NSF Directorate For Engineering
Civil, Mechanical and Manufacturing Division

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CMMI Research Clusters
Advanced Manufacturing

- Research leading to transformative advances in manufacturing and building technologies, with emphases on efficiency, economy, and sustainability

- Supporting programs
  - Manufacturing and Construction Equipment
  - Manufacturing Enterprise Systems
  - Materials Processing and Engineering
  - Nanomanufacturing
CMMI Research Clusters
Mechanics and Engineering Materials

• Research aimed at advances in the transformation and use of engineering materials efficiently, economically, and sustainably

• Supporting programs
  – Geomechanics and Geomaterials
  – Materials and Surface Engineering
  – Mechanics of Materials
  – Nano/Bio Mechanics
  – Structural Materials and Mechanics
CMMI Research Clusters
Systems Engineering and Design

- Research on the decision-making aspects of engineering, including design, control, and optimization

- Supporting programs
  - Control Systems
  - Dynamical Systems
  - Engineering Design and Innovation
  - Operations Research
  - Sensors and Sensing Systems
  - Service Enterprise Systems

EDI/GOALI: New Visualization Technologies Allow for Faster Virtual Prototyping
Manocha, UNC

O.R. - Methods for optimized ambulance deployment
Henderson, Cornell

SSS/EFRI: Learning from Plants (Wang, Mayer, Nielson (Michigan) Bakis, Rahn (PSU))

Multiple FMC cells

Twisting Motion

Bending Motion
CMMI Research Community

- Mechanical Engineering: 33.5%
- Civil Engineering: 21.3%
- Industrial Engineering: 11.4%
- MatSci: 7.6%
- Computer Science: 1.6%
- Electrical Engineering: 5.1%
- Environmental Engineering: 0.8%
- Physics: 3.2%
- Mathematics: 1.3%
- Management: 1.1%
- Geosciences: 0.3%
- Other Sciences: 1.0%
- Other Engineering: 0.4%
- Architecture: 0.8%
- Bio/Biomedical Engineering: 1.3%
- Chemical Engineering: 3.6%
- Chemistry: 1.0%
- Biology: 0.5%
CMMI Program Success Rates

Number of Submissions

Percentage Awarded

Proposal has been awarded
Decline, DDConcurred
Success Rate
Materials Research in ENG and DMR

- CMMI conducted a preliminary analysis to see how much overlap occurs between programs
- Data show complementary communities
  - 274 PIs from 99 universities submitted materials research proposals to both ENG (CMMI in this case) and DMR
  - On average, PIs submit to at least 2 distinct programs (which may or may not be in the same directorate)
- ENG/DMR are working on collaborative processes for review & funding of proposals and to unify communication with materials research community
CMMI Materials Research Awards
A few thoughts on emerging themes in CMMI

• CIF21 - Simulation-based engineering and science
• Advanced Manufacturing – Materials Design through Fabrication...
• Complex system design – underlying theories of design
• Resilient and Sustainable Infrastructure - Systems
Dear Colleague Letter: Submission of unsolicited proposals to NSF programs that address the interdisciplinary topic of physical and engineering sciences in oncology

Historically, the fields of cancer biology and clinical oncology have been dominated by researchers with classical training in the basic and clinical life sciences. More recently, the field has expanded to include physical and engineering scientists, whose background and expertise are complementary to those possessed by life scientists, leading to the recognition that significant advancements in the fundamental understanding of cancer diseases are possible through multidisciplinary research that involves experts in the physical and engineering science disciplines. Emerging and burgeoning opportunities for collaborative research at the intersection of the physical/engineering sciences and the life sciences have been identified through several NSF workshops over the past few years, including "The Cell as a Machine" (NSF award 0803692) and "Cell and Molecular Biomechanics" (NSF award 0834046); in addition, this topic was the focus of a well attended and highly participatory session at the Grantees Conference held by the Division of Civil, Mechanical, and Manufacturing Innovation (CMMI) in June of 2009; similarly, in October of 2009, the National Cancer Institute's (NCI) Office of Physical Sciences-Oncology (OPSO) launched its network of 12 Physical Sciences in Oncology Centers (PS-OCs). In addition, the National Academies has conducted and published similar studies, including those entitled "Research at the Intersection of the Physical and Life Sciences," "A New Biology for the 21st Century," and "Inspired by Biology: From Molecules to Materials to Machines." In summary, significant advances may be expected as the result of continued investments in inter- and multi-disciplinary research at the intersection of the engineering and physical sciences and the life sciences with a focus on unraveling, at the molecular level, the cause and origin of cancer cell formation and otherwise advancing the fundamental understanding of cancer biology and clinical oncology to underpin translational research that promotes the prevention, detection, and treatment of cancer diseases.

To foster fundamental research in this field, NSF, in collaboration with the NCI's OPSO, will accept and review investigator-initiated proposals. It is anticipated that programs in the Engineering Directorate, including Divisions of Civil, Mechanical, and Manufacturing Innovation (CMMI), Chemical, Bioengineering, Environmental and Environmental Systems (CBET), and Electrical, Communications, and...
NNI Signature Initiatives
President’s FY2011 Budget Supplement

• Nanoelectronics for 2020 and Beyond
• Sustainable Nanomanufacturing
• Nanotechnology for Solar Energy Collection and Conversion

http://www.nano.gov/html/research/signature_initiatives.html
**Objective:** Use origami to enable self-assembling, multifunctional, compliant structures (Adaptive Morphing Systems) through the integration of active materials, design theory & compliant mechanisms, mathematics, and artistic inspiration.

**Expected Transformative Impact:**

- Fosters advances in fundamental understanding of folding and unfolding mechanisms in active materials, design theory, and mathematics
- Underpins design of foldable products at all scales and across scales
- Promotes new collaborations between different communities
- Enables novel engineered adaptive morphing systems for breadth of national priorities, including energy, complex design, and manufacturing
Questions?
Frequency of Submissions by Materials PIs (More than 1 Program/1 Submission)
All Engineering Degrees

ENG Degrees 1966-2006

Bachelor's Total
Master's Total
Doctorate Total

(NSF SRS Data)
NNI Signature Initiatives
President’s Budget Supplement

• Nanoelectronics for 2020 and Beyond
• Sustainable Nanomanufacturing
• Nanotechnology for Solar Energy Collection and Conversion

http://www.nano.gov/html/research/signature_initiatives.html
Sustainable Nanomanufacturing

• Research Thrusts
  – Design of scalable and sustainable nanomaterials, components, devices, and processes
    • Scalable/sustainable processes and methods for “materials of known benefit”
    • Interactions of materials, components, devices with manufacturing process design
  – Nanomanufacturing measurement technologies
    • High-throughput measurements of material composition and behavior
    • Process-control, QC, system level tools