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Center for Emergent Materials – Making Progress in Year 2

When the National Science Foundation (NSF) awarded the grant establishing the Center for Emergent Materials (CEM) in September 2008, the materials community at The Ohio State University joined the elite ranks of 27 U.S. institutions with a Materials Research Science and Engineering Center (MRSEC).

The MRSEC program was created in 1994 to provide support and incentive for faculty to pursue cutting edge research of a scope and complexity that had been difficult to achieve under traditional funding mechanisms. The institutional culture of MRSECs is one of transformative inter-disciplinary and multi-disciplinary research, and the foundation of this program is the high standards set for collaborative research in the Interdisciplinary Research Groups (IRGs).

Two IRGs were funded through the CEM award. **IRG-1: Towards Spin-Preserving Heterogeneous Spin Networks** seeks to lay the foundation for the creation of spin-preserving networks for next generation information processing through the study of the fundamental interactions within the "unit cell" of a prototype spin network. **IRG-2: Double Perovskite Interfaces and Heterostructures** is focused on the synthesis, characterization, and modeling of double perovskite thin films and heterostructures for next generation multi-functional oxide-based electronics.

Double Perovskite Interfaces and Heterostructures

The research interests of IRG-2 lie at the intersection of two rich veins of condensed matter science. Physicists and engineers have made important advances over the past two decades by growing heterostructures of simple materials such as metals and semiconductors. Examples include the spin valves and magnetic tunnel junctions that retrieve information from the hard drive of your computer, and semiconductor quantum wells used in light emitting diodes (LEDs) and lasers, to name but a few applications. At the same time solid state chemists have been synthesizing new complex oxides with properties such as high temperature superconductivity, ferroelectricity, colossal magnetoresistance, and half-metallic spin transport. The perovskites are a particularly attractive family of oxides because a wide range of phenomena can be realized while maintaining a common structural framework (Figure 1). This raises intriguing opportunities for combining the nanoscale design principles of semiconductor devices with the chemical design principles of the solid state chemist. The work has resulted in a patent application and submission of a grant to the National Institutes of Health.

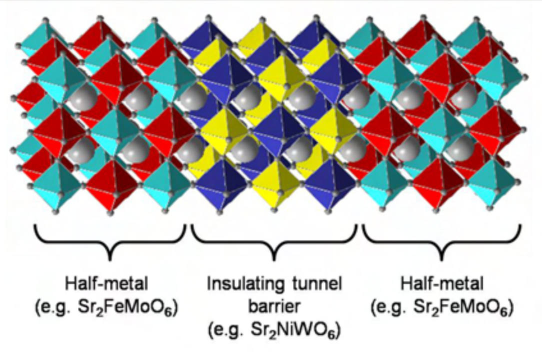


Figure 1.
A schematic of a double perovskite heterostructure magnetic tunnel junction.

Story continued on page 4

Faculty Spotlight: Roberto Myers

Roberto Myers joined the faculty at Ohio State University as an Assistant Professor in Materials Science and Engineering with a co-appointment in Electrical and Computer Engineering starting in fall 2008.

Director's Note

Dear Colleagues,

This is certainly a special issue of the IMR Quarterly newsletter, with its focus on the Center for Emergent Materials, Ohio State's first NSF-funded Materials Research Science and Engineering Center (MRSEC). MRSECs are the most coveted NSF programs in the materials field and ours is in excellent hands thanks to the leadership of CEM Director, Nitin Padture, a Distinguished Professor of Engineering in the Department of Materials Science and Engineering, and a terrific group of CEM faculty, students and staff. The CEM is now in its second year of operation and it is already making contributions that are pushing the fundamental boundaries of materials research targeting the future generation of magnetoelectronics exploring materials systems that include multifunctional oxides, novel nanostructures, organic materials and silicon. The partnership between the CEM and IMR is a close one, starting from the very outset of creating the CEM itself and now through intertwined efforts and commitments that share the common goal of creating excellence and impact in materials research. IMR is proud to be a supporter of CEM and inside you'll see why, with descriptions of activities in both of the Interdisciplinary Research Groups (IRGs) that constitute the core of CEM research, an overview of the IMR-supported CEM Seed Grant program, and a review of CEM's extensive outreach activities, of which we are highlighting a unique program that supports students with disabilities in STEM fields.

In this issue we also update a range of activities and successes within OSU's other materials centers around campus, including two new awards totaling $2 million from the Ohio Department of Development Third Frontier program for advanced solar energy conversion to groups collaborating through the Wright Center for Photovoltaics Innovation and Commercialization (PVIC). Updates to materials-allied facilities include several significant, new capabilities for low temperature and nanoscale measurements within the ENCOMM Nanosystems Laboratory, and a new facility for materials electron lifetime testing at Nanotech West Laboratory. We are delighted to announce that Dr. Evgeny Danilov has joined the technical staff and inside you will find a brief glimpse into the Center for Chemical Biophysical Dynamics laboratory (CCBD), which Dr. Danilov will soon be bringing on-line into our community of coordinated, openly-accessible materials research lab clusters.

