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June 2, 2008

Dr. Tony F. Chan
Assistant Director
Mathematical and Physical Sciences
National Science Foundation

Dear Tony,

I am writing to report to you our discussion of the Committee of Vistors (COV) report for the Division of Materials Research (DMR). The Mathematical and Physical Sciences Advisory Committee (MPSAC) received the full report in time to discuss it full at our meeting by teleconference on April 3. Dr. Paul Peercy, Chair of the COV, gave us a briefing on the report at that meeting. After some discussion, the MPSAC voted unanimously to accept the report. I will mention a few highlights of the report that received discussion at the MPSAC meeting, although I emphasize that the report speaks well for itself.

The Committee of Visitors did an excellent and thorough review which met all of the elements of the charge. They began their report with praise for the excellence of the Division and the outstanding research it supports. They emphasized the important role of DMR in supporting basic materials science that addresses many of society's critical needs, as spelled out in the recent National Academy decadal study on Condensed Matter and Materials Physics. They noted that the large increase in the FY 2009 budget request for DMR represents its central place in the American Competitiveness Initiative, but expressed concern about the difficulty of maintaining strength in materials research if these increases are not realized.

The COV noted that the DMR program directors do an excellent job but are stretched by a large and growing workload. The COV made recommendations on the organization of subfields and on the balance of different types of awards. We encourage the DMR to take a look at these thoughtful comments and consider how they can be used to inform further improvements in managing the research program. The COV said that the DMR had responded well to the recommendations made by the previous COV.

The MPSAC was very impressed with the quality of the COV report and with the excellent presentation of it by Dr. Peercy. The National Science Foundation and the Materials community are both well served by having such a distinguished group of scientists take a critical look at the Division of Materials Research. We are pleased to be able to transmit to you this report.

Sincerely,

Michael Witherell
Chair, MPS Advisory Committee

March 5, 2008

Dr. Michael Witherell
Vice Chancellor for Research
Professor of Physics
3227 Cheadle Hall
University of CA-Santa Barbara
Santa Barbara, CA 93106

Dear Dr. Witherell:

On behalf of the 2008 Committee of Visitors (COV) for the Division of Materials Research (DMR) of the National Science Foundation (NSF), I am submitting the compiled findings of our review on the attached templates. A brief summary of our most important observations is given below; in addition, specific recommendations are contained in each Sub-Panel Report.

Overall Findings of the Committee of Visitors

The COV finds that DMR is an exceptional Division within NSF, with highly respected and successful programs that are centrally relevant to the implementation of the recommendations of the American Competitive Initiative (ACI) and the recent National Academy of Sciences Condensed Matter and Materials Physics (CMMP) 2010 Report. These remarkable programs support foundational issues in materials science, and address many of the Nation's critical needs in health, the environment, clean and sustainable energy, and security.

The Division is a leader in developing and sustaining a quality scientific and technical workforce for the future economic success and viability of the Nation. Of central importance to ACI, during the last three years DMR-funded researchers have directly trained annually more than 2,000 undergraduate students, 2,400 graduate students, 600 postdoctoral associates, 200 K-12 students and 150 K-12 teachers. DMR-sponsored national and global outreach initiatives have communicated the importance of materials for the quality of life and have enjoyed remarkable success in developing new educational materials. As a result, the diversity of our campuses and the global competence of the scientific workforce are enhanced.

Discovery, learning, research infrastructure and stewardship

The Director of DMR has been pro-actively involved in developing a strategic plan for the Division, implementing diversity initiatives and initiating international programs. We applaud this effort as critical to effective management and increased societal impact of the Division (e.g., developing a competitive, diverse, globally-engaged workforce). The process that DMR uses for determining which proposals to fund is excellent, even though DMR manages probably the most interdisciplinary program in the Foundation. DMR program directors do an excellent job of ensuring participation of underrepresented groups in their portfolios. The staff is an enormously valuable resource, but program directors are burdened with an increasingly heavy workload without a commensurate staff increase.

In the area of research infrastructure, there appears to be an equipment funding gap in the $30k to $100k range, an amount which is impractical to seek support for in unsolicited proposals. The COV recommends that DMR should consider how this might be addressed.

DMR response to the 2005 COV recommendations

The Division has been very responsive to the recommendations of the 2005 COV. The Division appears to have responded to all recommendations within its control, and the practice of updating responses to each area annually is commended as an especially effective new 'best practice'. Examples of important actions include educating their community of reviewers as to the meaning of the broader impacts of the research being reviewed through workshops and a "Dear Colleague" letter on the web. The result is a significant improvement in the responsiveness (96%-level) of the reviewers to this issue. Requesting an annual educational outcomes highlight from each principal investigator is another new practice which has been effective in encouraging PIs to think carefully about the impact of their research and to encourage further educational coupling of their research activities. Another example of DMR's responsiveness to the COV recommendations is the addition of staff in response to the observation that the Division was understaffed. DMR has been effective in developing its own initiatives such as Partnership for Research and Education in Materials (PREM) and the Materials World Network (MWN) to target specifically underrepresented populations, and international partnerships, respectively. DMR has also been diligent in preventing the erosion of the fraction of individual investigator grants.

How DMR fares within the NSF

DMR is one of the leading divisions within NSF in investing in transformative research and in developing new concepts and new management strategies. Although a leader in the NSF, DMR has not received funding increases commensurate with its contribution to the NSF research and education missions and to the nation's economic well being.

DMR is uniquely situated to address the nation's critical needs in infrastructure, energy, and information technology, the latter two being highlighted in the American Competitive Initiative and the America Competes Act. For instance, energy conversion devices such as cost-effective and efficient solar cells, solid state lighting, etc., require the development of novel materials. Other materials hold the promise of utilizing carbon dioxide as a sustainable source of renewable fuel. The development of biochemical and chemical sensors essential to the nation's security needs requires the expertise of DMR-funded scientists. Future advances in electronics and information technology require novel and transformative materials. DMR is leading efforts in cyberinfrastructure programs and is participating in the new NSF wide Cyber Enabled Discovery and Innovation (CDI) initiative. These programs are helping maintain the Nation's position at the forefront of Materials Research.

Note that our global competitors are funding materials research at increasingly substantial levels. For instance, Singapore built IMRE (International Institute for Materials Research and Engineering) in 1996 and is progressing rapidly in this field, recruiting researchers globally. Taiwan has funded ITRI (Industrial Technology Research Institute) that American companies are working with. Similar efforts are underway in South Korea and other countries. Increased funding of DMR is essential if we are to compete globally and continue America's position as the leader in these areas so that the Nation can reap the resulting economic security this affords.

DMR budget

The Division of Materials Research is dramatically underfunded. Although DMR is poised to have the necessary impact on the national economy, workforce, and security priorities identified in the ACI, the current funding levels in DMR hinder that impact. The result is an inability for the division to fund enough proposals to cover many of the basic and emerging areas of importance in this field; this lack of funds is evident in the historically low proposal funding success rate (~ 20%). The field of materials science is changing rapidly as boundaries between science and engineering disciplines disappear and technology streams converge. DMR does not have adequate funding to respond effectively to these changes or to remain competitive with research and education initiatives in Europe and Asia, where leaders recognize the foundational nature of materials and materials research.

Balance (individual investigator, groups, Centers, Facilities)

In general, the appropriateness of the balance between individual investigators, and centers is difficult to assess given the limitations in time and data available during the COV meeting. While this balance is expected to change with time as the field evolves, the funding percentage for individual investigators should not decline below the current levels. The COV would like to suggest that the NSF evaluate the balance between funding for these groups and for facilities. For example, the COV notes that 19% of the DMR budget is used to fund facilities. DMR funds 95% of the NSF share of the National High Magnetic Field Facility; however, DMR does not use nearly 95% of the NSF supported time on this facility. The COV recommends that NSF evaluate this situation. Two approaches could be considered: manage the facility at the NSF Director's level or distribute the support for the facility among Divisions of the NSF that use it.

Balance between programs within DMR

The COV recommends that DMR examine the program taxonomy of the division to see how well-aligned it is with the changing materials community. In addition, theory has increased in importance to all areas in the DMR. We recommend that the Director examine the accessibility of theory to all areas of the DMR portfolio. Co-funding between programs of DMR is also strongly recommended to encourage consistent funding of the most transformative proposals submitted to DMR**.**

New initiatives

DMR has played a leadership role in many areas within the NSF. Examples include (i) instituting diversity programs such as Partnership for Research and Education in Materials (PREM), (ii) focusing on strategic planning, (iii) creating and managing interdisciplinary centers such as Materials Research Science and Engineering Centers (MRSECs) and Nanoscience and Engineering Centers (NSECs) and (iv) developing international research collaborations such as Materials World Network (MWN). Additionally, the Division has pro-actively moved into new research areas, such as Biomaterials.

Best practices by DMR

DMR has been a pioneer within NSF and, more broadly, within the national research enterprise in identifying potentially transformative opportunities and devising creative and effective programs to address them. DMR supports high-quality programs—such as MWN, PREM, MRSECs, NSECs, and, more recently, the Major Instrumentation Program (MIP). These programs fund projects that are innovative and transformative in both the technological area being addressed and in the manner that interdisciplinary and collaborative research is being managed and performed. A much appreciated, but often unrecognized, mechanism for the support for young investigators arises from SEED grants (within MRSEC programs). This support mechanism affords young investigators funding opportunities during difficult funding times and is also an effective means to support potentially transformative, high risk investigations.

Best practices by DMR program directors in management include: (i) instituting post-award reverse site visit evaluations for new programs (such as the PREM) and (ii) engaging the community through workshops to guide the strategic direction of the Division. Additionally, the PREM and REU programs are excellent vehicles for increasing the participation of minority serving institutions (MSIs) by offering workshops, conferences and summer research experiences. In general, the DMR approach of engaging the community through workshops to guide the strategic direction of the Division is very valuable. The programs which result from these efforts create real excitement within the research community.

Conclusion

The COV commends the NSF leadership for recognizing the need for increased funding for DMR as evidenced by its major proposed increase of 24.7% in the

FY2009 DMR budget compared to the 13% increase for NSF in the President's FY2009 budget. While the COV applauds this proposed funding increase for the DMR and hopes that Congress appropriates the President's recommended budget increase for the NSF, it recognizes that NSF, and in turn DMR, will face severe challenges in maintaining its excellent research portfolio in the future if it does not receive a significant increase in funding in the next few Federal budget cycles. The COV urges NSF to maintain its support of the excellent programs managed through DMR and to provide resources to take advantage of the opportunities emerging in the rapidly changing materials research arena. We have confidence that the DMR staff has the necessary expertise and perspective to make difficult decisions and respond to new opportunities using the effective and transparent processes the DMR staff has instituted.

Sincerely,

Paul S. Peercy

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2008 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2008 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2008. Specific guidance for NSF staff describing the COV review process is described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) that can be obtained at <www.inside.nsf.gov/od/oia/cov>.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the results generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals.

