Division of Material Research (DMR)
Mary Galvin, Division Director

From Project Summary of FY 13 Awards
Directorate of Mathematical and Physical Sciences

Office of the Assistant Director
F. Fleming Crim, Assistant Director
Celeste Rohlfing, 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

- Nano Ctrs: 4.9
- S&T Ctrs: 6.7
- Education: 13.3
- Individuals and Groups: 134.0
- CAREER: 20.3

FY12: $295M

- Nano Ctrs: 4.9
- S&T Ctrs: 4
- Education & Workforce: 14.0
- Individuals and Groups: 137.8
- CAREER: 23.8
- Fac/Instr: 55.9
- Centers: 49.6
- Individual and Groups: 142.5

FY13: $290.7 M

- Nano Ctrs, 4.9
- S&T Ctrs, 4
- Education and Workforce, 11.1
- Individuals and Groups, 48.705
- Centers, 48.705
- Fact/Instr, 60.5
- CAREER, 23.8
- Individual and Groups, 137.8

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](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.
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)
Discipline

CMP
Paul Sokol
Guebre X. Tessema (Tess)

SSMC
Michael Scott

CMMT
Daryl Hess
Serdar Ogut
Andrey Dobrynin
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**
- 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$_2$Se$_3$ 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
- Rubenstei, UNC, shown how dense mucopolysaccharides prevent mucous penetration – allow lungs to clear Infectious and toxic agents. CMMT
Materials Research Science & Engineering Centers (MRSECs)

- 1972 NSF established DMR with MRLs
- MRSECs must have 2 or more Interdisciplinary Groups (IRGs)
- Flexibility to develop new areas, support for ‘Seeds’
- Education and REU
- Shared experimental facilities
- Competition every 3 years – 6 year awards
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

Materials Research Facilities Network
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.
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, MoS$_2$ - ultrafast devices
Topological Insulators – topologically protect data
Nitrogen Vacancy Center Diamond – atomic memory
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)
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.
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
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.

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.