dregia, Materials Science and Engineering

Charles Drummond, Materials Science and Engineering

Prabir Dutta, Chemistry

Arthur Epstein, Physics

Edward Eteshola, Biomedical Engineering

Liang-Shih Fan, Chemical and Biomolecular Engineering

Katharine Flores, Materials Science and Engineering

Gerald Frankel, Materials Science and Engineering

Hamish Fraser, Materials Science and Engineering

Richard Freeman, Physics

Somnath Ghosh, Mechanical and Aerospace Engineering

Keith Gooch, Biomedical Engineering

Jianjun Guan, Materials Science and Engineering

Yann Guezennec, Mechanical and Aerospace Engineering

Jay Gupta, Physics

Prabhat Gupta, Materials Science and Engineering

Terry Gustafson, Chemistry

Nathan Hall, Radiology

P. Chris Hammel, Physics

Derek Hansford, Biomedical Engineering

Richard Hart, Biomedical Engineering

Joseph Heremans, Mechanical and Aerospace Engineering

Anton Heyns, Chemistry

Julia Higle, Integrated Systems Engineering

George Hinkle, Pharmacy Practice and Radiology

W.S. Winston Ho, Chemical and Biomolecular Engineering

Ezekiel Johnston-Halperin, Physics

Matt Kleinhenz, Horticulture and Crop Science

Kurt Koelling, Chemical and Biomolecular Engineering

Ashok Krishnamurthy, Electrical and Computer Engineering

Gregory Lafyatis, Physics

John Lannutti, Materials Science and Engineering

Robert Lee, Electrical and Computer Engineering

L. James Lee, Chemical and Biomolecular Engineering

Stephen Lee, Biomedical Engineering

Robert J. Lee, Pharmacy

Thomas Lemberger, Physics

Yebo Li, Food, Agricultural and Biological Engineering

John Lippold, Materials Science and Engineering

Wu Lu, Electrical and Computer Engineering

Edward Martin Jr., Surgery Oncology

Jeffery McNeal, Mathematics

Carolyn Merry, Civil, Environmental Eng and Geodetic Science

Julia Meyer, Physics

Fred Michel Jr., Food, Agricultural and Biological Engineering

Sharell Mikesell, NSEC-Polymer Biomedical

Terry Miller, Chemistry

Michael Mills, Materials Science and Engineering

Nicanor Moldovan, Opthamology/ Heart and Lung Institute

John Morral, Materials Science and Engineering

Patricia Morris, Materials Science and Engineering

Randy Moses, Electrical and Computer Engineering

Stephen Myers, Ohio BioProducts

Roberto Myers, Materials Science and Engineering

Susan Olesik, Chemistry

Michael Ostrowski, Molecular and Cellular Biochemistry

Umit Ozkan, Chemical and Biomolecular Engineering

Nitin Padture, Materials Science and Engineering

Wendy Panero, School of Earth Sciences

Jon Parquette, Chemistry

Srinivasan Parthasarathy, Computer Science and Engineering

Michael Paulaitis, Chemical and Biomolecular Engineering

Denis Pelekhov, Institute for Materials Research

Jonathan Pelz, Physics

Matthew Platz, Chemistry

Michael Poirier, Physics

Stephen Povoski, Surgery Oncology

Heather Powell, Materials Science and Engineering

Shaurya Prakash, Mechanical and Aerospace Engineering

Siddarth Rajan, Electrical and Computer Engineering

Mohit Randeria, Physics

Bill Ravlin, Ohio Agricultural Research and Development Center

Ronald Reano, Electrical and Computer Engineering

David Rigney, Materials Science and Engineering

Matthew Ringel, Molecular Virology, Immunology & Medical Genetics

Steven Ringel, Electrical and Computer Engineering

Giorgio Rizzoni, Mechanical and Aerospace Engineering

Patrick Roblin, Electrical and Computer Engineering

Thomas Rosol, Surgery Oncology

Gang Ruan, Chemical and Biomolecular Engineering

Yogeshwar Sahai, Materials Science and Engineering

Sadhana Sharma, Pharmacy

Sherwin Singer, Chemistry

Ratnasingham Sooryakumar, Physics

Krishnaswamy Srinivasan, Mechanical and Aerospace Engineering

Doru Stefanescu, Materials Science and Engineering

David Stroud, Physics

Vishwanath Subramaniam, Mechanical and Aerospace Engineering

Michael Sumption, Materials Science and Engineering

Nandini Trivedi, Physics

Claudia Turro, Chemistry

George Valco, Electrical and Computer Engineering

Hendrik Verweij, Materials Science and Engineering

Yael Vodovotz, Food Science and Technology

John Volakis, Electrical and Computer Engineering

Robert Wagoner, Materials Science and Engineering

Eric Walton, Electroscience Lab

Yunzhi Wang, Materials Science and Engineering

Gregory Washington, Mechanical and Aerospace Engineering

Janet Weisenberger, Research Administration

John Wilkins, Physics

James Williams, Materials Science and Engineering

Wolfgang Windl, Materials Science and Engineering

Jessica Winter, Chemical and Biomolecular Engineering

David Wood, Chemical and Biomolecular Engineering

Patrick Woodward, Chemistry

Yiying Wu, Chemistry

Ronald Xu, Biomedical Engineering

Fengyuan Yang, Physics

Sheng-Tao Yu, Mechanical and Aerospace Engineering

Ji-Cheng Zhao, Materials Science and Engineering

Yi Zhao, Biomedical Engineering

Yuan Zheng, Electrical and Computer Engineering

Appendix B

Activities Directly Resulting from IMR Resources and Activities for Fiscal Year 2009-2010

Research Outputs from OSU Materials Community Directly Resulting from IMR Resources and Activities

- Peer-Reviewed Publications
- Professional Presentations
- Honors and Awards (includes student notable accomplishments)
- External Research Funding

Appendix B: Publications Directly Resulting from IMR Resources and Activities for Fiscal Year 2009-2010

Note: This list relies on self reporting and is likely to be underestimated; an asterisk (*) indicates those items obtained through leveraging more than one IMR-supported activity

Sheikh Akbar

B. Dinan and S.A. Akbar, "One Dimensional Oxide Nanostructures by Gas-phase Reaction," Functional Nanomaterials Letters, 2[3], 87-94 (2009)

Gunjan Agarwal

L.A. Flynn, A.R. Blissett, E.P. Calomeni, G. Agarwal, "Inhibition of Collagen Fibrillogenesis by Cells Expressing Soluble Extracellular Domains of DDR1 and DDR2", Journal of Molecular Biology, Vol. 395, p. 533-543 (2010)

Heather Allen

D. Liang, H.C. Allen, G.S. Frankel, Z.Y. Chen, R.G. Kelly, Y. Wu, B.E. Wyslouzil, "Effects of Sodium Chloride Particles, Ozone, UV, and Relative Humidity on Atmospheric Corrosion of Silver", Journal of the Electrochemical Society, Vol. 157, p. C146-C156 (2010)

Suresh Babu

D. Schick, R. Hahnlen, R. Dehoff, S.S. Babu, M. Dapino, J.C. Lippold, "Microstructural characterization of bonding interfaces in aluminum 3003 blocks fabricated by Ultrasonic Additive Manufacturing," accepted for publication in Welding Journal (2010)

D. Schick, S.S. Babu, D. Foster, M. Short, M. Dapino, J.C. Lippold, "Transient Thermal Response in Ultrasonic Additive Manufacturing of Aluminum 3003," accepted for publication in Rapid Prototyping (2010)

M.R. Sriraman, S.S. Babu, M. Short, "Bonding Characteristics during Very High Power Ultrasonic Additive Manufacturing of Copper," Scripta Materialia, Vol. 62, pp. 560-563 (2010)

Y. Zhang, S.S. Babu, C. Prothe, M. Blackely, J. Kwasegroch, M. Laha, G. Daehn, Application of High Velocity Impact Welding at Varied Different Length Scales, J. Mater. Process. Tech. doi:10.1016/j.jmatprotec.2010.01.001 (2010)

S.C. Nagpure, R. Dinwiddie, S.S. Babu, G. Rizzoni, B. Bhushan, T. Frech, "Thermal Diffusivity Study of Aged Li-Ion Batteries Using Flash Method," J. Power Sources 195, 872–876, (2010)

R. Dehoff, and S.S. Babu, “Characterization of Interfacial Microstructures in 3003 aluminum alloys blocks fabricated by ultrasonic additive manufacturing,” accepted for publication in Acta Materialia, (2009)

S.C. Nagpure, B. Bhushan, S. Babu, G. Rizzoni, “Scanning Spreading Resistance Characterization of Aged Li-ion Batteries using Atomic Force Microscopy,” Scripta Materialia 60, 933–936, (2009)

S.S. Babu, “Thermodynamic and Kinetics Models for Describing Microstructure Evolution during Joining of Advanced Materials,” International Materials Reviews, Vol. 54, pp. 333-367 (2009)

T. Lolla, G. Cola, B. Narayanan, B. Alexandrov, S.S. Babu, “Development of Rapid Heating and Cooling (Flash Processing) process to produce Advanced High Strength Steel Microstructures,” Materials Science and Technology, available online, DOI 10.1179/174328409X433813 (2009)

S.C. Nagpure, S.S. Babu, M. Mills, L. Kovarik, B. Bhushan, G. Rizzoni, “STEM and EELS Analysis of LiFePO4 cathode during aging of cells” [Pending]

S.C. Nagpure, S.S. Babu, R. Cao, R. Downing, B. Bhushan, G. Rizzoni, “Neutron Depth Profiling for Analysis of Li in LiFePO4 Cathode during Aging of Cells” [Pending]

Stephen Bechtel

S.Piratla, S.E. Bechtel, M. Dapino, "Thermodynamic Potentials for Fully-Coupled Characterization of Thermo-Electro-Magneto-Mechanical Materials,” Acta Materials [Pending]

S. Piratla, S.E. Bechtel, M.J. Dapino, “Application of thermodynamics for optimal design of Galfenol devices," International Journal of Structural Changes in Solids -Mechanics and Applications [Pending]

P. Evans, M.J. Dapino, “Effect of Stress and Anisotropy on the Magnetic Susceptibility of Single-Crystal Galfenol," Journal of Physics D: Applied Physics [Pending]

M. Mahboob, C. Kagarise, K. Koelling, S.E. Bechtel, “Quantitative 3D Measurement of the Nanostructural Features that Dictate Mesoscale Performance Properties of Nanocomposites,” Composites Science and Technology, Polymer Composites (2009)

Paul Berger

W. J. Yoon, K. Y. Jung, J. Liu, T. Duraisamy, R. Revur, F. L. Teixeira, S. Sengupta, P. R. Berger, “Plasmon-enhanced optical absorption and photocurrent in organic bulk heterojunction photovoltaic devices using self-assembled layer of silver nanoparticles”, Solar Energy Materials & Solar Cells, 94, pp. 128-132 (2010).

S.Y. Park, R. Anisha, P.R. Berger, R.Loo, N.D. Nguyen, S. Takeuchi, M. Caymax, “Si/SiGe Resonant Interband Tunneling Diodes Incorporating delta-Doping Layers Grown by Chemical Vapor Deposition”, IEEE Electron Device Letters, vol. 30, Issue 11, p.1173-1175, (2009)

R.H. Yu, R. Anisha, N. Jin, S.Y. Chung, P.R.Berger, T.J. Gramila, P.E. Thompson, “Observation of strain in pseudomorphic Si1-xGex by tracking phonon participation in Si/SiGe resonant interband tunnel diodes via electron tunneling spectroscopy”, Journal of Applied Physics, vol. 106, Issue 3, (2009)

P. E. Thompson, G. G. Jernigan, S. Y. Park, R. Yu, R. Anisha, P.R. Berger, D. Pawlik, R. Krom, S. L. Rommel, “P and B doped Si resonant interband tunnel diodes with as-grown negative differential resistance”, Electronics Letters, vol.45, Issue 14, p.759-760, (2009)

Bharat Bhushan

M. Palacio and B. Bhushan, “Molecularly thick dicationic ionic liquid films for nanolubrication,” Journal of Vacuum Science and Technology A 27, 986-995, (2009)

M. Palacio and B. Bhushan, “Nanotribological properties of novel lubricants for magnetic tapes,” Ultramicroscopy 109, 980-990, (2009)

M. Palacio and B. Bhushan, “A review of ionic liquids for green molecular lubrication in nanotechnology,” Tribology Letters [Pending]

Dennis Bong

M. Ma, Y. Gong, D. Bong, “Lipid Membrane Adhesion and Fusion Driven by Designed, Minimally Multivalent Hydrogen-Bonding Lipids”, Journal of the American Chemical Society, 131, 16919-16926, (2009)

M. Ma, S. Chatterjee, M. Zhang, D. Bong, "Stabilization of vesicular and supported membranes by oxime linked trehalose lipids." [Pending]

Leonard Brillson

Y.F. Dong, F. Tuomisto, B.G. Svensson, A.Y. Kuznetsov, L.J. Brillson, "Vacancy defect and defect cluster energetics in ion-implanted ZnO", Physical Review, Vol. 81 (2010)

J. Zhang, M. Rutkowski, L.W. Martin, T. Conry, R. Ramesh, J.F. Ihlefeld, A. Melville, D.G. Schlom, L.J. Brillson, "Surface, Bulk and Interface Electronic States of Epitaxial BiFeO3", Journal of Vacuum Science and Technology, B, Vol. 27, p. 2012-2014 (2009)*

C.H. Lin, T.A. Merz, D.R. Doutt, M.J. Hetzer, J. Joh, J.A. del Alamo, U.K. Mishra, L.J. Brillson, "Nanoscale mapping of temperature and defect evolution inside operating AlGaN/GaN high electron mobility transistors", Applied Physics Letters, Vol. 95 (2009)

J. Zhang, J. Chakhalian, M. Kareev, J. Liu, S. Prosandeev, and L.J. Brillson, “Depth-Resolved Subsurface Defects in Chemically Etched SrTiO3,” Applied Physics Letters, 94, 092904 (2009).

L.J. Brillson, Y. Dong, D. Doutt, D.C. Look, Z.Q. Fang, "Massive Point Defect Redistribution Near Semiconductor Surfaces and Interfaces and Its Impact on Schottky Barrier Formation", Physica-Condensed Matter, 25th International Conference on Defects in Semiconductors, St Petersburg, RUSSIA, Vol. 404, p. 4768-4773 (2009)

Aimee Bross

A. L. Bross, G. Lafyatis, R. Ayachitula, A. Morss, R. Hardman, J. Golden, “Robust, efficient grating couplers for planar optical waveguides using no-photoacid generator SU-8 electron beam lithography”, Journal of Vacuum Science and Technology B. vol. 27 (6), p. 2602-2605 (2009)

Malcolm Chisholm

W. J. Yoon, K. Y. Jung, J. Liu, T. Duraisamy, R. Revur, F. L. Teixeira, S. Sengupta, P. R. Berger, “Plasmon-enhanced optical absorption and photocurrent in organic bulk heterojunction photovoltaic devices using self-assembled layer of silver nanoparticles.” Solar Energy Materials & Solar Cells, 94, pp. 128-132 (2010)

M. Chisholm, N. Hudson, N. Kirtley, C. Spivey, R. Rehfeld, M. Zawaideh, “Application of the "Strathclyde Route" to Branched Vinyl Polymers in Suspension Polymerization: Architectural, Thermal, and Rheological Characterization of the Derived Branched Products”, Macromolecules, vol. 42, Issue 20, p.7745-7752, (2009)

M. Chisholm, J.P.L. Dwan'isa , S. Thakur, G. Fenton,T. Caipen,G. Daehn,T. Vogler,D. Grady, “A Practical Method to Determine Polymer Concentration in Solution by Density”, International Journal of Polymer Analysis and Characterization, Vol. 14, Issue 2, p. 126-139, (2009)

B. G. Alberding, M. H. Chisholm, Y. Ghosh, T. L. Gustafson, Y. Liu, C. Turro, “Sexithiophenes Mediated by MM Quadruple Bonds: MM = Mo2, MoW and W2.” Inorganic Chemistry, 48(17), 8536-8543 (2009)

W. J. Yoon, P. Berger. "Surface Modifications To The Indium Tin Oxide (ITO) Anodes Through Plasma Oxidized Silver For Efficient P3HT:PCBM (1 :0.8) Bulk Heterojunction Photovoltaic Devices" IEEE Xplore [Pending]

W. J. Yoon, Paul R. Berger, “Atomic layer deposited HfO2 gate dielectrics for low-voltage operating, high-performance poly-(3-hexythiophene) organic thin-film transistors.” Organic Electronics [Pending]

Marcelo Dapino

C.D. Hopkins, D. Foster, M.J. Dapino, “Metal-Matrix Composites with Smart Switches Embedded by Ultrasonic Consolidation,” Proceedings of the ASME Conference on Smart Materials, Adaptive Structures, and Intelligent Systems, (2010)

D. Schick, R. Hahnlen, R. Dehoff, S. S. Babu, M. Dapino, J. C. Lippold, “Microstructural characterization of bonding interfaces in aluminum 3003 blocks fabricated by Ultrasonic Additive Manufacturing,” Welding Journal (2010)

C.D. Hopkins, M.J. Dapino, S.A. Fernandez, “Statistical characterization of Ti/Al composites made by Ultrasonic Additive Manufacturing," ASME Journal of Engineering Materials and Technology [Pending]

D.E. Schick, S.S. Babu, D. Foster, M. Short, M.J. Dapino, J.C. Lippold, “Transient thermal response in ultrasonic additive manufacturing of aluminum 3003,” Rapid Prototyping Journal [Pending]

Prabir K. Dutta

X.G. Li, P.K. Dutta, “Interaction of Dimethylmethylphosphonate with Zeolite Y: Impedance-Based Sensor for Detecting Nerve Agent Simulants”, Journal of Physical Chemistry C, vol. 114, Issue 17, p. 7986-7994, (2010)

J.C., Yang, P.K. Dutta**,** “High temperature potentiometric NO2 sensor with asymmetric sensing and reference Pt electrodes”, Sensors and Actuators B-Chemical, vol. 143, Issue 2, p. 459-463, (2010)

W.C. Schumacher, A.J. Phipps, P.K. Dutta, “Detection of Bacillus anthracis spores: comparison of quantum dot and organic dye labeling agents”, Advanced Powder Technology, vol. 20, Issue 5, p. 438-446, (2009)

I.H. Lee IH, S.A. Akbar, P.K. Dutta, “High temperature potentiometric carbon dioxide sensor with minimal interference to humidity”, Sensors and Actuators B-Chemical, vol. 142, Issue 1, p. 337-341, (2009)

X.G. Li , R. Ramasamy, P.K. Dutta, “ Study of the resistance behavior of anatase and rutile thick films towards carbon monoxide and oxygen at high temperatures and possibilities for sensing applications”, Sensors and Actuators B-Chemical, vol. 143, Issue 1, p. 308-315, (2009)

S. Vyas, K.K. Onchoke, C.S. Rajesh, W.Schumacher, A. Nagy, W.J. Waldman, P.K. Dutta , “Optical Spectroscopic Studies of Mononitrated Benzo[a]pyrenes”, Journal of Physical Chemistry A, vol. 113, Issue 45, p. 12558-12565, (2009)

Arthur Epstein

L.R. Nemzer, A. Schwartz, A.J. Epstein, "Enzyme Entrapment in Reprecipitated Polyaniline Nano- and Microparticles", Macromolecules, Vol. 43, p. 4324-4330 (2010)

J.W. Yoo, H.W. Jang, V.N. Prigodin, C. Kao, C.B. Eom, A.J. Epstein, "Tunneling vs. giant magnetoresistance in organic spin valve", Synthetic Metals, Vol. 160, p. 216-222 (2010)

M.B. Murphey, J.D. Bergeson, S.J. Etzkorn, L. Qu, L. Li, L. Dai, A.J. Epstein, "Spin-valve behavior in porous alumina-embedded carbon nanotube array with cobalt nanoparticle spin injectors", Synthetic Metals, Vol. 160, p. 235-237 (2010)

V.N. Prigodin, A.J. Epstein, "Spin dynamics control of recombination current in organic semiconductors", Synthetic Metals, Vol. 160, p. 244-250 (2010)