Many of the Core Questions are derived from NSF performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several subactivities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the subactivities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

Suggested sources of information for COVs to consider are provided for each item. As indicated, a resource for NSF staff preparing data for COVs is the Enterprise Information System (EIS) –Web COV module, which can be accessed by NSF staff only at http://budg-eis-01/eisportal/default.aspx. In addition, NSF staff preparing for the COV should consider other sources of information, as appropriate for the programs under review.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the ***processes*** related to proposal review; and (B) the quality of the ***results*** of NSF's investments that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future. Discussions leading to answers for Part A of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. *COV reports should not contain confidential material or specific information about declined proposals.* Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. The reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. Since material from COV reports is used in NSF performance reports, the COV report may be subject to an audit.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see http://www.nsf.gov/od/oia/activities/cov/covs.jsp.

FY 2007 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: Feb. 6 – Feb. 10, 2008
Program/Cluster/Section: Metals, Ceramics, Electronic Materials
Division: Materials Research
Directorate: Mathematical and Physical Sciences
Number of actions reviewed: 99 Awards: 49 Declinations: 45 Other: 5
Total number of actions within Program/Cluster/Division during period under review: 1497 Awards: 277 Declinations: 928 Other: 292
Manner in which reviewed actions were selected: The sub-panel picked and reviewed actions from all 3 areas within the MCEM cluster, covering both funded and declined proposals.

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process. Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[1]
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: There is a mix of panel reviews (typically for CAREER and MWN, although CER performed all panel reviews in FY06), mail reviews (typically for unsolicited proposals), and reviews carried out by the Program Directors (SGER, Creativity	YES

[1] If "Not Applicable" please explain why in the "Comments" section.

Awards). There is no single best format for reviews. The choice of review method appears appropriate: panel reviews are effective for groups of similar proposals and give considerable feedback to the PI, although they tend to be more conservative; mail reviews allow a greater diversity of reviewers; and reviews by the Program Manager enable rapid funding decisions to be made where necessary and are more sympathetic to high risk research. Source: Jackets and the EIS. Select the "Type of Review" module.	
2. Are both merit review criteria addressed a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses? Comments: The scientific community has come to understand the importance of addressing both criteria in reviews through education by the program managers. All the individual reviews, panel summaries and Program Manager analyses examined during the course of the COV meeting considered both merit criteria. However, reviewers (and PIs) hold differing views on what constitutes a broader impact. Some consider it necessary to have an innovative outreach activity, others consider routine faculty-student interactions and teaching activities sufficient, while others interpret broader impact to mean that the research should have some applicability to, for example, a product. This could be addressed by further clarification by the NSF staff. Source: Jackets	YES

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals? Comments: Nearly all the reviewers wrote substantial comments on both review criteria, although there was a small number of very brief reviews. Reviewers often do not provide a separate summary, and the text of the review sometimes appears inconsistent with the reviewer's E, V, G, F, P rating. Source: Jackets	YES
4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Comments: The summaries examined were often concise, but they were certainly adequate in their explanation for the panel's decision.	YES

Source: Jackets	
5. Does the documentation in the jacket provide the rationale for the award/decline decision? (Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.) Comments: The detailed proposal analysis carried out by the Program Managers is impressive in its thoroughness, and even included the insertion of quotations from the reviews and responses from PIs. The COV found this extremely helpful. The Program Managers clearly spend considerable time distilling the comments and ratings of the reviewers into an award decision for each proposal. Each action was well explained. This was particularly the case for award/decline decisions of borderline cases, where factors such as the PI's funding history, level of experience, and minority status were cited as helping to make the final decision. Program Managers also identified whether proposals appeared to represent 'transformative' research. In the case of SGERs, the Program Manager's analysis is the only review, and these appeared thorough and well explained. Source: Jackets	YES

6. Does the documentation to PI provide the rationale for the award/decline decision? (Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.) Comments: The communications with the PIs do explain the basis for the decision, though in understandably less detail than is reported in the Program Manager's analysis document. This communication is particularly important in cases where the decision was a borderline decline, even though the proposal reviewed well. In these cases, the additional feedback or encouragement provided by a call or email from the Program Manager is very valuable to the PI. The Program Managers are also commended for their handling of 'return without review' decisions, where the PI may be invited to resubmit a corrected proposal within a short time. Source: Jackets	YES

7. Is the time to decision appropriate? Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals. Comments: All three program areas have dwell times which are considerably better than the NSF's goal of 70% within 6 months. In FY05-07, the percentage of proposals with dwell times below 6 months was >82% for CER, >95% for EM and 76% (FY05)-96% (FY07) for MET. This reflects a considerable effort on the part of the program managers to decrease the dwell time compared to previous years. Source: Jackets and EIS-Web COV module. Select "Report View", then select "Average Dwell Time," and select any combination of programs or program solicitations that apply.	YES
8. Additional comments on the quality and effectiveness of the program's use of merit review process: The review process is well managed and fair, with peer review the primary mechanism, moderated by the experienced interpretation provided by the Program Managers. The reviews done by the Program Managers for SGER and Creativity Awards bypass the peer review process, but are necessary to ensure a rapid turnaround, and also allow funding of very speculative research that the normal peer review process may overlook.	

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[2]
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: The reviews indicate that the reviewers were chosen in appropriate areas and have sufficient expertise to give a responsible review of the proposals. Source: Jackets	YES
2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups? Note: Demographic data is self reported, with only about 25% of reviewers reporting this information. Comments: Based on data provided by the Program Managers, the diversity of reviewers (percentage of women/minorities) tracks well with the diversity of PIs. Institution type is primarily university, though there is a minority of reviewers from industry and from national labs. Many proposals had no industrial or national lab reviewer. Tabulated data from EIS is difficult to interpret because ~70% of reviewers do not self-identify their gender, minority, disability status or even the type of institution. However, for MET, CER and EM, tabulated data indicates 6.6% female and 24% male (data for the rest is not available), 2.5% minority (rest not minority or data unavailable) and 0.3% with disability (rest no disability or data unavailable). There is an increasing number of international reviewers (10% in FY07). Most reviewers are from PhD institutions with <1% from undergraduate institutions, 2.5% from masters' institutions, 8% from foreign, industrial, and national labs (placed in the same category), and 30% unknown. The Program Managers are encouraged to continue their current practice of using reviewers from diverse groups, while realizing that industrial and foreign researchers will be less familiar with the program goals of NSF, particularly the broader impacts criterion. To enable a more systematic analysis of diversity, it would be useful to collect data from a larger fraction of the reviewers. Source: Jackets and EIS-Web COV module. The "Report View" has reviewers by state, institution type, minority status, disability status, and gender	YES

[2] If "Not Applicable" please explain why in the "Comments" section.

3. Did the program recognize and resolve conflicts of interest when appropriate? Comments: COI is handled by careful selection of reviewers for mail and panel reviews, often involving a detailed study of the PI's collaborators and publications lists. In panel reviews, any COIs that exist are handled by recusing the affected reviewer from consideration of the conflicting proposal. The process appears to work very well. Source: Jackets	YES

4. Additional comments on reviewer selection:

A.4 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE[3], OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: Excellent research proposals with appropriate education programs and including those pursuing transformative concepts are included in the funded proposals. Source: Jackets and program information	Appropriate
2. Does the program portfolio promote the integration of research and education? Comments: The education projects are well connected to the research programs of the PI. The second criterion on broader impacts is taken very seriously and this promotes integrated research and education activities. Source: Jackets and program information	Appropriate
3. Are awards appropriate in size and duration for the scope of the projects? Comments: The duration of the projects is appropriate. However the size of awards is still at the marginal level as judged, for example, by the inability of a PI to support two graduate students within a single investigator award. The DMR staff have been attempting to address this difficulty but it has been very difficult to do so given the limitations in DMR funding increases which have been below inflation the last 3 years. The move towards 4 year awards is commended because it is better aligned with doctoral education. Source: Jackets and EIS-Web COV module has a "Report View" that gives average award size and duration for any set of programs or program solicitations you specify.	Appropriate
4. Does the program portfolio have an appropriate balance of: • Innovative/potentially transformative projects?	Appropriate

[3] If "Not Appropriate" please explain why in the "Comments" section.

Comments: There is a reasonable number of innovative, potentially transformative projects within the portfolio. We encourage the program managers to continue to monitor this balance. Source: Jackets and program information.	
5. Does the program portfolio have an appropriate balance of: • Inter- and Multi- disciplinary projects? Comments: The vast majority of the DMR projects are inter- and multi-disciplinary in nature, and this characteristic is even more striking in the group awards. Source: Jackets, program information, and some people use as a proxy data on jointly funded projects. See EIS-Web COV module, "Report Review" and select "co-funding from" and "co-funding contributed to" to find jointly supported awards.	Appropriate

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program? Comments: The portfolio has an appropriate balance between individual and multiple investigator awards. However, the portion of individual investigator awards is nearing the lower advisable limit and, along with the acceptance rate of highly regarded proposals, needs to be monitored carefully for adjustments as future budgets permit. Source: Jackets, program information, and EIS-Web COV module for information on award size.	Appropriate
7. Does the program portfolio have an appropriate balance of: • Awards to new investigators? NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant. Comments: The award rate for beginning investigators is understandably lower than for prior investigators, and we encourage the Program Managers to continue their practice of supporting beginning investigators in borderline award decisions. Source: EIS-Web COV module on "Funding Rate," filtered by PI Characteristic (use the pop-up filter).	Appropriate

8. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments: The EPSCoR co-funding is effective in addressing geographical imbalances. Source: EIS-Web COV module, using "Proposals by State"	Appropriate
9. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: The great majority of awards is for graduate-degree-awarding institutions, but RUI awards are valuable in supporting activities at undergraduate institutions. We encourage program managers to publicize these opportunities and promote greater involvement by undergraduate and minority-serving institutions. Source : EIS-Web COV module, using '' Proposals by Institution Type''	Appropriate
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity? Comments: The portfolio contains a balance between disciplines within MCEM. Source: Jackets and program information	Appropriate
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: The award success rate for women and minorities is above the average for all proposals in MCEM (~28% vs. ~20%), which helps to maintain participation of these underrepresented groups. However, we encourage Program Managers to continue their efforts in promoting submissions from these groups. Source: EIS-Web COV module, using "Funding Rate" with the pop-up filter (this allows you to see female and minority involvement, where involvement means being PI or co-PI).	Appropriate
12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.	Appropriate

Comments: This area is one that needs to be continuously addressed, and for example may present opportunities in partnering on fundamental materials science aspects of important priority areas with other more mission-oriented agencies. One example would be in energy-related work with DOE/BES. Source: Program information	
13. Additional comments on the quality of the projects or the balance of the portfolio:	

A.5 Management of the program under review. Please comment on:

1. Management of the program. Comments: The program management is excellent. They are handling very large numbers of proposals efficiently and the dwell times are decreasing. It is particularly valuable to have the advice of experienced managers during transitions, such as has been provided by Bruce McDonald in metals. We encourage continuation of this practice.
2. Responsiveness of the program to emerging research and education opportunities. Comments: The program managers have been responsive to new directions as evidenced by the strong participation in the nanoscale science initiatives, and by the portfolio containing new hot topics such as plasmonics and multiferroics. The SGER mechanism allows them to rapidly respond to new directions. The importance of the second review merit criterion has ensured that these new directions are well coupled to education initiatives.
3. Program planning and prioritization process (internal and external) that guided the development of the portfolio. Comments: The program managers are very involved in the scientific community in their area and are doing an excellent job of guiding the portfolio. They make good use of co-funding opportunities and interactions with peers in other divisions to optimize the overall portfolio in their field.

