Opportunities in Mechanics Research

National Science Foundation, Engineering Directorate
Division of Civil, Mechanical, and Manufacturing Innovation

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Program Director
Materials Engineering and Processing

Mechanics-Related Programs at NSF

- Mechanics of Materials and Structures (MoMS)
- Design of Engineering Materials Systems (DEMS)
- Materials Engineering and Processing (MEP)
- Designing Materials to Engineer and Revolutionize our Future (DMREF)

MoMS: Recent Changes

- Until 2015
  - Mechanics of Materials (MoM)
  - Thomas Siegmund, Program Director

- Beginning 2015
  - Program expanded to Mechanics of Materials and Structures (MoMS)
  - Two Program Directors (search underway)

MoMS Program Synopsis

The Mechanics of Materials and Structures program supports fundamental research in mechanics as related to the behavior of deformable solid materials and respective structures under internal and external actions. A diverse and interdisciplinary spectrum of research is supported with emphasis on research that leads to advances in i) theory, experimental, and/or computational methods in mechanics, and/or ii) uses contemporary mechanics methods to address modern challenges in materials and structures. Proposed research can focus on existing or emerging materials and structural systems, across time and length scales.

MoMS: Topics

Proposals related to material response are welcome, and would propose, but not limited to, advances in fundamental understanding of deformation, fracture, fatigue, as well as on contact and friction through constitutive modeling, multi-scale (spatial or temporal) and multi-physics analysis, computational methods, or experimental techniques

MoMS: Opportunity

Proposals at the intersection or considerate of the integration of material and structure (such as, but not limited to, metamaterials, hierarchical, microarchitectured and low-dimensional materials) are especially welcome. Of particular interest are research questions that address the integration and combination of geometry, topology of material distributions, length scales and deformation/failure mechanics.

MOM(S): Current Awards

MoMS CAREER Awards 2015

Avinash Dongare
University of Connecticut
Award 1454547

Jaafar El-Awady
Johns Hopkins University
Award 1454072

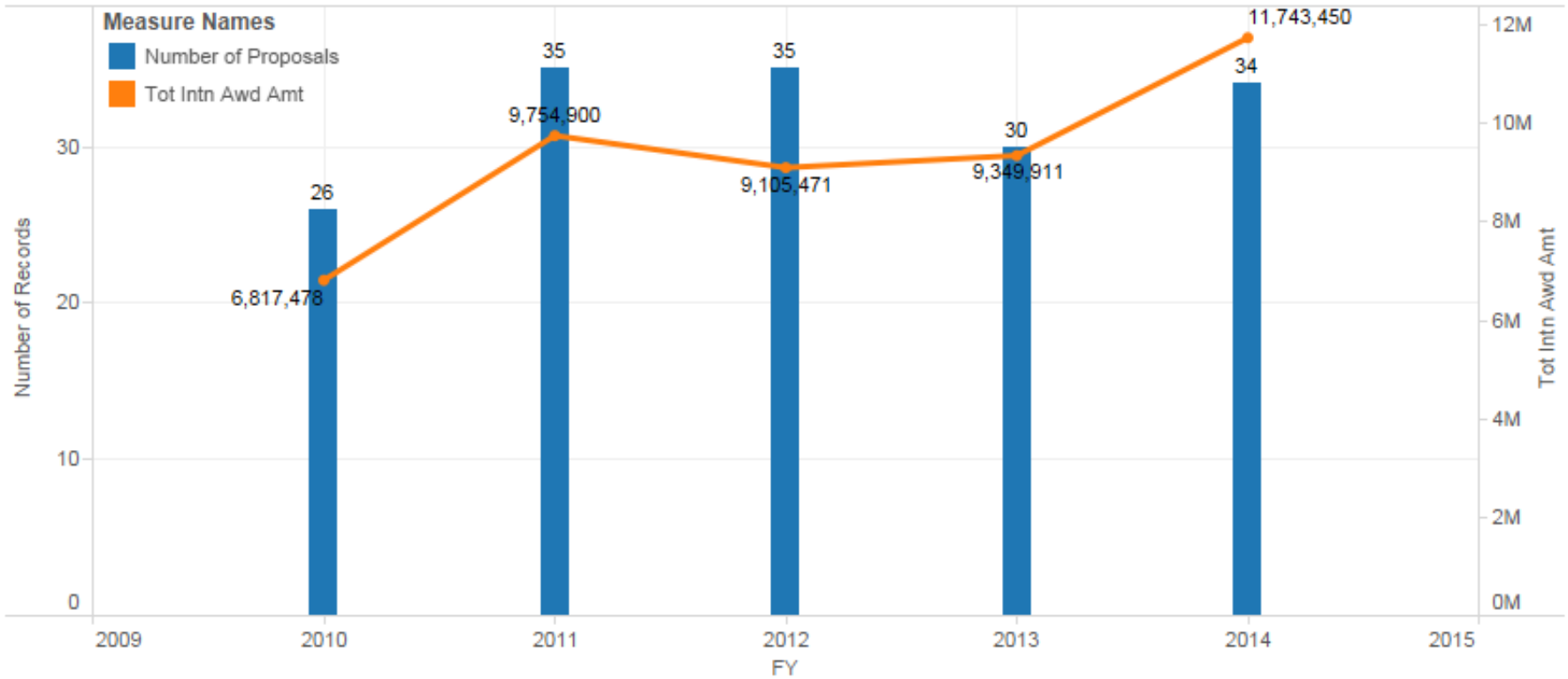
Douglas Holmes
Boston University
Award 1454153