K.D. Bozdag, N.R. Chiou, V.N. Prigodin, A.J. Epstein, "Magnetic Field, Temperature and Electric Field Dependence of Magneto-Transport for Polyaniline Nanofiber Networks", Synthetic Metals, Vol. 160, p. 271-274 (2010)*

J.L. Martin, J.D. Bergeson, V.N. Prigodin, A.J. Epstein, "Magnetoresistance for organic semiconductors: Small molecule, oligomer, conjugated polymer, and non-conjugated polymer", Synthetic Metals, Vol. 160, p. 291-296 (2010)

B. Li, J.-W. Yoo, C.Y. Kao, H.W. Jang, C.-B. Eom, A.J. Epstein, “Electrical Bistability and Spin Valve effect in a Ferromagnet/organic semiconductor/ferromagnet heterojunction,” Organic Electronics 11, 1149 (2010)

N.P. Raju, V.N. Prigodin, K.I. Pokhodnya, J.S. Miller, A.J. Epstein, "High field linear magnetoresistance in fully spin-polarized high-temperature organic-based ferrimagnetic semiconductor V(TCNE)(x) films, x similar to 2", Synthetic Metals, Vol. 160, p. 307-310 (2010)

O.O. Adetunji, N.R. Chiou, A.J. Epstein, "Effect of pressure on the morphology of polyaniline nanostructures", Synthetic Metals, Vol. 159, p. 2263-2265 (2009)

J.W. Yoo, H.W. Jang, V.N. Prigodin, C. Kao, C.B. Eom, A.J. Epstein, "Giant magnetoresistance in ferromagnet/organic semiconductor/ferromagnet heterojunctions", Physical Review, Vol. 80 (2009)

W.W. Shum, A.J. Epstein, J.S. Miller, "Spin-polarized electronic structure for the layered two-dimensional [Fe-II(TCNE)(NCMe)(2)][(FeCl4)-Cl-III] organic-based magnet", Physical Review, Vol. 80 (AUG 2009)

O.O. Adetunji, N.R. Chiou, A.J. Epstein, "Interface-driven conductance transition in nanostructured polymer networks", Physical Review, Vol. 80 (2009)

H.Y. He, Y. Yuan, W.X. Wang, N.R. Chiou, A.J. Epstein, L.J. Lee, "Design and testing of a microfluidic biochip for cytokine enzyme-linked immunosorbent assay", Biomicrofluidics , Conference on Advances in Microfluidics and Nanofluidics Hong Kong University of Science & Technology, Vol. 3 (2009)

Gerald Frankel

Z.Y. Chen, D. Liang, G. Ma, G.S. Frankel, H.C. Allen, R.G. Kelly, "Influence of UV irradiation and ozone on atmospheric corrosion of bare silver", Corrosion Engineering Science and Technology, Vol. 45, p. 169-180 (2010)

D. Liang, H.C. Allen, G.S. Frankel, Z.Y. Chen, R.G. Kelly, Y. Wu, B.E. Wyslouzil, "Effects of Sodium Chloride Particles, Ozone, UV, and Relative Humidity on Atmospheric Corrosion of Silver", Journal of the Electrochemical Society, Vol. 157, p. C146-C156 (2010)

G.S. Frankel, "CORROSION 2009 Plenary Lecture: The Future of Corrosion Education and the Effects on NACE International Assessing Corrosion Education", Materials Performance, Vol. 48, p. 28 (2009)

Hamish Fraser

S. Nag, R. Banerjee, R. Srinivasan, J.Y. Hwang, M. Harper, H. Fraser, “Omega Assisted Nucleation and Growth of Alpha Precipitates in the Ti-5Al-5Mo-5V-3Cr-0.5Fe Beta Titanium Alloy,” Acta Mater., 57(7), 2136 (2009)

S. Nag, R. Banerjee, A. Puthucode, H. Fraser, “Elemental Partitioning Between a and b Phases in the Ti-5Al-5Mo-5V-3Cr-0.5Fe (Ti-5553) Alloy”, Philos. Mag. A, 89(6), 535 (2009)

S. Nag, R. Banerjee, H. Fraser, “Intra-granular Precipitation in Ti-Nb-Zr-Ta Biomedical Alloys”, J. Mater. Sci., 44(3), 808 (2009)

J. Tiley, R. Srinivasan, R. Banerjee, G. B. Viswanathan, B. Toby, H. Fraser, “Application of X-ray and Neutron Diffraction to Determine Lattice Parameters and Precipitate Volume Fractions in Low Misfit Nickel Base Superalloys”, Mater. Sci. Technol., 25(11), 1369, (2009)

A. Genc, R.Banerjee, G.B. Thompson, D.M. Maher, A.W. Johnson, H. Fraser, “Complementary Techniques for the Characterization of Thin Film Ti/Nb Multilayers”, Ultramicroscopy, 109(10), 1276 (2009)

J.Y. Hwang, S. Nag, A. R. P. Singh, R. Srinivasan, J. Tiley, G. B. Viswanathan, R. Banerjee H. Fraser, “Compositional Variations between Different Generations of γ Precipitates Forming During Cooling of a Commercial Nickel-base Superalloy”, Metall. Mater. Trans. A, 40A(13), 3059 (2009)

J. Tiley, G. B. Viswanathan, R. Srinivasan, R. Banerjee, D. M. Dimiduk, H. Fraser, “Coarsening Kinetics of γ precipitates in the Nickel Base Superalloy Rene’ 88 DT”, Acta Mater. 57(8), 2538 (2009)

R. Srinivasan, R. Banerjee, G. B. Viswanathan, J. Tiley, D. M. Dimiduk H. Fraser, “Atomic scale structure and chemical composition across order-disorder interfaces”, Phys. Rev. Lett., 102 (8), 086101 (2009)

S. Bontha, N. Klingbeil, P. Kobryn, H. Fraser, “Effects of Process Variables and Size-Scale on Solidification Microstructure in Beam-Based Fabrication of Bulky 3-D Structures”, Mater. Sci. Eng. A, 513-514, p.311 (2009)

B. Peterson, P. Collins, H. Fraser, “On the Use of a Sub-scale Thermomechanical Simulator to Obtain Accurate Tensile Properties of α+β- and β-processed Ti-6Al-4V”, Mater. Sci. Eng., 513-514, p. 357 (2009).

A. Devaraj, , R. Williams, S. Nag, R. Srinivasan, H. Fraser, R. Banerjee, “Three Dimensional Morphology and Composition of Omega Precipitates in a Binary Titanium-Molybdenum alloy”, Scripta Mater., 61, 701 (2009)

R. Srinivasan, G. B. Viswanathan, H. Fraser, V. Levit, “Orientation Effect on Recovery and Recrystallization of Cold-rolled Niobium Single Crystals”, Mater. Sci. Eng. A., 507, p.179 (2009)

J. Y. Hwang, S. Nag, A.R.P. Singh, R. Srinivasan, J. Tiley, R. Banerjee and H. Fraser, “Evolution of the γ / γ Interface Width in a Commercial Nickel Base Superalloy Studied by Three Dimensional Atom Probe Tomography, Scripta Mat., 61(1), 92 (2009) Accepted for publication

J. Foltz, B. Welk, P. Collins, H. Fraser, and R. Williams, “Formation of Grain Boundary α in β Ti alloys: Its role in Deformation and Fracture of These Alloys”, Metallurgical Transactions [Pending]

Richard Freeman

A.G. MacPhee, L. Divol, A.J. Kemp, K.U. Akli, F.N. Beg, C.D. Chen, H. Chen, D.S. Hey, R.J. Fedosejevs, R.R. Freeman, M. Henesian, M.H. Key, S. Le Pape, A. Link, T. Ma, A.J. Mackinnon, V.M. Ovchinnikov, P.K. Patel, T.W. Phillips, R.B. Stephens, M. Tabak, R. Town, Y.Y. Tsui, L.D. Van Woerkom, M.S. Wei, S.C. Wilks, "Limitation on Prepulse Level for Cone-Guided Fast-Ignition Inertial Confinement Fusion", Physical Review Letters, Vol. 104 (2010)

T. Ma, M.H. Key, R.J. Mason, K.U. Akli, R.L. Daskalova, R.R. Freeman, J.S. Green, K. Highbarger, P.A. Jaanimagi, J.A. King, K.L. Lancaster, S.P. Hatchett, A.J. Mackinnon, A.G. MacPhee, P.A. Norreys, P.K. Patel, R.B. Stephens, W. Theobald, L.D. Van Woerkom, M.S.

Wei, S.C. Wilks, F.N. Beg, "Transport of energy by ultra intense laser-generated electrons in nail-wire targets", Physics of Plasmas, Vol. 16, (2009)

K.L. Lancaster, M. Sherlock, J.S. Green, C.D. Gregory, P. Hakel, K.U. Akli, F.N. Beg, S.N. Chen, R.R. Freeman, H. Habara, R. Heathcote, D.S. Hey, K. Highbarger, M.H. Key, R. Kodama, K. Krushelnick, H. Nakamura, M. Nakatsutsumi, J. Pasley, R.B. Stephens, M. Storm, M. Tampo, W. Theobald, L. Van Woerkom, R.L. Weber, M.S. Wei, N.C. Woolsey, T. Yabuuchi, P.A. Norreys, "Effect of reentrant cone geometry on energy transport in intense laser-plasma interactions", Physical Review, Vol. 80, (2009)

D.T. Offermann, R.R. Freeman, L.D. Van Woerkom, M.E. Foord, D. Hey, M.H. Key, A.J. Mackinnon, A.G. MacPhee, P.K. Patel, Y. Ping, J.J. Sanchez, N. Shen, T. Bartal, F.N. Beg, L. Espada, C.D. Chen, "Observations of proton beam enhancement due to erbium hydride on gold foil targets", Physics of Plasmas, Vol. 16 (2009)

S. Le Pape, Y.Y. Tsui, A. Macphee, D. Hey, P. Patel, A. Mackinnon, M. Key, M.S. Wei, T. Ma, F.N. Beg, R. Stephens, K. Akli, T. Link, L. Van-Woerkom, R.R. Freeman, "Characterization of the preformed plasma for high-intensity laser-plasma interaction", Optics Letters, Vol. 34, p. 2997-2999 (2009)

W. Theobald, C. Stoeckl, P.A. Jaanimagi, P.M. Nilson, M. Storm, D.D. Meyerhofer, T.C. Sangster, D. Hey, A.J. MacKinnon, H.S. Park, P.K. Patel, R. Shepherd, R.A. Snavely, M.H. Key, J.A. King, B. Zhang, R.B. Stephens, K.U. Akli, K. Highbarger, R.L. Daskalova, L. Van Woerkom, R.R. Freeman, J.S. Green, G. Gregori, K. Lancaster, P.A. Norreys, "A dual-channel, curved-crystal spectrograph for petawatt laser, x-ray backlighter source studies", Review of Scientific Instruments, Vol. 80 (2009)

K.L. Lancaster, M. Sherlock, J.S. Green, C.D. Gregory, P. Hakel, K.U. Akli, F.N. Beg, S.N. Chen, R.R. Freeman, H. Habara, R. Heathcote, D.S. Hey, K. Highbarger, M.H. Key, R. Kodama, K. Krushelnick, H. Nakamura, M. Nakatsutsumi, J. Pasley, R.B. Stephens, M. Storm, M. Tampo, W. Theobald, L. Van Woerkom, R.L. Weber, M.S. Wei, N.C. Woolsey, T. Yabuuchi, P.A. Norreys, "Effect of reentrant cone geometry on energy transport in intense laser-plasma interactions", Physical Review, Vol. 80, (2009)

D.T. Offermann, R.R. Freeman, L.D. Van Woerkom, M.E. Foord, D. Hey, M.H. Key, A.J. Mackinnon, A.G. MacPhee, P.K. Patel, Y. Ping, J.J. Sanchez, N. Shen, T. Bartal, F.N. Beg, L. Espada, C.D. Chen, "Observations of proton beam enhancement due to erbium hydride on gold foil targets", Physics of Plasmas, Vol. 16 (2009)

S. Le Pape, Y.Y. Tsui, A. Macphee, D. Hey, P. Patel, A. Mackinnon, M. Key, M.S. Wei, T. Ma, F.N. Beg, R. Stephens, K. Akli, T. Link, L. Van-Woerkom, R.R. Freeman, "Characterization of the preformed plasma for high-intensity laser-plasma interaction", Optics Letters, Vol. 34, p. 2997-2999 (2009)

W. Theobald, C. Stoeckl, P.A. Jaanimagi, P.M. Nilson, M. Storm, D.D. Meyerhofer, T.C. Sangster, D. Hey, A.J. MacKinnon, H.S. Park, P.K. Patel, R. Shepherd, R.A. Snavely, M.H. Key, J.A. King, B. Zhang, R.B. Stephens, K.U. Akli, K. Highbarger, R.L. Daskalova, L. Van Woerkom, R.R. Freeman, J.S. Green, G. Gregori, K. Lancaster, P.A. Norreys, "A dual-channel, curved-crystal spectrograph for petawatt laser, x-ray backlighter source studies", Review of Scientific Instruments, Vol. 80 (2009)

C.D. Chen, P.K. Patel, D.S. Hey, A.J. Mackinnon, M.H. Key, K.U. Akli, T. Bartal, F.N. Beg, S. Chawla, H. Chen, R.R. Freeman, D.P. Higginson, A. Link, T.Y. Ma, A.G. MacPhee, R.B. Stephens, L.D. Van Woerkom, B. Westover, M. Porkolab, "Bremsstrahlungand K alpha fluorescence measurements for inferring conversion efficiencies into fast ignition relevant hot electrons", Physics of Plasmas, Vol. 16 (2009)

Jianjun Guan

F. Wang, Z. Li, J. Lannutti, W. R. Wagner, J. Guan, "Synthesis, Characterization and Surface Modification of Low Moduli Polyurethanes for Soft Tissue Engineering", Acta Biomaterilia, 5(8):2901 (2009)

F. Wang, Z. Li, M. Khan, K. Tamama, P. Kuppusamy, W. R. Wagner, C. K. Sen, J. Guan, "Injectable, Rapid Gelling and Highly Flexible Hydrogel Composites as Insulin-like Growth Factor and Mesenchymal Stem Cell Carriers", Acta Biomaterilia, doi:10.1016/j.actbio.2009.12.011. (2009)

B. Wang, A. Borazjani, J. Guan, S. Elder, J. Liao. "Fabrication of Cardiac Patch with Decellularized Myocardial Scaffold and Mesenchymal Stem Cells", J. Biomed. Mater. Res. Part A.

Z. Li, F. Wang, S. Roy, C. Sen, J. Guan, "Injectable and thermosensitive hydrogel capable of delivering superoxide dismutase", Biomacromolecules, DOI:10.1021/bm900900e (2009)

F. Wang, Z. Li, K. Tamama, C.K. Sen, J. Guan, "Fabrication and characterization of prosurvival growth factor releasing, anisotropic scaffolds for enhanced mesenchymal stem cell survival/growth and orientation", Biomacromolecules, 10(9):2609 (2009)

F. Wang, Z. Li, J. Guan, "Rapid Fabrication of Growth Factor Releasing, Anisotropic and Flexible Scaffolds", Acta Biomaterials [Pending]

Thomas Gramila

W.Schumacher, A. Nagy, W.J. Waldman, R.H. Yu, R.Anisha, N.Jin, S.Y. Chung, P.R.Berger, T.J. Gramila, P.E. Thompson, “Direct Synthesis of Aqueous CdSe/ZnS-Based Quantum Dots Using Microwave Irradiation”, Journal of Physical Chemistry C, vol. 113, Issue 28, p. 12132-12139, (2009)

R.H. Yu, R.Anisha, N.Jin, Y. Shiroyanagi, G. Gopalakrishnan, S. An, T.J. Gramila, “Observation of strain in pseudomorphic Si1-xGex by tracking phonon participation in Si/SiGe resonant interband tunnel diodes via electron tunneling spectroscopy”, Journal of Applied Physics, vol. 106, Issue 3, (2009)

Chris Hammel

P. Banerjee, F. Wolny, D.V. Pelekhov, M.R. Herman, K.C. Fong, U. Weissker, T. Muhl, Yu. Oboukhov, A. Leonhardt, B. Buchner, P.C. Hammel, “Magnetization reversal in an individual 25 nm iron filled carbon nanotube,” Applied Physics Letters (2010)

I. Lee, Y. Obukhov, G. Xiang, A. Hauser, F. Yang, P. Banerjee, D. V. Pelekhov, P.C. Hammel, “Nanoscale scanning probe ferromagnetic resonance imaging using localized modes", Nature, publication pending (2010)

Yu. Oboukhov, D.V. Pelekhov, E. Nazaretski, R. Movshovich, P.C. Hammel, "Effect of localized magnetic field on the uniform ferromagnetic resonance mode in a thin film," Applied Physics Letters, 94, 172508 (2009)*

Y. Obukhov, D.V Pelekhov, E. Nazaretski, R. Movshovich, and P.C. Hammel, “Effect of Localized Magnetic Field on the Uniform Ferromagnetic Resonance Mode in a Thin Film,” Journal of Materials Chemistry 19 [24], 4138 (2009)*

E. Nazaretski, D. V. Pelekhov, I. Martin, M. Zalalutdinov, D. Ponarin, A. Smirnov, P.C. Hammel, R. Movshovich, “Detection of Localized Ferromagnetic Resonance in a Continuous Thin Film via Magnetic Resonance Force Microscopy ", Physical Review B, vol. 79 Issue 13, (2009)*

E. Nazaretski, K.S. Graham, J.D. Thompson, J.A. Wright, D.V Pelekhov, P.C Hammel, R. Movshovich, “Design of a Variable Temperature Scanning Force Microscope,” Review Of Scientific Instruments, 80 [8] 083704 (2009)*

E. Nazaretski, Y. Obukhov, I. Martin, D.V. Pelekhov, K.C. Chan, E.A. Akhadov, P.C Hammel, R. Movshovich, “Localized Ferromagnetic Resonance Force Microscopy in Permalloy-cobalt Films,” Journal Of Applied Physics, 106 [4] 046103 (2009)*

R.P. Pandian, M. Dolgos, C. Marginean, P.M. Woodward, P.C. Hammel, P.T. Manoharan, P. Kuppusamy, "Molecular packing and magnetic properties of lithium naphthalocyanine crystals: hollow channels enabling permeability and paramagnetic sensitivity to molecular oxygen", Journal of Materials Chemistry, Vol. 19, p. 4138-4147 (2009)

P.C. Hammel, “Nanoscale MRI", Nature, vol. 458, Issue 7240, p. 844-845 (2009)

K.C. Fong, Y. Che, P. Banerjee, Yu. Obukhov, D.V. Pelekhov, P.C. Hammel, "Manipulating Spins by Cantilever Synchronized Frequency Modulation: A Variable Resolution Magnetic Resonance Force Microscope," Applied Physics Letters [Pending]

Derek Hansford

Y. Shiroyanagi, G. Gopalakrishnan, S. An, E. Apaydin, Y. Zhou, S. Koulouridis, J.L. Volakis, D. Hansford, "A Novel Approach for Magnet Leads", Journal of Low Temperature Physics, vol. 155, Issue 1-2 p. 127-152, (2009)

J. Xu, M.J. Dapino, D. Gallego-Perez, R. Butler, N. Ferrell, D. Hansford, R. Naik, "Microphone based on Polyvinylidene Fluoride (PVDF) micro-pillars and patterned electrodes", Sensors and Actuators A-Physical, vol. 153, Issue 1, p. 24-32, (2009)

Joseph Heremans

C.M. Jaworski, J. Tobola , E.M. Levin, V. Jovovic, J. P. Heremans, "Antimony as an amphoteric dopant in lead telluride", Physical Review B, vol. 80, Issue 12, (2009)

M. Murata, D. Nakamura, Y. Hasegawa, T. Komine, T. Taguchi, S. Nakamura, V. Jovovic, J.P. Heremans, "Mean free path limitation of thermoelectric properties of bismuth nanowire", Journal of Applied Physics, vol. 105, Issue 11, (2009)

M. Murata, D. Nakamura, Y. Hasegawa, T. Komine, T. Taguchi, S. Nakamura, V. Jovovic, J.P. Heremans, "Thermoelectric properties of bismuth nanowires in a quartz template", Applied Physics Letters, vol. 94, Issue 19, (2009)