4. Responsiveness of program to previous COV comments and recommendations.

Comments: The program managers are clearly cognizant and have been very responsive to the issues raised by the COV, in spite of funding constraints which have prevented them from increasing award sizes or the success rates of highly rated proposals. We commend the NSF for making progress in staffing levels within DMR to help support their heavy workload. They have also effectively used reserve funds to mitigate the low award rates among the underrepresented groups and beginning investigators. The MCEM group has responded to concern about industrial reviewers and have a reasonable proportion of such reviews. Finally, they have effectively responded to the suggestion to better publicize broader impacts by their annual request to PIs to provide a highlight in this area.

5. Additional comments on program management:

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 <u>OUTCOME GOAL for Discovery:</u> "*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.*"

Comments:

The 49 awarded proposals that were reviewed are excellent examples of research projects that have or will lead to fundamental discoveries that will promote global competitiveness of the US. NSF-DMR continues to push the frontiers in materials research through funding of the most competitive research proposals.

Specific examples include:

ECCS 0708759; PI: Chang-Beom Eom (co-funded by ECCS and DMR)
This research has developed a fundamental scientific understanding of nanoscale piezoelectric phenomena and their application to *hyper*-active nanoscale electromechanical devices, which can be applied for novel and high performance signal processing, communications, sensors, and nano-positioning actuators. The relationship between piezo-response and nanoscale strain and domain configurations developed here can be applied to multifunctional materials to develop new nanoelectromechanical devices.

DMR 0652424; PI: Jennifer A. Lewis
This project has led to a new fundamental understanding of colloidal film drying and pattern formation, flow of dense colloidal suspensions through confined microchannel geometries, phase behavior and rheology of colloid-nanoparticle mixtures, and colloid-filled hydrogels, and drying, packing, and deformation behavior of dense colloidal granules formed via microfluidic-based assembly routes. The knowledge that has been gained from the proposed research will broadly impact the field of colloidal processing of ceramics as well as colloidal assemblies used in applications ranging from controlled drug release to novel membrane and support structures.

DMR 0706058; PI: Jeffrey W. Kysar
This project has validated physics-based material models that have a true predictive capability. This can significantly shorten the product development of new metal alloys with enhanced strength and toughness for engineering structural applications.

DMR 0704354; PI: Edmund G. Seebauer
This project offers new possibilities for controlling bulk defects in a wide variety of applications. Such defect manipulation might be helpful for energy production by semiconductors using solar power (*e.g.*, water splitting). In surface reactions, bulk defect creation, destruction, and diffusion near surfaces plays an important role in adsorption and some forms of thermal catalysis by metal oxides. In sensor applications, bulk defect generation at surfaces and interfaces influences the behavior of solid-state electrolytes. Furthermore, solid-state diffusivities find very widespread application in their own right for modeling processes and devices, and have long been used to estimate defect formation energies.

DMR 0606511; PI: Viola L. Acoff
The proposed research has the potential to provide vital information for the further development of

cold roll bonding/reaction annealing as a simplistic processing technique for advanced metals and materials. This technique can be scaled-up to create large sheets of Ti/Al/Nb intermetallics, as well as other intermetallics, which can be used to fabricate various items for marine, aerospace, structural and high temperature applications. By developing this simple, less time consuming processing method, production costs for these materials will be decreased significantly. The proposed technique can potentially have a significant impact on alloy systems that are presently too difficult or too expensive to process using existing, or conventional techniques. It will probably also lead to a significant increase in the practical applications and further development of intermetallic compounds in addition to numerous other alloy systems.

DMR 0606464; PI: Alexander Demkov
CMOS technology is largely responsible for the extraordinary economic advances made by the US in the past fifty years. The work of the PI has provided fundamental understanding that can possibly pave the way for using amorphous hafnia films as gate dielectrics in microelectronics. This can extend Moore's law for several technology generations.

DMR 0604314; PI: Manish Chhowalla
In this project the incorporation of Si into boron carbide could produce a material with vastly superior properties, second only to diamond, as a strong, highly resilient material for wear resistant coatings and high energy impact applications. The new material will have potential uses in applications such as blast shielding, vehicular safety and ballistics.

DMR 0605731; PI: Eric M. Taleff
The new single-crystal production technology for refractory metals that has been created in this project is likely to revolutionize the process furnace industry and could potentially replace the W and Mo wire materials used across numerous industries, such as in incandescent light bulbs.

DMR 0606389; PI: Charles W. Tu
This project has developed solid-state lighting by the use of light-emitting diodes (LEDs). These devices have many applications in displays, illumination, and white-light generation. Replacing incandescent bulbs and fluorescent tubes by high-efficiency and low-cost LEDs will reduce energy consumption, carbon dioxide emission, and infrastructure cost of electricity generation.

DMR 0605621; PI: George G. Malliaras
This research program has the potential to lead to major advances in our fundamental understanding of the science of mixed conductors and will impact other materials classes, such as ceramics, and other technologies, such as fuel cells and photovoltaics. Understanding device-relevant materials degradation pathways will have beneficial effects for the field of organic electronics. Finally, iTMCs have the potential to yield devices that require little or even no encapsulation. Should this become a reality, it will enable deposition on substrates such as plastic, paper, and textiles and revolutionize the way electronic devices are fabricated.

DMR 0504950; PI: Mark L. Weaver
This research relies on the application of novel micromechanical and analytical techniques to characterize the microstructures and properties of multiphase sputter deposited overlay coatings. The technological motivation for this research is grounded in the desire to develop novel coatings that will increase the capability and durability of critical and emerging engineering structures targeted for high-temperature structural applications. This program is directed towards the development of bond coatings for thermal barrier coating systems; however, related applications include environmental barrier coatings for silicon based ceramics, and overlay coatings for high speed cutting tools. Furthermore, a basic understanding of the changes in properties induced by microstructure (i.e., grain morphology and precipitate distribution) can open new horizons in the

development and application of thinner, more durable coatings.

B.2 <u>OUTCOME GOAL for Learning:</u> ***"Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens."***

Comments:

The 49 awarded proposals that were reviewed have a strong component of education and career development for undergraduate students, graduate students, K-12 teachers, and/or postdoctoral researchers. As a whole, these activities have provided training and have cultivated a world-class, broadly inclusive science and engineering workforce, and have expanded the scientific literacy of all citizens.

In many cases achieving outcome goals for learning do not require the kinds of innovations in approach necessary for achieving the outcome goals for discovery. Accordingly, reviewers of proposals should place an equal value on outreach activities and methodologies that are already established and have proven themselves effective, as opposed to giving more value to new programs that might have higher risk.

While NSF-DMR is doing what it can with its limited budget, it is clear that the US is falling behind in developing a scientifically educated workforce.

Specific examples of successful programs are:

ECCS 0708759; PI: Chang-Beom Eom (co-funded by ECCS and DMR)
This project brought secondary school science teachers from University of Puerto Rico, Mayagüez, to UW-Madison each summer for a nanotechnology learning/research experience. The teachers developed classroom material in both English and Spanish, and put in place programs for implementation in secondary schools across the country.

DMR 0745945; PI: Alexis G. Clare
This project is based at Alfred University. Since Alfred is in a rural setting, the PI brought local high school students from the surrounding rural areas into the university to enhance their interest in science and engineering. The focus was on women students since representation of women in science and engineering tends to be much weaker in a rural setting than in an urban environment.

DMR 0735410; PI: Karl Sieradzki
Expertise in chemical effects on the mechanics of materials requires the ability to integrate knowledge in the disciplines of electrochemistry, applied mechanics and materials science. In order to give students the opportunity to bring together such a diverse set of disciplines, the PI developed a new undergraduate course in this area that was taught at the senior undergraduate level specifically aimed at providing students with this integrated background. Additionally, the PI involved undergraduate students in his research through Arizona State University's NSF funded Minority Graduate Education @ Mountain State Alliance (MGE@MSA) program.

DMR 0705675; PI: James Kakalios
The PI has developed a pre-baccalaureate program in Engineering at the Native-American College of Menomenie Nation in Wisconsin, and has hosted summer research high school and undergraduate students from the Menomenie Nation tribe. He is also the author of a popular science book (The Physics of Superheroes) and frequently gives well-attended lectures to the

general public.

DMR 0704142; PI: John L. Stickney
At the pre high school level, the PI has begun a program “Drum Majors for Science” (DMS), designed to bring science into predominantly minority elementary schools, to capture the minds of young students while they are still interested in science, before they move on through middle and high school.

DMR 0704354; PI: Edmund G. Seebauer
The PI has developed an industry-supported laboratory course for upper-division undergraduates and graduate students called “*Chemistry and Transport in Semiconductor Materials Synthesis.*” This course contains a module on deposition of TiO_2, which leverages the knowledge he has gained from the proposed research on TiO_2 thin film synthesis.

DMR 0642363; PI: Megan E. Frary
The PI had been developing web-based reusable learning objects as a novel approach to disseminating the results of the research to a broad audience. These stand-alone, electronic Lessons are available online and can be used independently by high school or college teachers or integrated into existing courses.

DMR 0645312; PI: Daniel Gall
The PI has designed and constructed a hands-on thin film growth simulator, called “The Materials Machine”, at the Children’s Museum of Science and Technology. In this simulator 5- to-12-year old children learn about atomic aspects of materials and nanostructure synthesis by experimenting with ping-pong ball size “atoms.” The number of children that have been impacted by this activity is around 45,000 per year.

DMR 0606006; PI: Matthew O. Zacate
This research is being undertaken at an undergraduate institution, which will have significant impact for the undergraduate students that will participate in the research. This opportunity is rare and very valuable for such undergraduates.

DMR 0602649; PI: Dhiraj K. Sardar
This project is particularly relevant to the University of Texas, San Antonio (UTSA) in that the University is declared a minority institution with more than 55% of its students belonging to underrepresented minority groups. Efforts have been made to enhance the students’ participation in research projects through active recruitment and retention of minority students. Because of the large Hispanic student population (>55%) at UTSA, the proposed research program attracta a significantly large number of underrepresented students.

DMR 0605621; PI: George G. Malliaras
The partnership between Cornell and Simmons College (a predominately undergraduate women’s college) that has been established in this project has involved over 35 undergraduate students in research. In addition, the Chemistry and Physics Liaison (a student organization for chemistry and physics majors) has incorporated a new demonstration highlighting light emitting diodes into its yearly outreach activities for middle school and high school classrooms.

DMR 0547134; PI: Jon-Paul Maria
The PI has established an annual summer workshop for North Carolina K-12 science teachers. The workshop presents affordable, hands-on, materials science demonstrations to capture interest in science classrooms. Demonstrations focus on basic concepts of electronic materials, with links to everyday devices. The intent is to generate excitement for Materials Science in young students.

DMR 0547976; PI: Chekesha M. Liddell
The PI has developed pre-collegiate level "play" and cognitive activities that integrate art and technology. The jigsaw puzzle outreach to middle school students uses scanning electron microscopy art as a tool in science and engineering education.

