



National Science Foundation
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NSF 14-020

Dear Colleague Letter: Designing Materials to Revolutionize and Engineer our Future (DMREF)

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The National Science Foundation (NSF) announces the third year of a national materials initiative, Designing Materials to Revolutionize and Engineer our Future (DMREF). DMREF is the primary program by which NSF participates in the Materials Genome Initiative (MGI) for Global Competitiveness¹. MGI recognizes the importance of materials science to the well-being and advancement of society and aims to "deploy advanced materials at least twice as fast as possible today, at a fraction of the cost." As a national initiative, MGI integrates all aspects of the materials continuum, including materials discovery, development, property optimization, systems design and optimization, certification, manufacturing, and deployment, with each employing a toolset to be developed within a materials innovation infrastructure. The toolset will synergistically integrate advanced computational methods and visual analytics with data-enabled scientific discovery and innovative experimental techniques so as to revolutionize our approach to materials science and engineering.

NSF will support DMREF through well-coordinated activities involving the Directorates of Mathematical and Physical Sciences (MPS), Engineering (ENG) and Computer & Information Science and Engineering (CISE). Within MPS, the Divisions of Chemistry (CHE), Materials Research (DMR) and Mathematical Sciences (DMS) will participate in DMREF. The Divisions of Civil, Mechanical, Manufacturing Innovation (CMMI), Electrical, Communication & Cyber Systems (ECCS) and Chemical, Bioengineering, Environmental and Transport Systems (CBET) in ENG will also participate. All the divisions of CISE will engage in the DMREF 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. Also of interest to NSF is research that seeks to advance fundamental understanding of materials across length and time scales to elucidate the effects of microstructure, surfaces, and coatings on the properties and performance of materials and devices. 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. The approach envisioned to achieve this goal involves modeling, analysis and computational simulations, validated and verified through measurement, experimentation or device demonstration. This requires new data analytic tools and statistical algorithms; advances in predictive modeling that leverage machine learning, data mining, and sparse approximation; data infrastructure that is accessible, extensible, scalable, and sustainable; and new collaborative capabilities for managing large, complex, heterogeneous, distributed data supporting materials design, synthesis, and longitudinal study.

It is anticipated that many proposed efforts will bridge program and divisional interests and that these will be coordinated, co-reviewed, and funded by the programs and divisions, as appropriate. The complexity

and challenge of activities addressed by this initiative require a transformative approach to discovering and developing new materials, predicting and optimizing properties of materials, and informing the design of material systems. Accordingly, the proposed research must be a collaborative and iterative process wherein theory guides computational simulation, computational simulation guides experiments, and experiments further guide theory. The proposal should provide a plan for enhanced data management that ensures transparency, data-sharing and open source software. While not required, ties with industry, national laboratories, engineering partners, or other organizations are encouraged. If there are strong collaborations with industry, please see the Grant Opportunities for Academic Liaison with Industry (GOALI) program solicitation, which can be used in conjunction with this effort². Because this DMREF approach emphasizes a more integrated approach to materials research, cross-disciplinary educational activities are encouraged, as are public outreach activities.

DMR, CHE, DMS, CMMI, CBET, ECCS and all the divisions in CISE invite proposals based on MGI principles in FY 14. DMREF proposals must be submitted to the Design of Engineering Material Systems (DEMS/PD 12-8086) program with the applicable submission window (15 January to 18 February 2014). The title of the proposal should begin with "DMREF".

Participants interested in submitting proposals are strongly encouraged to first contact one of the following program officers: CHE, Timothy Patten (tpatten@nsf.gov); DMR, John Schlueter (jschluet@nsf.gov), Linda Sapochak (lsapocha@nsf.gov); DMS, Michael Steuerwalt (msteuerw@nsf.gov); CMMI, Mary M. Toney (mtoney@nsf.gov); CBET, William Olbricht (wolbrich@nsf.gov); ECCS, John Zavada (jzavada@nsf.gov), Dimitris Pavlidis (dpavliidi@nsf.gov); CISE, Ralph Wachter (rwachter@nsf.gov).

We are excited by the opportunities created by the national Materials Genome Initiative and the contribution made to it by this joint venture.

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¹ Materials Genome Initiative (MGI) for Global Competitiveness
http://www.whitehouse.gov/sites/default/files/microsites/ostp/materials_genome_initiative-final.pdf

² Grant Opportunities for Academic Liaison with Industry (GOALI)
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf12513