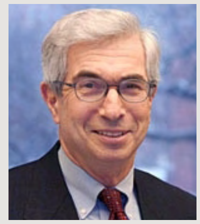
Finally, this issue's Faculty Spotlight focuses on the exciting work of one of our newest faculty members, Roberto Myers, an assistant professor who joined OSU in 2008 in a joint appointment between the Department of Materials Science and Engineering and the Department of Electrical and Computer Engineering as part of the Advanced Materials Initiative funded by OSU's Office of the Provost Targeted Investment in Excellence program.

Warm Regards,

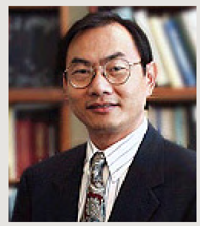
Steven A. Ringel, Ph.D.
Neal A. Smith Chair Professor
Director, The Ohio State University Institute for Materials Research

IMR Member News

As compiled from various OSU department and college communications



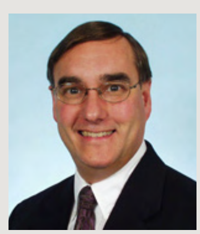
Stuart L. Cooper, Chair of the William G. Lowrie Department of Chemical and Biomolecular Engineering, has been awarded the Society for Biomaterials 2010 Founders Award. This award is specifically given for long-term, landmark contributions to the discipline of biomaterials. The award will be formally presented to Stuart at the Society for Biomaterials Annual Meeting which will be held in Seattle Washington, April 21-24, 2010.



L.S. Fan was recently elected as a Foreign Member of the Chinese Academy of Engineering. The election was based on his outstanding achievements in engineering and technological sciences as well as his contributions to China's development in Engineering and Technological Sciences. The 10th General Assembly of the Chinese Academy of Engineering will be held in Beijing, June 2010, where Dr. Fan will have the opportunity to attend and accept his certificate of membership.

L.S. Fan was recently awarded a $5 million grant by the U.S. Department of Energy for research related to clean coal technology. Professor Fan, internationally recognized for his expertise in energy and environmental reaction engineering, will use the grant to further develop a process he invented to convert coal and biomass to electricity while capturing carbon dioxide emissions.

Winston Ho, Chemical and Biomolecular Engineering and Materials Science and Engineering, received a $205,558 National Science Foundation Chemical, Bioengineering, Environmental and Transport Systems grant for "Liquid Membranes in Nanopores with Strip Dispersion for Antibiotic Recovery."



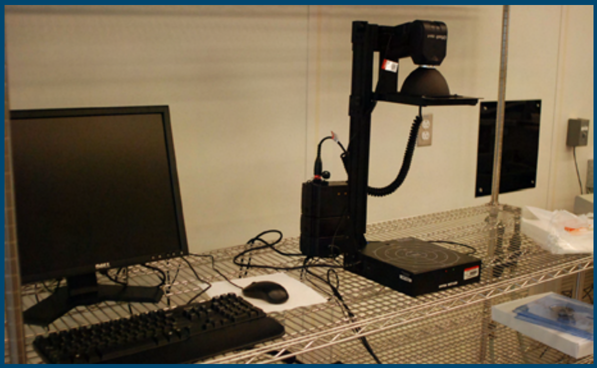
Randy Moses was elevated to IEEE fellow for contributions to statistical signal processing recently elevated to fellow status by the Institute of Electrical and Electronics Engineers beginning January 1, 2010.

Giorgio Rizzoni, Mechanical Engineering and Center for Automotive Research, and Ümit Özgüner, Electrical and Computer Engineering, received a $49,965 National Science Foundation grant funded under the American Recovery and Reinvestment Act for a workshop, "The Future of Intelligent Transportation Systems and its Implication with Regard to Mobility and Sustainability."

Facilities Updates

From OSU's materials research laboratories

Nanotech West Laboratory



Thanks to capital funding from the Ohio Wright Center for Photovoltaics Innovation and Commercialization (PVIC), Nanotech West now has a Sinton Instruments WCT-120 contactless semiconductor lifetime tester. The instrument uses an infrared-filtered flash to excite carriers in the material, and an RF probe monitors the decay of the photoconductivity in the material to estimate the minority carrier lifetime. Measurements can be made in transient mode or a quasi-static mode for indirect bandgap semiconductors such as crystalline or multi-crystalline silicon. The purchase was made primarily in response to the needs of PVIC industrial collaborators, although its use is open to all Nanotech West users. For information, contact Dr. Bob Davis, Director of the Nanotech West Laboratory, at davis.2316@osu.edu or (614) 292-7309.