R.B. Sears, J. Heremans, D. Sun, E. Martin Jr., C. Turro "Selective Detection of Cancer Cells by Antibody-Near-IR Dye Conjugates" J. Med. Chem. [Pending]

Ezekiel Johnston-Halperin

J.T. Tee, P.A. Truitt, M.H. Chisholm, E. Johnston-Halperin, N. Abdullah, "Preparation, Thermal and Magnetic Studies of Novel Dinuclear Copper (II) Complex of 2,2'- [Nonane-1,9-diybis(nitrilomethylidyne)]diphenol" [Pending]

Harris Kagan

K.K. Gan, B. Abi, W. Fernando, H.P. Kagan, R.D. Kass, M.R.M. Lebbai, J.R. Moore, F. Rizatdinova, P.L. Skubic, D.S. Smith, "Radiation-hard/high-speed data transmission using optical links", Nuclear Physics-Proceedings Supplements, 11th Topical Seminar on Innovative Particle and Radiation Detectors Siena, Italy, p. 175-179 (2009)

Roland Kawakami

K.M. McCreary, K. Pi, A.G. Swartz, W. Han, W. Bao, C.N. Lau, F. Guinea, M.I. Katsnelson, R.K. Kawakami, “Effect of Cluster Formation on Graphene Mobility,” Physics Review B, 81, 115453 (2010)

W. Han, K. Pi, W. Bao, K.M. McCreary, Yan Li, W.H. Wang, C.N. Lau, R.K. Kawakami, “Electrical Detection of Spin Precession in Single Layer Graphene Spin Valves with Transparent Contacts,” Applied Physics Letters 94, 222109 (2009)

K. Pi, K.M. McCreary, W. Bao, W. Han, Y.F. Chiang, Y. Li, S.-W. Tsai, C.N. Lau, R.K. Kawakami, “Electronic Doping and Scattering by Transition Metals on Graphene,” Physics Review B, 80, 075406 (2009)

W. Han, K. Pi, W.H. Wang, K.M. McCreary, Y. Li, W. Bao, P. Wei, J. Shi, C.N. Lau, R. K. Kawakami, “Spin Transport in Graphite and Graphene Spin Valves,” Proceedings SPIE, 7398, 739819 (2009)

Gregory Lafyatis

A. Bross, G. Lafyatis, R. Ayachitula, A. Morss, R. Hard Man, J. Golden, "Robust, efficient grating couplers for planar optical waveguides using no-photoacid generator SU-8 electron beam lithography", Journal of Vacuum Science and Technology B, 27 2602 (2009)

Stephen Lee

T. Nicholson III, S. Gupta, X. Wen, W. Lu, L. Xu, L. Brillson, P. Berger, A. Ramesh, K. J. Kwak, B. Bhushan, S. C. Lee, "Approaches for Optimization of Nanobiotechnological Devices Illustrated by Partial Optimization of a FET Biosensor", Journal of Nanoengineering and Nanosystems [Pending]

S. Gupta, X. Wen, P. Casal, H. H. Wu, W. Lu, L. Brillson, S. C. Lee, "Importance of interfacial characteristics to AlGaN HFET sensor performance in physiologic environments", Langmuir [Pending]

S. Gupta, T. Nicholson III, P. Casal, B. Bhushan, X. Wen, W. Lu, L. Xu, L. Brillson, S. C. Lee, "Interfacial design leading to differential durability of protein/polymer films on epitaxially grown AlGaN surfaces", J. Physics D [Pending]

Thomas Lemberger

D.S. Caplan, V. Orlyanchik, M.B. Weissman, D.J. Van Harlingen, E.H. Fradkin, M.J. Hinton, T.R. Lemberger, "Anomalous Noise in the Pseudogap Regime of YBa2Cu3O7-delta", Physical Review Letters, Vol. 104 (2010)

H. Yang, H. Wang, B. Maiorov, J. Lee, D. Talbayev, M.J. Hinton, D.M. Feldmann, J.L. MacManus-Driscoll, A.J. Taylor, L. Civale, T.R. Lemberger, Q.X. Jia, "Self-assembled multilayers and enhanced superconductivity in (YBa2Cu3O7-x)(0.5): (BaZrO3)(0.5) nanocomposite films", Journal of Applied Physics, Vol. 106 (2009)

John Lippold

B. Alexandrov, J.C. Lippold, "Non-equilibrium Phase Diagrams in Advanced Engineering Alloys", Trends in Welding Research [Pending]

B. Alexandrov, J.C. Lippold, "Non-equilibrium Phase Transitions in Ni-Base Super Alloys", Superalloys [Pending]

Wu Lu

S. Gupta, M. Elias, X. Wen, J. Shapiro, L. Brillson, W. Lu, S. Lee, "AlGaN heterojunction field effect transistors for detection of clinically relevant MIG concentrations at physiological salt concentrations", Biosensors and Bioelectronics [Pending]

X. Wen, J. Song, W. Lu, "Responses of AlGaN/GaN Heterojunction Field Effect Transistors to DNAs", Journal of Science and Technology B [Pending]

H. Kim, W. Lu, "A simple model for extraction of effective trap density and gate legnth in AlGaN/GaN high-electron mobility transistors based on pulse I-V characteristics", Applied Physics Letters [Pending]

D. Liu, M.udait, Y. Lin, H. Kim, S. A. Ringel, W. Lu, "80nm InAlA/InGaAs/InAsP Composite Channel HEMTs with an f[symbol] of 280 GHz", Solid State Electronics [Pending]

X. Wen, S. Wang, L.J. Lee, W. Lu, "AlGaB/GaN heterostructure field-effect transistors for label-free detection of DNA hybridization," IEEE Sensors Journal [Pending]

Q.H. Wei, W. Lu, "Scaling of Nanoscale Chemical/Biological Biosensors" [Pending]

X. Wen, S. Wang, L. J. Lee, W. Lu, "AlGaN/GaN Heterostructure Field Transistor for Label-Free Detection of DNA Hybridization”, Biosensors and Bioelectronics [Pending]

Chia-Hsiang Menq

G.R. Jayanth, C.H. Menq, "Modeling and Design of a Magnetically Actuated Two-Axis Compliant Micromanipulator for Nanomanipulation", IEEE-ASME Transactions on Mechatronics, Vol. 15, p. 360-370 (2010)

Y.N. Huang, Z.P. Zhang, C.H. Menq, "Minimum-variance Brownian motion control of an optically trapped probe", Applied Optics, Vol. 48 p. 5871-5880 (2009)

Y.A. Huang, J.F. Wan, M.C. Cheng, Z.P. Zhang, S.M. Jhiang, C.H. Menq, "Three-axis rapid steering of optically propelled micro/nanoparticles", Review of Scientific Instruments, Vol. 80 (2009)

Z.P. Zhang, C.H. Menq, "Best linear unbiased axial localization in three-dimensional fluorescent bead tracking with subnanometer resolution using off-focus images", Journal of The Optical Society of America A-Optics Images Science and Vision, Vol. 26, p. 1484-1493 (2009)

Michael Mills

P.J. Phillips, R.R. Unocic, L. Kovarik , D. Mourer, D. Wei, M. J. Mills, “Low cycle fatigue of a Ni-based superalloy: Non-planar deformation”, Scripta Materialia, vol. 62, Issue 10, p. 790-793, (2010)

E.J. Payton, PJ. Phillips, MJ. Mills, “Semi-automated characterization of the gamma ' phase in Ni-based superalloys via high-resolution backscatter imaging”, Materials Science and Engineering A-Structural Materials Properties Microstructure and Processing, vol. 527, Issue 10-11, p. 2684-2692, (2010)

B.K. Narayanan, L. Kovarik, PM. Sarosi, M.A. Quintana, M.J. Mills, “Effect of Micro-Alloying on Precipitate Evolution in Ferritic Welds and Implications for Toughness”, Acta Materialia, vol. 58, Issue 3, p. 781-791, (2010)*

K.A. Unocic, M.J. Mills, G.S. Daehn, “Effect of Gallium Focused Ion Beam Milling on Preparation of Aluminum Thin Foils,” J. Microscopy, in press (2010)

M.C. Brandes, M.J. Mills, and J.C. Williams, “The Influence of Slip Character on the Creep and Fatigue Fracture of an α-Ti-Al Alloy,” Metall. Mater. Trans. A, in press (2010)

K.A. Unocic, RW. Hayes , MJ. Mills, G. S. Daehn, “Microstructural Features Leading to Enhanced Resistance to Grain Boundary Creep Cracking in ALLVAC 718Plus”, Metallurgical and Materials Transactions A-Physical Metallurgy and Materials Science, vol. 41A, Issue 2 P. 409-420, (2010)*

J.H. Schneibel, C.T. Liu, M.K. Miller, M.J. Mills, P. Sarosi, M. Heilmaier, D. Sturm, “Ultrafine-grained nanocluster-strengthened alloys with unusually high creep strength”, Scripta Materialia, vol. 61, Issue 8, p. 793-796, (2009)*

L. Kovarik, R.R. Unocic, J. Li, P.Sarosi, C. Shen, Y. Wang, M.J. Mills, “Microtwinning and Other Shearing Mechanisms In Ni Base Superalloys at Intermediate Temperatures,” Prog. Mater. Sci., 54, 839–873 (2009)

D.M. Norfleet, P.M. Sarosi, M. C. Uchic, M. F.-X. Wagner, S. Manchiraju, P. M. Anderson, M. J. Mills, “Transformation-Induced Plasticity During Pseudo-Elastic Deformation in Ni-Ti Microcrystals,” Acta Mater., 57, pp. 3549–3561 (2009)*

J.H. Moon, S. Karthikeyan, B.M. Morrow, S.P. Fox, M.J. Mills, “High-Temperature Creep Behavior and Microstructure Analysis of Binary Ti-6Al alloys with Trace Amounts of Ni,” Mater. Sci. Eng. A, 510-511, pp. 35-41 (2009)

G. Wang, D.S. Xu, N. Ma, N. Zhou, E.J. Payton, R. Yang, M.J. Mills, Y. Wang, “Simulation Study of Effects of Initial Particle Size Distribution on Dissolution,” Acta Materialia, 57, pp. 316–325 (2009)

U. Lienert, M.C. Brandes, J.V. Bernier, J.Weiss, S.D. Shastri, M.J. Mills, M.P. Miller, “In situ Single-Grain Peak Profile Measurements on Ti–7Al During Tensile Deformation,” Materials Science and Engineering A-Structural Materials Properties Microstructure and Processing, A 524, pp. 46–54 (2009)*

T. J. Grassman, M. R. Brenner, S. Rajagoplalan, R. Unocic, R. Dehoff, M. Mills, S. Ringel, H.L. Fraser, “Control and Elimination of Nucleation-related Defects in GaP/Si(001) Heteroepitaxy”, App. Phys. Letts, 94, 232106 (2009)

Nicanor Moldovan

M. Anghelina, C. Lee, J. Johnson, A. Bratasz, L. Moldovan, P. Kuppusamy, J. Lannutti, N. I. Moldovan, "Controlling the impact of peri-implant foreign body reaction with stem cells-containing electrospun biomaterials for improved neovascularization and oxygen exchange", Nature Biotechnology [Pending]

Susan Olesik

S.V. Olesik, “Science outreach: an important endeavor for active scientists”, Analytical and Bioanalytical Chemistry, vol. 394, Issue 5, p. 1233-1236, (2009)

J.E. Clark, S.V. Olesik, “Technique for Ultrathin Layer Chromatography Using an Electrospun, Nanofibrous Stationary Phase”, Analytical Chemistry, vol. 81, Issue 10, p. 4121-4129, (2009)

Roberto Myers

M. J. Wilson,M. Zhu,R. C. Myers,D. D. Awschalom,P. Schiffer, N. Samarth, “Interlayer and interfacial exchange coupling in ferromagnetic metal/semiconductor heterostructures”, Phys. Rev. B 81, 045319 (2010).

X. Li, R. C. Myers, F. M. Mendoza, D. D. Awschalom, N. Samarth, “Polarized emission from twin microdisk photonic molecules”. IEEE J.Quant. Electron. 45, 932 (2009).

Nitin Padture

D. Li, W. Windl, N.P. Padture, “Towards Site-Specific Stamping of Graphene,” Advanced Materials, 21 [12] 1243-1246 (2009)

E.D. Herderick, M.R. Reddy, R.N. Sample, T.I. Draskovic, N.P. Padture, " Bipolar Resistive Switching in Individual Au—NiO—Au Segmented Nanowires ", Applied Physics Letters Vol. 95, 203505 (2009)*

E. Zapata-Solvas, R. Poyato, D. Gomez-Garcia, A. Dominguez-Rodriguez, N.P. Padture, "High-temperature mechanical behavior of Al2O3/graphite composites", Journal of the European Ceramic Society, Vol. 29, p. 3205-3209 (2009)

N.P. Padture, “Multifunctional Composites of Ceramics and Single-Wall Carbon Nanotubes,” Advanced Materials, 21 [17] 1767 (2009)

Jonathan Parquette

H. Shao, J. R. Parquette, “A π-Conjugated Hydrogel Based on an Fmoc-Dipeptide Naphthalene Diimide Semiconductor", Chem. Commun. 46, 4285–4287 (2010)

H. Shao, T. Nguyen, N.C. Romano, D.A. Modarelli, J.R. Parquette, “Self-Assembly of 1-D n-Type Nanostructures based on Naphthalene Diimide-appended Dipeptides,” J. Am. Chem. Soc., 131, 16374-16375 (2009)

H. Shao, J.R. Parquette, "Controllable Peptide-Dendron Self-Assembly: Interconversion of Nanotubes and Fibrillar Nanostructures," Angew. Chem., Int. Ed., 48, 2525-2528 (2009)

Denis Pelekhov

E. Nazaretski, K. S. Graham, J. D. Thompson, J. A. Wright, D.V. Pelekhov, P.C. Hammel and R. Movshovich, “Design of a variable temperature scanning force microscope”, Review of Scientific Instruments vol. 80, p. 083704 (2009)

E. Nazaretski, Yu. Obukhov, I. Martin, D.V. Pelekhov, K.C. Cha, E.A. Akhadov, P.C. Hammel and R. Movshovich, “Localized ferromagnetic resonance force microscopy in Permalloy-cobalt films”, Journal of Applied Physics vol. 106, p. 046103 (2009)

E. Nazaretski, D.V. Pelekhov, I. Martin, M. Zalalutdinov, D. Ponarin, A. Smirnov, P.C. Hammel and R. Movshovich, “Detection of localized ferromagnetic resonance in a continuous thin film via magnetic resonance force microscopy”, Physical Review B vol. 79, p. 132401 (2009)

Yu. Obukhov, D.V. Pelekhov, E. Nazaretski, R. Movshovich and P.C. Hammel, “Effect of localized magnetic field on the uniform ferromagnetic resonance mode in a thin film”, Applied Physics Letters vol. 94, p. 172508 (2009)

I. Lee, Yu. Obukhov, G. Xiang, A. Hauser, F. Yang, P. Banerjee, D.V. Pelekhov and P.C. Hammel, “Nanoscale scanning probe ferromagnetic resonance imaging using localized modes”, accepted to Nature

P. Banerjee, F. Wolny, D. V. Pelekhov, M. R. Herman, K. C. Fong, U. Weissker, T. Muhl, Yu. Obukhov, A. Leonhardt, B. Buchner and P.C. Hammel, “Magnetization Reversal in an Individual 25 nm Iron-Filled Carbon Nanotube”, accepted to Applied Physics Letters

Jonathan Pelz

W. Cai, K.B. Park, J.P. Pelz, "Nanometer-resolution measurement and modeling of lateral variations of the effective work function at the bilayer Pt/Al/SiO2 interface", Physical Review, Vol. 80 (2009)

Michael Poirier

S. Javaid, M. Manohar, N. Punja, A. Mooney, J.J. Ottesen, M.G. Poirier, R. Fishel, "Nucleosome Remodeling by hMSH2-hMSH6", Molecular Cell, Vol. 36, p. 1086-1094 (2009)

M.G. Poirier, E. Oh, H.S. Tims, J. Widom, "Dynamics and function of compact nucleosome arrays", Nature Structural and Molecular Biology, Vol. 16 (2009)

M. Manohar, A.M. Mooney, J.A. North, R.J. Nakkula, J.W. Picking, A. Edon, R. Fishel, M.G. Poirier, J.J. Ottesen, "Acetylation of Histone H3 at the Nucleosome Dyad Alters DNA-Histone Binding", Journal of Biological Chemistry, Vol. 284, p. 23312-23321 (2009)

R.A. Forties, R. Bundschuh, M.G. Poirier, "The flexibility of locally melted DNA", Nucleic Acids Research, Vol. 37, p. 4580-4586 (2009)

William Putikka

N.J. Harmon, W.O. Putikka, R. Joynt, “Theory of electron spin relaxation in n-doped quantum wells”, Physical Review B, vol. 81, Issue 8, (2010)

Siddarth Rajan

D.F. Brown, S. Rajan, S. Keller, Y.H. Hsieh, S.P. DenBaars,U.K. Mishra, “Electron transport in nitrogen-polar high electron mobility transistors,” Physica Status Solidi C. Vol. 6, no. S2: S960-3.(2009)

T. Fujiwara, S. Rajan, S. Keller, M Higashiwaki, J.S. Speck, S.P. DenBaars, U.K. Mishra, “Enhancement-mode m-plane AIGaN/GaN heterojunction field-effect transistors,” Applied Physics Express. Vol. 2, no. 1: 011001 (2 pp.) (2009)

A.C. Tamboli, M.C. Schmidt, S. Rajan, J.S. Speck, U.K. Mishra, S.P. DenBaars, E.L. Hu, “Smooth top-down photoelectrochemical etching of m-plane GaN,” Journal of the Electrochemical Society. Vol. 156, no. 1: H47-H51 (2009)

Y. Pei, S. Rajan, M. Higashiwaki, C. Zhen, S.P. DenBaars, U.K. Mishra, “Effect of dielectric thickness on power performance of AlGaN/GaN HEMTs,” IEEE Electron Device Letters. Vol. 30, no. 4: 313-15 (2009)

D. Nath, E. Gur, S. Ringel. S. Rajan, "Molecular Beam Epitaxy of N-polar InGaN", Applied Physics Letters (2010) [Pending]*

D. Nath, E. Hsieh, S. Keller, S.P. DenBaars, U. K. Mishra, S. Rajan, "Electron Transport in Vicinal AlGaN/GaN Heterostructures", Applied Physics letters (2010) [Pending]

P. S. Park, S. Rajan, "Comparison of N-Polar and Ga-Polar AlGaN/GaN HEMTs". Electron Device Letters (2010) [Pending]

Mohit Randeria

R. B. Diener, M. Randeria, “BCS-BEC crossover with unequal-mass fermions”, Physical Review A, vol. 81, Issue 3, (2010)

W. Schneider, M. Randeria , “Universal short-distance structure of the single-particle spectral function of dilute Fermi gases”, Physical Review A. vol. 81, Issue 2, (2010)

U. Chatterjee, M. Shi, D. Ai, J. Zhao, A. Kanige, S. Rosenkranz, H. Raffy, Z.Z. Li, K. Kadowaki, D. G. Hinks, Z.J. Xu, J.S. Wen, G. Gu, C.T. Lin, H. Claus, M.R. Norman, M. Randeria & J.C. Campuzano, “ Observation of a d-wave nodal liquid in highly underdoped Bi2Sr2CaCu2O8+δ”, Nature Physics. vol. 6, Issue 2, p. 34-38 (2010)

T. Paiva, R. Scalettar, M. Randeria, N. Trivedi, “Fermions in 2D Optical Lattices: Temperature and Entropy Scales for Observing Antiferromagnetism and Superfluidity”, Physical Review Letters. Vol. 104, Issue 6, (2010)

Ronald Reano

P. Sun, R.M. Reano, "Low-power optical bistability in a free-standing silicon ring resonator", Optics Letters, Vol. 35, p. 1124-1126 (2010)

P. Sun, R.M. Reano, "Submilliwatt thermo-optic switches using free-standing silicon-on-insulator strip waveguides", Optics Express, Vol. 18, p. 8406-8411 (2010)