Several GOALI's and other proposals with strong industrial ties have provided students with industrial experience that strengthens the connection between basic research in the US and its industries; thus, providing opportunities for increasing the global competitiveness of this country. For example:

DMR 0705953; PI: Gottlieb S. Oehrlein
DMR 0604314; PI: Manish Chhowalla
DMR 0605662; PI: Wayne J. Jones

B.3 <u>OUTCOME GOAL for Research Infrastructure:</u> ***"Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools."***

Comments:

The funded projects through the metals, ceramics, and electronic materials programs in DMR do not have large investments in research infrastructure. Large investments can be found through the MRSEC and research instrumentation programs.

Smaller instrumentation (with a price tag of less than ~$30,000) can many times be included in a proposal, but it is impractical to seek support for equipment in the $30,000 to $100,000 range in unsolicited proposals. Furthermore, university laboratories are notoriously ill-equipped to maintain facilities as federal dollars are available for large instrumentation, but generally not for staff support. Graduate students routinely perform instrument maintenance, which on the one hand provides them with in-depth training on equipment, but on the other hand is problematic for long-term operation of instruments as the students move on. NSF-DMR should consider addressing this gap in funding.

Nonetheless, development of useful instrumentation tools has taken place by a select number of PI's in MCEM. Some examples include:

DMR 0705675; PI: James Kakalios
This project developed a novel new deposition system capable of synthesizing thin film mixed phase materials consisting of nanocrystalline particles embedded within a semiconducting or insulating matrix. The dual-plasma co-deposition process generates one type of nanocrystalline particles in an upstream flow-through tube reactor, which are then injected into a second, capacitively-coupled plasma deposition system in which the surrounding semiconductor or insulating material is grown.

DMR 0652424; PI: Jennifer A. Lewis
Evaporative lithography of colloidal films has been systematically investigated using a mask-assisted drying process in which particle migration is controlled by generating a periodically, or otherwise, varying evaporative landscape just above the drying film surface.

DMR 0606006; PI: Matthew O. Zacate
This project is developing computer code that is sufficiently general to support stochastic models for

all types of hyperfine interactions and for nuclei with any spin state. The code will allow calculation of theoretical spectra for the hyperfine methods that can be used in least-squares-fits of experimental data. In addition to helping in data analysis, the computer code will support simulation of spectra under varying experimental conditions such as for different crystal structures, defect models, compositions, temperatures, and diffusion mechanisms.

DMR 0547134; PI: Jon-Paul Maria
The cornerstone of this investigation involves developing a novel thin film processing methodology, offering control of both cation stoichiometry and point defects in a complex oxide through gas-phase equilibrium. The PI will accomplish this by designing a quantitative atmosphere-controlled furnace enabling independent and reproducible variation of temperature, BiO_x overpressure and pO_2 for the $BiFeO_3$ system. This instrumentation and methodology represents a fundamental contribution to electroceramic processing science.

PART C. OTHER TOPICS

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

Overall, the MCEM programs are in excellent shape in terms of technical and educational coverage. There are no obvious programmatic gaps within MCEM. Creation of the biomaterials program was a positive step, demonstrating NSF's responsiveness to a changing research landscape.

However, there are still many gaps in our understanding of fundamental issues within the areas covered by the MCEM programs. These gaps would be addressed by increasing funding for these programs.

The COV feels that Materials research is a leading enabler for a number of grand challenges, including innovation-driven prosperity, national security, and energy sustainability. Thus, continued and increased funding for these programs should be a national priority.

As mentioned in Section B, PI's are reluctant to seek support for equipment in the $30,000 to $100,000 range in unsolicited proposals because the requested award sizes significantly exceed the average funding levels and are perceived by the PI's as uncompetitive. NSF-DMR should consider addressing this gap in funding.

C.2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

The MCEM programs have been very successful in meeting programmatic goals and objectives. A significant number of high-profile seminal publications in the materials field cite NSF support.

The award success rate for women and minorities is above the average for all proposals in MCEM (~28% vs. ~20%), which helps to maintain participation of these underrepresented groups. However, we encourage Program Managers to continue their efforts in promoting submissions from these groups.

The COV feels that the core programs are in some danger in the present funding climate. The success rate in all areas is becoming dangerously low as programs are forced to turn down excellent proposals for lack of funds. We wish to make a strong statement on the need to preserve the core programs that are the natural niche for innovative, curiosity-driven research carried out by individual investigators.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

The ever increasing workload of NSF staff is a continuing concern. In a time of shrinking financial resources, the importance of thorough and fair proposal review cannot be overestimated. The requirement for post award management is also important to the success of all NSF programs and must be maintained. Both of these areas require significant efforts by the program directors. Therefore, we recommend that staffing levels should be increased in the MCEM programs.

The scientific community has come to understand the importance of addressing both criteria in reviews through education by the program managers. Reviewers (and PIs) hold differing views on what constitutes a broader impact. Some consider it necessary to have an innovative outreach activity, others consider routine faculty-student interactions and teaching activities sufficient, while others interpret broader impact to mean that the research should have some applicability to, for example, a product. This could be addressed by further clarification by the NSF staff.

As was mentioned in Section B, achieving outcome goals for learning do not require the kinds of innovations in approach necessary for achieving the outcome goals for discovery. Accordingly, reviewers of proposals should place an equal value on outreach activities and methodologies that are already established and have proven themselves effective, as opposed to giving more value to new programs that might have higher risk.

C.4. Please provide comments on any other issues the COV feels are relevant.

The COV supports DMR's approach of broad area solicitations that encourage bottoms-up, scientific community input into research directions rather than more targeted solicitations in specific technical areas. In the current funding climate, highly targeted solicitations could decrease the breadth of research that can be supported in the programs, with deleterious effects on innovation.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

At this COV meeting, the EIS-COV module was not accessible online, severely impeding our ability to gather and assess the requested data. Also, all letters in eJacket were not available.

The interactive panel system review feature for making "Comments" to scribes would be useful to exchange text.

There were significant discrepancies in the printed EIS-COV data, so the committee was unclear as to which set of data was correct. For example, funding levels for new PIs and minority PIs did not appear consistent among different sets of data.

Tabulated data from EIS is difficult to interpret because ~70% of reviewers do not self-identify their gender, minority, disability status, or even the type of institution. An effort should be made to improve collection of such data in a centralized automated way.

Some scheduled meeting time without NSF staff would be helpful in order to have an open discussion. While this sub-panel of the COV was very satisfied with the interactions with NSF staff, there might be future occasions when a closed meeting would be appropriate.

SIGNATURE BLOCK:

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For the Division of Material Research COV
Paul S. Peercy
Chair

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2008 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2008 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2008. Specific guidance for NSF staff describing the COV review process is described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) that can be obtained at <www.inside.nsf.gov/od/oia/cov>.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the results generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals.

Many of the Core Questions are derived from NSF performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several subactivities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the subactivities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

Suggested sources of information for COVs to consider are provided for each item. As indicated, a resource for NSF staff preparing data for COVs is the Enterprise Information System (EIS) –Web COV module, which can be accessed by NSF staff only at http://budg-eis-01/eisportal/default.aspx. In addition, NSF staff preparing for the COV should consider other sources of information, as appropriate for the programs under review.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the ***processes*** related to proposal review; and (B) the quality of the ***results*** of NSF's investments that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future. Discussions leading to answers for Part A of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. *COV reports should not contain confidential material or specific information about declined proposals.* Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. The reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. Since material from COV reports is used in NSF performance reports, the COV report may be subject to an audit.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see http://www.nsf.gov/od/oia/activities/cov/covs.jsp.

FY 2008 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: February 6 - 8, 2008
Program/Cluster/Section: Instrumentation, Facilities, MRSECs, Office of Special Programs
Division: Materials Research
Directorate: Mathematical and Physical Sciences
Number of actions reviewed: **Awards: 61** **Declinations: 37** **Other: 17**
Total number of actions within Program/Cluster/Division during period under review: 1565 **Awards: 157** **Declinations: 1007** **Other: 401**
Manner in which reviewed actions were selected: **Either the reviewers looked at all of the proposals available, or they selected a few from each category (awarded, declined, marginal award, marginal decline).**

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process. Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[1]
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: Comments: Yes, particularly given the size and scope of the awards being considered. The review methods were well matched to different types of awards. The post award reverse site visit was very effective for a new program such as PREM. Source: Jackets and the EIS. Select the "Type of Review" module.	Yes
2. Are both merit review criteria addressed a) In individual reviews? Yes. b) In panel summaries? Yes. c) In Program Officer review analyses? Yes. Comments: There has been considerable documented improvement by both individual reviews and panelists in addressing both categories (intellectual merit and broader impacts). Source: Jackets	Yes

[1] If "Not Applicable" please explain why in the "Comments" section.

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals? Comments: Comments: Yes, by and large, although there still exists some—to be expected—variation in the performance of individual reviewers. Program officers are doing an excellent job of assuring reasonable assessment of proposals with substantive comments, e.g., assuring that a minimum number of reviewers are responsive in cases where a number of mail reviewers do not respond to requests for proposal review or in panel reviews where expertise for review of certain aspects of proposals is not uniformly available across all panelists. Source: Jackets	Yes
4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Comments: Yes. Again there is some variation but not beyond what is reasonable. In general, the PIs are provided with clear information regarding panel recommendations. Again, program officers are doing a good job in assuring that this is achieved uniformly across proposal reviews. Source: Jackets	Yes
5. Does the documentation in the jacket provide the rationale for the award/decline decision? (Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.) Comments: Yes. In general, documentation in jackets was well suited to the particular type of proposal being considered. Review analysis and diary notes were very helpful. Source: Jackets	Yes

6. Does the documentation to PI provide the rationale for the award/decline decision? (Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.) Comments: Yes. The documentation provided to the PI is a useful resource in guiding career development and evolution of research strategies and activities. In this regard, program officers have a good and important relationship with the communities that they serve. Source: Jackets	Yes
7. Is the time to decision appropriate? Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals. Comments: Yes. Most definitely, given the scope and complexity of the awards being considered. The NSF staff is to be commended. The scope and complexity of the award type should be considered by NSF in defining “Time to Decision” goals. Source: Jackets and EIS-Web COV module. Select “Report View”, then select “Average Dwell Time,” and select any combination of programs or program solicitations that apply.	Yes
8. Additional comments on the quality and effectiveness of the program’s use of merit review process: The Foundation has a well-recognized high standard of meritorious review of proposals, and DMR has met that high standard for all programs and award types considered.	

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	**YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[2]**
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: Yes. It is extremely difficult to identify individuals possessing the necessary breadth of expertise to review many of the multidisciplinary proposals that are received. This is particularly challenging with regard to instrumentation programs and multidisciplinary research center proposals. Quite often it is necessary to select reviewers with limited expertise in certain areas. The DMR staff has done an excellent job identifying and assigning proposals to appropriate reviewers. Source: Jackets	yes
2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups? Note: Demographic data is self reported, with only about 25% of reviewers reporting this information. Comments: This sub-panel of the COV feels that where there are adequate statistics, the efforts are good and that a reasonable balance between academic institutions, national laboratories, and industry has been obtained. DMR is to be commended for increasing the percentage of industry reviewers in its panels. Efforts to improve diversity in the reviewer pool have also proved successful. For example the percentages of female and minority reviewers in OSP and MRSEC programs are at 101/528 (19%) and 98/350 (29%) respectively. Efforts to increase the balance of panels may have inadvertently stretched the reviewer pool, increasing individual review loads. DMR is encouraged to seek and use more reviewers from minority serving institutions (MSIs). This is particularly applicable for multidisciplinary center related programs such as MRSECs where interactions with MSIs are mandated. Source: Jackets and EIS-Web COV module. The “Report View” has reviewers by state, institution type, minority status, disability status, and gender	yes

[2] If “Not Applicable” please explain why in the “Comments” section.

