NSF Perspective
DOE Composites Workshop
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The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."
Advanced Manufacturing Research
Our role in the “ecosystem”

• NSF supports fundamental research and early innovation
• Historically NSF has supported frontier research that has led to transformational advances in manufacturing
  – Additive manufacturing grew out, in part, from basic research investments in the 70’s/80’s
  – MEMS enabled by fundamental research in mid-80s (NSF & DARPA)
• Present research extends traditional advances and builds upon convergence of trans-disciplinary advances
  – National Robotics Initiative (NRI): towards autonomous systems
  – Cyber-Physical Systems (CPS): smart manufacturing
  – Materials design (DMREF / Material Genome Initiative)
    • Materials Discovery
    • Processes
  – Bio-manufacturing
  – Sustainable Manufacturing
  – Nanomaterials and Nanomanufacturing
The Innovation Spectrum and Where NSF Programs Reside

- **Resources Invested**
  - Discovery
  - Development
  - Commercialization

- **Level of Development**
  - Valley of Death
  - Translational Research

- **Innovators**
  - University
  - Small Business
  - Investors
  - Industry
  - Foundations
  - NSF Core Research
  - NSF George Research
  - ERC
  - I/UCRC
Advanced Manufacturing Research
“How” we invest

• “Core” research programs: unsolicited research supported by individual programs from across NSF (opportunities for collaboration with industry (GOALI))*

• Solicitations and “Dear Colleague Letters” : Targeted research in specific areas generally crossing multiple Directorates (e.g. nanomanufacturing, national robotics initiative, cyberphysical systems, etc.)*

• Research Centers (I/UCRCs, ERCs, MRSECs, STCs, etc.)

• Innovation Programs (iCorps, Parternship for Innovation, etc.)

• Research Facilities: National Nanotechnology Infrastructure Network

• SBIR/STTR: Funding to commercialize promising technologies

* A complete list of relevant programs and solicitations can be found at www.nsf.gov
NSF-relevant questions for Proposed Research Projects
(also stated: how we look at proposals)

• Intellectual Merit
  – Is the work research? Or is it development?
    • Are there fundamental knowledge gaps?
    • Are the barriers scientific or economic?
  – Of these, what are the most important basic research questions that need to be resolved?
  – What opportunities now exist? What’s new?

• Broader impacts of proposed research
  – Education? Broadening Participation?
  – Translation of research into technological products?
  – Will it address national priorities?
Key Scientific Drivers Affecting Advanced Mfg. Research

- **Nano** –
  - Improving understanding and new tools at the atomic and molecular scales
  - Manipulation and design
- **Bio/Med** –
  - Interaction of engineered systems and biology at all scales – DNA to cells to organisms to eco-systems
  - Convergence of life sciences, physical sciences, and engineering
- **Computing** –
  - Computational modeling, simulation, optimization, pervasive in all fields of engineering
  - Networks and computation deeply integrated into engineered systems
- **Behavioral/economic/cognitive**
  - Human behavior in engineered systems and technology
  - Regulatory issues
- **Systems science** –
  - Multi-scale analysis, design, and optimization
  - Integration of engineered components (including cyber)
  - Range from nano to micro to macro
  - Few to billions
- **Design, creativity, aesthetics, …**
Some open research challenges for composite materials and manufacturing

- Capturing relevant physics and chemistry to capture materials response – materials discovery through processing through service and end-of-life
- Theoretical models that will correctly describe the underlined physics (e.g. failure theories, process models, etc.)
- Appropriate and usable integrated computational analysis tools
- Linkage to Systems / Design / Optimization
- V&V Strategies; Design with uncertainty
- New approaches for education and training
What are some possible programs composites research at NSF?

- Support from multiple core research programs in the Division for Civil, Mechanical, and Manufacturing Innovation
- New Design of Engineered Materials Systems Program (DEMS)
- Cross NSF program: Designing Materials to Revolutionize and Engineer our Future (DMREF)
- Cross NSF program: National Robotics Initiative
NSF Industry-University and Innovation Programs Relevant to Advanced Manufacturing

• Grant Opportunities for Academic Liaison with Industry (GOALI) Supports collaborations with Industry.

• iCorps:

Centers:

• Engineering Research Centers (ERC)
  • http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5502&org=EEC

• Industry/University Cooperative Research Centers (I/UCRC)
  • http://www.nsf.gov/eng/iip/iucrc/

Thank You!

Please visit [www.nsf.gov](http://www.nsf.gov) for more information on NSF programs, funding opportunities, and active awards.