G.B. Hoffman, W. Zhou, R. Sooryakumar, R.M.Reano, "Direct write of optical waveguides on chalcogenide thin films using electron beams", Journal of Vacuum Science and Technology, Vol. 27, p. 2737-2741 (2009)

A.C. Ruege, R.M. Reano, "Multimode Waveguides Coupled to Single Mode Ring Resonators", Journal of Lightwave Technology, Vol. 27, p. 2035-2043 (2009)

K.Y. Jung, F.L. Teixeira, R.M. Reano, "Surface Plasmon Coplanar Waveguides: Mode Characteristics and Mode Conversion Losses", IEEE Photonics Technology Letters, Vol. 21, p. 630-632 (2009)

Steven Ringel

A. R. Arehart, T. Homan, M. H. Wong, C. Poblenz, J. S. Speck, and S. A. Ringel, “Impact of N- and Ga-face polarity on the incorporation of deep levels in n-type GaN grown by molecular beam epitaxy,” Accepted for publication, Appl. Phys. Lett. (2010)

T. J. Grassman, M. R. Brenner, M. Gonzalez, A. M. Carlin, R. Unocic, R. Dehoff, M. Mills, and S. A. Ringel, “Characterization of Metamorphic GaAsP/Si Materials and Devices for Photovoltaic Applications,” IEEE Trans. Electron Devices, accepted for publication (2010)

A.R. Arehart, C. Poblenz, J.S. Speck, S.A. Ringel, "Effect of nitrogen plasma power on defect levels in Ni/n-GaN Schottky diodes grown bymolecular beam epitaxy", Journal of Applied Physics, Vol. 107 054518 (2010)*

S.A. Ringel, “The III-V solar cell on Silicon, in III-V Compound Semiconductors: Integration with Silicon-Based Microelectronics”, ed. by T. Li, E. Piner and A. Dadgar, in press (CRC Press, 2010)

M. K. Hudait, Y. Lin, S.A. Ringel, “Strain relaxation properties of InAsyP1-y metamorphic materials grown on InP substrates,” J. Appl. Phys. 105, 061643 (2009)

M.K. Hudait, M. Brenner, S.A. Ringel, “Metamorphic In0.7Al0.3As/In0.69Ga0.31As thermophotovoltaic devices grown on graded InAsyP1-y buffers by molecular beam epitaxy,” Solid State Electronics 53, 102-106 (2009)

T.J. Grassman, M.R. Brenner, S. Rajagopalan, R. Unocic, R. Dehoff, M. Mills, H. Fraser, S.A. Ringel, "Control and elimination of nucleation-related defects in GaP/Si(001) heteroepitaxy", Applied Physics Letters, Vol. 94 232106 (2009)*

Ratnasingham Sooryakumar

T. Henighan, A. Chen, G. Vieira, A.J. Hauser, F.Y. Yang, J.J. Chalmers, R. Sooryakumar, "Manipulation of Magnetically Labeled and Unlabeled Cells with Mobile Magnetic Traps", Biophysical Journal, Vol. 98, p. 412-417 (2010)

G.B. Hoffman, W. Zhou, R. Sooryakumar, R.M. Reano, "Direct write of optical waveguides on chalcogenide thin films using electron beams", Journal of Vacuum Science and Technology, Vol. 27, p. 2737-2741 (2009)

W.C. Liu, Y.B. Yao, C.Y. Lam, C.S. Ng, C.L. Mak, K.H. Wong, W. Zhou, R. Sooryakumar, "Epitaxial Sr1.8Ca0.2NaNb5O15 thin film wave guides grown by pulsed laser deposition: Optical properties and microstructure", Journal of Applied Physics, Vol. 106 (2009)

W. Zhou, R.P. Tiwari, R. Annamalai, R. Sooryakumar, V. Subramaniam, D. Stroud, "Sounds Propogation in light-modulated carbon nanosponge suspensions”, Physical Review B79, 104204 (2009)

D. Thakur, S. Deng, T. Baldet†, J.O. Winter, "pH Sensitive CdS–Iron Oxide Fluorescent–Magnetic Nanocomposites". Nanotechnology. 20(48):485601, (2009)

G. Ruan, D. Thakur, S. Hawkins, J.O. Winter, "Synthesis and Manipulation of Multifunctional, Fluorescent-Magnetic Nanoparticles for Single Molecule Tracking", Proceedings of SPIE, [Pending]

S. Deng, G. Ruan, N. Han, J.O. Winter, "Interactions in Fluorescent-Magnetic Heterodimer Nanocomposites", Nanotechnology. [Pending]

David Stroud

R.P. Tiwari, D. Stroud, "Tuneable Band Gap in Graphene with a Noncentrosymmetric Superlattice Potential", Physical Review B. vol. 79, Issue 20, (2009)*

R.P. Tiwari, D. Stroud, "Tuneable Band Gap in Graphene with a Noncentrosymmetric Superlattice Potential", Physical Review B. vol. 80, Issue 15 (2009)

Michael Sumption

Z.X. Shi, M.A. Susner , M. Majoros, et al, "Anisotropic connectivity and its influence on critical current densities, irreversibility fields, and flux creep in in situ processed MgB2 strands", Super Conductor Science and Technology, Vol. 23, Issue 4, (2010)

M. Majoros, M.D. Sumption, M.A. Susner, et al, "A Model Superconducting Helical Undulator Wound Using a Wind and React MgB2 Multifilamentary Wire", IEEE Transactions on Applied Superconductivity, Vol. 19, Issue 3, p. 1376-1379, Part: Part 2, (2009)

M. Majoros, MD. Sumption, EW.Collings, et al, "Numerical Modeling of the AC Limiting Properties of Insulated, Conduction Cooled MgB2 Strands, IEEE Transactions on Applied Superconductivity, Vol. 19, Issue 3, p. 1872-1875, Part: Part 2, (2009)

M.D. Sumption, M.A. Susner, E.W.Collings, et al, " Effect of Cable Edge Deformation on RRR and Magnetization of Strands Extracted From Nb3Sn Rutherford-Type Cables", IEEE Transactions on Applied Superconductivity, Vol. 19, Issue 3, p. 2481-2485, Part: Part 2, (2009)

S. Bhartiya, M.D. Sumption, X.Peng, et al, "Investigation of the Effects of Low Temperature Heat Treatments on the Microstructure and Properties of Multifilamentary, Tube-Type Nb3Sn Strands", IEEE Transactions on Applied Superconductivity, Vol. 19, Issue 3, p. 2588-2592, Part: Part 3, (2009)

E. Gregory, M. Tomsic, X. Peng, et al, "Nb3Sn Superconductors Made by an Economical Tubular Process", IEEE Transactions on Applied Superconductivity, Vol. 19, Issue 3, p. 2602-2605, Part: Part 3, (2009)

M.A.A. Mahmud, M.A. Susner, M.D. Sumption, et al, “Comparison of Critical Current Density in MgB2 With Different Boron Sources and Nano-Particle Dopant Additions”, IEEE Transactions on Applied Superconductivity, Vol. 19, Issue 3, p. 2756-2759, Part: Part 3, (2009)

M. Majoros, M.D. Sumption, M.A. Susner, et al , “AC Losses in MgB2 Multifilamentary Strands With Magnetic and Non-Magnetic Sheath Materials”, IEEE Transactions on Applied Superconductivity, Vol. 19, Issue, p. 3106-3109, Part: Part 3, (2009)

T.J. Haugan, F.J. Baca, M.J. Mullins, et al. “Temperature and Magnetic Field Dependence of Critical Current Density of YBCO With Varying Flux Pinning Additions”, IEEE Transactions on Applied Superconductivity, Vol. 19, Issue 3, p. 3270-3274, Part: Part 3, (2009)

Nandini Trivedi

T. Paiva, R. Scalettar, M. Randeria, N. Trivedi, “Fermions in 2D Optical Lattices: Temperature and Entropy Scales for Observing Antiferromagnetism and Superfluidity”, Physical Review Letters. Vol. 104, Issue 6, (2010)

Q. Zhou, Y. Kato, N. Kawashima, N. Trivedi, “Direct Mapping of the Finite Temperature Phase Diagram of Strongly Correlated Quantum Models”, Physical Review Letters, vol. 103, Issue 8 (2009)

N. Trivedi, N. Balakrishnan, “Graphical Models for Distributed Inference in Wireless Sensor Networks” Conference Information: 3rd International Conference on Sensor Technologies and Applications, JUN 18-23, 2009 Athens, GREECE, 2009 3rd International Conference on Sensor Technologies and Applications, p. 596-603 (2009)

Claudia Turro

Y. Liu, D. B. Turner, T. N. Singh, A. Chouai, K. R. Dunbar, and C. Turro,“Ultrafast Ligand Exchange: Detection of a Pentacoordinate Ru(II) Intermediate and Product Formation”, J. Am. Chem. Soc., 131, 26-27, (2009)

Y. Liu, R. Hammitt, D. A. Lutterman, L. E. Joyce, R. P. Thummel, C. Turro,"Ru(II) Complexes of New Tridentate Ligands: DNA Photocleavage and Unexpected High Yield of Sensitized 1O2”, Inorg. Chem., 48, 375-385, (2009)

B. Alberding, M. Chisholm, Y.H. Chou, Y. Ghosh, T.L. Gustafson, C. Turro, C.Reed, N. Patmore, J. Gallucci, "Quadruply Bonded Dimetal Units Supported by 2,4,6-triisopropylbenzoates (MM = Mo2, MoW and W2): Preparations and Photophysical Properties”, Inorganic Chemistry [Pending]

J. J. D. Aguirre, H. T. Chifotides, A. M. Angeles-Boza, A. Chouai, C. Turro, K. R. Dunbar, "Redox-Regulated Inhibition of T7 RNA Polymerase via Establishment of Disulfide Linkages by Substituted Dppz Dirhodium(II,II) Complexes”, Inorganic Chemistry [Pending]

B. McClure, N. Mockus, D. Butcher, D. A. Lutterman, C. Turro, J. Petersen, J. Rack, "Photochromic Ruthenium Sulfoxide Complexes: Evidence for Isomerization through a Conical Intersection", Inorganic Chemistry [Pending]

R. B. Sears, J. Heremans, D. Sun, E. Martin Jr., C. Turro, "Selective Detection of Cancer Cells by Antibody-Near-IR Dye Conjugates", Jouranl of Medical Chemistry [Pending]

Yael Vodovotz

S. Modi, K. Koelling, Y. Vodovotz, "Thermal and Rheological Properties of Poly-(3-hydroxybutyrate-co-3-hydroxyvalerate) and Poly (Lactic Acid) blends for Food Packaging Applications", Proceedings of Society of Plastic Engineers-Antec conference (2010)

S. Modi, K. Koelling, Y. Vodovotz, "Thermal and Rheological Properties of PHB Synthesized with Various Hydroxyvalerate Content for Potential Use in Food Packaging", Proceedings of Society of Plastic Engineers-Antec conference (2009)

S. Modi, K. Koelling, Y. Vodovotz, "Assessment of PHB with Varying Hydroxyvalerate content for Potential Packaging Applications" European Polymer Journal [Pending]

S. Modi, K. Koelling, Y. Vodovotz, "Miscibility of Poly-(3-hydroxybutyrate-co-3-hydroxyvalerate) and Poly (Lactic Acid) blends Determined by Thermal Analysis." Journal of Applied Polymer Science [Pending]

S. Modi, K. Koelling, Y. Vodovotz, "Mechanical and Rheological Properties Poly-(3-hydroxybutyrate-co-3-hydroxyvalerate) and Poly (Lactic Acid) blends." Journal of Applied Polymer Science [Pending]

Wolfgang Windl

I.Santos, P. Castrillo, W. Windl, D.A. Drabold, L. Pelaz, L.A. Marques, "Self-trapping in B-doped amorphous Si: Intrinsic origin of low acceptor efficiency", Physical Review B, vol. 81, Issue 3, (2010)

R. Heinen, K. Hackl, W. Windl, M.F.-X Wagner, "Microstructural evolution during multiaxial deformation of pseudoelastic NiTi studied by first-principles-based micromechanical modeling", Acta Materialia, vol. 57, Issue 13, p. 3856-3867, (2009)

David Wood

B.A. Fong, W.Y. Wu, D.W. Wood, "The potential role of self-cleaving purification tags in commercial-scale processes," Trends in Biotechnology (2010)

I. Ghazi,D.W. Wood, “Large-Scale Protein Purification Using Self-Cleaving Aggregation Tags,” Encyclopedia of Industrial Biotechnology: Bioprocess, Bioseparation, and Cell Technology, (ed. Michael C. Flickinger). John Wiley & Sons, Inc., Hoboken, NJ, USA, (2009).

A. Gillies, M. R. Banki, D.W. Wood, “PHB-Intein Mediated Protein Purification Strategy,” in Methods in Molecular Biology: High Throughput Protein Expression and Purification, Vol. 498, (ed. Sharon A. Doyle). Humana Press, Totowa, NJ, USA, (2009).

A.G. Gillies, D.W. Wood, "Inteins in Protein Engineering," in Protein Engineering Handbook, (eds. Stefan Lutz and Uwe Bornscheuer). Wiley-VCH Publishers, Weinheim, Germany, (2009).

W.Y. Wu, B.A. Fong, A.R. Gillies, D.W. Wood, “Recombinant Protein Purification by Self-cleaving Elastin-like Polypeptide Fusion Tag,” Current Protocols in Protein Science, Chapter 26: Unit 26.4.1-18, (2009)

M.D. Gawrys, I. Hartman, L.F. Landweber, D.W. Wood, “Use of engineered Escherichia coli Cells to Detect Estrogenicity in Everyday Consumer Products,” Journal of Chemical Technology and Biotechnology, Vol. 84, pp. 1834-1840, (2009)

I. Hartman, A.R. Gillies, S. Arora, C. Andaya, N. Royapet, W.J. Welsh, R.J. Zauhar, D.W. Wood, “Novel Screening Methods Using Shape Signatures and Engineered Biosensors for Identification of Estrogen Antagonists,” Pharmaceutical Research, Vol. 26 (10), pp. 2247-2258, (2009)

B.A. Fong, W.Y. Wu, D.W. Wood, “Optimization of ELP-intein mediated protein purification by salt substitution,” Protein Expression and Purification, Vol. 66 (2), pp. 198-202, (2009)
Wood, D. W., “Non-chromatographic Recombinant Protein Purification by Self-Cleaving Purification Tags,” Separations Science and Technology, (In Progress).

B.A. Fong, A.R. Gillies, I. Ghazi, G. LeRoy, k.C. Lee, L.F. Westblade, D.W. Wood, “Purification of Escherichia coli RNA polymerase using a self-cleaving elastin-like polypeptide tag,” Protein Science, (In Progress).

W.Y. Wu, A.R. Gilles, J. Hsii, L. Contreras, S. Oak, M.B. Perl, D.W. Wood, “Self-cleaving purification tags re-engineered for rapid Topo® cloning,” Biotechnology Progress, (In Progress)

Patrick Woodward

R. A. Ricciardo, H. L. Cuthbert, P. M. Woodward, Q. Zhou, B. J. Kennedy, Z. Zhang, M. Avdeev, L.-Y. Jang, “Structure and Properties of Sr1–xCaxMn0.5Ru0.5O3 perovskites: Using Chemical Pressure to Control Mn/Ru Mixed Valency” Chemical Materials 19 [26] 6451–6458 (2010).

G. King, P.M. Woodward, “Cation ordering in perovskites,” Journal of Material Chemists, (published online, April 15, 2010, DOI: 10.1039/b926757c).

G. King, S. Garcia-Martin, P.M. Woodward, " Octahedral Tilt Twinning and Compositional Modulation in NaLaMgWO6", Acta Crystallographica Section B-Structural Science, Vol. 65, p. 676-683 (2009)*

A.M. Abakumov, G. King, V.K. Laurinavichute, M.G. Rozova, P.M. Woodward, E.V. Antipov, "The Crystal Structure of alpha-K3AlF6: Elpasolites and Double Perovskites with Broken Corner-Sharing connectivity of the Octahedral Framework", Inorganic Chemistry, Vol. 48, p. 9336-9344 (2009)

R.L. Withers, L. Bourgeois, K. Balamurugan, N.H. Kumar, P.N. Santhosh, P.M. Woodward, "A TEM Investigation of the (Bi1-xSrx)Fe3+O3-x/2, 0.2 <= x <= 0.67, Solid Solution and a Suggested Superspace Structural Description Thereof", Journal of Solid State Chemistry, Vol. 182, p. 2176-2184 (2009)

G. King, A.S. Wills, P.M. Woodward, "Magnetic structures of NaLMnWO6 perovskites (L=La,Nd,Tb)", Physical Review, Vol. 79 (2009)

M.R. Dolgos, A.M. Paraskos, M.W. Stoltzfus, S.C. Yarnell, P.M. Woodward, “The electronicstructures of vanadate salts: Cation substitution as a tool for band gap manipulation", Journal of Solid State Chemistry, Vol. 182, p. 1964-1971 (2009)

R.P. Pandian, M. Dolgos, C. Marginean, P.M. Woodward, P.C. Hammel, P.T. Manoharan, P. Kuppusamy, "Molecular Packing and Magnetic Properties of Lithium Naphthalocyanine Crystals: Hollow Channels Enabling Permeability and Paramagnetic Sensitivity to Molecular Oxygen " Journal of Materials Chemistry, Vol. 19, p. 4138-4147 (2009) *

G. King, L.M. Wayman, P.M. Woodward, " Magnetic and Structural Properties of NaLnMnWO6 and NaLnMgWO6 Perovskites", Journal of Solid State Chemistry, Vol. 182, p. 1319-1325 (2009)*

G. King, A.S. Wills, P.M. Woodward, “Complex Magnetic Structures in Perovskites with Ordering of the A-site and B-site Cations,” Physics Review B, 79, 224428 (2009).