3. Did the program recognize and resolve conflicts of interest when appropriate? Comments: Yes. COIs were documented and addressed appropriately. Source: Jackets	

4. Additional comments on reviewer selection:

This sub-panel of the COV applauds efforts to increase participation of industrial and National Laboratory reviewers. DMR should consider developing a mechanism for formal recognition of excellent reviewers. In addition, it would be helpful if it is possible to provide some level of reviewer training, particularly for new reviewers. This could streamline the process and bring more consistency to the reviews.

A.3 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE[3], OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: The overall quality of the proposals is high as is evident in the reviews; however, not as many of these high quality proposals as one would like to support can be funded due to budgetary constraints. As examples of high proposal quality, PREMs were awarded in emerging technological fields such as spintronics (Howard University), Biomaterials (University of New Mexico) and Metamaterials (Norfolk State University). Norfolk State has created a PhD program as a result of a PREM educational component between Norfolk State, Cornell and Purdue Universities where web-based and co-taught courses between the institutions were developed. Source: Jackets and program information	Appropriate

[3] If "Not Appropriate" please explain why in the "Comments" section.

2. Does the program portfolio promote the integration of research and education? Comments: This is one of the strengths of this program cluster and DMR as a whole. Education is a required component of all proposals and is evident in the inclusion of K-12, undergraduate, graduate and post docs in the proposals. However, it is somewhat of a challenge in proposal for programs such as MIP where education is largely focused toward students on the graduate level. Regarding solicitations for MIP, the COV feels that the scope of education proposed is suitable for that particular program and that both PI's/reviewers should consider this when preparing/reviewing proposals. Source: Jackets and program information	Appropriate
3. Are awards appropriate in size and duration for the scope of the projects? Comments: The awards are appropriate in size. The committee has taken into consideration that NSF has to make adjustments to the proposed budgets due to budget constraint. The committee applauds DMR for maintaining the integrity of their programs given the realities of these budget constraints. When appropriate the DMR should consider longer term awards to reduce the burden on reviewers and DMR staff. Source: Jackets and EIS-Web COV module has a "Report View" that gives average award size and duration for any set of programs or program solicitations you specify.	Appropriate
4. Does the program portfolio have an appropriate balance of: • Innovative/potentially transformative projects? Comments: DMR supports high-quality programs such as MWN, PREM, and MRSEC programs that fund innovative and potentially transformative projects. This sub-panel of the COV also found evidence of high-risk high payoff projects within the SEED element in MRSECs as well as the MIP/IMR programs. MWN brings together collaborators across the globe to work on projects, which span the scope of the research covered by DMR. THE SEED program provides funding for a PI who has innovative idea that may potentially be transformative. Source: Jackets and program information.	Appropriate
5. Does the program portfolio have an appropriate balance of: • Inter- and Multi- disciplinary projects? Comments: The DMR portfolio is appropriate and new programs are being	Appropriate

put into place, i.e., biomaterials, to ensure that there is diversity in the multidisciplinary projects funded. Facilities, MRSECs and the Materials World Network, by their intrinsic nature, enjoy broad participation across disciplines. This cluster within DMR has in fact defined the nature of multidisciplinary research for much of NSF. Source: Jackets, program information, and some people use as a proxy data on jointly funded projects. See EIS-Web COV module, “Report Review” and select “co-funding from” and “co-funding contributed to” to find jointly supported awards.	

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program? Comments: Overall, the portfolio is very diverse and well balanced. Source: Jackets, program information, and EIS-Web COV module for information on award size.	Appropriate
7. Does the program portfolio have an appropriate balance of: • Awards to new investigators? NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant. Comments: The overall perception of this sub-panel of the COV is that there is room for improvement in funding to new investigators. A much appreciated, but often unrecognized mechanism, for the support for young investigators is within the MRSEC/SEED grants. This discretion ability on the part of the MRSEC center allows new investigators to conduct research, and obtain data that may later lead to submission of a full proposal to a funding agency. This flexibility is particularly important in this time of reduced funding, lowered proposal success rates, and suspension of programs such as IMR. Source: EIS-Web COV module on “Funding Rate,” filtered by PI Characteristic (use the pop-up filter).	Appropriate
8. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments: The geographical distribution is appropriate. This appropriateness is based	Appropriate

on the fact that geographic balance is driven by the number of institutions and the population of a given state and that the distribution is a result of the merit based proposal review process. Also the geographical input to the program may not be uniform, hence neither will the output. The COV did not see serious discrepancies in the portfolio. Source: EIS-Web COV module, using "Proposals by State"	
9. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: The sub-panel found the PREM and REU programs to be excellent vehicles for increasing the participation of minority institutions. Source : EIS-Web COV module, using '' Proposals by Institution Type''	Appropriate
10. Does the program portfolio have an appropriate balance: • Across disciplines and sub-disciplines of the activity? Comments: The program is well covered in all disciplines and sub-disciplines. Source: Jackets and program information	Appropriate
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: The REU and PREM programs, which offer workshops, conferences and summer research experiences, offer many opportunities for under represented minorities. DMR has a higher involvement of underrepresented groups, percentage wise, than NSF overall in their role as reviewers, individual investigators, and participants generally. A continued effort is being made on the part of DMR through the participation in workshops for women, minorities and scientists with disabilities. The program officers should be commended for their efforts to increase participation by under represented minorities and this sub-panel of the COV encourages continued efforts to increase under represented group participation in its programs. Source: EIS-Web COV module, using "Funding Rate" with the pop-up filter (this allows you to see female and minority involvement, where involvement means being PI or co-PI).	Appropriate

12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports. Comments: The program cluster is relevant in that meets all the challenges set forth in the CMMP report (complex phenomena, energy demands, physics of life, physics far from equilibrium, nano-world, and information technology) and the similar challenges put forth by NSF as being transformative areas of research. This cluster within DMR is also heavily involved in creating a globally engaged materials science enterprise. Below is a list of highlight of DMR funded research that touches upon these topics. Source: Program information	Appropriate
13. Additional comments on the quality of the projects or the balance of the portfolio:	

A.4 Management of the program under review. Please comment on:

1. Management of the program. Comments: A distinctive feature of Program Group B (including MRSEC, OSP, NAF, and MIP/IMR) management is the personal attention and direct involvement by the program monitors on the everyday activities of their respective research portfolios. Their management activities include multiple site visits to all MRSECs (all 26 of them), all NSECs, and facilities sites, participation and organization of multiple program-wide meetings, conferences and workshops, and the expedient handling of often grueling competitions, to name a few. This very high level of involvement has allowed DMR program officers to arrive at effective management strategies that provide excellent oversight while maintaining flexibility. This level of involvement is conducive to communication and allows DMR program officers to maintain a commendable level of awareness of the research needs, challenges, and opportunities facing the Materials Research community. This high-level of performance by DMR's management has come at a price. DMR staff are overworked and stretched too thin. While this sub-panel of the COV commends DMR on its efforts to augment their staff, more needs to be done, lest valuable programs such as MWN, MRSEC, NSEC,

PREM, NAF, or MIP/IMR start to suffer. It was also noted by this sub-panel of the COV that group B's activities must rely heavily on institutional memory and personal contacts. This is particularly true of large centers (MRSECs and NSECs), research programs involving program officers from overseas (e.g. MWN), or instrumentation and facilities. This sub-panel of the COV commends DMR for adding permanent staff to its management team, and it also urges NSF to adopt strategies (such as improving workload) that will allow to retain that staff within DMR and within NSF itself.
Again, this sub-panel of the COV also noted that, within Program Group B's activities, the issue of dwell time cannot be viewed through the same criteria that apply to other sections of the division and of NSF. Centers and major instrumentation investments should be evaluated on a time scale that sometimes exceeds 6 months. Within the restrictions pertaining to their research portfolio, Program Group B is doing an admirable job of reviewing applications for funding in an expedient manner.

2. Responsiveness of the program to emerging research and education opportunities.

Comments: As mentioned above, responsiveness to emerging research and education opportunities has been one of the strengths of Program Group B. DMR has been a pioneer within NSF and, more broadly, within the national research enterprise in identifying such opportunities and devising creative and effective programs to address them. Examples of such programs include MRSEC, MWN, PREM and, more recently, MIP. This sub-panel of the COV notes that such programs are being emulated throughout NSF and other funding agencies. This sub-panel of the COV also notes that, in direct response to the needs of the research and educational community, the Program Group B management is engaged in a dynamic cycle of assessment and improvement of their own activities that directly benefits the scientific community. Examples include the implementation of post-award workshops within the context of PREM, the idea to implement a Super-Seed competition for MRSECs, efforts to adopt multi-country review panels for the MWN, and the development of a Materials Research Facilities Network (MRFN).

Materials research has become highly cyber-intensive, both in its needs to design or engineer materials on the basis of computationally intensive models (the concept of "Materials by Design") and in its need to handle and interpret large amounts of experimental data. DMR should benefit from new resources allocated to cyber infrastructure development. While this sub-panel of the COV commends DMR's efforts to take advantage of the opportunities provided by new cyber investments, as exemplified by DANSE in MIP, it also encourages NSF to be aware of the needs and opportunities for cyber-enabled research in materials research.

This sub-panel of the COV again notes that such a high-level of responsiveness can only be maintained by providing DMR with additional staff. Failure to do so risks doing harm to the division.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

The budgetary fluctuations and uncertainty of the last three years have been catastrophic to DMR. Valuable, essential programs such as IMR are no longer run on a yearly basis, highly visible programs such as MRSEC have been funded at effectively lower levels for several years (the proposal success rate is on the order of 10%), and emerging, effective programs such as PREM run the risk of being dismantled.

The DMR management has been effective in keeping the funding to researchers, facilities, centers and programs as steady as possible in the highly uneven fiscal environment of the past several years. This has required that priorities be set and that painful decisions be made. But this environment is hurting morale within DMR, it is leading to disillusionment amongst the materials research community, and it is driving talented individuals away from scientific and engineering careers.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

This sub-panel of the COV recognizes that it is a tremendous challenge to maintain an appropriate balance amongst diverse programs, and it applauds the efforts of DMR to increase access by the entire research community to centers and facilities. The DMR management has been careful and effective in responding to the need for assessment of balance among centers, special programs, instrumentation and facilities. Evidence for that response is provided throughout several recent NRC reports that have examined and complemented the MRSEC program, the Midsize Facilities programs, and the Condensed-Matter and Materials Physics activities. In response to the previous COV report, Program Group B has been particularly effective in increasing the number of reviewers from underrepresented minority backgrounds, from industry, and from national laboratories.

