



Directorate of Mathematical and Physical Sciences

Office of the Assistant Director
F. Fleming Crim, Assistant Director
Celeste Rohlring, Deputy Assistant Director

Office of Multidisciplinary Activities
Clark Cooper

**Astronomy
(AST)**
Jim Ulvestad

**Materials
Research
(DMR)**
Mary Galvin

Physics (PHY)
Denise Caldwell

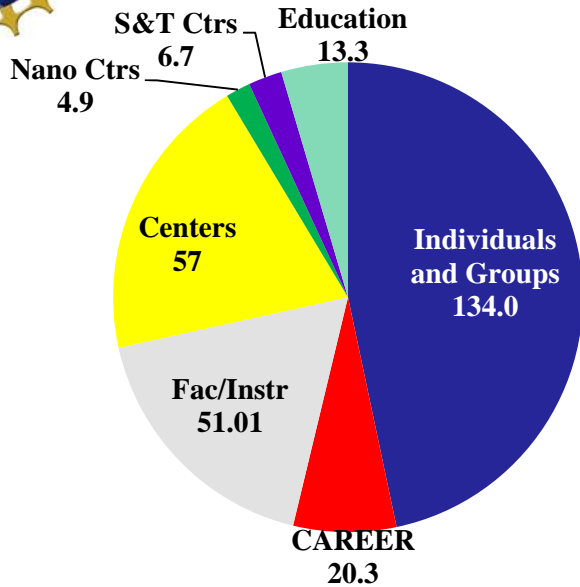
**Chemistry
(CHE)**
Jacquelyn Gervay-Haque

