National Science Foundation
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NSF 13-025

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

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The National Science Foundation (NSF) is excited to bring to your attention our second year of a national materials initiative, Designing Materials to Revolutionize and Engineer our Future (DMREF), which is NSF's way of participating in the Materials Genome Initiative (MGI) for Global Competitiveness[1]. 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 the toolset developed within the 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), Division of 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.

For the second year of DMREF, 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 engineering materials. The ultimate goal is to control material properties through design via the establishment of computational interrelationships between composition, processing, structure, properties, performance, and process control, validated and verified through measurement and experimentation. 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, optimizing and/or predicting properties of materials, and informing the design of material systems. Accordingly, the proposed research must be a collaborative and iterative process where computation guides experiments and theory, while experiments and theory advance computation. 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 effort[2]. 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 13. DMREF proposals must be submitted to the above divisions in accordance with the applicable submission window 15 January to 15 February 2013. The title of the proposal should begin with "DMREF". Awards made in FY12 by ENG and DMR can be viewed at http://www.nsf.gov/news/news_summ.jsp?cntn_id=125712& .

Participants interested in submitting proposals are strongly encouraged to first contact one of the following program officers: CHE, Timothy Patten (tpatten@nsf.gov); DMR, Daniele Finotello(dfinotel@nsf.gov), Linda Sapochak (lsapocha@nsf.gov), or Diana Farkas (dfarkas@nsf.gov); DMS, Michael Steuerwalt (msteuerw@nsf.gov); CMMI, Martin Dunn (mldunn@nsf.gov), or Mary M. Toney (mtoney@nsf.gov); CBET, Ashok Sangani (asangani@nsf.gov); ECCS, John Zavada (jzavada@nsf.gov), Dimitris Pavlidis (dpavlidi@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