ENCOMM NanoSystems Laboratory

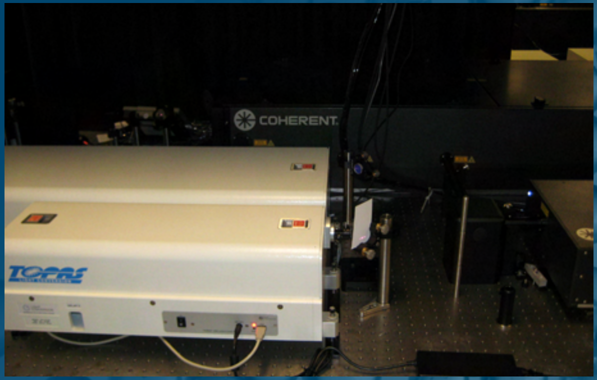
A pair of Kleindiek nanomanipulators have been installed in the vacuum chamber of the existing dual beam FEI FIB/SEM, thus transforming the instrument into a hands-on tool for nanomanipulation. Nano/micro objects can be manipulated in situ while observing the process with SEM.

A new Low-Temperature system for electronic transport measurements is being constructed. This is a system where electrical properties of materials and devices can be measured at temperatures as low as 4 K and in magnetic fields as high as 2.2T. The system is equipped with a Janis Research flow cryostat and a GMW electro magnet. For more information about the ENCOMM NanoSystems Laboratory, contact Dr. Denis Pelekhov, Director of ENSL, at pelekhov.1@osu.edu or (614) 292-9125.

New IMR Member of Technical Staff Prepares Laser Facility

In late January, 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 will manage the operations of the Center for Chemical and Biophysical Dynamics (CCBD), a laser facility in Newman-Wolfrom Laboratory. Through a partnership between IMR and Chemistry, he has been tasked with taking this multi-user research facility and turning it into a facility open to the entire materials community.

Researchers use CCBD instrumentation to perform several forms of ultrafast laser spectroscopy to observe photogenerated intermediates in biological, chemical, physical, and materials systems on femtosecond (10^{-15} s) time scale. A highlight of the lab is a million-dollar ultrafast laser system which makes it possible to perform dynamic studies of photochemical intermediates over a wide time and spectral range.



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. IMR and the Chemistry Department plan to announce the CCBD as an open facility in the upcoming months. In the interim, Dr. Danilov can be reached at danilov.3@osu.edu.

Center for Emergent Materials – Making Progress in Year 2, continued

Half-metallic double perovskites, such as Sr_2FeMoO_6 (see Figure 2a), are of particular interest to researchers in IRG-2. The electronic conductivity of ordered bulk samples is highly spin polarized, which means that most of the electrons that carry the current have parallel spins. For example in Sr_2FeMoO_6 it is the spin-down electrons that reside in a delocalized Mo/Fe band that carry the current,

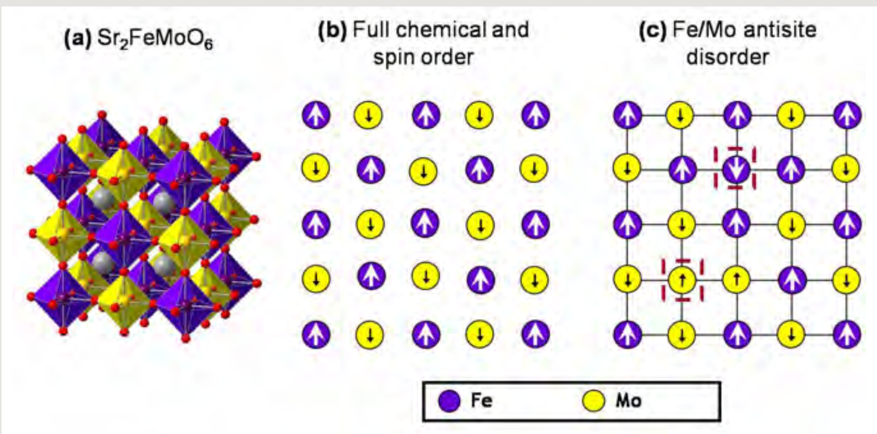


Figure 2.
(a) The structure of Sr_2FeMoO_6
(b) The spin order of the Fe and Mo sites in a fully ordered plane. The Mo-based electrons are mobile and the Fe-based electrons are localized.
(c) An Fe/Mo antisite defect. In parts (b) and (c) the Sr and O atoms have not been shown for clarity.

while the localized Fe spins are aligned parallel and are responsible for the spin polarization of the delocalized carriers (Figure 2b). Materials of this type, often called “half metals”, are highly sought after as components of spintronic devices because they can either enable or dramatically enhance the performance of such devices. Unfortunately, half-metals are rare, and nearly all of the materials that exhibit this behavior do so only at temperatures well below room temperature. The double perovskite family of half-metals retain their magnetic ordering, and in principle their half-metallic behavior, to temperatures as high as 450º C, which makes them very attractive for technological applications.