5. Additional comments on program management:

PART B. RESULTS OF NSF INVESTMENTS

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The NSF mission is to:
- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship. The COV should look carefully at and comment on (1) noteworthy achievements based on NSF awards; (2) ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcome goals; and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio as it relates to the three outcome goals of Discovery, Learning, and Research Infrastructure. The COV is not asked to review accomplishments under Stewardship, as that goal is represented by several annual performance goals and measures that are monitored by internal working groups that report to NSF senior management.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 OUTCOME GOAL for Discovery: "*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering."*

Comments:

The NSF is the premier agency in the Nation for researchers to bring their best ideas. Within NSF, DMR does an excellent job of funding the highest quality proposals in all categories–individual investigator, group investigators, centers, instrumentation and facilities. The portfolio of funded research includes high-risk high-payoff activities that may lead to high reward. Examples of this are the Seed funding within MRSECs and the funding for DANSE as a construction project to merge data analysis, theory, and simulation into a single computational environment for neutron facilities.

DMR has put high quality initiatives in place that get the scientific community excited. Examples are the Nanoscale Science and Engineering Centers (NSECs), the Partnerships for Research and Education in Materials (PREMs), the Materials Research Science and Engineering Centers (MRSECs) and the new Materials World Network (MWN).

The sub-panel reviewed examples of research in the areas under review among the highlights in the report "DMR Program Report FY2005 - 2007." Placed in the context of the recent CMMP-2010

report there are outstanding examples of research that is advancing the frontiers in these important areas: 1. Under discoveries in the nanoworld, there is the remarkable Penn State MRSEC’s "synthesis and imaging of a "nanocar" and the Northwestern University MRSEC's aligned pyramidal nanoparticle fabrication, as well as the Stanford University MRSEC's demonstration of patterning of large arrays of organic semiconductor single crystals onto transistor electrodes. 2. Under energy-related research, there is accomplishment of the collaboration (UC Santa Barbara, UMass Amherst, and CPIMA) MRSECs thin chip fabrication that allows chips to run faster and use less energy. 3. Under science far from equilibrium, there is the surprising results regarding graphene at high magnetic fields demonstrating several inter-Landau level transitions in contrast to traditional semiconductors where only one transition (the cyclotron resonance) is seen. Relevant to the physics of life, there is the measurement of elongated DNA molecules by means of fluorescence light microscopy. Under the American Competitiveness Initiative, there are the accomplishments of the Research Experience for Undergraduates (REU) and the Research Experience for Teachers (RET), as well as the many educational elements of the MRSECs that are demonstrating remarkable success in bring science literacy into all elements of our society.

B.2 OUTCOME GOAL for Learning: "*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.*"

Comments:

Materials Research Science and Engineering Centers (MRSECs): Many MRSECs have developed effective and engaging outreach programs. MRSECs have been leaders in the development of educational materials—including museum exhibits (by staffing the Strange Matter Exhibit). In fact, DMR staff members have led by example with direct involvement—as many DMR staff members have volunteered to staff the Strange Matter Exhibit. Other examples include MRSEC faculty involved in helping 4th grade students to meet New York State science standards (Hines, Cornell Univ., DRM-0520404), development of an exhibit for the Franklin Institute (Philadelphia, PA) titled: Materials Matter: It's a Nanoworld After All" by the Penn State University MRSEC (Weiss, Penn State, DMR-0213623i) and the implementation of undergraduate research programs housed at the National Institute for Standards and Technology (Vanderah, NIST, DMR-0648986).

National Facilities: The COV was very impressed with how the National High Field Magnetic Laboratory (NHFML) has embraced its user community (Boebinger, Florida State University, DRM-0084173). Other examples for National Facilities impacting workforce development include, (i) the Center for High Resolution Neutron Scattering (CHRNS) program at the NIST (Neumman, NIST, DMR-0454672) which runs summer schools and supports summer undergraduate research projects, (ii) the Los Alamos Neutron Science Center (LANSCE) Winter School on "Structural Applications of Neutron Scattering" (Nakotte, NMSU, DMR-0444225), and (iii) a series of workshops supported by DMR with targeted attendance. Other examples for engaging the general public includes the uncovering of ancient inscriptions by scientists at Cornell's CHESS facility (Gruner, CHESS, DMR-0224180g).

Office of Special Programs (OSP): The OSP impacts broad inclusion on several levels, including the Research Experiences for Undergraduates (REU) program, the Research Experiences for Teachers (RET) program, and the Materials World Network (MWN) program. The basis of research experiences for undergraduates (REU) programs is to involve students who would not otherwise receive research training. REU programs have been established at 44 sites. Research experiences for teachers (RETs) have been established at 8 sites. Additionally, the Materials World Network (MWN) has involved graduate students world-wide.

Partnership for Research and Education in Materials (PREM):
The PREM program is noted as particularly transformative as both a model for increasing science and engineering among underrepresented minority groups and in the nature of research programs conducted, including projects in photonic metamaterials (Noginov, Norfolk State University DMR-0611430), biomaterials (Lopez, University of New Mexico, DMR-0611616), and spintronics (Halpern, Howard University, DMR-0611595). In the PREM workshop report, April 2007, the PREM program participants recommend that "…PREM be framed within the context of the February 2006 American Competitive Initiative (ACI)". This will improve PREM Institutions' visibility and participation in cutting-edge basic research.

Instrumentation for Materials Research (IMR) and Major Research Instrumentation (MRI) Programs: The IMR/MRI programs are responsible for developing and placing instruments at universities, colleges, and national laboratories. Undergraduate institutions that would not otherwise be able to afford research instrumentation realize the benefit of those instruments through the IMR and MRI programs. As an example, faculty members in a small college setting are able to teach using an Atomic Force Microscope (Waldow, Pacific Lutheran University, DMR-0619826) which will directly impact undergraduate student understanding of the nanosciences.

Major Instrumentation Program (MIP): This sub-panel of the COV commends the efforts of large-scale projects in reaching the general public. In order to reach an audience beyond the scientific community, the cyber infrastructure-based Distributed Data Analysis for Neutron Scattering Experiments (DANSE) program (Fultz, CalTech, DMR-052547) has developed a wikipedia page (link: http://wiki.cacr.caltech.edu/danse/index.php/Main_Page).

B.3 <u>OUTCOME GOAL for Research Infrastructure:</u> "*Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools.*"

Comments:

NAF: The national multiuser facilities such as the National High Magnetic Field Laboratory (NHMFL), Cornell High Energy Synchrotron Source (CHESS), etc. supported by this program provide specialized research capabilities that are critical for addressing the research priorities identified in the ACI, as well as all six of the scientific challenge areas listed by the Committee on CMMP 2010 in their NRC report. The scientific impact of these programs is evident from the expansive number of users (~2200/year), the significance of the research highlights, and the large number of publications in high impact journals. DMR's efforts as the primary steward of NHMFL are particularly commendable as that program is a valuable national resource, and it continues to lead the world in the innovation and development of sophisticated magnet instrumentation such as the 900 MHz NMR magnet (Grant # 084173). The education and outreach programs of the NHMFL, which include an annual open house for K-12 students, are also notable and serve as a model for other user-based facilities. Within the NAF program, DMR has fostered a variety of creative, specialized models for partnering with the facilities themselves as well as other funding agencies such as DOE. For example, the CHRNS program at the NIST Center for Neutron Research is an excellent model for cooperative stewardship in which DMR support is focused on the development and operation of a limited suite of neutron instruments that have high user throughput. The role of DMR in supporting research at synchrotron sources is also vital, though it is challenging to set priorities for future funding. DMR is sponsoring ongoing workshops to define the needs for next generation synchrotron capabilities and to identify realistic opportunities in which DMR can have an impact.

In general, this sub-panel of the COV is fully supportive of all of DMR's efforts to expand and enhance the user base at the national facilities. DMR has identified a need for enhancement of cyberaccess to national facilities, as well as to mid-size user facilities. Materials research is cyber intensive in analysis and interpretation of data, and DMR is already positioning itself to exploit these advances. This sub-panel of the COV concurs that this is a promising area for growth and development.

Due to the current funding crisis, this sub-panel of the COV recognizes the challenges faced by DMR in setting priorities for future support of these facilities. As the programs at these successful facilities continue to grow and expand, it is difficult to balance their financial needs relative to other DMR programs. Since the user communities of these facilities have expanded well beyond the scientific community served by DMR, it may be worthwhile to pursue opportunities for partnering with other directorates within NSF in order to provide continued support at the needed levels.

IMR/MIP: This sub-panel of the COV is impressed by the effectiveness of these programs and agrees that they both provide an opportunity for developing and building sophisticated, specialized instrumentation for use at the national facilities, as well as at regional research centers. Successful examples of this program include the development of the Intermediate Energy X-ray instrument (Proposal 0703406) at the Advanced Photon Source and the design of a 30 T hybrid magnet (Proposal # 0603126) for the Spallation Neutron Source that was awarded in partnership with DOE. The detrimental effects of the recent budget crisis are clear, as the IMR grants were awarded only in 2005. This effective program should be supported again in the future.

MRSEC: These centers spend approximately 10 – 15% of their budget on the development and operation of user facilities. These facilities are a key component of the measurement infrastructure at many universities. Without DMR's ongoing support for the MRSEC program, it is doubtful that funding for these valuable resources could be sustained by the universities alone. To further leverage these resources and increase their impact on a broader research community, the COV applauds efforts such as the MRFN (Materials Research Facility Network). The COV notes that these goals are consistent with the conclusions of the NRC report on Midsize Facilities in 2006.

OSP: In agreement with the previous COV report, the committee believes that REUs and RETs provide undergraduates, high school students, and K-12 teachers with essential access to state-of-the-art instrumentation at national and mid-size facilities. These opportunities play a key role in promoting the careers of future scientists.

PART C. OTHER TOPICS

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

There are many strong programs within the area of review by this sub-panel. Of great concern is sustaining these excellent areas and growing their reach and the scope of their success in the future. The sub-panel recommends that DMR consider increasing the role of partnering in the construction of instrumentation and operation at the facilities.

Another area of possible cooperative partnering may be in the NSF emerging support of cyber-infrastructure and DOD requirements for cyber-infrastructure and security.

The recent removal of cost sharing of up to 30% by universities (or the States) has affected DMR in a negative way. We understand that the NSB is looking at the possibility of reinstating it. After observing the effect of removal, this sub-panel would recommend bringing it back. Unfortunately, this would negatively affect minority-serving institutions, and a compensating process may be necessary in this area.

This sub-panel of the COV recommends that the materials world network be continued and broadened to include more research in Asia and Africa. We are pleased to recognize that DMR is already working toward this goal.

Cyber access to national facilities is an important growth area, the importance of which is certainly recognized, but nothing is funded yet. Such access is essential to ensure greater effective participation for remote users in unique facilities.