**Mathematical
Sciences
(DMS)**
Michael Vogelius

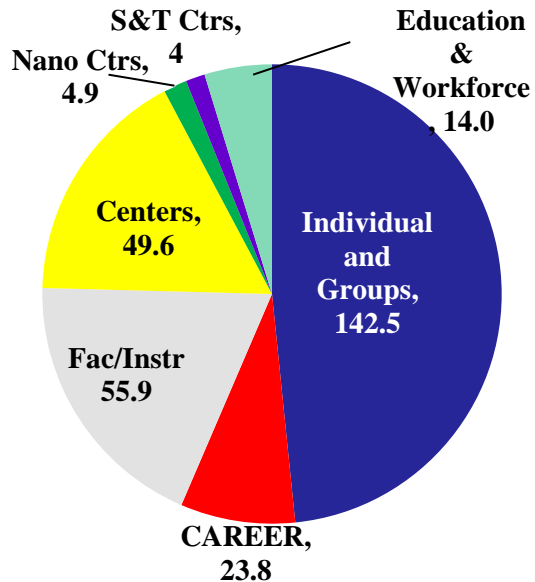


DMR Budget

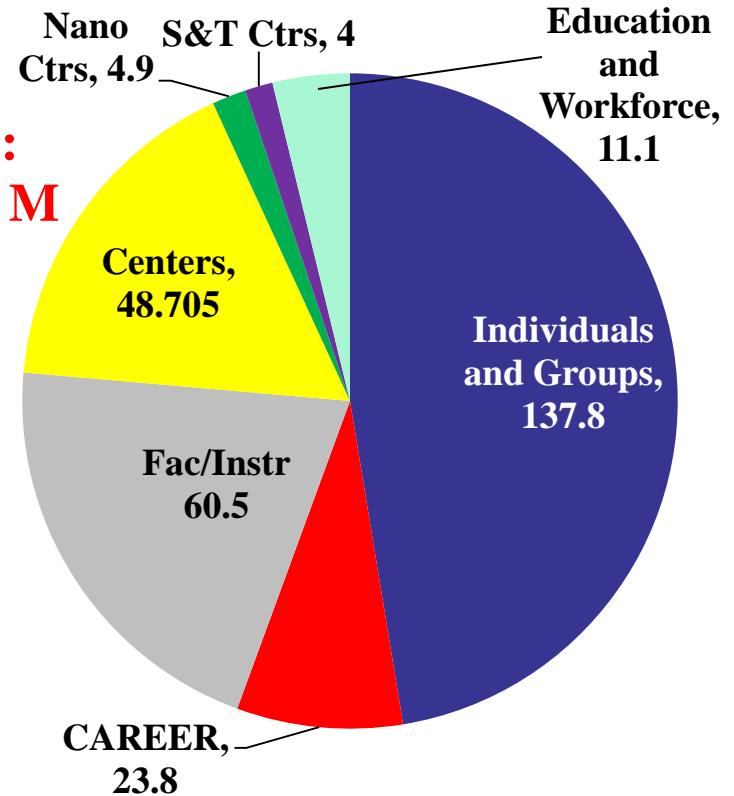
FY11: \$287 M



FY12: \$295M



FY13: \$290.7 M



56.3% to **55.6%** - Individual Investigators

18.9% to **20.8%** - Facilities

19.8 % to **19.8 %** - Centers MRSEC, Nano, STC

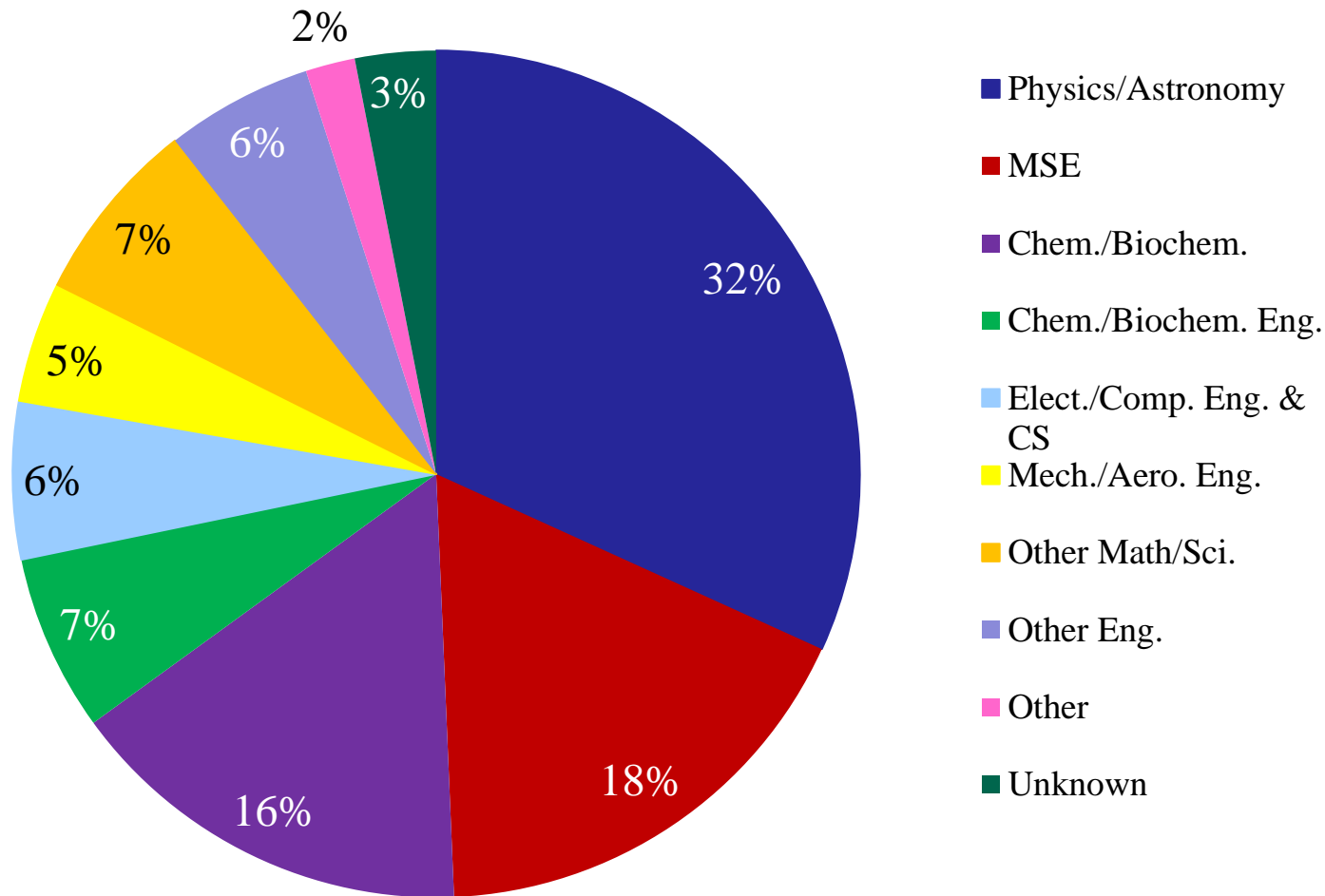


FY14 and FY15

- FY14 has not come back from Congress
 - *legislation will provide the National Science Foundation with \$7.172 billion, an increase of \$287.8 million (or 4.2 percent) over the FY '13 Current Plan (CP)* (http://www.nsf.gov/about/congress/113/highlights/cu14_0123.jsp)
 - Not every Division will get 4.2% increase.
- FY15 – President's request released today -
 - \$7.3B for the National Science Foundation
 - \$1295.96M for MPS vs **\$1299.80** FY14 Estimate
 - \$298.99M for DMR vs \$298.01 FY14 Estimate
- Going forward budget decreases may not be taken exclusively from new awards.



PI Distribution DMR



*But diverse as they are, materials scientists look at materials from a unified point of view: they look for connections between the underlying **structure** of a material, its **properties**, how **processing** changes it, and what the material can do - its **performance**. (From Strange Matter)*