The complex chemistry that is responsible for the half-metallic behavior of these perovskites represents a fabrication challenge. These compounds are prone to non-stoichiometry and antisite disorder (Figure 2c), as well as various other types of extended and point defects. Computational modeling and experimental measurements show that such defects degrade the spin-polarized conductivity. IRG-2 researchers are exploring various strategies for controlling the stoichiometry, phase purity and defects of epitaxial films of double perovskites such as Sr_2FeMoO_6, Sr_2FeMoO_6 and Sr_2FeMoO_6. Film growth techniques include sputtering, pulsed laser deposition and molecular beam epitaxy. As the films are grown, state-of-the-art characterization tools characterize the structure, composition, defects and properties of these films. An example is a high resolution TEM image of a $SrTiO_3$/Sr_2FeMoO_6 interface fabricated by sputtering shown in Figure 3.

Complementing the experimental efforts in IRG-2 is a strong emphasis on theory, computations, and modeling of the properties of double perovskites. There are many aspects of their fundamental properties that are currently not well understood. Theoretical efforts include a study

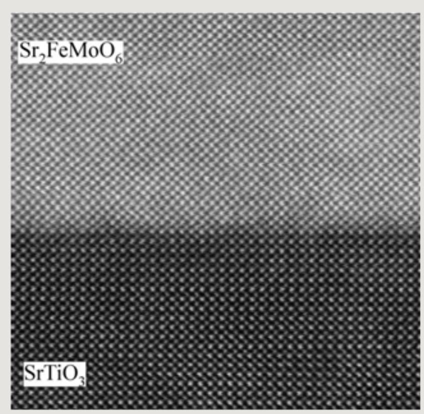


Figure 3.
A transmission electron microscopy image of an atomically abrupt interface between $SrTiO_3$ and Sr_2FeMoO_6

of the way in which chemical substitution alters the magnetic and electrical properties of these compounds. Computational modeling of how the spin polarization is modified by defects and interfaces is also under investigation.

Towards Spin-Preserving Heterogeneous Spin Networks

The goal of IRG-1 is to expand the materials basis for spin functionality, including both the study of fundamental spin-physics in emerging materials systems (in particular silicon and carbon based materials) and the transfer of spin between disparate materials. These studies are carried out using state-of-the-art microscopy correlating structure, charge and spin characteristics with atomic-scale resolution. This microscopy in turn informs device and network level measurements of spin transfer across heterointerfaces and through channels of varied dimensionality.

Recent work focusing on the organic-based ferromagnet offers new V[TCNE]x opportunities for incorporating electron spin into next generation electronics. For example, complexes of transition metals with the molecule tetra-cyanoethylene (TCNE) form a range of semiconductors which are magnetic beyond room temperature, a feat that has proven difficult to achieve with conventional inorganic materials. In addition, the properties of organic magnets can be chemically tuned over a wide range; in the M[TCNE] family for instance, the magnetic Curie temperature ranges from 40K to 400K for different metals (M=Co, Mn, Fe, V).

Under the auspices of the CEM, IRG-1 is fostering an interdisciplinary approach to understanding organic magnets at scales ranging from single molecules to functional devices. This effort builds on the discovery and characterization of the M[TCNE] family of organic magnets by Prof. Art Epstein's group at OSU, in collaboration with Prof. Joel S. Miller of University of Utah. Collaborative efforts between Professors Art Epstein, Jay Gupta, Ezekiel Johnston-Halperin, and David Stroud at Ohio State are providing new avenues for understanding key issues of charge transfer within the complexes and spin transport within, to, and from M[TCNE] films.

For example, Prof. Gupta's effort is focused on scanning tunneling microscope (STM) studies of charge transfer between metal atoms and TCNE at the single molecule limit. TCNE molecules are studied on a thin insulating film of Cu_2N, which suppresses coupling to the conducting Cu substrate. The figure illustrates how the STM tip can be used as a crane to transfer a TCNE molecule from the bare Cu surface (left panel) to form a Co[TCNE] complex on an isolated Cu_2N island (right panel) with atomic precision. The insulating film allows for direct imaging of the complex's lowest unoccupied molecular orbital, revealing a distortion of the lower right lobe near the Co-TCNE bond (arrow in right panel). In collaborative efforts fostered by the CEM, Prof. Stroud is developing density functional theory methods to calculate how much charge is transferred from Co to TCNE during the formation of such complexes.