C.2. Please provide comments as appropriate on the program's performance in meeting

Diversity plans have made a transformative difference to university campuses because the MRSECs required it. A wonderful outgrowth of this activity is the new PREM program. As this sub-panel tried to measure the success of the programs, it recognized that the metrics are many and very broad. In all the areas we reviewed the metrics–such as numbers of unique users/year of facilities, facility performance in delivered hours, peer-reviewed publications and publications in high-impact journals, program highlights, large numbers of students who are involved, production of PhDs, diversity requirements, outreach efforts, transformative research–of the programs are doing very well indeed.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

Part of DMR's remarkable success is due to its strong support of facilities. As this is a great financial responsibility, it would be reasonable to explore possibilities for distributed funding within NSF for construction and operations of unique facilities. Such partnerships are emblematic of the existing relationships between individual investigators and the instrumentation they need for frontier research. As operations costs escalate, a creative solution will have to be found or we risk the loss of these world-class capabilities.

Funding at DMR has not increased at the same rate as other divisions at NSF, and this needs to be addressed.

C.4. Please provide comments on any other issues the COV feels are relevant.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

The management of DMR is to be commended for implementation of annual updates to the response to the previous COV report. This provides the Foundation, various advisory committees, and the next COV with an excellent perspective on the evolution of the manner in which DMR is responding to perceived issues. Members of this COV suggest that this excellent feature should be implemented more broadly in other COV reports.

Minor adjustments that would facilitate the COV's tasks are:
1. please make the template available on the web in advance of the COV visit
2. the network speed needs improvement
3. If possible, put presentations on the web in advance of the visit, or if that is not possible, at least no later than the presentation.
4. It is very valuable to invite early career investigators to participate in COV as an enriching experience.
5. Ability to do pre-work on a secure network would be helpful. Such advance preparation would allow discussion to proceed the COV meeting immediately following the program managers' presentations.

SIGNATURE BLOCK:

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For the Division of Materials Research COV
Paul S. Peercy
Chair

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2008 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2008 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2008. Specific guidance for NSF staff describing the COV review process is described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) that can be obtained at <www.inside.nsf.gov/od/oia/cov>.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the results generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals.

Many of the Core Questions are derived from NSF performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several subactivities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the subactivities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

Suggested sources of information for COVs to consider are provided for each item. As indicated, a resource for NSF staff preparing data for COVs is the Enterprise Information System (EIS) –Web COV module, which can be accessed by NSF staff only at http://budg-eis-01/eisportal/default.aspx. In addition, NSF staff preparing for the COV should consider other sources of information, as appropriate for the programs under review.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the ***processes*** related to proposal review; and (B) the quality of the ***results*** of NSF's investments that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future. Discussions leading to answers for Part A of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. *COV reports should not contain confidential material or specific information about declined proposals.* Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. The reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. Since material from COV reports is used in NSF performance reports, the COV report may be subject to an audit.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see http://www.nsf.gov/od/oia/activities/cov/covs.jsp.

FY 2008 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: Feb. 6 – 8, 2008
Program/Cluster/Section: Condensed Matter and Materials Theory & Condensed Matter and Materials Physics
Division: Materials Research
Directorate: Mathematical and Physical Sciences
Number of actions reviewed: **Awards: 45** **Declinations: 35** **Other: 3**
Total number of actions within Program/Cluster/Division during period under review: 1455 **Awards: 305** **Declinations: 901** **Other: 249**
Manner in which reviewed actions were selected: The sub-panel reviewed selected actions from those recommended by NSF and also reviewed a few additional actions.

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process.

Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	**YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[1]**
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: For CMP and CMTT ad-hoc reviewers are the norm (the CAREER program perhaps being the only exception). Four or five reviews were quite common across the CMP program; however, not a small number of proposals were reviewed by only 3 reviewers. No correlation was found between small number of reviewers and abnormal number of declines. If anything, the opposite seems to be true: very few of the declined proposals had only 3 reviews, as if the PD had made an extra effort to get sufficient information before a decline decision was made. Source: Jackets and the EIS. Select the "Type of Review" module.	YES
2. Are both merit review criteria addressed a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses? Comments: Reviewers consistently comment on both merit review criteria. However, there still appears to be some confusion, or at least considerable variability, on the part of PIs regarding what is acceptable regarding 'broader impact'. There is enough information generally for the program directors to make adequate judgments, which are then well reflected in the review analyses.	YES

[1] If "Not Applicable" please explain why in the "Comments" section.

Source: Jackets	

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals? Comments: By and large the reviews contain detailed analyses of the intellectual merit of proposals and less detailed discussions of broader impacts. However, there still is a small number of superficial reviews, and in some cases the rating given does not reflect the comments in the review. Source: Jackets	YES
4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Comments: Comments: Only two proposals were reviewed by panels (CAREER award panels), one rejected and another awarded. The comments were short, quite general and somewhat superficial. Source: Jackets	YES
5. Does the documentation in the jacket provide the rationale for the award/decline decision? (Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.) Comments: Almost without exception, the documentation supports very well the decision made. Source: Jackets	YES

6. Does the documentation to PI provide the rationale for the award/decline decision? (Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.) Comments: The documentation provided to the PI includes the technical reviews as well as panel reports, when available. The documentation reflects accurately the rationale for the award decision. It was suggested that direct discussions between the program officers and the investigators could further clarify the basis for the decision process. In this regard, individuals whose proposals are declined could be encouraged to contact program officers if additional clarification would be useful to them. Source: Jackets	YES
7. Is the time to decision appropriate? Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals. Comments: **CMP** Yes. For 2007, CMP met its goal of informing applicants within 6 months and informed 99% of applicants within 9 months. In 2005 and 2006 CMP came very close to its goal, and in both cases informed more than 95% of applicants within 9 months. **CMMT** No. In 2005 CMMT came close to its goal of informing applicants within 6 months and informed approximately 95% of applicants within 9 months. For 2006 and 2007 the system broke down due to staffing issues. There should be continued discussion on increasing the staff to deal with the number of proposals from an increasingly broad array of sub-disciplines. In the future, it would be very useful to build in a period of overlap between rotators so that there's an opportunity for the new rotator to be trained by the existing one.	YES/NO

Source: Jackets and EIS-Web COV module. Select "Report View", then select "Average Dwell Time," and select any combination of programs or program solicitations that apply.	

8. Additional comments on the quality and effectiveness of the program's use of merit review process:

It may be useful to attempt to "grade" the performance of reviewers so as to ensure suitable comprehensive evaluation of proposals.

The program officers clearly read and digest the content of the written reports in reaching decisions. This is especially true in those instances in which there are serious reservations or criticism of the work and at the same time high grades.

The merit review process is quite rigorous and is used effectively. Whereas the technical level (both in research and education) is thoroughly discussed and analyzed, less consistency is noted when applying programmatic considerations to the review (balance among topical areas, diversity issues, young versus established researchers). Because these considerations are more difficult to asses and quantify, they seem to be applied differently in different contexts.

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[2]
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: The comments of reviewers indicate informed evaluation of the proposals. In addition, from the limited number of proposal reviews we had time to read and digest, there appeared to be an attempt to match the PI's type of institution (e.g. undergraduate) with that of at least one of the reviewers. Source: Jackets	YES
2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups?	DATA NOT AVAILABLE

[2] If "Not Applicable" please explain why in the "Comments" section.

Note: Demographic data is self reported, with only about 25% of reviewers reporting this information. Comments: In terms of underrepresented groups, the largest class is "not reporting". Surprisingly, almost 40% of the reviewers' institutions are listed as "unknown". Therefore there is not sufficient information to assess this point. Source: Jackets and EIS-Web COV module. The "Report View" has reviewers by state, institution type, minority status, disability status, and gender	
3. Did the program recognize and resolve conflicts of interest when appropriate? YES Comments: Most COIs are screened before hand by the system or the reviewers themselves. A few that still go through are handled properly by the PDs. It would be more efficient if the following statement that now appears in fastlane were modified: "Even if you have any affiliation or interests that represent a potential conflict of interest, NSF would like your review unless you believe you cannot be objective." Wouldn't it be better to clarify with the PDs any possible conflicts of interest before going ahead with a review that may not be taken into account? Source: Jackets	

4. Additional comments on reviewer selection: The quality of the reviews is generally high, and they represent a reliable indicator of the probability of success of a given research program.

A.3 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE[3], OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: The overall quality of projects supported by the program is excellent. In fact, some projects that received ratings of excellent weren't funded due to budgetary constraints. Source: Jackets and program information	APPROPRIATE
2. Does the program portfolio promote the integration of research and education? Comments: Almost every proposal that was awarded involved the training of graduate students and many include training of undergraduates. The latter is true for both Ph.D. granting institutions and non-Ph.D granting institutions, where only undergraduates would be supported. The program supports efforts to improve the climate for female faculty members through workshops. Source: Jackets and program information	YES

[3] If "Not Appropriate" please explain why in the "Comments" section.

3. Are awards appropriate in size and duration for the scope of the projects? Comments: The size of the awards is often insufficient to carry out many of the projects at a reasonable level. The scope of many projects calls for a minimum of two graduate students and preferably a graduate student and one post doc (or at least 50% post doc support). With current funding levels this becomes impossible, especially given the increasing costs of supplies and coolant fluids such as liquid He. As a result the scope of the project is reduced and/or experiments are limited, thus missing opportunities for important scientific discoveries. Source: Jackets and EIS-Web COV module has a "Report View" that gives average award size and duration for any set of programs or program solicitations you specify.	NO/YES
4. Does the program portfolio have an appropriate balance of: • Innovative/potentially transformative projects? Comments: The number of transformative research projects, as identified by reviewers and program directors, is quite high. The last few years have been remarkable for the number of breakthroughs in materials-related disciplines, including nanotechnology, the discovery of new states of matter, and an unparalled push into Biology. In the latter case, we note the development of materials tools to understand cell biology, cell regulation, neurophysiology, and inroads into systems Biology. We have found that the annual reports of the division present an excellent summary of noteworthy and unexpected developments in materials. A member of the panel wondered whether it might be helpful to set aside a small fraction of the budget for high risk/high pay-off projects, labeled that way from the start, as apparently it is done in the NSF Chemistry program. Source: Jackets and program information.	YES
5. Does the program portfolio have an appropriate balance of: • Inter- and Multi- disciplinary projects? Comments: Approximately 22% of the over 300 active awards in CMP are multidisciplinary, which is a reasonable balance. Source: Jackets, program information, and some people use as a proxy data on jointly funded projects. See EIS-Web COV module, "Report Review" and select "co-funding from" and "co-funding contributed to" to find jointly supported awards.	YES

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program? Comments: The panel was somewhat concerned about the perceived retreat from the single-investigator/small group award mode of funding, which provides much of the *intellectual infrastructure* of the overall research effort. Special attention must be paid to sustaining the long term viability of single investigator efforts. In this regard, it could be useful to have a study of the impact of single investigator and small grant-based research as compared with research supported by MRSECs and large groups. This is especially the case given the diversity of areas that fall under materials theory because of the interdisciplinary training and tastes of the PIs in the program. Indeed, the program extends from low temperature, single atom phenomena all the way to living matter. The synergy across phenomena and scales that the tools of materials theory afford is truly unique. In different words, a large degree of interdisciplinarity takes place at the single investigator level. Source: Jackets, program information, and EIS-Web COV module for information on award size.	YES
7. Does the program portfolio have an appropriate balance of: • Awards to new investigators? NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant. Comments: It is difficult to know what the "right" balance is. Still, a 2:1 renew: new ratio in CMP seems reasonable. On the other hand, in CMMT that ratio is much more skewed against new awards. Source: EIS-Web COV module on "Funding Rate," filtered by PI Characteristic (use the pop-up filter).	YES
8. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments: All states were represented in the 2116 DMR awards and continuing grant increments for 2005 – 2007. Geographic distribution of awards closely reflects the strengths of the research community, and appears adequate. Source: EIS-Web COV module, using "Proposals by State"	YES