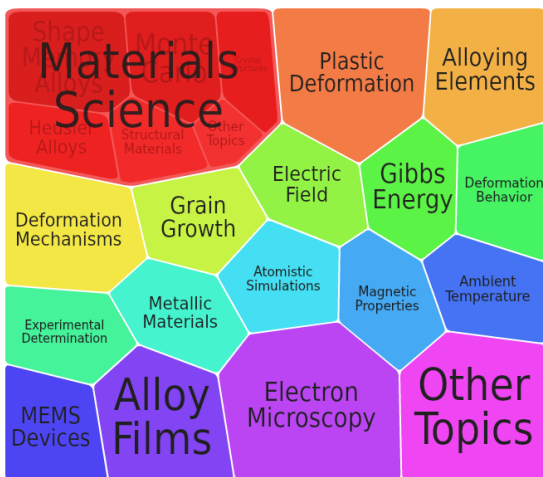
Material



BMAT

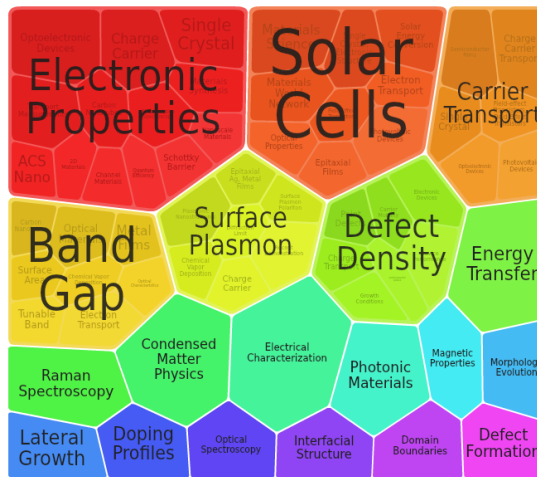
Joseph Akarra

Mohan Srinivasarao



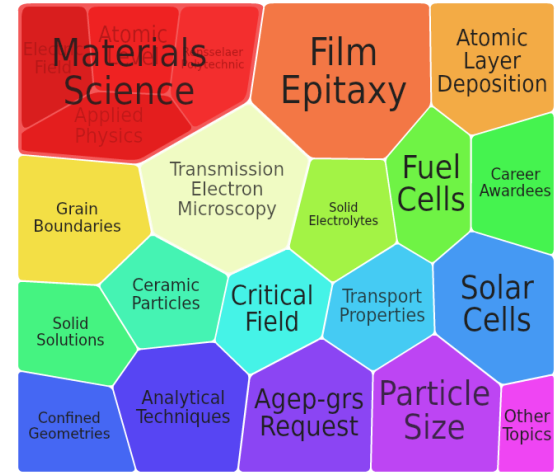
MMN

Diana Farkas



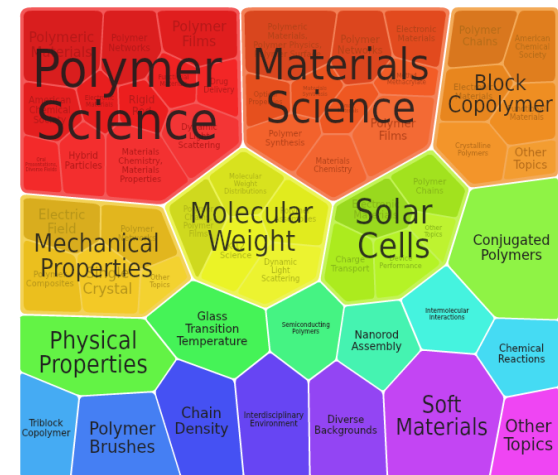
EPM

Charles Ying
Haiyan Wang



CER

Lynnette Madsen

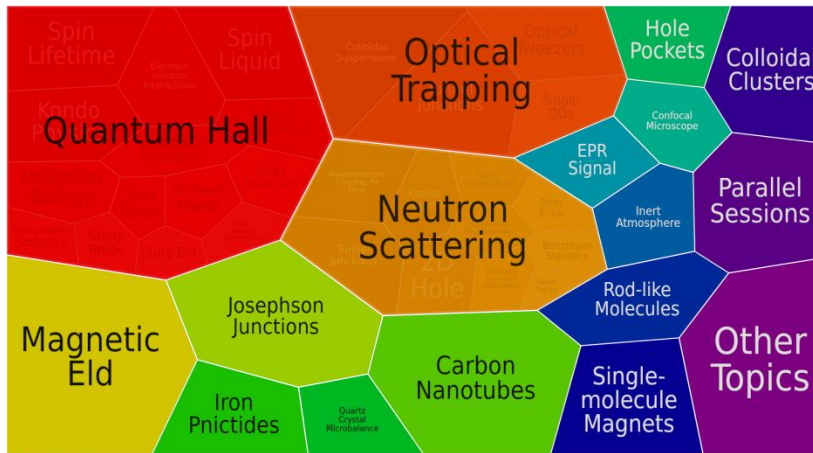


POL

Andrew Lovinger



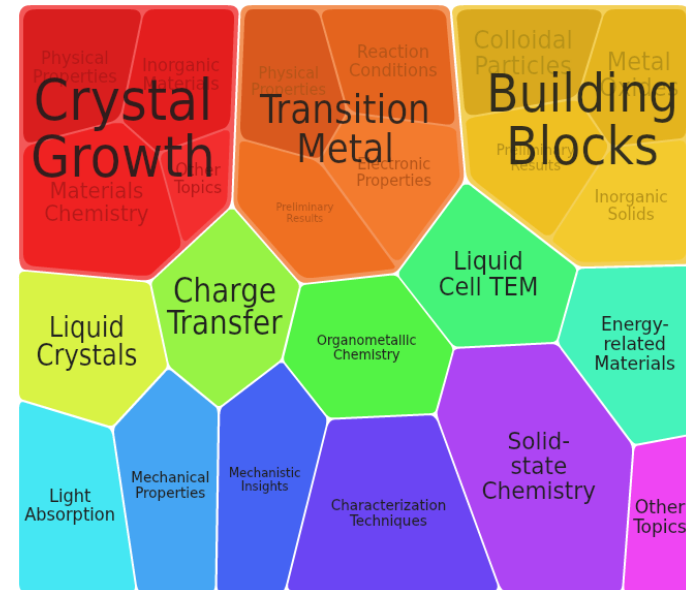
Discipline



CMP

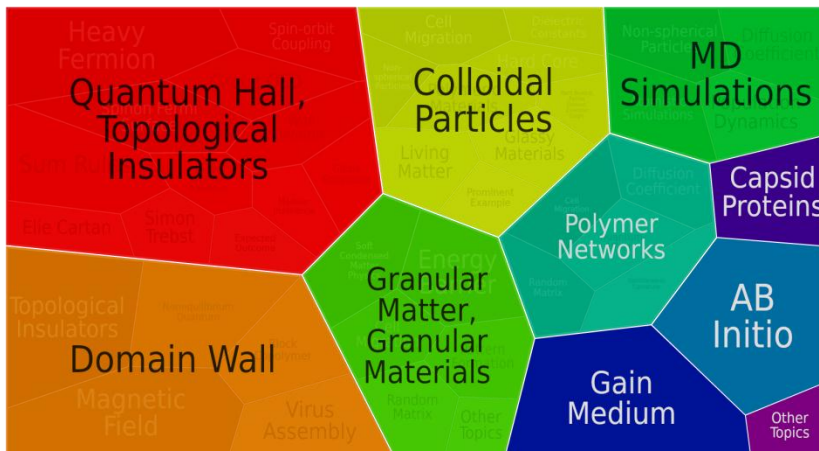
Paul Sokol

Guebre X. Tessema (Tess)