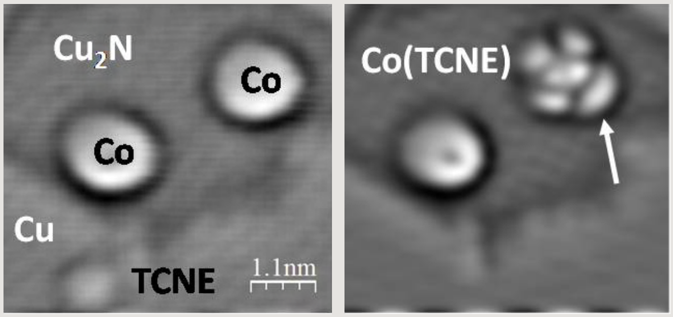


Figure 4.
Scanning Tunneling Microscope images showing the formation of a single Co(TCNE) complex on a Cu_2N surface

These results can be compared to spin transport measurements of M[TCNE]-based spin valve and spin LED structures by the Epstein and Johnston-Halperin groups. Such comparisons help to provide a more comprehensive understanding of spin and charge transfer in organic magnets, and may suggest chemical routes for improved materials synthesis.

For more information about the Center for Emergent Materials, visit their website: cem.osu.edu

Materials Centers Updates

Applied Sciences, Inc. — A Model Collaborator and CMPND Partner

The Wright Center for Multifunctional Polymer Nanomaterials and Devices (CMPND/"compound") is head-quartered at The Ohio State University and works with researchers and industry to put Ohio at the forefront of nanotechnology research and commercialization opportunities. Applied Sciences, Inc. (ASI) in Cedarville is one of CMPND's industry partners and through CMPND, ASI has been introduced to and collaborated with many university laboratories and companies that are innovators and use nanomaterials for their products. ASI has established a multitude of business collaborations related to identifying the most appropriate nano-materials to use in various products, manufacturing nanomaterials, and characterizing the performance of the nanofibers in their products – all of which serve as a technical support resource for customers.

Founded in 1984, ASI has dedicated nearly three-fourths of its efforts to carbon nanofibers and composites in one form or another. In 2000, ASI launched a pilot production plant that has helped the company to become the third largest producer of carbon nanofibers (CNFs) worldwide. Partly due to the strength of its collaborations, ASI has helped define the quality control metrics for the industry, particular to describing nanofibers and the quality of materials and degree of allowable contaminant materials. ASI specializes in developing materials that possess exceptionally high electrical and thermal conductivity, and mechanical properties. In pursuit of novel and improved materials, ASI has done work in synthesis of vapor-grown carbon fibers (VGCF), CNFs, diamond thin films, and various composite materials reinforced with VGCF or CNF. ASI has also collaborated with the National Institute of Occupation Safety and Health (NIOSH) to further the quality control processes for nanomaterials.

Because of ASI's early entry in the market, its CNFs have been part of the pioneering work in using nanofibers for reinforcing polymer-based materials. ASI and its manufacturing affiliate, Pyrograf Products, Inc., now produce vapor-grown carbon fiber and nanofiber products. One such product, Pyrograf-I carbon fiber, is of-ten used to manufacture thermal management materials that exceed the thermal conductivity of metals at a fraction of the weight and can be used in the manufacture of metal matrix, polymer matrix, and carbon-carbon composites. Through collaborative relationships – many of which were facilitated by CMPND - ASI has become a market leader in CNFs and related products and services.

IMR's Shuttle Service

transports over 170 passengers each month!

The shuttle service runs 6 times every weekday

IMR shuttle departs every 90 minutes at
9:00am, 10:30am, 12:00pm, 1:30pm, 3:00pm, and 4:30pm
from main campus in front of Dreese Laboratories
at the corner of West 19th and Neil Avenues,
stopping at Nanotech West Labs and the Center for Automotive Research

PVIC-OSU Collaborations Win Over $2 Million in Funding

Collaborations developed through the Ohio State node of the Wright Center for Photovoltaics Innovation and Commercialization (PVIC) were awarded funding to support two substantial new research projects, as announced by the Ohio Department of Development in late December 2009. PVIC-OSU was a collaborator in two of the six new research projects awarded state-wide through the Ohio Third Frontier Photovoltaics Program.

Paul R. Berger, Professor of Electrical & Computer Engineering and Physics, and his research group will collaborate on one new project led by the Ferro Corporation of Cleveland, in collaboration with StrateNexus Technologies of Columbus, the Edison Welding Institute and Oak Ridge National Laboratory. This $1 million, two-year project, matched with another $1 million, will develop and test hermetic sealing for a wide range of photovoltaic (PV) modules including both flexible organic and rigid inorganic PV. If PV module lifetime could be extended well beyond the full amortized rate has depreciated to zero, then surviving PV modules will provide virtually free energy thereafter, significantly lowering their cost-of-ownership. The Berger research group brings to the team expertise in organic photovoltaic cells, having won awards at the Photovoltaic Specialists Conference for the last two years. Preliminary sealing results from Berger's group with the Edison Welding Institute during a pilot program supported by PVIC and EWI on organic photovoltaic encapsulation provided the groundwork for this award. The unique chemistry of Ferro's glass frits and StratesNexus' organic binders complete the team for hermetic sealing of rigid and flexible PV modules, respectively.