H.A. Seibel, P. Karen, T.R. Wagner, P.M. Woodward, "Synthesis and characterization of color variants of nitrogen- and fluorine-substituted TiO2", Journals of Materials Chemistry, Vol. 19, p. 471-477 (2009)

Fengyuan Yang

A. J. Hauser, R. A. Ricciardo, A. Genc, R. E. Williams, P. M. Woodward, H. L. Fraser, F. Y. Yang, " Magnetic and Structural Properties of Half-Metallic Sr2FeMoO6 epitaxial Films Fabricated by ultra-High Vaccuum Sputtering," Journal of Applied Physics [Pending]

Ji-Cheng Zhao

R. J. Thompson, J. C. Zhao, K. J. Hemker, "Effect of ternary elements on a martensitic transformation in β-NiAl", Intermetallics, Vol. 18, p. 796-802 (2010)

H. K. Lingam, X. N. Chen, T. Yisgedu, Z. G. Huang, J. C. Zhao, S. G. Shore, "Redetermination of di-mu-hydrido-hexahydridotetrakis(tetrahydrofuran)dialuminium(III)magnesium(II)", Acta Crystallographica Section E-Structure Reports Online, Vol. 66, p. M575-U994 (2010)

Z. G. Huang, J. Gallucci, X. NA. Chen, T. Yisgedu, H. K. Lingam, S. G. Shore, J. C. Zhao, "$Li_2B_{12}H_{12} \cdot 7NH_3$: a new ammine complex for ammonia storage or indirect hydrogen storage", Journal of Materials Chemistry, Vol. 20, p. 2743-2745 (2010)

X. Zheng, D.G. Cahill, J.C. Zhao, "Effect of MeV ion irradiation on the coefficient of thermal expansion of Fe-Ni Invar Alloys: A combinatorial study", Acta Materialia, Vol. 58, p. 1236-1241 (2010)

D.G. Cahill, X. Zheng, J.C. Zhao, "Spatially Resolved Measurements of Thermal Stresses by Picosecond Time-Domain Probe Beam Deflection", Journal of Thermal Stresses, Vol. 33, p. 9-14 (2010)

T.B. Yisgedu, X.N. Chen, H.K. Lingam, Z.G. Huang, E.A. Meyers, S.G. Shore, J.C. Zhao, "Intermolecular Dihydrogen- and Hydrogen-Bonding Interactions in Ammonium Closo-Decahydro Decaborate Sesquihydrate", Acta Crystallographica Section C-Crystal Structure Communications, Vol. 66, p. M1-M3 (2010)

X. Chen, H. K. Lingam, Z. Huang, T. Yisgedu, J.-C. Zhao, S.G. Shore, “Thermal Decomposition Behavior of Hydrated Magnesium Dodecahydrododecaborates”, Journal of Physical Chemistry Letters, vol. 1, pp. 201-204 (2010)

J.C. Zhao, Y. Du, Q. Chen, "Editorial", Journal of Phase Equilibria and Diffusion Vol. 30, p. 417 (2009)

Yi Zhao

Y. Zhao, H. Zheng, "Fabricating Freeform Polymer Microstructures for Micromechanical and Microfluidic Applications", Sensors and Actuators B: Chemical (2009)

Y. Zhao, H. Zeng, "Fabricating Non-Photodefinable Polymer Microstructures for Micro-Total-Analysis", Sensors and Actuators B: Chemical, 139 673-681, (2009)

H. Zeng, Y. Zhao, B. Wu, C. Taylor, R. Jacobsen, Y. Gao, "Picosecond Laser Ablation of Polydimethylsiloxane (PDMS)", Proceedings of ASME international Manufacturing Science and Engineering Conference 2009,West Lafayette, IN (2009)

H. Zeng, and Y. Zhao, “Creating Microstructures in Electrospun Nanofibers Using a Micropatterned Collector Chip,” Proceeding of the 15th International Conference on Solid-State Sensors and Actuators and Microsystems (Transducers '09), Denver, CO. pp. 1099-1102 (2009)

B. Kim, D. M. Grzybowski, P. Weber, C. J. Roberts, and Yi Zhao, “Electrospun Micro/Nanofiber Assisted In Vitro Construction of Trabecular Meshwork for Glaucoma Investigation,” Proceeding of the 13th International Conference on Miniaturized Systems for Chemistry and Life Sciences (MicroTAS '09), JeJu Island, Korea, November 1-5, pp. 1192-1194 (2009)

Y. Zhao, H.S. Zeng, “Rotational Maneuver of Ferromagnetic Nanowires for Cell Manipulation”, IEEE transactions on Nanobioscience, Vol. 8, p. 226-236 (2009)

Appendix B: Professional Presentations Directly Resulting from IMR Resources and Activities for Fiscal Year 2009-2010

Note: This list relies on self reporting and is likely to be underestimated; an asterisk (*) indicates those items obtained through leveraging more than one IMR-supported activity

Gunjan Agarwal

T. Nocera, A. Blissett, G. Agarwal. 2009. “Magnetic Force microscopy of Magnetic Nanoparticles in Cells”, Biomedical Engineering Society National Meeting- Poster Presentation. Pittsburgh, PA

G. Agarwal. 2009. “Magnetic Force Microscopy of Magnetic Nanoparticles”. National Chemical Laboratory. Pune, India

Sheikh Akbar

B. Dinan, S.A. Akbar and S.D. Dregia. 2010. "1-D nano-structured TiO2 for Chemical Sensing," IMCS-13. Perth, Australia

S.A. Akbar. 2009. "Nano-structured Ceramics and Novel Applications," Chonnam National University. Gwangju, Korea

Suresh Babu

S.C. Nagpure, S.S. Babu, B. Bhushan, B. Bhushan and Y. Guezennec. 2009. “Correlation of Lithium-ion Battery Performance with Material Degradation,” Edison Welding Insitute Battery Assembly Technology Conference

S.C. Nagpure, S.S. Babu, B. Bhushan, Y. Guezennec, and R. Dinwiddie. 2009. “Battery Aging: Micro- and Nano-Characterization,” 1st Center for Automotive Research Battery Symposium

S.C. Nagpure, S.S. Babu, B. Bhushan, B. Bhushan and Y. Guezennec. 2009. “Aging Mechanisms in L-ion Batteries,” Institute for Materials Research, Materials Week. Columbus, OH

B. Narayanan, M.J. Mills, E.D. Specht, M.L. Santella, and S.S. Babu. 2009. “Characterization of solid state phase transformation in continuously heated and cooled ferritic steel weld metal.” International workshop on IN-situ Studies with Photons, Neutrons, and Electrons Scattering (keynote - invited). BAM, Berlin, Germany

S.S. Babu.2009. “Role of characterization tools and multi-scale materials modeling for joining of advanced materials.” Thermec 2009 (keynote - invited). Berlin, Germany

S.S. Babu. 2009. “Microstructure evolution in Steels and Alloys During Nonequilibrium Processing.” HERO-M and Brinnell Vinn Seminar (Invited). KTH, Sweden

S.S. Babu. “Use of computational modeling to predict microstructure evolution in steel welds.” 3rd Congress on Metallurgy and Materials (Keynote). Monclova City, Mexico

S.S. Babu. 2009. “Role of Joining Science in Developing Hybrid Structural Material,” Invited Presentation at the MaRIE work shop: Structural Mateirals under Extreme Conditions. Los Alamos National Laboratory, NM

Paul Berger

P.R. Berger. 2010. “Electrode Surface Modifications for Efficient Polymer Bulk Heterojunction Photovoltaic Devices”. SEMICON, Symposium on Emerging Semiconductor Technologies at ISTC/CSTIC. Shanghai, China

P.R. Berger. 2009. “Tunneling Based Devices for Next Generation Quantum Functionality”. SEMICON, Symposium on Emerging Semiconductor Technologies at ISTC/CSTIC. Shanghai, China

S.Y. Park, A. Ramesh, S. Jiang, P.R. Berger, R. Loo, N.D. Nguyen, S. Takeuchi, J. Goossens, M. Caymax. 2009. “Zero-Bias Si Backward Diodes Detectors Incorporating P and B δ-Doping Layers Grown by Chemical Vapor Deposition,” International Semiconductor Device Research Symposium. College Park, MD

W.J. Yoon, K.Y. Jung, F.L. Teixeira, P.R. Berger, J. Liu, T. Duraisamy, R. Revur, S. Sengupta. 2009. "Efficient Poly(3-hexylthiophene)-Fullerene Derivative Bulk Heterojunction Photovoltaic Devices using Unique Self-assembled Layer of Ag Nanoparticles with Controllable Particle-to-particle Spacing”. 34th IEEE Photovoltaic Specialists Conference. Philadelphia, PA

W.J. Yoon, Y.i Ghosh, B. Alberding, M.H. Chisholm, P.R. Berger. 2009. "Efficient Organic Bulk Heterojunction Solar Cells through Near Infrared Absorbing Metallated Thiophene Complexes”. 34th IEEE Photovoltaic Specialists Conference. Philadelphia, PA (Runner-up Best Poster Award)

Dennis Bong

D. Bong. 2010. University of Pennsylvania, Department of Chemistry. State College, PA

D. Bong. 2010. University of Chicago, Department of Chemistry. Chicago, IL

D. Bong. 2010. University of California, Irvine, Department of Chemistry. Irvine, CA

D. Bong. 2010. University of Californa, Los Angleles, Department of Chemistry/Bioengineering. Los Angeles, CA

D. Bong. 2010. Purdue University, Department of Chemistry. West Lafayette, IN

D. Bong. 2010. Northwestern University, Department of Chemistry. Evnaston, IL

D. Bong. 2010. New York University, Department of Chemistry. New York, NY

D. Bong. 2010. Columbia University, Department of Chemistry. New York, NY

D. Bong. 2010. University of Wisconsin, Madison, Department of Chemistry. Madison, WI

D. Bong. 2010. The Scripps Research Institute. La Jolla, CA

D. Bong. 2010. "Medical/Biochemical Diagnostic, Pharmaceutical, and Drug Delivery Applications of Particle Technology". Particles 2010 conference. Regal Sun Resort, Lake Buena Vista, FL.

D. Bong. 2009. "Structure and function of membranes, proteins and lipids, COLL.". ACS National Conference. Salt Lake City, UT

D. Bong. 2009. Muskingum College, New Concord, OH

D. Bong. 2009. "Supramolecular chemistry and assemblies". Gordon Research conference (Poster). Colby College. Waterville, ME

2009. Spring Natioinal American Chemical Society Meeting. Salt Lake City, UT

2009. Central Regional Meeting. Cleveland, OH

2009. Fall National American Chemical Society Meeting. Washington, DC

Aimee Bross

A.Bross, G.Lafyatis, R.Ayachitula, A.Morss, R.Hardman and J. Golden, R. Davis. 2009. "Robust, Efficient Grating Couplers for Planar Optical Waveguides Using No-PAG SU-8 EBL", EIPBN Conference. Marco Island, FL

Malcolm Chisholm

2010. "Organic PV", 35th IEEE Photovoltaic Specialist Conference. Waikiki, HI

P.R. Berger. 2010. "Electrode Surface Modifications for Efficient Polymer Bulk Heterojunction Photovoltaic Devices." SEMICON, Symposium on Emerging Semiconductor Technologies at ISTC/CSTIC. Shanghai, China

L. M. Mier, A. Carter, T. L. Gustafson, A. J. Epstein. 2009. "Ultrafast Time-Resolved Spectroscopy of Photoinduced Electron Transfer for Use in Novel Photovoltaic Devices." American Physical Society Meeting. Pittsburgh, PA

W.J. Yoon, K.Y. Jung, F.L. Teixeira, P. R. Berger, J. Liu, T. Duraisamy, R. Revur, S. Sengupta. 2009. "Efficient Poly(3-hexylthiophene)-Fullerene Derivative Bulk Heterojunction Photovoltaic Devices using Unique Self-assembled Layer of Ag Nanoparticles with Controllable Particle-to-particle Spacing." 34th IEEE Photovoltaic Specialists Conference. Philadelphia, PA

W.J. Yoon, P.R. Berger, Y. Ghosh, Y.H. Chou, C. Reed, B. Alberding, M.H. Chisholm. 2009. "Efficient Organic Bulk Heterojunction Solar Cells through Near Infrared Absorbing Metallated Thiophene Complexes." 34th IEEE Photovoltaic Specialists Conference. Philadelphia, PA (Runner-up Best Poster Award)

M.H. Chisholm. 2009. "Oligothiophenes Incorporating MM Quadruple Bonds (MM = Mo2, MoW and W2). A Chemical Approach to Photon Harvesting and Spectral Expansion." 34th IEEE Photovoltaic Specialist Conference. Philadelphia, PA

B.G. Alberding, M.H. Chisholm. "Photophysics of Paddlewheel Complexes Involving Molybdenum and Tungsten Quadruple Bonds Supported by Amidinate and Carboxylate Ligands". The International Symposium on Molecular Spectroscopy. Columbus, OH

C.R. Reed, M.H. Chisholm, C. Turro. 2009. "The Photophysical Properties of Quadruply Bonded M2 Arylethynylcarboxylate Complexes." The International Molecular Spectroscopy Symposium. Columbus, OH

Y. Ghosh, M.H. Chisholm, Y. Liu, B.G. Alberding, C. Turro, T.L. Gustafson. "Metallo-Thiophenes with Novel Electronic and Optical Properties: Photoharvestors in Solar Cells." Central Regional Meeting of the American Chemical Society. Cleveland, OH

C.R. Reed, M.H. Chisholm, C. Turro. 2009. "Incorporation of Ethynylaryl Carboxylates into Quadruply Bonded M2 Complexes." 237th ACS National Meeting. Salt Lake City, UT

M.H. Chisholm. 2009. "Sexithiophenes Mediated by MM Quadruple Bonds: MM = Mo2, MoW and W2." 237th Amarican Chemical Society National Meeting. Salt Lake City, UT

M. Chisholm. 2009. "Molecular Infomatics". Northwestern University/Argonne National Lab, IL

M. Chisholm. 2009. "Mixed Valence Complexes". University of Wisconsin. Madison, WI

M. Chisholm. 2009. "Mixed Valence Complexes". University College London. London, UK

M. Chisholm. 2009. "New Generation Polymers from Renewable Resources: Opportunities for Single-Site Metal Alkoxide Catalysts.". University of Bristol, Gordon Stone Lecture. Bristol, UK

M. Chisholm. 2009. "Towards Molecular Infomatics: Studies of Mixed Valency and M2δ-π Conjugation". University of Bristol, Gordon Stone Lecture. Bristol, UK

M. Chisholm. 2009. "Molecular Infomatics". Manchester University. Manchester, UK

M. Chisholm. 2009. “Excited State Mixed Valence”. CERMACS. Columbus, OH

M. Chisholm. 2009. “Control of Lactide Polymerization by Coordination Metal Complexes and Organic Catalysis”. Biopolymers Symposium. Chicago, IL

M. Chisholm. 2009. “Spectral Expansion for Solar Harvesting”. IEEE PVSC, Philadelphia, PA

M. Chisholm. 2009. “Sexithiophenes”. American Chemical Society. Salt Lake City, UT

M. Chisholm. 2009. “Chemical Amplification”. Gordon Research Conference. Ventura, CA

M. Chisholm. 2009. “Control of Lactide Polymerization by Coordination Metal Complexes and Organic Catalysis”. IUPAC. Glasgow, UK

Marcelo Dapino

M. Dapino. 2010. “Active Metal-Matrix Composites Produced by Ultrasonic Consolidation”. ARO Workshop on Intelligent and Active Protective Systems for Dynamic Load Mitigation. Aberdeen, MD

M. Dapino. 2010. “Metal-Matrix Composites with Smart Switches Embedded by Ultrasonic Consolidation,” ASME Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS)

Arthur Epstein

D. Duman. 2009. Spinos Meeting. Salt Lake City, UT

D. Duman. American Physical Society March Meeting. Pittsburgh, PA

M. Murphey. American Physical Society March Meeting. Pittsburgh, PA

Hamish Fraser

V. Dixit, J. M. Sosa, P. C. Collins, H. L. Fraser. 2010. “Microstructural evolution and Tensile behavior in Ti-5111 alloy.” TMS Annual Meetin. Seattle, WA

J. Foltz, B. Welk, P. Collins, R. Williams, H. Fraser. 2010. “Microstructural Evolution and Properties of Timetal 555.” AeroMat. Dayton, OH

J. Foltz, B. Welk, P. Collins, R. Williams, H. Fraser. 2010. “The Development of Databases Relating Microstructure and Mechanical Properties in Ti-5Al-5Mo-5V-3Cr-0.5Fe (Timetal 555).” TMS Annual Meeting. Seattle, WA

H. Fraser. 2010. “University Activities in Additive Manufacturing.” EWI Additive Manufacturing Consortium Meeting. Columbus, OH

H. Fraser. 2010. “Ti Alloys by Design for Lighter, Stronger and Tougher Alloys - Modeling, Simulation and Validation.” Boeing Workshop. Seattle, WA

H. Fraser. 2010. “Pushing to the Limits of Spatially Resolved Compositional Determinations in Aberration-Corrected Scanning Transmission Electron Microscopy.” EMSI-2010. Mumbai, India

H. Fraser. 2010. “Towards Modeling the Mechanical Properties of Ti Alloys.” NIMS. Tsukuba, Japan

H. Fraser. 2010. “Integrated Computational Materials Science and Engineering.” iVEC and Curtin University. Perth, Western Australia

H. Fraser. 2010. “Cool New Stuff with Experiments.” USAF Workshop on Nucleation. Maui, HI

H. Fraser. 2010. “Applying Novel Techniques to the Determination of Nucleation Mechanisms.” USAF Workshop on Possibilities and Limitations of Modeling and Characterization of Defects, Interfaces and Phase Transformations. Bernkastel, Germany

J. Sosa. 2010. “Application of Novel Techniques to the Three-dimensional Characterization of Microstructural Features in α+β Titanium Alloys.” TMS Annual Meeting, Seattle, WA

R. Williams. 2010. “Direct Three Dimensional Characterization of Microstructures in a/ß- and ß-Ti Alloys”, TMS Annual Meeting, Seattle, WA

J. Sosa. 2009. “Characterization of Kinetic Metallization, a Novel Subsonic Cold Spray Metal Deposition Technique.” Materials Science & Technology, Pittsburgh, PA

J. Sosa. 2009. “2D/3D Characterization Tools.” ONR Annual Review., Washington, DC

R. Williams. 2009. “Three Dimensional Atom Probe Analysis of Heterogeneous Phases in Binary Titanium-Molybdenum Alloys”, Microscopy and Microanalysis 2009, Richmond, VA

J. Foltz, B. Welk, P. Collins, R. Williams, H. Fraser. 2009. “Development of Microstructure-Mechanical Property Knowledge Bases in Timetal 555.” Gordon Research Conference on Physical Metallurgy, Andover, NH

S. Koduri, V. Dixit, P. Collins, H. Fraser. 2009. “The Application of Bayesian Neural Network Modeling and Critical Experimentation for the Prediction of Fracture Toughness Properties in Alpha/Beta Titanium Alloys.” Materials Science & Technology. Pittsburgh, PA

H. Fraser. 2009. “Progress Towards Predicting the Interrelationships between Microstructure and Properties in Ti Alloys.” Indian Institute of Materials Lecture and Defence Metallurgical Research Laboratory. Hyderabad, India

H. Fraser. 2009. “Limits to High Spatial Resolution of EDS and EELS in an Aberration-Corrected (S)TEM.” Frontiers of Electron Microscopy, Microanalysis and Spectroscopy, FEMMS2009, Huis ten Bosch. Nagasaki, Japan

H. Fraser. 2009. “Phase Stabilities in Metallic Multilayers.” MS&T’09. Pittsburgh, PA

V. Dixit, J. M. Sosa, S. Koduri, D. Huber, P. C. Collins and H. L. Fraser. 2009. “Two and Three-Dimensional Characterization of Microstructural Evolution in Ti-5111, Ti-550 and Ti-6Al-4V.” MS&T-2009. Pittsburgh, PA

H. Fraser. 2009. “Factors Affecting Elemental Quantification at the Atomic Scale using EDS and EELS.” MS&T’09. Pittsburgh, PA

H. Fraser. 2009. “Development of Neural Networks for the Assessment of the Interrelationships between Microstructure and Properties of Ti Alloys.” ExxonMobil Research and Engineering Company. Annandale, NJ

H. Fraser. 2009. “Experimental and Computational Tools for the Digital Representation and Prediction of Microstructure and its Incorporation in the Designer’s Knowledge Base.” GE Aviation. Evendale, OH

H. Fraser. 2009. “Integration of Microstructural Characterization and Neural Networks for the Prediction of Microstructure and Properties in Titanium Alloys.” Annual Workshop of the ARC Light Metals Design Centre. Geelong, Australia

Jianjun Guan

J. Guan. 2009. "Biomimetic Biomaterials for Cardiovascular Tissue Engineering”. Seminar at Department of Materials Science and Engineering. Purdue University, West Lafayette, IN

J. Guan. 2009. "Biomimetic Engineering of Microenvironment for Cardiovascular Tissue Engineering”. Seminar at Davis Heart and Lung Research Institute. Ohio State University, Columbus, OH

Jay Gupta

D. Daughton. 2010. "Low temperature Scanning Tunneling Spectroscopy of C60 Films on the Cu(100) Surface". American Physical Society

Chris Hammel

P.C. Hammel. 2010. “Generation of localized ferromagnetic resonance modes for scanned probe imaging”. Workshop: Opportunities for Magnetism in MEMS/NEMS. Argonne National Laboratory

Ezekiel Johnston-Halperin

P. Truitt, I. Khalaf, H. Yu, M. Chisholm, E. Johnston-Halperin. 2010. “Contacting Organic and Organometallic Monolayers with Ferromagnetic Electrodes.” American Physical Society. Portland, OR

P. Truitt, J. Tee, N. Abdullah, I. Khalaf, M. Chisholm, E. Johnston-Halperin. 2009. “Langmuir Monolayer / Magnetic Hybrid Structures: A Platform for Molecular Spintronics.” (Poster) IMR Materials Week 2009. Columbus, OH

P.A. Truitt, R. Talwar, E. Johnston- Halperin, N. Abdullah, C. Reed, N. Singh, C. Chatterjee, M. Chisholm. 2009. “Magnetic and Surface Studies of Transition Metal Complexes for Molecular Spintronics". American Physical Society. Pittsburgh, PA

S. Parks. 2009. “Structural Characterization of Spin-Torque Osciallators”. American Physical Society. Pittsburgh, PA

Ke Li. 2009. “Sub-lithographic Patterning of Extended Arrays of Graphene Nanostructures”. American Physical Society. Pittsburgh, PA

Gregory Lafyatis

G. Lafyatis. 2009. "Atom Optics with Planar Optical Waveguides". Midwest Cold Atom Workshop IV. Chicago IL.

G. Lafyatis. 2009. "Robust, efficient grating couplers for planar optical waveguides using no-photoacid generator SU-8 electron beam lithography". EIPBN 53 (Three Beams) Conference. Marco Island, FL

Stephen Lee

T. Nicholson III, S. Gupta, P. Casal, X. Wen, H.-H. Wu, W. Lu, L. Brillson, and S.C. Lee. 2010. "Influence of Recognition Element Conformation and Conjugation parameters on FET Protein Sensors". BMES Fall Meeting. Austin, TX

P. Casal, T. R. Nicholson III, S. K. Gupta, and S. C. Lee. 2010. "Impact of receptor of conjugation strategy on FET protein sensor function". BMES Fall Meeting. Austin, TX.