SSMC

Michael Scott



CMMT

Daryl Hess

Serdar Ogut

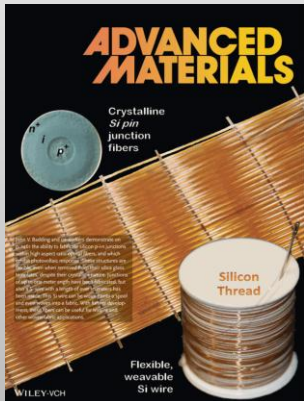
Andrey Dobyrynin



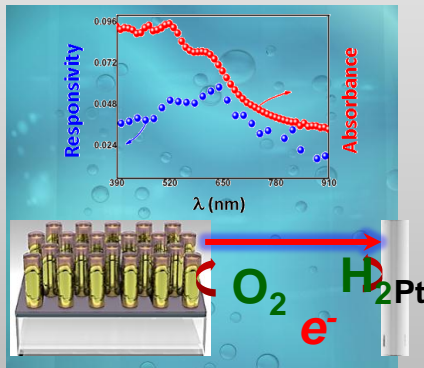
DMR Research

ENERGY

Flexible Si solar cell fabrics,
John Badding, Penn State,
 EPM & MRSEC



Plasmonic Nanostructures for
 Solar Water Splitting, **Stucky,**
 UCSB, SSMC



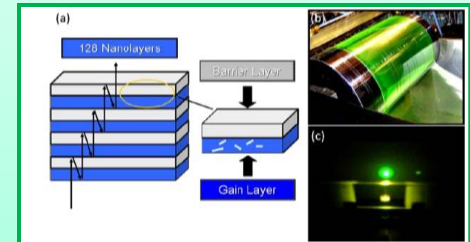
Future Electronics/Photonics



Springboard. Scientists achieved the simplest quantum states of motion with this vibrating device, which is as long as a hair is wide.

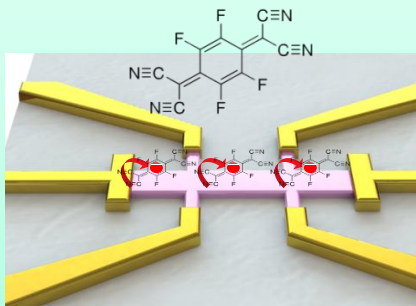
First device of this size to exhibit quantum behavior – absorb energy in discrete units, always moving and be in two places at once. **Cleland, UCSB,** CMP

STC Layered Polymeric Systems

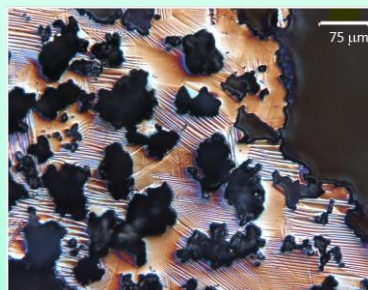


Company just spun off: Multilayer distributed feedback lasers and terabyte optical data storage, Case Western

Complex Phenomena



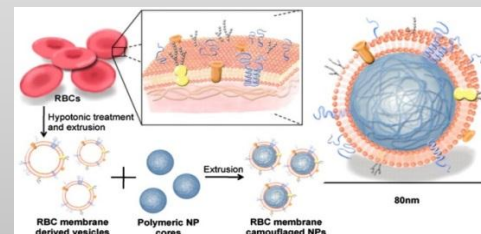
New gating technique reveals the conducting surface of a topological insulator, Bi_2Se_3 bulk charges removed with F4TCNQ to reveal surface conduction in TI. **Fuhrer, U MD, EPM**



Ni-Mn-Ga alloy foam. Magnetic shape memory alloys exhibit strains of ~ 9% compared to 0.1% , **Mullner, Boise State, MMN**

Health and Environment

Stealth Vectors -Schematic for the preparation of RBC-membrane-coated PLGA nanoparticles (NPs), **Liangfang Zhang, UCSD BMAT**



Rubenstein, UNC, shown how dense mucopolysaccharides prevent mucous penetration – allow lungs to clear Infectious and toxic agents. CMMT