Robert J. Davis, Director of the Ohio State PVIC site and IMR Associate Director, is the OSU collaborator on the second funded project, working with Replex Plastics of Mt. Vernon as the lead organization and Dovetail Solar and Wind of Athens as a systems tester and integrator. This $1.25 million, two-year project will develop low-cost, low-concentration photovoltaic ("LC2PV") systems based on compound parabolic concentrators (CPCs). Replex brings its existing line of low-cost, high-quality mirrors and systems integration experience to the collaboration, and Davis and OSU PVIC staff will design, fabricate and test cells tailored for 3x – 10x solar concentration at the Nanotech West Laboratory. Dovetail, an experienced PV installer, will weather-test systems.

The Third Frontier Program aims to accelerate the movement of high technology into the marketplace, creating Ohio jobs. More information on the Program and the new awards can be found at www.thirdfrontier.com.

Faculty Spotlight: Roberto Myers

Roberto Myers joined the faculty at Ohio State University as an Assistant Professor in Materials Science and Engineering with a co-appointment in Electrical and Computer Engineering starting in fall 2008. He received his B.S.E. in Materials Science and Engineering at the University of Pennsylvania in 2001 and completed his PhD in Materials in 2006 at the University of California, Santa Barbara in the group of Prof. Art Gossard. Dr. Myers was a Post-Doctoral Fellow in the group of Professor David Awschalom in the Physics department at UC Santa Barbara. His previous research focused on the epitaxial fabrication of semiconductor spintronic systems combined with fundamental electronic and optical spectroscopies aimed at exploring spin dynamics in the solid state.

His current research focuses on Molecular beam epitaxy growth of III-Nitride heterostructures and nanostructures with applications in advanced optoelectronics and spin-based electronics. Current activities include:

- Self-assembled nanowire heterostructures for ultrafast optoelectronics
- Spin-based electronics in wide band gap heterostructures

Molecular beam epitaxy (MBE) of III-Nitrides

We have installed a new crystal growth system for producing state of the art III-Nitride heterostructures using molecular beam epitaxy techniques (fig. 1). This system is shared with Prof. Siddharth Rajan (ECE/MSE) and housed in the semiconductor epitaxy and analysis laboratory (SEAL) in collaboration with Prof. Steve Ringel. Dr. Myers group has launched an aggressive materials development effort, currently growing high electron mobility heterostructures, self-assembled GaN nanowire heterostructures (fig. 2), and rare-earth doped magnetic quantum structures (fig. 3).

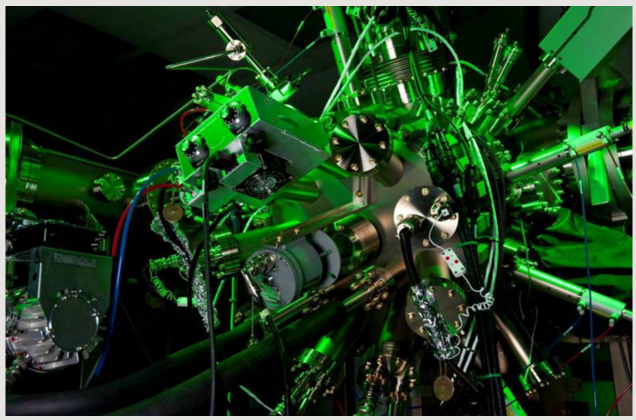


Figure 1.
Plasma-assisted molecular beam epitaxy system for growth of GaN/AlGaN/InGaN heterostructures. Additional sources include Si, Mg, and Gd for n-type, p-type, and magnetic doping in Nitrides.

These nanostructures are being studied with a suite of high-resolution, atomically specific structural measurements, optical spectroscopies, and magneto-electronic characterization. This growth method allows bandgap engineering of heterostructures with atomic layer precision.

Self-assembled nanowire heterostructures for ultrafast optoelectronics

GaN-based self-assembled nanowires can be grown on economical Si substrates using MBE that allows three-dimensional design of nanostructures with atomic precision (fig. 2). Such nanowires contain no threading dislocations and allow compositional control along the length and radius. Epitaxial strain can be fully accommodated in nanowires allowing highly

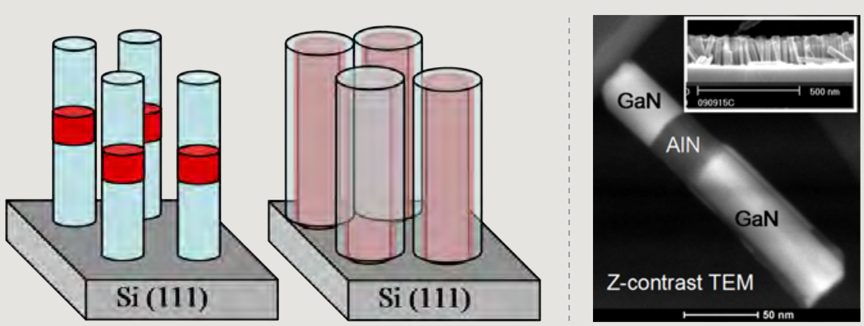


Figure 2.
(Left) Vertical and coaxial nanowire heterostructures.
(Right) Self-assembled GaN nanowire heterostructures on Si.
*TEM work courtesy of Patrick Phillips, from Prof. Mike Mills group (MSE).

