

Response of the Division of Materials Research to the 2015 Committee of Visitors (COV) Recommendations

The Division of Materials Research (DMR) in the Directorate for Mathematical and Physical Sciences wishes to thank the members of the 2015 COV panel members for the time and effort that they devoted to an extremely in-depth and detailed review of the activities of the Division during the period FY 2011 through FY 2014. DMR realizes that there was a great deal of material to review and understand, and the Division appreciates the care and thoroughness that the committee applied to examine the material and to ask many salient, probing questions over the three-day period. The Division especially extends its gratitude to Professor Nicholas Abbott, University of Wisconsin-Madison, for accepting DMR's invitation to chair the Committee and for bringing the report to a final conclusion in so brief a time. DMR staff members were excited to share with the COV the many fine examples of transformative research that the programs within the Division have sponsored over the four years under review and appreciate the enthusiasm with which the COV members embraced these investments and scientific advancements.

DMR is pleased that the Committee generously praised the Division in all aspects of the operations that were under review. We regard the support given in the report as an expression of confidence that the Division is serving the community well. At the same time, we are sensitive to the points that the Committee has raised in which it believes the Division could do better, and we will endeavor to respond to the request made by the Committee that its recommendations be taken as guidance and implemented to the fullest extent possible.

The DMR COV report contains many helpful comments and suggestions in the sections that address the DMR programs that comprise the Division; DMR staff members will use this COV input as guidance in the future. This initial response to the COV report will focus on the 12 summary recommendations that are presented in Section I of the COV report, "Summary and Recommendations." The DMR response to the COV report will be updated annually.

COV Key Recommendations and DMR Responses:

Recommendation 1: There is an urgent need to benchmark the investment in basic materials research in DMR in a global context...[and] a new National Academies-level report is needed to assemble the facts and guide investment in basic materials research across the US.

DMR Response: DMR agrees that a comprehensive study to identify opportunities and challenges in the broad scope of materials research is urgently needed. DMR has made a conscientious decision to team with other entities

within NSF that sponsor materials research, notably the Division of Civil, Mechanical, and Manufacturing Innovation (CMMI) in the Engineering Directorate, to undertake this comprehensive study as a means to benchmark the Division's investment and return-on-investment relative to those that are occurring internationally.

Recommendation 2: The current prioritization of funding in DMR appears to be largely historical...[and] there needs to be a process at the Division level by which investments are deliberately evaluated and transformed over time

DMR Response: DMR acknowledges that investments in some core programs have remained relatively constant or grown at a uniform rate relative to other programs within the Division. However, DMR has taken decisive action to direct and redirect its precious financial resources to capitalize on emerging scientific opportunities within the disciplines represented by DMR. Important examples include deliberate divestment in the Materials World Network (MWN) and International Materials Institutes (IMI) programs and equally deliberate investment in the new "Designing Materials to Revolutionize and Engineer our Future" (DMREF) program, NSF's foray in support of the National Materials Genome Initiative (MGI). As stated in DMR's response to the COV's first recommendation, DMR will sponsor a comprehensive study of emerging opportunities and challenges that lie at the frontiers of science and engineering and will evaluate the results of the study as a means to inform future investments at NSF in materials research.

Recommendation 3: The COV recommends that (i) a work-load analysis be used to guide investment of FTEs across the Foundation, (ii) DMR explore other models for conducting reviews, including engagement of the broader community in the review process (precedents exist for such processes, such as the review process used by NASA), and (iii) the merits of hiring temporary help (contractors) be evaluated.

DMR Response: DMR particularly appreciates the COV's recognition that workload in DMR is demanding and its recommendation that NSF address this issue through specifically identified means. Subsequent to the conclusion of the DMR COV, representatives within the Division of Human Resource Management (HRM) of the NSF Office of Information and Resource Management (OIRM) have met with leadership in the five MPS Divisions, including DMR, to discuss Divisional needs for additional human resources. The NSF Office of the Director (OD) has been generous recently in allocating additional "full-time equivalents" (FTEs) to address the heavy workload that plagues DMR and its sibling MPS Divisions. With critical Divisional input, the MPS Office of the Assistant Director (OAD) has made a sound case that supports a request for additional human resources and is in the process of formalizing such a request, which is expected

to be successful and to result in the allocation of additional FTEs in DMR. DMR and MPS are advocating for HRM to conduct a comprehensive, NSF-wide study.