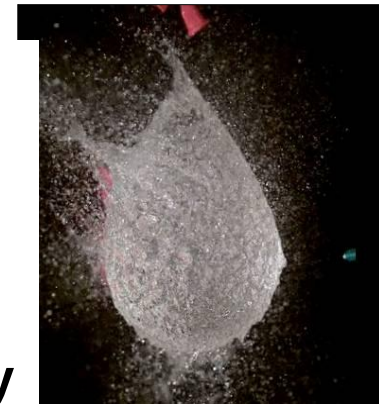


Infrastructure



Users of MRSEC Facilities

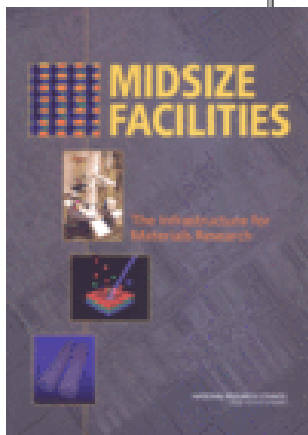
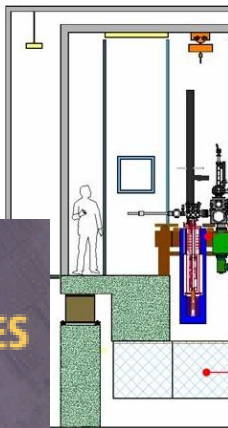
- > 2000/yr Academic
- > 550/yr Industry
- > 100/yr National Labs



Over 500 Publications annually

Shared Facilities Workshop in 2011

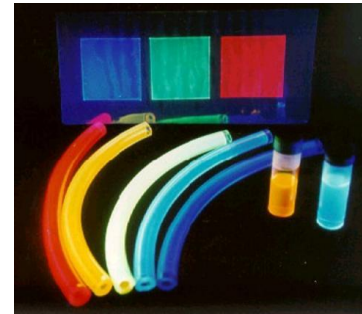
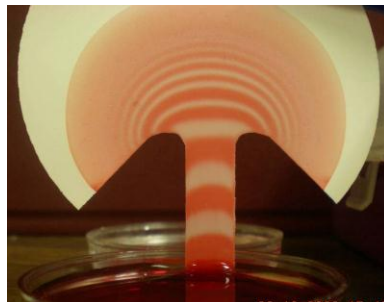
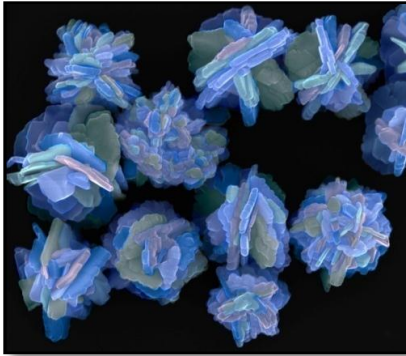
- 77 Technical Staff in SEFs
- 31 Other Technicians
- 70 Administrative Staff
- 28 Education Staff



The Partnership for Research and Education in Materials (PREM) Program

... to address the pipeline of under-represented minority materials scientists...

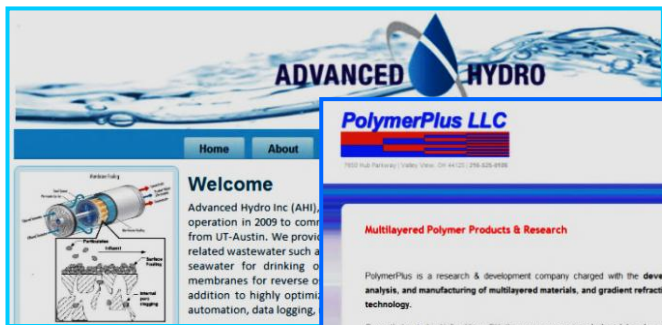
The Division of Materials Research (DMR) seeks to broaden participation in materials research and education by stimulating the development of long-term, collaborative partnerships between minority serving institutions and DMR-supported groups, centers, institutes, and facilities.





Science and Technology Centers

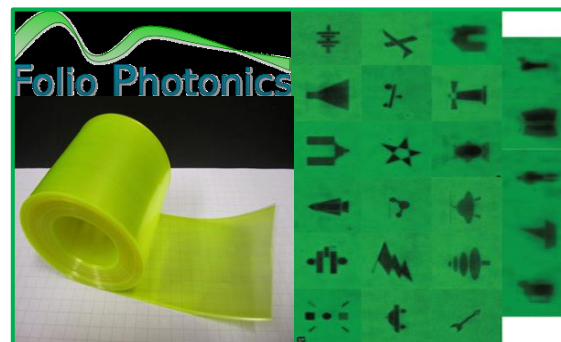
Center for Layered Polymeric Systems Case Western Reserve