S. Gupta, X. Wen, P. Casal, H.H. Wu, M. Palacio, W. Lu, B. Bhushan, L. Brillson, S.C. Lee. 2010. "Detection of picomolar levels of protein analyte in physiologic buffer using a planar BioFET". BMES Fall Meeting. Austin, TX

S.C. Lee, T. Nicholson III, P. Berger, X. Wen, A. Ramesh. 2010. "Protein and interfacial engineering addressing limitations of bioFET protein sensors operating in physiological buffers".

3rd Annual Unither Nanomedicine & Telemedical Technology Conference. Magog Quebec, Canada

S.C. Lee, T. Nicholson III, P. Berger, X. Wen, A. Ramesh. 2010. "Protein engineering to solve problems at nanoscale". International Conference on Nanoengineering and Nanosystems. University of Edinburgh, UK

S. Gupta, T.R. Nicholson, III, K.J. Kwak, X. Wen, B. Bhusan, L. Brillson, W. Lu, 2009. and SC. Lee. "Optimization of the sensing interface of a MIG-detecting immunoFET intended for in vivo application". BMES Fall Annual Meeting. Pittsburgh, PA

Michael Mills

M. Mills, G. Eggeler, A. Dlouhy, D. Norfleet, M. Bowers. 2010. “The Role of Dislocations in Superelasticity and Functional Fatigue In Shape Memory Alloys.” Shape Memory and Superelastic Technologies (SMST 2010). Asilomar, CA

M. Mills. 2010. “Mechanisms of Creep and Fatigue Damage in Polycrystalline Disk Superalloys.” Euro-Superalloys 2010. Munich, Germany

M. Mills, L. Kovarik, K.A. Unocic, Wang, S. Ghosh. 2009. “Microstructure- and Micromechanism-Sensitive Modeling of Creep and Fatigue in Ni-Base Superalloys”. Gordon Research Conference of Physical Metallurgy. Proctor Academy, New Hampshire

M. Mills L. Kovarik, K.A. Unocic, Wang, S. Ghosh. 2009. “Characterization and Modeling of Superalloy Performance.” Cambridge University Workshop on Superalloys. Cambridge, England

M. Mills, L. Kovarik, K.A. Unocic, Wang, S. Ghosh. 2009. “Creep Deformation in Superalloys: Characterization and Modeling.” International Conference on High Temperature and High Strength Structural Materials. Hong Kong, China

M. Mills, L. Kovarik, K.A. Unocic, Phillips, Wang. 2009. “Mechanisms of Deformation in Superalloys.” Symposium to Honor Vasek Vitek, Materials Research Society Fall Meeting. Boston, MA

Nicanor Moldovan

M. Anghelina, O. I. Butt, A. Bratasz, L. Moldovan, P. Kuppusamy, N. I. Moldovan. 2010. "Tissue Engineering of Peri-Implant Space with Stem/Progenitor Cells for Improvement of Implant-Level Oxygenation". Oxygen Club of California Meeting. Santa Barbara, CA

M. Anghelina, O. I. Butt, J. Johnson, J. Lannutti, N. I. Moldovan. 2009. "Tissue Engineering of Peri-Implant Space with Stem/Progenitor Cells: A Novel Approach to Limit the Impact of Foreign Body Reaction". Biomedical Engineering Society Annual Meeting. Pittsburgh, PA

Patricia Morris

P. Morris. 2010. "Properties and Characterization of Nano-Structured Metal-Oxides Used for Gas Sensor Array Devices". Materials Science and Technology, Dielectric Ceramic Materials and Electronic Devices Symposium. Houston, TX

P. Morris. 2009. Materials Research Society. San Fransisco, CA

Roberto Myers

S. Carnevale, J. Yang, P. Phillips, M.J. Mills, and R. C. Myers. 2010. “Self-assembled GaN/AlN nanowire superlattices on Si toward non-polar intersubband photonics”. Electronic Materials Conference

R. Myers. 2010. “Wide band gap nanostructures toward room temperature semiconductor spintronics”. Electrical Engineering Department Seminar (Invited). Notre Dame University, South Bend, IN

J. Yang. 2010. “Engineering ferromagnetism in Gd-doped GaN two-dimensional electron gases”. Electronic Materials Conference. Notre Dame University, South Bend, IN

B. Chapler, R.C. Myers, S. Mack, E. Namdas, J.D. Yuen, A.J. Heeger, N. Samarth, M.C. Martin, K.S. Burch, D.N. Basov, D.D. Awschalom. 2010. “Infrared probe of charge density modification in GaMnAs films.” March Meeting of the American Physical Society. Portland, OR

G. Calusine. 2010. “Spin dynamics of magnetic ions in semiconductor optical cavities.”March Meeting of the American Physical Society. Portland, OR

Denis Pelekhov

D. Pelekhov. 2010. “Micromagnetic Modeling of Magnetic Resonance Force Imaging of Individual Ferromagnetic Nanowires.” American Physical Society 2010 March Meeting. Portland, OR

Nitin Padture

N. Padture. 2009. "Towards Rational Tailoring of Functional and Structural Nanomaterials: Nanowires (1-D), Graphene (2-D), and Nanocomposites (3-D)”. University of Michigan, Ann Arbor, MI

N. Padture. 2009. "Novel Concepts in Structural Ceramics: Thermal Barrier Coatings and Contact-Damage-Resistant Ceramic Nanocomposites,” Case Western Reserve University, Cleveland, OH

N. Padture. 2009. "Towards Rational Tailoring of Functional and Structural Nanomaterials: Nanowires (1-D), Graphene (2-D), and Nanocomposites (3-D)," University of Seville, Seville, Spain

N. Padture. 2009. "Towards Rational Tailoring of Functional and Structural Nanomaterials: Nanowires (1-D), Graphene (2-D), and Nanocomposites (3-D)," University of Extremadura, Badajoz, Spain

Siddarth Rajan

S. Rajan. 2010. "N-polar GaN Materials and Devices". Presented at University of Notre Dame. South Bend, IN

S. Rajan. 2010. "Electron Transport in Vicinal N-polar Heterostructures". Presented at Workshop on Compound Semiconductor Devices and Materials. Miami, FL

S. Rajan. 2010. "Electron Mobility in Graded AlGaN Layers." Presented at Workshop on Compound Semiconductor Devices and Materials. Miami, FL

S. Rajan. 2010. "Nanoscale GaN Electronics". Presented at Workshop on Compound Semiconductor Materials and Devices. Newport Beach, CA

S. Rajan, D. Nath, F. Akyol, E. Gur, S. Ringel. 2010. "MBE Growth of N-polar InGaN". Electronic Materials Conference. South Bend, IN

S. Rajan. 2009. "Polarization Engineering in Gallium Nitride". Presented at Worskshop on Compound Semiconductor Materials and Devices. Palm Springs, CA

S. Rajan. 2009. "A Tutorial on Gallium Nitride Transistors". Presented at International Workshop on Semiconductor Devices. Delhi, India

S. Rajan. 2009. "New Approaches to GaN Electronics". Presented at International Workshop on Physics of Semiconductor Devices. Delhi, India

P. Ramesh, S. Krishnamoorthy, P. S. Park, S. Rajan, G. Washington. "Distributed Intelligence using Gallium Nitride based Active Devices." SPIE/ASME Conference

Steven Ringel

S.A. Ringel. 2009. "III-V/Si Heterointegration for Photovoltaics." 216th Electrochechemical Society Meeting. Vienna, Austria

S.A. Ringel. 2009. "The impact and control of defects in III-V/Si heterostructures for photovoltaics." 13th International Conference on Defects Recognition, Imaging and Physics in Semiconductors (DRIP XIII)

A. Malonis , S.A. Ringel. 2009. "Electronic trap characterization in operating AlGaN/GaN Heterojunction Field Effect Transistors." Dayton Area Graduate Student Institute (DAGSI)

S.A. Ringel, T.J. Grassman, M.R. Brenner, R. Unocic, R. Dehoff, M. Mills. 2009. “Solar cells using metamorphic substrates.” Proc. WOCSDICE. Malaga, Spain

T. J. Grassman, M. R. Brenner, A. M. Carlin, J. Park, S. Rajagopalan, R. Unocic, R. Dehoff, M. Mills, H. Fraser, S. A. Ringel. 2009. “Toward Metamorphic Multijunction GaAsP/Si Photovoltaics Grown on Optimized GaP/Si Virtual Substrates Using Anion-Graded GaAsyP1-y Buffers.”extended oral/plenary, Proc. 34th IEEE Photovoltaic Specialists Conf. Philadelphia, PA

S.A. Ringel. 2009. “III-V Compound Photovoltaics: The Need for Bandgap Engineered Heterostructure Solar Cells on Si.” Singapore Clean Energy Research Program. Nanyang Technological Institute, Singapore

I. Suh, P. Roblin, Y. Ko, C-K. Yang, A. Malonis, A. Arehart, S.A. Ringel, C.Poblenz, Y. Pei, J. Speck, U. Mishra. 2009. “Additive Phase Noise Measurements of AlGaN/GaN HEMTs Using a Large Signal Network Analyzer and a Tunable Monochromatic Light Source." 74th ARFTG Conference Digest, 2009, 5 pp., in print

C-K. Yang, P. Roblin, A. Malonis, A. Arehart, S.A. Ringel, C. Poblenz, Y. Pei, J. Speck, U. Mishra. 2009. “Characterization of Traps in AlGaN/GaN HEMTs with a Combined Large Signal Network Analyzer/Deep Level Optical Spectrometer System.” Proc. IEEE-MTT International Microwave Symposium (IMS), pp. 1209-1212

X.J.Chen, H.J. Barnaby, J.H. Warner, S.R. Messenger, R. Walters, S.A. Ringel, M. Brenner, A. Carlin. 2009. “Non-linear behaviors of dark current slope in p+n GaAs solar cells following proton irradiations.”Proc. 34th IEEE Photovoltaic Specialists Conf. Philadelphia, PA

T.K. Ng, S.F. Yoon, K.H. Tan, W.K. Loke, S. Wicaksono, K.L. Lew, E.A. Fitzgerald, A.J. Pitera, S.A. Ringel, A.M. Carlin, J.S. Harris. 2009. “1 eV GaNAsSb for lattice-matched III-V solar cell implementation on GaAs and Ge,”Proc. 34th IEEE Photovoltaic Specialists Conf. Philadelphia, PA

T. Homan, A. Arehart, A. Malonis, M. H. Wong, Y. Pei, C. Poblenz, A. Corrion, R.M. Chu, U.K. Mishra, J.S. Speck, S. A. Ringel. 2009. “Characterization of Traps in N-face AlGaN/GaN Materials and Devices Using Deep Level Optical Spectroscopy.” 51st TMS/IEEE Electronic Materials Conf., abstract proceedings p. 103. State College, PA

T. J. Grassman, M. R. Brenner, J. Park, A. Ringel. 2009. “Toward Metamorphic Multijunction GaAsP/Si Photovoltaics Grown on Optimized GaP/Si Virtual Substrates Using Anion-Graded GaAsyP1-y Buffers.” 51st TMS/IEEE Electronic Materials Conf., abstract proceedings pp. 96-97. State College, PA

K. Swaminathan, T. Grassman, Q. Gu, T. Homan, S.A. Ringel. 2009. “Metamorphic InGaAs and InGaP on GaAs for Multispectral detector applications.” 51st TMS/IEEE Electronic Materials Conf., abstract proceedings pp. 46-47. State College, PA

R. Sooryakumar

G. Ruan, D. Thakur, S. Hawkins, J.O. Winter. 2010. “Synthesis and Manipulation of Multifunctional, Fluorescent-Magnetic Nanoparticles for Single Molecule Tracking”. SPIE Photonics West. San Jose, CA

R. Sooryakumar. 2010. “Mobile magnetic traps for biological applications”. March Meeting of the American Physical Society. Portland, OR

Claudia Turro

C. Turro. 2010. “Symposium on Metal-Nucleic Acid Interactions”. PACIFICHEM. HI

C. Turro. 2009. Department of Chemistry, Massachusetts Institute of Technology. Cambridge, MA

C. Turro. 2009. Department of Chemistry, Rice University. Houston, TX

Yael Vodovotz

S. Modi, K. Koelling, Y. Vodovotz. 2010. “Thermal and Rheological Properties of Poly-(3-hydroxybutyrate-co-3-hydroxyvalerate) and Poly (Lactic Acid) blends for Food Packaging Applications”. Poster Presentation Society of Plastic Engineers- Plastics Environmental Division (GPEC)

S. Modi, K. Koelling, Y. Vodovotz. 2010. “Thermal and Rheological Properties of Poly-(3-hydroxybutyrate-co-3-hydroxyvalerate) and Poly (Lactic Acid) blends for Food Packaging Applications”. North American Thermal Analysis Society (NATAS) Thermal and Bio-plastics division

S. Modi, K. Koelling, Y. Vodovotz. 2010. “Thermal and Rheological Properties of Poly-(3-hydroxybutyrate-co-3-hydroxyvalerate) and Poly (Lactic Acid) blends for Food Packaging Applications”. Proceedings of Society of Plastic Engineers-Antec conference

S. Modi, K. Koelling, Y. Vodovotz. 2009."Thermal and Rheological Properties of PHB Synthesized with Various Hydroxyvalerate Content for Potential Use in Food Packaging Applications". Antec Conference

S. Modi, K. Koelling, Y. Vodovotz. 2009. “Characterization of PHB Synthesized with Various Valerate Content for Potential Food Packaging Applications”. Poster Presentation-Institute of Food Technologist

David Wood

B. Fong, W.Y. Wu, D. W. Wood. 2010. “Recent advances in elastin-like polypeptide-mediated nonchromatographic protein purification.” The 239th ACS National Meeting. San Francisco, CA

B. Fong, W.Y. Wu, D. W. Wood. 2010. “Sequence optimization of elastin-like polypeptide and its potential use in non-chromatographic bioseperation.” The 239th ACS National Meeting. San Francisco, CA

B. Fong, W.Y. Wu, D. W. Wood. 2010. “Recent developments in intein-mediated protein purification technology.” The 239th ACS National Meeting. San Francisco, CA

I.Hartman, J. Li, M. Gawrys, T. Eyster, K. Shapiero, A.R. Gillies, G. Skretas, D.W. Wood. 2010. “Bacterial biosensors: Design and application,” The 239th ACS National Meeting. San Francisco, CA

B. Fong, K. Lee, D.W. Wood. 2010. “Large scale production and purification of elastin-like polypeptide tagged organophophate hydrolase.” The 239th ACS National Meeting. San Francisco, CA

2009. “Self-Cleaving Tags Based on Engineered Inteins: Recent Results and Future Prospects.”The Bioprocessing Summit: Affinity Tag Protein Purification, Cambridge Healthtech Institute. Cambrige, MA

2009. “Novel ELP-intein based purifications (affinity methods).” (Keynote) 15th International Conference on Biopartitioning and Purification, Brunel Institute for Bioengineering. Uxbridge, UK

2009. “Advances in Non-Chromatographic Bio-Separation Techniques; Significantly Improving Process Through-Out' Production.”BioInnovation Leaders Summit 2009, GBX Summits. Syon Park, London

2009. “Recombinant Protein Purification Using Self-Cleaving Non Chromatographic Bioseparation Tags.” PepTalk: Processes to Optimize Protein Purification and Recovery (Featured Presentation), Cambridge Healthtech Institute. San Diago, CA

2009. “Simple Biosensors to Detect Endocrine Active Compounds: Application to ASD related targets.” Nancy Lurie Marks Family Foundation, Boston Club Presentations. Newton, MA

2009. “New Technologies from Self-Modifying Proteins.” Rensselaer Polytechnic Institute, Department of Chemical and Biological Engineering. Troy, NY

2009. “Novel Bioseparations Using Self-Cleaving Purification Tags.” Ortho Clinical Diagnostics, Department of Research and Development. Rochester, NY

2009. “Novel Bioseparations Using Self-Cleaving Purification Tags.” National Cancer Institute at Frederick, SAIC, Biopharmaceutical Development Program. Frederick, MD

2009. “New Technologies from Self-Modifying Proteins.” City College of New York (AIChE Ambassador Series), Department of Chemical Engineering. New York, NY

W.Y. Wu, A.R. Gillies, J.F. Hsii, L. Contreras, S. Oak, M.B. Perl, D.W. Wood. 2009. “Engineered Self-Cleaving Purification Tags for Rapid Cloning and Protein Purification.” AIChE National Meeting (2009). Nashville, TN

I. Hartman, A.R. Gillies, M.R. Banki, T. Reichel, D.W. Wood. 2009. “Concentration-Controlled Single-Step Protein Purification Using a Tunable Self-Cleaving Affinity-Tag.” AIChE National Meeting (2009). Nashville, TN

B. Fong, K. Lee, N. Ko, D.W. Wood. 2009. “Large-Scale Production of Elastin-Like Polypeptide-Tagged Organophosphate Hydrolase (OPH).” AIChE National Meeting (2009). Nashville, TN

B. Fong, W.Y. Wu, D.W. Wood. 2009. “Optimization of ELP-Intein Mediated Protein Purification by Salt Substitution.” AIChE National Meeting (2009). Nashville, TN

B. Fong, W.Y. Wu, D. W. Wood. 2009. “Optimization of elastin-like polypeptide sequences for better genetic stability.” The 238th ACS National Meeting. Washington, DC

B. Fong, W.Y. Wu, D. W. Wood. 2009. “Investigation of Hofmeister ions to optimize ELP-intein mediated protein purification.” The 238th ACS National Meeting. Washington, DC

I. Ghazi, A.R. Gillies, G. LeRoy, K.C. Lee, D.W. Wood. 2009. “Purification of assembled multisubunit Escherichia coli RNA polymerase by a self-cleaving elastin-like polypeptide (ELP) tag.” The 238th ACS National Meeting. Washington, DC

J. Li, I. Hartman, A. Gillies, C. Warden, D.W. Wood. 2009. “A bacterial sensor for peroxisome proliferator-activated receptors gamma ligands.” The 238th ACS National Meeting. Washington, DC

Fengyuan Yang

F. Yang. 2010. "Photoluminescence Polarization Results in InP and ZnO Nanowires". MRS. SanFrancisco, CA

F. Yang. 2010. "Photoluminescence Polarization Results in InP and ZnO Nanowires". Materials Research Society. San Francisco, CA

Ji-Cheng Zhao

J.-C. Zhao, X. Chen, Z. Huang, H. Kumar, T. Yisgedu, B. Billet, and S.G. Shore. 2010. "Lightweight Metal Hydrides for Hydrogen Storage." (Oral presentation) International Energy Agency (IEA) Task 22 Hydrogen Storage Experts' Meeting. Death Valley, CA

R.C. Bowman, Jr., G.M. Brown, D.A. Knight, J.-C. Zhao, J. Reiter, and J. Zan. 2010. "Characterization Studies of Boron-Containing Compounds for Hydrogen Storage Applications." (Invited talk) Materials Challenges in Alternative & Renewable Energy Sources 2010 Conference. Cocoa Beach, FL

J.C. Zhao, X. Zheng, D. Cahill. 2010. "Compositional Point Defect Evaluation using Diffusion Multiples." (Invited talk) TMS Annual Meeting. Seattle, WA

J.C. Zhao. 2009. "Hydrogen Storage Materials." (Invited talk) Central South University. Changsha, China

J.-C. Zhao, X. Chen, Z. Huang, H. Kumar, T. Yisgedu, B. Billet, J. Hoy, and S.G. Shore. 2009. "Lightweight Metal Hydrides for Hydrogen Storage." (Oral presentation) US Department of Energy Hydrogen Storage Tech Team Meeting, USCAR. Southfield, MI

J.-C. Zhao, Xuan Zheng and D.G. Cahill. 2009. "Combinatorial / High-Throughput Techniques with Micron-Scale Resolution for Property Imaging of Solids." (Invited talk) North American Solid State Chemistry Conference. Columbus, OH

X. Chen, Z. Huang, H. Kumar, T. Yisgedu, B. Billet, J. Hoy, S.G. Shore, J.-C. Zhao. 2009. "Borohydrides for Hydrogen Storage" (Poster) North American Solid State Chemistry Conference. Columbus, OH

X. Zheng, J.C. Zhao, D. Cahill. 2009. "Spatially-Resolved Measurements of Thermal Stresses by Picosecond Time-Domain Probe Beam Deflection." (Keynote Lecture) 8th International Congress on Thermal Stresses (TS'2009). Urbana, IL

Appendix B: Honors and Awards Directly Resulting from IMR Resources and Activities for Fiscal Year 2009-2010

Note: This list relies on self reporting and is likely to be underestimated; an asterisk (*) indicates those items obtained through leveraging more than one IMR-supported activity

Betty Lise Anderson

Senior member of the Optical Society of America

Suresh Babu

AWS McKay-Helm Award for his paper, "Effect of GMAW Process and Material Conditions on DP780 and TRIP 780 Welds, N. Kapustka, C. Conrardy, S. Babu, and C. Albright" printed in the June 2008 Welding Journal.