lattice mismatched heterostructures that strongly confined electrons at energies not possible in other materials. Our graduate students' have grown initial nanowires and studied them using atomically specific electron microscopy (fig. 2) revealing vertical and coaxial growth of GaN/AlN

[TEM work courtesy of Patrick Phillips, from Prof. Mike Mills group (MSE)]. We will study the ultrafast optical transitions within the conduction band, so-called intersubband transitions that are the basis of quantum cascade lasers and detectors operating at mid-infrared wavelengths that exhibit remarkable properties of unipolar operation, high power/efficiency, wavelength tunable light sources, and ultrafast light detection. Nitrides exhibit the largest conduction band offsets in any semiconductor family providing the unique potential to extend quantum cascade lasers and detectors from the mid-infrared into an entirely new spectrum of operation, the near-infrared and visible wavelengths. This work is supported by the office of naval research (ONR).

Spin-based electronics in wide band gap heterostructures

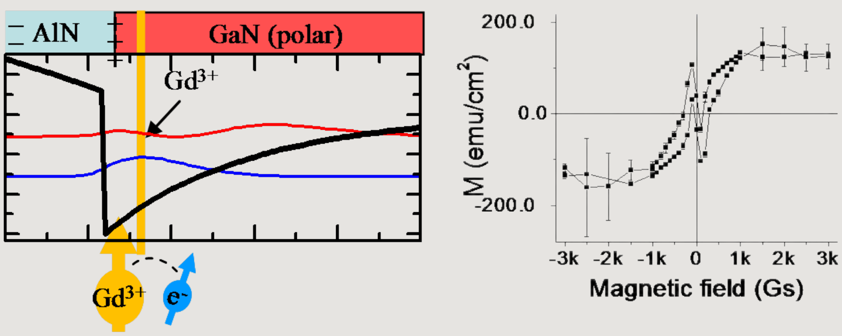


Figure 3.
(Left) Engineering ferromagnetism in Gd-doped two-dimensional electron gases in GaN. (Right) Ferromagnetism observed in GaN magnetic 2DEG.

We are exploring electron-mediated magnetism in two-dimensional electron gases (2DEGs) doped with rare-earth (Gd) magnetic moments. If successful, this project would demonstrate the electron-mediated ferromagnetism in a semiconductor that could be electrically tuned by gating the electron sheet. Initial structures grown by our graduate students exhibit ferromagnetism (fig. 3), but additional optical and electronic measurements are needed to determine the origin of the magnetism. This work is supported by the center for emergent materials at Ohio State (NSF-DMR) as well as the institute for materials research (IMR).

For more information see Dr. Myers' Research group web page: http://www.mse.osu.edu/~myers/

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CEM Seed Program – Building Future IRGs

As detailed in this issue's cover story, the Center for Emergent Materials, OSU's MRSEC program, features two Interdisciplinary Research Groups (IRGs) that share the mission of laying down the scientific foundation for building future spin- and oxide-based electronic devices that can perform multiple functions, as well as energy-efficient, fast computers with integrated memory and logic. However, the CEM's focus is not limited to these currently funded IRG areas. The long-term success of the center beyond the first six-year funding period is also an important goal of the CEM, and the basis of recent changes to the CEM Seed Program.

The CEM Seed Program was designed to facilitate a quick and effective response to new discoveries, opportunities beyond the current scope of the CEM, and high-risk/high impact/transformative research. In 2010, the mission of the CEM Seed Program has been revised in anticipation of the forthcoming CEM renewal proposal to NSF in 2013. This new direction repositions the CEM Seed Program, which continues to stimulate interdisciplinary group research in promising areas, but now explicitly supports incubating projects with the potential to evolve into full IRGs. Proto-IRG Seed Grants are the new tool designed to achieve this goal.

Proto-IRG Seed Grants will support research by small interdisciplinary groups of 3 to 4 investigators, who will form the core of a new proposed full IRG (consisting of 6-10 researchers) within 2 years. Proposed research should be broad and interdisciplinary while maintaining a focus on a central theme to meet the requirements of a MRSEC IRG. Although not required for Proto-IRGs, a strong synergy between experimental and theoretical components is essential for full IRGs. The 2010 Proto-IRG Seed Grants will be up to $100,000 in direct costs per Proto-IRG per year, with smaller awards possible for proposals with technical merit but insufficiently developed IRG-potential. The initial funding period is 12 months. Successful Proto-IRGs can be renewed on a yearly basis until the OSU MRSEC renewal, and funded teams will be expected to participate actively in further team building and CEM activities.