Water filters



Nanolayered gradient-index lenses



Distributed feedback lasers and terabyte optical data storage through 23 separately addressable microlayers

3 startups on water filters, nanolayered gradient-index lenses, distributed feedback lasers and terabyte optical data storage – 23 separately addressable microlayers



New STC: CIQM

Center for Integrated Quantum Materials

Harvard, MIT and Howard

PI: Robert Westervelt

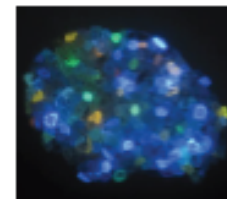
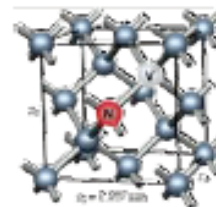
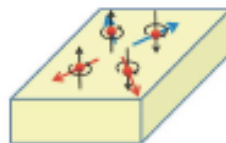
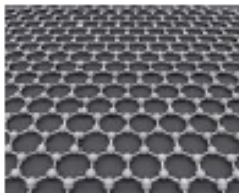
Mission

Transform electronics and photonics using 2D atomic layers,
electron surface states and single-atom devices in
Quantum Materials:

Atomic Layers: Graphene, BN, MoS₂ - *ultrafast devices*

Topological Insulators – *topologically protect data*

Nitrogen Vacancy Center Diamond – *atomic memory*





Managing the Nation's Multidisciplinary User Facilities for Research

Stewardship: OMINaF Provides high cost and unique experimental capabilities to the DMR community.

- **Cornell High Energy Synchrotron Source**
- **National High Magnetic Field Laboratory**

Partnership: OMINaF partners with others to provide resources to the DMR community.

- With NIST: The Center For High Resolution Neutron Scattering (CHRNS) at the NIST Center for Neutron Research
- With DOE: The Intermediate Energy X-Ray (IEX) beamline 29-ID currently under construction at the Advanced Photon Source.
- With NSF/Chem: ChemMatCARS Beamline at the Advanced Photon Source
- With NSF/ENG: National Nanotechnology Infrastructure Network (NNIN)



NSF Initiatives

Feb 14, 2013



Designing Materials to Revolutionize and Engineer the Future (DMREF)

In Response to Materials Genome Initiative

- Build the fundamental knowledge base needed to progress towards designing and making a material with a specific and desired function or property from first principles
- Accelerate materials discovery and development.
- Experiments must drive theory/simulation and theory/simulation must drive experiments: through a Collaborative and Iterative process.

DMREF now in 3rd year

MPS: DMR, CHE, DMS

ENG: CMMI, CBET

CISE

Proposal Window – Jan 15 - Feb 15

John Schlueter – Program Officer





DMREF PROPOSALS

- Must go beyond simple collaborations.
- Most awards have been to research groups. (Award size has gone to \$1.45M over 4 years)
- Address open access to algorithms and data.
- **Most successful go beyond:**
 - Simply including theoretical and computational research.
 - Simply comparing theory/simulation and experiment.
 - Collaborations already funded in DMR and NSF.



Sustainable Chemistry, Engineering and Materials (SusChEM)

SusChEM proposals are expected to take a systems-based approach to understanding, predicting and facilitating advances towards global sustainability.

MPS – Chemistry (CHE), Materials (DMR)

ENG – Division of Chemical, Bioengineering,
Environmental and Transport Systems (CBET) and
Division of Civil, Mechanical and Manufacturing
Innovation(CMMI)

GEO – Division of Earth Sciences (EAR)



SusChEM: DMR

Promote Fundamental Research For:

- **Materials for the Preservation and Extension of Natural Resources:**
 - Enhance recyclability, reuse, repurposing, and/or reclamation
 - Extend the durability, lifetime, or enhance the biodegradability of materials
- **Material Replacement for a Safer and more Secure Future:**
 - Elimination of toxic elements/materials
- **Improved Materials during Operating Conditions:**
 - Increase the lifetime of materials (normal, extreme or harsh conditions)
 - Extend the operational range of materials to increase efficiency or efficacy
- **Materials Designed for Zero Waste:**
 - Minimize waste and/or emphasize the use of bio-related materials
 - Increasing the self-sensing, -repairing, -healing (smart) properties of materials
- **Not Energy Focus in FY14**
- Contact Andy Lovinger and/or Diana Farkas