Recommendation 4: Given the likely increase in use of virtual panels, the COV judged it timely to evaluate... [the] strengths and weakness [of virtual panels] as a mechanism for reviewing proposals.

DMR Response: DMR, and NSF, in general, uses a combination of in-person, virtual, and “hybrid” panels—panels in which some participants are in-person and other participants are virtual—as well as the *ad hoc* mechanism to review submitted proposals. Each panel type has advantages and disadvantages. Virtual panels, for example, allow for the participation of a broader cross section of subject matter experts, including those with child or elder care responsibilities and those who are unable to travel due to teaching and other commitments. However, virtual panels are limited to a smaller number of participants and proposals, so the NSF program director must convene a greater number of panels for a given number of proposals to be reviewed. Virtual panels tend to be less effective in the aspects of interpersonal interaction and networking. Conversely, in-person panels are able to accommodate greater numbers of proposals and panel referees and further afford participants the important aspect of networking with NSF program directors and with senior members of the scientific community, an element that is especially important to junior researchers. NSF’s latitude to decide which panel type best suites the needs of the program and the scientific community has been limited by the US Office of Management and Budget (OMB), which has imposed targets on the minimum percentage of virtual panels. In FY 2015, this minimum percentage was 33%; in FY 2016, OMB has increased the minimum percentage of virtual panels to 40%.

Recommendation 5: The COV suggests that both DMR and the Foundation examine if the success of DMREF presents an opportunity that can be capitalized on to bring additional funds to NSF as part of the MGI, and to Federally funded research in the US as a whole.

DMR Response: The “Designing Materials to Revolutionize and Engineer our Future” (DMREF) program, NSF’s foray into the National Materials Genome (MGI), has been highly successful and is an important example of a program that DMR leads and that involves multiple NSF Directorates and several other Federal Agencies. NSF has been in a period of relatively flat or even declining budgets, but flagship NSF programs such as DMREF are expected to help attract additional Federal funding in the future. DMR fully concurs with this suggestion, with the caveat that it, as a Federal agency, is unable to lobby Congress for funding.

Recommendation 6: DMR should explicitly justify the investment in CHESS in the context of uniqueness of capabilities for materials research given the other synchrotrons that exist in the US and elsewhere.

DMR Response: All proposals submitted to NSF compete for funding through a process that promotes fair and equitable competition for scarce resources. The current grant to Cornell University to operate and maintain the “Cornell High Energy Synchrotron Source” (CHESS) facility is an example of an NSF investment in facilities that enables the conduct of important science. Because of the magnitude of the NSF annual investment (\$20 M) in CHESS, its funding must be approved by the National Science Board (NSB). In making a funding decision, as with all investment decisions, DMR will carefully evaluate the merits of CHESS on an absolute basis and relative to other proposals that compete with CHESS for funding, including its uniqueness as a user facility.

Recommendation 7: The COV encourages DMR to explore new mechanisms that enable international interactions without the overhead of the prior programs.

DMR Response: International engagement of DMR-supported researchers has a rich history of support within the Division. Recent budget constraints and pressures led to the inactivation of two DMR programs, the Materials World Network (MWN) and the International Materials Institutes (IMI). The NSF Office of International Science and Engineering (OISE) recently was separated from the Office of International and Integrative Activities (OIIA) to become an independent office within the NSF Office of the Director (OD), and a new Office Director has been hired. Importantly, OISE has appointed individuals within its ranks to serve as liaison with each Directorate. DMR has met with the MPS liaison in OISE and will continue to do so on a regular, quarterly basis. Historically, scientists supported by DMR grants have collaborated principally with research colleagues in the UK and Germany. DMR is keenly interested in supporting international research collaborations but must do so in a way that keeps the workload manageable. In conjunction with the OISE liaison, DMR currently is considering and investigating several specific options to foster and incentivize international collaborations between DMR-supported PIs and their international counterparts.