The Seed Program will evaluate the proposals by internal and external reviewers and allocate resources based on the quality of the proposed research and the synergy with the CEM activities. Review criteria for the 2010 Seed Program include intellectual merit of proposed research activity, potential to evolve into a full IRG and to leverage the existing capability of the CEM, extent to which proposed research fosters interdisciplinary collaborations, and availability of resources. In particular, each Proto-IRG proposal requires a plan for expansion into a full IRG, which consists of synergistic experimental and theoretical components.

Ultimately, the CEM plans to hold an internal competition, down-selecting the field of proposed IRGs to a unified group of 4 to 5 that together will form the renewal proposal of the CEM. This competition is projected for Winter 2013. Recipients of Proto-IRG Seed Awards are expected to participate in this competition, which will be open to all OSU faculty independent of participation in this Seed Program.

Applicants are encouraged to review the most recent MRSEC call for proposals from the NSF for further details as to what is expected of a fully developed IRG. To address questions related to the CEM Seed Program, an open workshop on what makes a successful IRG was co-sponsored by the CEM, ENCOMM and the Institute for Materials Research (IMR) in February 2010. Various venues to assist in team-building will be announced in the coming months.

2010 Proto-IRG Seed Grants Proposal Guidelines

All regular faculty members of OSU are eligible to apply to the CEM Seed Program. Current core members of the CEM are not eligible to be the lead Applicant, but can be co-Applicants.

Proposal components include:

- cover page
- references
- CVs and current/pending support
- project description (4 pages),
- budget

Written proposals for the 2010 Seed Program are due 5:00 PM, Friday, April 30, 2010. Selected teams shall be asked to make 30-minute presentations to the Executive Committee of the CEM. The anticipated start date is September 1, 2010. Email applications in a single file in PDF format to mohler@mps.ohio-state.edu.

Potential applicants may contact the Seed Board Co-Chairs Ezekiel Johnston-Halperin (ejh@mps.ohiostate.edu, 614-247-4074) or Fengyuan Yang (fyyang@mps.ohio-state.edu, 614-688-4390) for questions related to potential research activities.

CEM Supporting Students with Disabilities in STEM Fields

Amid the call for improving the nation's scientific, technological, and economic competitiveness, increasing attention is being focused on the untapped potential of people from groups underrepresented in science, technology, engineering and mathematics (STEM) fields. A primary goal of Ohio State's Center for Emergent Materials' education and human resource development program is to increase the participation in center activities by members of underrepresented groups, including women, racial/ethnic minorities, and people with disabilities.

While an estimated 20% of the U.S. population has a disability, studies show that only 7% of employed scientists and engineers have a disability. The CEM is emerging as a leader among STEM research centers in the inclusion of people with disabilities through its work with Ohio's STEM Ability Alliance (OSAA), one of nine National Science Foundation's Alliances for Students with Disabilities in STEM.

The goal of this state-wide alliance is to increase the number of people with disabilities who enroll in degree programs in STEM fields. OSAA accomplishes this by following a targeted set of strategies to attract students with disabilities into the STEM K-12 educational pipeline, facilitating the students' transition into 2- or 4-year colleges, and supporting them academically, economically, and socially as they pursue undergraduate and graduate degrees and ultimately transition into STEM careers. The OSAA model centers around partnership "quads" consisting of local K-12 schools, a community college, a research university, and a business and industry partner. In the Columbus metropolitan area, the quad partners include all Franklin County school districts, the Ohio State School for the Blind, Columbus State Community College, The Ohio State University, Battelle Memorial Institute, American Electric Power, and Nationwide Insurance.

◄ Robert Hooper

Ohio State School for the Blind

Metro Early College High School

Developing podcasts about materials research for high school teachers

◄ Stephanie Fernandes

Boston College

Developed evaluation instruments for CEM REU students

During OSAA's first year, the Center for Emergent Materials has served as the lead academic and research partner in introducing K-12 and undergraduate students to STEM research and careers. CEM was instrumental in including students with disabilities in the center's outreach programs, recruiting CEM mentors for OSAA students, and creating internship placements. During 2009, the CEM's impact included:

- Internships for two students with visual impairments (See photos above)
- Laboratory tours by eight high school and undergraduate OSAA students and their mentors
- Outreach activities involving over 450 K-12 students with disabilities

The CEM's success in working with students with disabilities is serving as a collaboration model for OSAA's other higher education and industry partners through its recruitment and incorporation of students with disabilities into the activities of the center.

2010 IMR Materials Week

Monday, September 13 — Wednesday, September 15, 2010
Ohio Union at OSU's Columbus campus

Join us for this 3rd annual event showcasing the full breadth of materials-allied research at The Ohio State University and beyond, including plenary sessions on cross-cutting topics and technical sessions highlighting recent research findings

More details coming soon on IMR's website, via email, and mail!
See our Flickr page for photos from 2009 IMR Materials Week, go to www.flickr.com and search for osuimr.

IMR
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