Paul Berger

Senior member of the Optical Society of America

Leonard Brillson

Selected as one of ten American Competitiveness and Innovation (ACI) Fellows for 2010 by NSF Division of Materials Research.

Stuart L. Cooper

Society for Biomaterials 2010 Founders Award

Glen Daehn

ASM Materials Education Foundation Board of Trustees*

L.S. Fan

Foreign Member of the Chinese Academy of Engineering

Gerald Frankel

The Ohio State University Distinguished Scholar Award

Hamish Fraser

Re-appointment as Honorary Professor of Materials Science and Technology, University of Birmingham, UK

Somanth Ghosh

IACM Fellow Award

Fellow of The American Academy of Mechanics

Joseph Heremans

Inventor of the Year by TechColumbus

Winston Ho

Lumley Research Award, College of Engineering, The Ohio State University, 2010

L. James Lee

Society for Plastics Engineers (SPE) 2010 International Award

Lumley Research Award, College of Engineering, The Ohio State University, 2010

Julia Meyer

National Science Foundation Faculty Early Career Development (CAREER) Program Award*

Jeffrey McNeal

Fellow of the American Association for the Advancement of Science

Randy Moses

IEEE fellow

Nitin Padture

Elected Fellow of the American Association for the Advancement of Science, 2008

Srinivasan Parthasarathy

Google Research Award

Ronald Reano

National Science Foundation, Faculty Early Career Development (CAREER) Award.

Steve Ringel

Lumley Research Award, College of Engineering, The Ohio State University, 2010

John Wilkins

2010 Fellow of American Academy of Arts & Sciences (AAAS)

Jessica Winter

Senior Member Institute of Electrical and Electronics Engineers (IEEE)

David C. McCarthy Engineering Teaching Award

Lumley Research Award, College of Engineering, The Ohio State University, 2010

Semi-finalist Columbus Tech Innovation Awards, Inventor of the year

Ji-Cheng Zhao

Named by the National Academy of Engineering as one of thirty outstanding young engineers from U.S. with thirty outstanding engineers from China to participate at the 1st China-America Frontiers of Engineering Symposium at Beijing and Changsha, October 17-21, 2009. (http://www.nae.edu/File.aspx?id=16468)

Yi Zhao

National Science Foundation Faculty Early Career Development (CAREER) Program Award*

Graduate Students: **(including competitive scholarships and grants)**

Ashwini Bharathula (Department of Materials Science and Engineering; Advisor: **Flores**)

Best poster award, International Workshop on Structural and Mechanical Properties of Metallic Glasses in Barcelona

Taeyoung Choi (Department of Physics; Advisor: **Gupta**)

The Ohio State University Presidential Scholarship*

Julie Drexler (Department of Materials Science and Engineering; Advisor: **Padture**)

The Ohio State University Women in Engineering Distinguished Graduate Student Award*

Wei Han (Advisor: **Kawakami**)

Leo Falicov Award

Daniel Hoy (Department of Materials Science and Engineering; Advisor: **Meyers**)

National Science Foundation graduate fellowship honorable mention

Inhee Lee (Department of Physics; Advisor: **Hammel**)

The Best Student Poster Award, IMR materials week, Ohio State University, September 2009

The Clifford Heer Scholarship as a winner in physics graduate student poster competition, Ohio State University, May 2010.

Tanya Nocera (Advisor: **Agarwal**)

Travel award, Biomedical Engineering Society*

Prashanth Ramesh (Department of Mechanical Engineering; Advisor: **Rajan**)

3rd Place in Best Student Paper Competition at SPIE/ASM conference

Hansong Zeng (Department of Biomedical Engineering; Advisor: **Zhao**)

Best presentation award, The Ohio State University Biomedical Engineering Conference

Best presentation award, The Ohio State University Ophthalmology Research Symposium

Undergraduate Students: **(including competitive scholarships and grants)**

Tom Byvank (Department of Physics; Advisor: **Sooryakumar**)

The Ohio State University Smith Sophomore Scholarship Award

The Ohio State University, Physics Caren Summer Undergraduate Research Scholarship

Dominic Labanowski (Department of Electrical and Computer Engineering; Advisor: **Hammel**)

The Ohio State University Biological, Mathematical and Physical Sciences 2010 Research Forum Best Poster

First Place at The Ohio State University Denman Undergraduate Forum Poster Competition (2010)

Center for Emergent Materials Research Experiences for Undergraduates Poster Competition (2010)

Jeremy Lucy (Department of Physics; Advisor: **Yang**)

Star Research Grant

Academic Enrichment Grant

Tyler Merz (Department of Electrical and Computer Engineering; Advisor: **Brillson**)

Goldwater Scholarship

First Place at The Ohio State University Denman Undergraduate Forum Poster Competition (2010)

Michael Page (Department of Physics; Advisor: **Hammel**)

The Ohio State University Biological, Mathematical and Physical Sciences 2009 Research Forum Best Poster

The Ohio State University Biological, Mathematical and Physical Sciences 2010 Research Forum Best Poster

Third Place at The Ohio State University Denman Undergraduate Forum Poster Competition (2010)

The Ohio State University 2010 Arts and Sciences Undergraduate Achievement Award

Adam Reed (Department of Physics; Advisor: **Hammel**)

Biological, Mathematical and Physical Sciences 2009 Research Forum Best Poster

Second Place at The Ohio State University Denman Undergraduate Forum Poster Competition (2010)

Michael Roe (Department of Electrical and Computer Engineering; Advisor: Gupta)

Third Place at The Ohio State University Denman Undergraduate Research Forum Poster Competition (2010)

First Place at The Ohio State University Denman Undergraduate Forum Poster Competition (2009)

Engineering Research Scholar 2009-2010

Austin Schwartz (Department of Physics; Advisor: **Epstein**)

L.D.Huff Award for Outstanding Sophomore Physics Student

Palmetto Fellows Recipient

IPTAY Scholarship Recipient

Appendix B: Externally Funded Research Awards Directly Resulting from IMR Resources and Activities for Fiscal Year 2009-2010

Note: This list relies on self reporting and is likely to be underestimated; an asterisk (*) indicates those items obtained through leveraging more than one IMR-supported activity

Sudarsanam Suresh Babu

"Fundamental understanding of microstructure and mechanical property evolution during welding of ArcelorMittal's high strength steel plates for energy application," ArcelorMittal, 4/1/2010 – 3/31/2013, $210,000

"Friction stir welding of hard metals," Edison Welding Institute, Inc., 8/14/208 – 5/1/2009, $10,000

"Very high power ultrasonic additive manufacturing system for advanced materials (VHP UAM), Edison Welding Institute, Inc., Co-PI: Marcelo Dapino, 9/3/2008 – 9/3/2011, $342,000

"Characterization of friction stir processed magnesium alloys," Edison Welding Institute, Inc., 5/1/2009 – 11/30/20009, $25,173

"Characterization of ultrasonic additive manufacturing," Edison Welding Institute, Inc., 11/23/2009 – 6/25/2010, $25,000

"Evaluation of simultaneous transformation kinetic model for describing microstructure," Engineering Mechanics Corp. of Columbus, 1/2/2008 – 6/30/2009, $20,005

"Collaborative research/planning grants: Center for integrative materials joining science for energy applications," National Science Foundation, Co-PIs: Avraham Benatar, Glenn S. Daehn, Dave F. Farson, John C. Lippold, 7/1/2009 – 6/30/2010, $10,000

"Correlation of 1-g aerospace materials flammability data with data in reduced and microgravity environments," Ohio Space Grant Consortium, 2/8/2010 – 9/30/2010, $10,000

"Fundamental understanding of low-cost flash heating and cooling process to develop high-strength and high-ductility steel microstructure," SFP Works, LLC, Co-PI: Boian T. Alexandrov, 1/7/2008 – 8/31/2010, $137,384

"Very High Power Ultrasonic Additive Manufacturing," Edison Welding Institute, PI(s): S.S. Babu, M. Dapino, 9/3/08- 9/2/11, $189,556

“Effect of Magnetic Stirring on Nickel Clad Microstructure,” Electric Power Research Institute, PI(s): S.S. Babu, D.F. Farson, 6/15/08- 12/31/09, $64,088

“Development and Application of 3D tools for Weld Characterization,” Office of Naval Research, PI(s): S.S. Babu, J.C. Lippold, 5/6/08- 9/30/10, $577,825

“Computational Analysis of Fracture,” Engineering Mechanics Corporation of Columbus, Ohio, PI: S.S. Babu, 12/1/08- 11/30/09, $78,750

“Intelligent manufacturing initiative,” Universal Tech Corporation, PI(s): J.C. Lippold and S.S. Babu, 4/30/09- 4/19/11, $2,124,461

“Planning Grant: Center for Integrative Materials Joining Science for Energy Applications,” National Science Foundation, PI(s): S.S. Babu, G. Daehn, Lippold, Farson, Benatar, 7/1/09-6/30/10, $10,000

Paul Berger

“Advanced Durability Sealing Systemsfor Solar Cells,” Ferro Corp., 1/25/2010-1/24/2012, $250,000

Dennis Bong

Bio-Based Materials from Chemical Derivation of Soy Proteins,” Ohio Soybean Council, 12/1/2008-1/31/2009, $114,000

"Selective aqueous phase adhesion by molecularly engineered materials", National Science Foundation (Civil Mechanical and Manufacturing Innovation) 9/1/2009-831//2012, $380,000

“*Synthesis of amphiphilic core-shell latex emulsions from soy proteins and delivery of corrosion inhibitors and biocides for coatings applications,” The Sherwin-Williams Company, Co-PI: Stephen C. Myers, 8/1/2008 – 7/31/2011, $150,000*

Leonard Brillson

"Development of AlGaN biosensor sensitive in physiological saline," Nationa Science Foundation, PI: Stephen C. Lee, Co-PIs: Leonard J. Brillson, Wu Lu, 9/1/2008 – 8/31/2011, $229,773

John A. Carlin

“Point source hydrogen electrolysis to enable MOCVD development of III-V solar concentrator cells,” Edison Materials Technology Center, Co-PI: Robert J. Davis, 2/15/2008 – 2/14/2009, $150,000

Robert J. Davis

"Wright Center for Photovoltaic Innovation and Commercialization (PVIC)," Ohio Department of Development (Subcontract through University of Toledo), PI: Robert J. Davis, Co-PIs: Paul Berger, Malcolm Chisholm, Arthur Epstein, Joseph Heremans, Nitin Padture, Steven Ringel, 2/16/2007 – 2/15/2010, $18.62 million total ($6.9 million to Ohio State)

"Low-Cost Low-concetration Photovoltaic Systems for Mid-Northern Latitudes," Ohio Department of Development Third Frontier Program (Subcontract through Replex Plastics, lead, and Dovetail Solar and Wind), PI: Robert J. Davis, 03/01/2010 – 02/29/2012, $1,258,000 ($357,500 to Ohio State)

"Concentrated solar power-capital," Ohio Department of Development, 4/21/2008 – 4/20/2010, $1,000,000 (Subcontract through Replex Plastics, lead)

Hamish Fraser

"Scientific challenges associated with multi-materials system with adaptive microstructures for aerospace applications," Air Force Office of Scientific Research, PI: H. Fraser, Co PI(s): M. Mills, Y. Wang, J. Williams, J.-C. Zhao, 10/01/2008 - 12/31/2013, $5,048,070*

"Air Force center of excellence on bio-nano-enabled inorganic/organic nanostructures and improved cognition (BIONIC)," Air Force Research Laboratory (through Georgia Institute of Technology), PI(s): H. Fraser, 03/01/2009 - 11/30/2014, $500,000

P. Chris Hammel

"High Performance Nuclear Magnetic Resonance Imaging Using Magnetic Resonance Force Microscopy," US Army Research Office, 7/15/2009-2//14/2011, $280,000

Ezekiel Johnston-Halperin

"MRI: Acquisition of a hybrid diamond/III-N synthesis cluster tool," National Science Foundation, Co-PIs: Harris P. Kagan, Roberto C. Myers, Siddharth Rajan, Steven A. Ringel, Fengyuan Yang, 10/1/2009 – 9/30/2011, $601,890 ($421,323 from NSF plus $180,576 cost share from The Ohio State University and Ohio Board of Regents Action Funds)

Wu Lu

"III-Nitride Heterojunction Field Effect Transistors for Biological Sensing", National Science Foundation, PI: W. Lu, 4/15/2007 - 3/31/2011, $296,000

"Collaborative Research: Scaling Laws for NanoFET Biosensors", National Science Foundation, 10/1/2008 - 9/30/2011, $222,722

Michael Mills

"Mechanisms and Modeling of High Output Shape Memory Alloys," DOE-OBES, PI(s): M. J. Mills, P. M. Anderson, 09/01/09-08/31/12, $612,000.

"The Evaluation of Cold Dwell Fatigue in Ti Alloys," Federal Aviation Administration, PI(s): M. J. Mills, J. C. Williams, S. Ghosh, S. Rokhlin, 07/01/09-06/31/10, $490,000.

"GOALI: Micromechanic Experiments and Modeling of Shape Memory Response in Ni-Ti Base Alloys," NSF/DMR, PI(s): M. J. Mills, P. M. Sarosi, P. M. Anderson, 06/01/09-05/31/12, $375,000.

"Self-Assembly of Stable Nanoclusters in Metallic Matrices," Oak Ridge National Laboratory, PI: M. J. Mills, 06/01/09-05/31/10, $45,000.

"Energy Frontier Center for Defect Physics in Structural Materials," Oak Ridge National Laboratory, PI: M. J. Mills, 01/11/2010-01/10/2015, $400,000.

"GE-USA Materials Program at the Ohio State University," General Electric Aircraft Engines, PI(s): M. J. Mills, Y. Wang, 01/01/2009 - 03/31/2010, $165,000

"Research on High Temperature Shape Memory Alloys (HTSMAs)," Los Alamos National Laboratory, PI: M. J. Mills, 10/08/2009 - 08/31/2012, $270,000.

"Creep testing, dislocation characterization and creep model development in Zircaloy," Bechtel Bettis, Inc, PI: M. J. Mills, 04/01/2008 - 03/31/2011, $220,000.

"Development of FCAW-S electrodes for welding high strength steels - correlation of microstructure to mechanical properties," Lincoln Electric Corporation, PI: M. J. Mills, 07/01/2006 - 12/31/2009, $150,991

Nicanor Moldovan

"In vivo monitoring of oxygenation in implants: Applications to tissue engineering," National Heart, Lung, and Blood Institute (R01 HL096524),Co-PIs: Keith J. Gooch, Periannan Kuppusamy, John J. Lannutti, 5/10/2010-4/30/2014, $381,250

Roberto Myers

"Epitaxial growth of highly confined nitride nanostructures toward short wavelength quantum cascaded and ultrafast optical devices", Office of Naval Research, 8/12/09-8/31/12, $157,000

Nitin Padture

"Center for Emergent Materials," National Science Foundation Division of Materials Research, Co-PIs: Leonard J. Brillson, P. Chris Hammel, Ezekiel Johnston-Halperin, Patrick M. Woodward, 9/1/2008 – 8/31/2014, $10,800,000

"High-Performance Graphene-Based Devices," National Science Foundation, Co-PIs: Siddharth Rajan and Wolfgang Windl, 8/1/2009 – 7/31/2011, $350,000

Siddarth Rajan

"High-frequency N-polar AlGaN/GaN HEMTs," Office of Naval Research, PI: Siddharth Rajan, 07/2010 – 07/2011, $100,000

"(ARRA) I-SMART: Integrated curriculum for smart power engineering", Department of Energy, PI: Jin Wang, Co-PIs: S. Rajan and 14 others, 5/13/2010 – 5/12/2013, $2,499,939

"AlGaN/GaN 1 - Dimensional Channel HEMT," Office of Naval Research, PI: Siddharth Rajan, 02/25/09-04/30/12, $339,348

"Investigation of Electron Transport in N-polar AlGaN/GaN HEMTs," Office of Naval Research, PI: Siddharth Rajan, 7/2/2009 – 6/30/2010, $40,000

"High-Performance Graphene-Based Devices," National Science Foundation, PI: N. Padture, co-PIs: S. Rajan and W.Windl, 08/01/09 - 07/31/12, $350,000

"III nitride NEMS devices for chemical and biological sensing," National Science Foundation, PI: Wu Lu, co-PI: S.Rajan, 10/01/2009 - 09/30/2012, $360,000

Steven Ringel

"Ohio Research Scholars Program: Technology-Enabling and Emergent Materials," Ohio Department of Development, PI: Steven Ringel, Co-PIs: Jeffery McNeal, Steven Slack, Greg Washington, 8/18/2009 – 8/17/2013, $18,153,846 ($8,953,846 to Ohio State)

"Lattice-Engineering for Novel Materials and Devices," Army Research Office, PI: S.A. Ringel, E.A. Fitzgerald (MIT), 5/1/09 –4/30/13, $1,301,000

"AlGaInP Wide Bandgap Solar Cell Materials," Emcore Corp, PI: S.A. Ringel, 10/1/09 – 12/31/10, $256,000

"Rapidly Deployable Solar Electricity and Fuel Cells," Air Force Research Laboratory (Kirtland) via U. Toledo, PI: S.A. Ringel, 4/1/08 – 9/30/11, $500,000

"Defect Studies in Advanced Nitride Materials and Heterostructures for Next Generation Electronics," Office of Naval Research, PI: S.A. Ringel, 1/1/09 – 12/31/11, $420,498

"MRI – Acquisition of a Hybrid Diamond/III-Nitride Synthesis Cluster Tool," National Science Foundation, PI(s): E.Johnston-Halperin, R. Meyers, S. Rajan, H. Kagan, S.A. Ringel, 10/1/09 – 9/30/11, $480,000 (excluding cost share)

"Growth,Properties and Defect Microstructures in Lattice Engineered III-V Materials on Si," Intel Corporation, PI: S.A. Ringel, 4/1/07 – 6/30/11, $480,000

Claudia Turro

"Design, Synthesis, and Photochemistry of New Ru (II) Complexes as Potential Photo-Cisplatin Analogs", National Science Foundation (Renewal of CHE-0503666), 9/1/09 - 8/31/12, $690,000

Jessica Winter

"Fluorescent-Magnetic Nanomanipulators for Cytoskeletal Mechanical Investigations," National Science Foundation (CMMI-0900377), Co-PIs: Anthony Brown, Jeffrey Chalmers, 06/01/2009-05/31/2012, $313,433

David W. Wood

"Large-scale production of recombinant enzymes for carbon sequestration," Carbozyme, 7/1/2009 – 6 /30/2010, $100,000