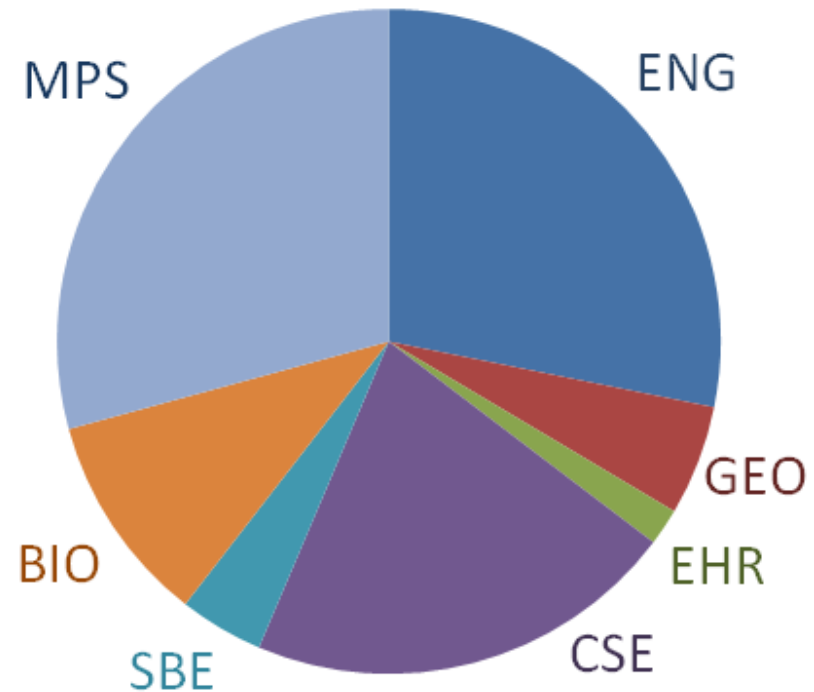
CAREER Program

NSF's most prestigious awards for junior faculty.

Awardees are selected based on a plan of outstanding research and education, and the integration of research and education.

CAREER awards are a priority for DMR

- FY13 DMR spent \$23.8 M
- Proposal Deadline
 - **MPS/DMR – July 23, 2014**





Major Research Instrumentation

Proposals in range of \$100,000 to \$4M

Track 1 – acquisition

Track 2 – development

over \$1 million should address the potential impact of the instrument on the research community of interest and at the regional or national level when appropriate

Limit 3 per institution and 1 must be development if submitting 3

30% cost sharing required PhD institutions

Electron Microscopes, X-ray Diffractometers, X-ray Photoelectron Spectroscopy, X-ray Fluorescence, Ultrafast Lasers, Atomic force microscopes, Surface Plasmon Resonance, Electron beam lithography, Cryo-systems for magnets, etc.

**NATIONAL SCIENCE FOUNDATION
MAJOR RESEARCH
INSTRUMENTATION**

MRI GOALS

- Catalyzing new knowledge and discoveries
- Empowering the Nation's scientists and engineers
- Providing state-of-the-art research instrumentation
- Enabling research-intensive learning environments
- Building capacity for a diverse workforce
- Developing next generation instrumentation
- Promoting academic/private sector partnerships

MRI@NSF.GOV
www.nsf.gov/od/oia/programs/mri

Proposals due 4th Thursday in Jan.

<http://www.nsf.gov/od/oia/programs/mri/>



Early-Concept Grants for Exploratory Research (EAGER)

Formerly: Small Grants for Exploratory Research (SGER)

- Supports **high-risk, exploratory**, and potentially transformative research
- Began Jan. 1, 2009
- Up to \$300K over two years
- May be submitted any time; contact program officer prior to proposal submission

- **Also, Grants for Rapid Response Research (RAPID)** supports research of great urgency

- **Contact Program Officer to discuss these.**



How you can help. Acknowledging your support from the Foundation

Support from the NSF must be appropriately acknowledged in all presentations and publications as well as web sites.

Reporting work supported by multiple agencies or programs within NSF is accepted but the contribution from each funding agency must be acknowledged appropriately.

Centers, institutes and facilities need to display the program name, for example “MRSEC” , should appear on websites, publications, and presentations. The “brand name” must be featured prominently.

We need your support to ensure NSF DMR activities receive appropriate recognition



Thank You.