Recommendation 8: For audiences such as COVs and the materials science community, the COV recommends that a broader range of metrics and descriptors be used to communicate the impact of the research, including, for example, a more detailed description of the research accomplishment, citations and citation maps of projects, and descriptions of broader societal impacts.

DMR Response: The identification of appropriate, effective metrics to measure the positive impact of an investment in basic research is a great challenge. The key is to identify a metric that is a true measure of impact. Generally, the

incubation period of an NSF investment in basic research is quite long before the impact of that investment is manifest in the form of a new product or process or otherwise benefits society. DMR has formed a Division-level working group (WG), focusing on program assessment, which has begun to consider this and related issues. This WG is charged with identifying and implementing means of assessing program impact, focusing on two major components: (i) metrics applicable and related to Intellectual Merit, which include the impact of publications, and (ii) possible ways to assess Broader Impacts of funded research. DMR is fully aware and appreciates the wide breadth of journals in which the results of its funded research is published. The WG will analyze tools that hold potential for the quantitative assessment of the direct impact of research, including, for example, the number and distribution of citations within a subfield. Systemic, NSF-wide recommendations may be needed to ensure that the workload required for full analysis is feasible. Mindful of the needs of all programs that comprise DMR, the WG will test metrics and visualizations, estimate the workload necessary for their implementation, and offer Division-wide recommendations.

Recommendation 9: The COV recommends that a greater fraction of this [careful and insightful] analysis be routinely provided to applicants, unless there are compelling reasons for not doing so. Even for proposals that were not discussed at panels, the COV observed that the jackets often contained useful summaries of the deficiencies in the proposals.

DMR Response: DMR has encouraged and will continue to encourage the widespread use of the “PO comments” module in eJacket, a practice that many DMR program directors employ already. This module allows the program director to notify the PI of a submitted proposal insights as to the most important proposal deficiencies and the rationale that led to its recommendation for declination. Ideally, at least part of this narrative would be excerpted from the Review Analysis and Panel Summary documents.

Recommendation 10: The current process for the selection of reviewers for proposals seemed, in general, to be cumbersome and inefficient, and the COV felt that the review process would benefit from a formal database to guide the selection process.

DMR Response: DMR fully concurs with this recommendation. The central, internal NSF reviewer database is obsolete, and access to its content is cumbersome, at best. The process of its replacement is in progress, the result of which is expected to be an improvement in functionality and usability, including searchability.

Recommendation 11: The COV recommends that the buying power of grants awarded by DMR not be allowed to decrease further, and that funding be commensurate with the scope of the work that is described in a proposal.

DMR Response: Over the past four years, the average size of a DMR grant has increased by 20%. Nonetheless, DMR agrees that, historically, NSF grant funding has failed to keep pace with inflation, especially as represented by the annual increase in university tuition. Over the past two years, DMR has made a conscious decision to reduce its out-year financial commitments (“mortgage”) so that a greater percentage of the annual DMR budget is available to support research grants. This process of reducing the Division’s mortgage, however, exacts a short-term, transient “cost” in the form of less funding being available to support research grants. Following the completion of this transition, DMR will be able to invest more funds in active research grants and will focus on the grant size being commensurate with the scope of the proposed research.

Recommendation 12: For program managers to maintain their understanding of the key challenges and opportunities in their field, and to maintain contact with researchers in their field, the COVs viewed it as essential that program managers have access to funding and time to attend technical meetings.

DMR Response: In FY 2014, NSF-wide travel expenses were reduced by approximately 17% relative to expenses incurred in FY 2010, including travel done by NSF staff members and that done by others outside of but in support of NSF and its mission. By FY 2015, the OMB restriction on NSF-related travel had been lifted. As a result, existing budgets are now providing better support for Program Directors to attend technical meetings.