"Development of bacterials screens for ASD-associated compounds," Nancy Lurie Marks Family Foundation, 7/1/2009 – 6/30/2011, $171,471

"CAREER: Protein switches for molecular biotechnolgy," National Science Foundation, 7/1/2009 – 8/31/2010, $12,467 (remainder transferred from previous university)

Yiying Wu

"Designing nanoparticle/nanowire composites and "nanotree" arrays as electrodes for efficient dye-sensitized solar cells," U.S. Department of Energy, 9/1/2007 – 8/31/2010, $750,000

Fengyuan Yang

"Optical study of spin dynamics in semiconductor nanowires," U.S. Department of Energy. Co-PI: Ezekiel Johnston-Halperin Yang, 8/15/2009 – 6/14/2011, $200,000

Ji-Cheng (J-C) Zhao

"Second phase particle optimization for improved corrosion resistance," GE Global Research, 6/1/2008 – *6/30/09*, $30,000

"Microscale, high-throughput thermal mapping for characterization of order-disorder transformations in Ti alloys," GE Global Research, 12/28/2009 – 12/20/2010, $20,000

“Mg-based laves phases for hydrogen storage,” National Institue of Standards and Technology, 9/1/2008 – 8/31/2011, $100,000

“High-throughput measurements for high-fidelity thermodynamic databases,” National Science Foundation, 7/1/2008 – 8/31/2011, $330,00

“Microscale thermal property measurements of Fe-based diffusion multiples,” Sandia National Lab, 5/1/2009 – 7/31/2010, $20,000

“Lightweight metal hydrides for hydrogen storage,” U.S. Department of Energy, 5/13/2008 – 8/31/2011, $2,023,580

“Lightweight intermetallics for hydrogen storage,” Department of Energy (DOE), PI: J.C. Zhao, 1/5/08 – 8/31/11, $1,063,648

“Aluminoborane compounds for on-board hydrogen storage,” Department of Energy (DOE), PI: J.C. Zhao, 9/1/08 – 8/31/11, $1,172,511

“Oxidation life modeling of turbine metallic coatings,” AFRL / Rolls-Royce, PI: J.C. Zhao, 9/1/09 – 1/31/11, $88,000

Yi Zhao

"CAREER: Integrated Micro-Electro-Mechanical-System for Cellular Mechanotransduction Studies", National Science Foundation-CAREER, 3/1/2010 – 2/28/2015, $151,211

Appendix C

Activities of Members of Technical Staff (MTS) for Fiscal Year 2009-2010

- Dr. John Carlin, Research Scientist, Nanotech West Laboratory
- Dr. Evgeny Danilov, Senior Research Associate, Center for Chemical and Biophysical Dynamics
- Dr. Robert J. Davis, Director, Nanotech West Laboratory and Associate Director, Institute for Materials Research
- Dr. Denis V. Pelekhov, Research Scientist, ENCOMM NanoSystems Laboratory
- Aimee Bross Price, Senior Research Associate, Nanotech West Laboratory

Dr. John Carlin
Research Scientist, Nanotech West Laboratory
Notable Activities June 2009 – May 2010

Dr. Carlin is a lead scientist located at OSU's Nanotech West Laboratory (NTW). In addition to other research activities, Dr. Carlin contributes much time to the day-to-day operation of the NTW cleanroom and expanding the process knowledge and capabilities to meet the growing needs of the user. These activities have included tool training for new users, tool acquisition and installations, process development and documentation and assisting internal and external users with project and process planning. Dr. Carlin has been responsible for directing the activities of the various undergraduate and graduate students (currently 5 students) hired to provide laboratory and process support to the NTW user base. While currently the primary contact for seven pieces of process and metrology equipment, two new deposition systems acquired in FY09 require special emphasis. The atomic layer deposition (ALD) system used to deposit thin oxide layers and the metal organic chemical vapor deposition (MOCVD) system used to deposit arsenide, phosphide and antimonide based III-V device layers. While the ALD system (a $0.4M investment) has been operational since the beginning of FY10 and the MOCVD system (a $1.6M investment) only completed the full process qualification at the end of FY10, both systems have received significant interest from NTW users, have attracted new NTW users and are still ramping up in utilization.

For the ALD system, more than 15 different graduate students representing 7 different research groups utilized the various processes previously developed on the system for both passivation and anti-reflection coatings. In addition, during the fourth quarter of FY10 Dr. Carlin worked with 4 different external companies to provide ALD training and process support (the first to use the system since installation) as IMR was able to successfully target outside users. For one external user, a new ALD process for vanadium oxide was jointly explored to support the research goals of their government sponsored small business innovative research (SBIR) contract. Successful results will be further explored should funding for the phase II proposal be awarded.

For the MOCVD system, while the process qualification of the system has only recently been completed two OSU research groups in addition the PVIC program under which the system was purchased are already waiting to utilize the system. In addition, two external companies and a third OSU research group have expressed interest in developing joint proposals to utilize the MOCVD systems capabilities for various device applications. For two of the currently funded activities Dr. Carlin will be the primary researcher responsible for MOCVD development. In addition, for the proposed programs Dr. Carlin will also serve as a Co-PI involved in joint proposal development.

Since in the FY10 period Dr. Carlin primarily engaged in the types of activities just described, he did not participate in publications or presentations. This is anticipated to change next year due to both the ALD and MOCVD activities being led by him.

User Impact Summary

In addition to general cleanroom activities and providing primary support of various NTW tools, Dr. Carlin provides process and project expertise to the NTW user base on a daily basis impacting almost all NTW users in some way. In addition to the internal OSU groups which receive support, Dr. Carlin has collaborated with or provided process support for 9 external companies (including Lakeshore Cryotronics, 4Power LLC, Newcyte, L-3 Communications Cincinnati Electronics, Veeco Turbodisc and Replex Plastics) during FY10. Dr. Carlin and IMR continue to foster these relationships to both generate future proposal opportunities as well as expand the regular user base of OSU's NTW lab.

a) Graduate student and undergraduate student notable accomplishments (grants, publications, presentations, fellowships, awards)

- While not directly involved with student publication development, assisting graduate students in their access to and use of Nanotech West facilities contributed substantially to their research progress.

b) Additional funding via grants and contracts (all external funding)

- Enabled a substantial fraction of the $350,000 of user fee income into Nanotech West in FY10 via primary support to Nanotech Director

c) Outreach and engagement activities

- Attended and represented IMR at Ohio State booths at both the Ohio Innovation Summit and at the Ohio State Research Expo, to develop new interactions.
- Nanotech West tour and presentation to government delegation from Hubei Province (China) as part of Ohio Department of Development arranged visit
- Nanotech West tours and discussions to various groups: Faculty candidates (3), postdocs (3), graduate student open house (1), OSU Material Science course (Nano) (1), new IMR faculty member (1), Industry Liaison Office (ILO) outreach (1), External industry and government (8)
- 2009 IEEE Photovoltaic Specialists Conference attendee and poster session lead judge (Philadelphia, PA)
- 2009 Organometallic Vapor Phase Epitaxy conference attendee (Lake Geneva, WI)

Proposals Developed:

During FY10 Dr. Carlin collaborated on various proposals including many large multi-year efforts and mostly with industry. Although unfunded, many of these proposals represented key and growing collaborations and there are plans to re-tool several for future submissions.

- Title: "50% Efficient III-V Solar Cell at Low Cost Using Existing Silicon Infrastructure"
  Agency: Advanced Research Projects Agency - Energy (ARPA-E)
  Lead PI: Energy Focus Inc
  Co-PI's: Steve Ringel (OSU), John Carlin (OSU), Siddharth Rajan (OSU), Eugene Fitzgerald (MIT)
  Amount Requested: $3,800,000
  Period of Performance: 24 months

- Title: "Low-Cost Low-Concentration Photovoltaic (LC2PV) Systems for Mid-Northern Latitudes"
  Agency: Advanced Research Projects Agency - Energy (ARPA-E)
  Lead PI: Replex
  Co-PI's: Robert Davis (OSU), John Carlin (OSU), Steve Ringel (OSU), Battelle Memorial Institute
  Amount Requested: $5,000,000
  Period of Performance: 24 months

- Title: "Non-tracking Solar 25X Concentration onto Ultra Low-Cost III-V Woven into a 'Red Quilt'"
  Agency Program: DARPA call for "Low-Cost Lightweight Portable Photovoltaics"
  Lead PI: Energy Focus Inc
  Co-PI's: Steve Ringel (OSU), John Carlin (OSU), Robert Davis (OSU), MicroLink Devices , PhosphorTech, Optical Research Associates
  Amount Requested: $6,000,000
  Period of Performance: 54 months

- Title: "High Efficiency Photovoltaic Enabled Off-Grid Solar/Led Lights"
  Agency: Ohio Third Frontier
  Lead PI: Energy Focus Inc
  Co-PI's: Steve Ringel (OSU), John Carlin (OSU), Mark Schuetz (Replex Plastics)
  Amount Requested: $1,000,000
  Period of Performance: 24 months

- Title: "High Efficiency, Radiation Hard, Quantum Dot Enhanced Solar Cells for Space Applications"

Agency Program: Missile Defense Agency (MDA) under the Small Business Technology Transfer (STTR) call
Lead PI: NewCyte Inc.
Co-PI's: John Carlin (OSU)
Amount Requested: $100,000
Period of Performance: 6 months

- Title: "High Efficiency, Radiation Hard, Quantum Dot Enhanced Solar Cells for Space Applications"
  Agency Program: Department of Energy call titled "Energy Innovation Hubs-Fuels from Sunlight"
  Lead PI: Penn State University
  Co-PI's: Steve Ringel (OSU), John Carlin (OSU), Robert Davis (OSU), Len Brillson (OSU), Siddharth Rajan (OSU), Rob Collins (University of Toledo), Carnegie Mellon, University of Pittsburgh, National Energy Technology Laboratory (NETL), Calyxo USA, PPG, Plextronics, Proton Energy Systems
  Amount Requested: $25,000,000
  Period of Performance: 60 months

Dr. Evgeny Danilov

Senior Research Associate, Center for Chemical and Biophysical Dynamics (CCBD)

Notable Activities June 2009 – May 2010

Dr. Evgeny Danilov joined the staff of Ohio State's Department of Chemistry in February 2010 as a Senior Research Associate and the CCBD manager, becoming the fourth IMR Member of Technical Staff on campus. He came from the Center for Photochemical Sciences at Bowling Green State University where he participated in obtaining funds for (1.6 M from Ohio Hayes Fund, 0.6 M NSF MRI grant), built instrumentation for, and managed the Ohio Laboratory for Kinetic Spectrometry. His academic record includes 47 publications in highly ranked peer-reviewed journals such as Phys. Rev. A., Journal of Physical Chemistry, JACS, Inorganic Chemistry, etc. and multiple presentations. Dr. Danilov's immediate activities involve turning the CCBD into a multi-user research facility open to the entire materials community, assembling its budget, finishing the construction of the femtosecond Raman spectrometer, the newest addition to the laboratory, upgrading and modernizing the time-correlated single-photon counting emission spectrometer, and establishing collaborations with the materials research community (Profs. S. Ringel, R. Myers, A. Epstein of OSU and Dr. E. Kreidler of Honda Research Institute).

Dr. Robert J. Davis
Director, Nanotech West Laboratory and
Associate Director, Institute for Materials Research
Notable Activities June 2009 – May 2010

Honors and Awards

Named Co-Editor, Nanofabrication and Materials Section, for upcoming Encyclopedia of Nanotechnology, SpringerLink Publishing (2011)

Named Adjunct Associate Professor of Electrical and Computer Engineering, Ohio State University, September 2009.

Session Co-Chair, 34th IEEE PV Specialists Conference, Philadelphia PA, June 7-12, 2009

Additional Funding via Grants and Contracts

Title: Ohio Wright Center for Photovoltaics Innovation and Commercialization (PVIC)
OSU PI: Robert J. Davis
Amount: $18.62M / initial 3 years ($7.0M to OSU), plus $29M cost-share of participants
Agency: Ohio Department of Development Third Frontier Program (with Univ. Toledo, Lead Applicant, and fourteen other Ohio collaborators)
Duration: 02/27/07 – 02/27/10; in early CY2010, a one-year no-cost extension was granted to this program by ODOD, with additional extensions possible

Title: Low-Cost Low-Concentration Photovoltaic Systems for Mid-Northern Latitudes
OSU PI: Robert J. Davis
Amount: $1.258M / 2 years ($357,500 to OSU)
Agency: Ohio Department of Development Third Frontier Program (with Replex Plastics, Lead Applicant, and Dovetail Solar and Wind)
Duration: 03/01/10 - 02/29/12

Title: Concentrated Solar Power
OSU PI: Robert J. Davis
Amount: $1.0M / 2 years ($100,000 to OSU)
Agency: Ohio Department of Development Third Frontier Program (with Replex Plastics, Lead Applicant)
Duration: 04/21/08 - 04/20/10

Additional Impact on Funded Programs

As Nanotech West Director, PVIC Co-Director, and IMR Associate Director, Davis continues also to positively impact numerous other programs for both OSU and Ohio

industry. Two examples of new awards in this timeframe in which Davis, Nanotech West, and PVIC have directly collaborated on include:

- A new DARPA award (Feb. 2010) to Srico Inc. of Columbus, OH, for $6.4M for advanced electric field detectors. Srico uses Nanotech West for device fabrication and has already hired three more engineers for this new program.
- A new ODOD award (Dec. 2009) to Ferro, Inc. of Cleveland, OH, Stratenexus Inc. of Columbus OH, and OSU (Berger research group), for $1.0M in new materials for sealing photovoltaics.

Outreach and Engagement Activities

Continue to serve on Proposal Review Committee, Center for Nanophase Materials Science, Oak Ridge National Laboratory.

Organized and hosted PVIC Semi-Annual Meeting at Ohio State, April 22, 2010

Discussed solar energy and micro- and nanofabrication on the “Ohio Means Business” television show on the Ohio News Network, April 2010

At the 2010 Ohio Innovation Summit, served as a panelist at “Ohio Third Frontier Grantees and Technologies at the Intersection of Advanced Energy and Advanced Materials”, Columbus OH, April 20, 2010.

Attended Space Photovoltaics Research and Technology Conference (SPRAT XXI) at NASA Glenn Research Center, October 6-8, 2009.

Attended and helped staff the State of Ohio Booth at Solar Power International Conference, Anaheim CA, October 27-29 2009

Helped to organize and Co-Chair the Photovoltaics Materials and Technology Symposium at the 2nd Annual IMR Materials Week meeting, September 01, 2009

Attended the Alternative Energy Supply Chain Reception at the Governor’s Mansion, August 12 2009

Dr. Denis V. Pelekhov
Research Scientist, ENCOMM NanoSystems Laboratory
Notable Activities June 2009 – May 2010

Publications

1. E. Nazaretski, K. S. Graham, J. D. Thompson, J. A. Wright, D.V. Pelekhov, P.C. Hammel and R. Movshovich, "Design of a variable temperature scanning force microscope", Review of Scientific Instruments vol. 80, p. 083704 (2009)

2. E. Nazaretski, Yu. Obukhov, I. Martin, D.V. Pelekhov, K.C. Cha, E.A. Akhadov, P.C. Hammel and R. Movshovich, "Localized ferromagnetic resonance force microscopy in Permalloy-cobalt films", Journal of Applied Physics vol. 106, p. 046103 (2009)

3. E. Nazaretski, D.V. Pelekhov, I. Martin, M. Zalalutdinov, D. Ponarin, A. Smirnov, P.C. Hammel and R. Movshovich, "Detection of localized ferromagnetic resonance in a continuous thin film via magnetic resonance force microscopy", Physical Review B vol. 79, p. 132401 (2009)

4. Yu. Obukhov, D.V. Pelekhov, E. Nazaretski, R. Movshovich and P.C. Hammel, "Effect of localized magnetic field on the uniform ferromagnetic resonance mode in a thin film", Applied Physics Letters vol. 94, p. 172508 (2009)

5. I. Lee, Yu. Obukhov, G. Xiang, A. Hauser, F. Yang, P. Banerjee, D.V. Pelekhov and P.C. Hammel, "Nanoscale scanning probe ferromagnetic resonance imaging using localized modes", accepted to Nature

6. P. Banerjee, F. Wolny, D. V. Pelekhov, M. R. Herman, K. C. Fong, U. Weissker, T. Muhl, Yu. Obukhov, A. Leonhardt, B. Buchner and P.C. Hammel, "Magnetization Reversal in an Individual 25 nm Iron-Filled Carbon Nanotube", accepted to Applied Physics Letters

Presentations

1. "Micromagnetic Modeling of Magnetic Resonance Force Imaging of Individual Ferromagnetic Nanowires", American Physical Society 2010 March Meeting, March 15–19, 2010; Portland, Oregon

Aimee Bross Price
Senior Research Associate, Nanotech West Laboratory
Notable Activities June 2009 – May 2010

Main Responsibilities: Nanolithography and Imaging at Nanotech West Lab, Direct Write Electron Beam Lithography, Field Emission SEM, Photomask fabrication

Ebeam, Masks, and Layout

Aimee is the lead engineer for OSU Nanotech West's nanolithography process, specifically direct write ebeam lithography with the Vistec EBPG5000 electron beam lithography tool. She works with users on the unique aspects of process design for ebeam and nanolithography, including running the lithography exposure for most users. She has trained several high level users to become independent on the ebeam lithography tool, three of whom have become very successful ebeam lithographers and have recently completed their Ph.D. degrees in ECE with Professor Wu Lu. Additionally, Aimee uses the ebeam to fabricate photomasks for the Nanotech West community for use in lower resolution lithography. Much of Aimee's time is devoted to interacting and training users on layout and pattern design because often, a student or researcher's first experience with pattern design and layout is in creating a photomask. Over the past year, Aimee has worked with 20 individual users performing either direct write EBL or mask fabrication. These users come from 10 OSU research groups and 4 external companies. Future collaboration at Nanotech West is expected with all 4 external companies within the coming year.

High Resolution SEM

Aimee has trained over 45 users and staff for the Zeiss Ultra Plus SEM, 19 of whom have been trained within the last year (June '09-May'10). With the addition of the Zeiss Ultra Plus, researchers at OSU Nanotech West can now image nanometer range structures immediately after patterning on conductive AND non-conductive substrates, indeed even polymers/resists without coating the surface. This gives researchers a true image of their nanostructures from both a quality and size standpoint, early in the fabrication flow, resulting in real time feedback and more efficient process development.

Research Highlights

Aimee was primary author for a peer reviewed publication (Journal of Vacuum Science and Technology B.) in November/December 2009. This work was presented by Dr. Robert Davis at EIPBN conference in May 2009. The proceedings of this conference are always a peer reviewed publication (JVST B) the following November/December edition. The work was a collaboration with the Professor Greg Lafyatis group in Physics and Microchem Corp. and was made possible by an IMR User Facility Grant.

Outreach/tours

As a public research institution one of OSU's missions is outreach. Aimee takes part in numerous tours of the capabilities at Nanotech West including: faculty candidates, future students, visiting speakers, and other guests. Two of the largest and most

memorable groups from ’09-’10 included a large contingent of dignitaries from Hubei Province (China) and over 40 students and professors from ITT Tech in Huntingdon, West Virginia.

Publications

1) A. L. Bross, G. Lafyatis, R. Ayachitula, A. Morss, R. Hardman, J. Golden, “Robust, efficient grating couplers for planar optical waveguides using no-photoacid generator SU-8 electron beam lithography”, Journal of Vacuum Science and Technology B. vol. 27 (6), p. 2602-2605 (2009)

Presentations

1) “Robust, Efficient Grating Couplers for Planar Optical Waveguides Using No-PAG SU-8 EBL” A.Bross, G.Lafyatis, R.Ayachitula, A.Morss, R.Hardman and J. Golden (presented by R. Davis), *EIPBN Conference, Marco Island, FL, May, 2009*

Outreach and Engagement Activities

Assisted with Nanotech West (NTW) tour and presentation to government delegation from Hubei Province (China) as part of ODOD arranged visit, October 2009

Co-facilitated Nanotech West tour to over 40 students and professors from ITT Technical Institute (Huntingdon, West Virginia). January 2010