Julian Rimoli
Georgia Tech
Award 1454104

Aaron Stebner
Colorado School of Mines
Award 1454668

(1) High rate deformation/failure in metals;
(2) Hydrogen assisted fracture, coupled diffusion discrete dislocation mechanics
(3) Soft structures and instabilities, active structures
(4) Thermoelastic stress and failure under phononic considerations in heat transfer
(5) 3D X-ray tomography in situ

MoM(S) Program Size



Design of Engineering Materials Systems (DEMS)

Program Directors

- Thomas Siegmund
- Chris Paredis
- Mary Toney

DEMS Program Description

The Design of Engineering Material Systems (DEMS) program supports fundamental research intended to lead to new paradigms of design, development, and insertion of advanced engineering material systems.

Fundamental research that develops and creatively integrates theory, processing/manufacturing, data/informatics, experimental, and/or computational approaches with rigorous engineering design principles, approaches, and tools to enable the accelerated design and development of materials is welcome.

DEMS Objectives

Research proposals are sought that strive to develop systematic scientific methodologies to tailor the behavior of material systems in ways that are driven by performance metrics and incorporate processing/manufacturing.

While an emphasis on a specific material system may be appropriate to provide the necessary project focus, techniques developed should transcend materials systems.

Ultimately it is expected that research outcomes will be methodologies to enable the discovery of materials systems with new properties and behavior, and enable their rapid insertion into engineering systems.

Design Methodology

Design is defined as a process that starts with an intended function or performance and works back to a material formulation/microstructure/processing route to achieve that end.

Typically but not exclusively considers issues such as objective functions, constraints, preferences, alternatives, decision-making, uncertainty, data-information-knowledge integration, etc.

Materials Engineering & Processing (MEP)

The Materials Engineering and Processing (MEP) program supports fundamental research addressing the processing and/or mechanical performance of engineering materials by investigating the interrelationship of materials processing, structure, properties and/or lifecycle performance for targeted applications

Materials Engineering & Processing (MEP)

Fundamental research driven by application/performance

- Process-structure-property relationships
- Life cycle performance in the built environment

Full range of material systems

- Structural, Functional, Surfaces & Interfaces
- Metals, ceramics, semiconductors, polymers (natural and synthetic), composites, hybrid materials

Complementary to :

- CMMI – mechanics, design, systems, manufacturing
- CBET – in situ transport, fluid dynamics, sustainability
- ECCS – device- and system-level, sustainability
- DMR – materials synthesis, discovery, characterization, performance

Materials Engineering & Processing (MEP)

Processing

- Proposed research should focus on manufacturing processes that convert material into useful form as either intermediate or final composition
- All material systems

Performance

- Proposed research should be driven by a targeted application(s)
- Mechanical or multifunctional (not electronic) performance
- Structural, functional and responsive materials
- Surface engineering, tribology
- Corrosion and degradation
- Length scales from molecular to macro

The DMREF Solicitation

Designing Materials to Revolutionize and Engineer our Future

NSF's Response to and participation in the Materials Genome Initiative

NSF is interested in activities that accelerate materials discovery and development by building the fundamental knowledge base needed to progress towards designing and making a material with a specific and desired function or property from first principles.

The DMREF goal is to control material properties through design: this is to be accomplished by understanding the interrelationships of composition, processing, structure, properties, performance, and process control.

DMREF: Collaborations

The proposed research must be a collaborative and iterative process wherein theory guides computational simulation, computational simulation guides experiments, and experiments further guide theory.

PIs: Computational Materials Scientists, Experimentalists (Scientists and Engineers), Theorists, Mathematicians, Computer scientists…

Contact

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DMREF Solicitation

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