9. Does the program portfolio have an appropriate balance of: institutional types? Comments: There seems to be a good balance between public and private institutions, large research universities and colleges. Source : EIS-Web COV module, using ‘’ Proposals by Institution Type‘’	YES
10. Does the program portfolio have an appropriate balance: across disciplines and subdisciplines of the activity? Comments: The distribution of proposals comes directly from the scientific community; the PDs make a remarkable (and successful) effort to respond positively to that "street pressure" without neglecting less fashionable areas with high intellectual merit and potential for breakthroughs. Source: Jackets and program information	YES
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: DMR/All: 22%, 20%, 22% DMR/Minority: 36%, 29%, 22% DMR/Female: 29%, 29%, 27% CMP/All: 24%, 27%, 28% CMP/Minority: 23%, 23%, 33% CMP/Female: 35%, 29%, 40% The percentages are all healthy; continued vigilance is necessary given that the absolute numbers continue to be low. Source: EIS-Web COV module, using "Funding Rate" with the pop-up filter (this allows you to see female and minority involvement, where involvement means being PI or co-PI).	YES
12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports. Comments: The program plays an exceptional role in training students and thus contributes to the infrastructure of science and technology. The focus is on fundamental research in	YES

areas that can in principle be the wellspring of future new technologies. The portfolio of awards that the program has developed contains significant elements reflective of national priorities. The program has direct impact on a number of national priorities, both in research and education, current and future. We mention an important role in the development of the national cyber infrastructure initiative that supports the development of high performance computing resources; the petascale initiative, which focuses on next generation modeling and simulation tools; and a very aggressive and focused effort toward biological physics. Source: Program information	
13. Additional comments on the quality of the projects or the balance of the portfolio:	

A.4 Management of the program under review. Please comment on:

1. Management of the program. Comments: The management of the CMP program remains very strong, despite the pressure that comes from an increasing number of proposals and increasing demands upon the time of the PDs. If this trend continues, it seems that more help will be necessary for both the CMP and CMMT programs.
2. Responsiveness of the program to emerging research and education opportunities. Comments: By the charter (discovery, not-mission oriented) and structure of DMR, the program's emphasis is on excellence regardless of the topic, which is good! As a result, the division's programs reflect the scientific trends and responds quickly to them. At the same time, the program does an excellent job in maintaining balance, not just following the latest trend (or fashion) at the expense of less fashionable topics but of large intellectual value.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

The program responds to proposals that are mostly unsolicited and makes decisions based on scientific excellence as determined in the peer review process, along with other considerations relating to a wide range of factors that include broader impacts, the importance of the topic in current state of the subfield, and educational contributions. This has resulted in a portfolio of excellent science with significant elements focused on national priorities.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:
The program is very responsive to previous COV comments, and documents in detail its responses to issues raised by COV and progress in implementing any recommendations.

5. Additional comments on program management:

The PDs should be commended on their efforts (and successes) in managing a complex program and maintaining the right balances among all the various factors that enter into the proposal decision. A concern that the COV has is that they may be overworked.

PART B. RESULTS OF NSF INVESTMENTS

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The NSF mission is to:

- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship. The COV should look carefully at and comment on (1) noteworthy achievements based on NSF awards; (2) ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcome goals; and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio as it relates to the three outcome goals of Discovery, Learning, and Research Infrastructure. The COV is not asked to review accomplishments under Stewardship, as that goal is represented by several annual performance goals and measures that are monitored by internal working groups that report to NSF senior management.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 OUTCOME GOAL for Discovery: "*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering."*

Comments:
The Condensed Matter Physics Program is to be commended for its support of research that has led to major scientific discoveries. An example is the research involving angle resolved photoemission and scanning tunneling microscopy that is transforming the understanding of the electronic structure of high temperature superconductors. This work depends upon large facilities for photemission, and extending the use of scanning tunneling microscopy into new regimes of temperature and vibration isolation (Yazdani, DMR-0308045 and DMR-0514522 , Campuzano, DMR-0606255, and Shen, DMR-0604701). Another example is the discovery of supersolid behavior in solid helium-4 that has opened a new chapter in the story of quantum fluids and is now the subject of intense, world-wide, experimental and theoretical work. (Chan DMR-0207071, DMR-0442068). This is transformative research which emerged in an area in which there was little expectation of a breakthrough. CMP-supported work by the Awschalom group (NSF-0305223 and NSF-0071888) on the observation of spin current, and the spin Hall effect is an important scientific discovery with the promise of spin-direction-dependent devices. The principle investigator shared the 2005 Oliver E. Buckley Prize of the American Physical Society and the 2005 Agilent Prize of the European Physical Society.

The coupling of a superconducting artificial atom to a single photon in a novel integrated circuit by the Schoelkopf-Girvin team at Yale opens the way to a possible new architecture for quantum computing and a new field called circuit quantum electrodynamics. This is transformative and interdisciplinary research combining experiment and theory that may lead to new realizations of q-bits using superconductors (NSF - 0325580, ITR: Center for Quantum Information Physics, David DeMille) and (NSF-0342157, Condensed Matter Theory, Steven Girvin].

Theoretical and computational studies of the properties of novel materials have continued to produce a number of unexpected discoveries. Examples include nanoscale capacitor charging [Spalding, DMR-0605852], dopant segregation in nanocrystals [Chelikowsky, 0551195], understanding of factors that determine the strength of nanowires and the influence of thermal fluctuations [Stafford], or further developments in the field of organic electronics [Stafford, DMR-0312029, Mazumdar, DMR-0406604]. Organic displays are already commercially available after merely two decades since the initial discovery of organic conductors. High performance computing is enabling novel forms of research, more akin to data mining efforts so common in Biology. A computer based learning tool has been developed [Ceder, Morgan, DMR-0312537] that creates rules from existing databases of material properties to aid in property prediction. If these efforts become reliable enough, they can certainly aid in the development of the inverse problem: the development of a material that satisfies a required function.

A new area in which a number of breakthroughs have been obtained recently concerns the application of materials related tools to problems of biological interest. An outstanding example is the elasticity of DNA, which has been modeled over a range of scales [Nelson, DMR-0404674] by using tools derived from the theory of phase transitions.

B.2 <u>OUTCOME GOAL for Learning:</u> "*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.*"

Comments:
PIs funded under CMP continue to provide excellent mentoring and training of students. The most essential and natural way to cultivate a world-class workforce in science is through the financial support of graduate students and post-docs. Since training and mentoring of graduate students is one of the jewels of our educational system, we take it as a baseline that PIs funded over the past three years have sought and received funding for graduate students. In addition, PIs funded by CMP have made a conscious effort to train graduate students from underrepresented groups. The importance of 'broader impact' in evaluating proposals appears to be creating the appropriate outcome in this regard.

PIs continue to involve undergraduates in their research. This serves the very useful function of preparing students for graduate school. More importantly, it exposes a generation of students to the excitement of fundamental research and motivates many to continue on to graduate school. The RUI program, ROAs and REU supplements are excellent, strategic tools for supporting PIs at undergraduate institutions and for continuing to draw students into careers in science. For example, Jerry Gollub at Haverford (award #0405187) relies solely on undergraduates to support a strong research program on fluid dynamics. Regarding ROAs, we have heard that discussion is underway to make these more attractive from the standpoint of the undergraduate institution by making the awardee the PI (as opposed to the faculty member at the host university). This is a very good idea that is worthy of further discussion.

PIs funded through CMP continue to reach out to the broader community to draw in K-12 students from underrepresented groups. The list is extensive, including the following brief sampling. Dhananjay Kumar (award #0403480), a PI from a HBCU ran a summer nanomaterials camp for high school students. Myriam Sarachik (award #0451605) hosted 8^{th} grade students from Harlem in her low temperature physics lab and commented on the opportunity this provided to the 8^{th} graders as well as the graduate students who were cast in the role of teacher. Eric Weeks from Emory University (award #0603055) turns kids on to science by making them curious about ordinary substances like shaving cream, exposing them to a cutting-edge area of physics he dubbed 'squishy physics'. His ability to draw in students of all age groups, from grammar school to college is noteworthy.

Finally, PIs have made a conscious effort to educate the broader public about the importance and excitement of physics, giving many public lectures.

While almost all projects funded by CMMT involve the education and training of graduate and undergraduate students, some have aimed for horizons that extend beyond the research group. For example, Makse (DMR-0239504), City University New York, engages students and teachers at the Mott High School in Harlem on Saturday mornings in science activities. Kamien, U of Penn (DMR-0547230) also engages students in playing with crystal structures to understand the patterns of Alhambra in Grenada, Spain.
PI's funded through interdisciplinary, multiple PI grants such as ITR and NIRT have been able to identify explicit contributions of the project to the education of a broader group of individuals. Here are some examples:
"Advanced Education at the Cross Roads of Condensed Matter, Atomic, and Optical Physics," (Radzihovsky, U of Colorado, DMR-0437903) served to educate 60 US graduate students with diverse backgrounds about fascinating and novel phenomena when atoms trapped in beams of laser or magnetic field are cooled to very low temperatures. Applications of experimental and theoretical techniques in creating artificial atoms, quantum computing, etc., helped advance the knowledge of these students in very timely scientific issues which they could not have obtained in their local surroundings. Also "Computational science Workshop for

Underrepresented Groups" (P. Vashishta, U of Southern California, ITR-0427188) engaged 25 undergraduate students and 10 faculty mentors in assembling a parallel processor and then using it for advanced computing and visualization.

B.3 <u>OUTCOME GOAL for Research Infrastructure: "</u>*Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools."*

Comments:

Although the CMP and CMMT programs of the DMR are not directly responsible for developing the research infrastructure in a large scale, the work these programs support nevertheless contributes with new techniques and new instrumentation to the RI. As examples, one can mention the following:

The Materials Computation Center at U. Illinois Urbana Champaign, which began as a focused research group, has contributed significantly to the cyberinfrastructure of the computational materials research community by creating software tools to calculate and predict materials properties and making them available to others, as well as by providing a forum (in the form of a workshop) for exchange of ideas and new algorithms for computational materials research.
(2005 highlight)

David Grier's group at New York University have perfected holographic trapping to capture microscopic beads floating in a liquid and to move and arrange them in specific patterns. The technique allows researchers to fabricate and study wires polymers, colloidal particles, carbon nanotubes, and membranes. Applications of the technique range from surgery within living cells to rapidly sorting fluid-borne objects.
(Awards No. 0451589 &0304906)

Hanno Weitering, U. Tennessee, and collaborators at Deft University of Technology, The Netherlands, have developed a new method to grow nanowires by means of atomic self-organization. The team evaporated gold atoms onto the a silicon wafer oriented along a special crystallographic direction to produce a staircase surface. The atoms organized themselves in perfect rows parallel to the steps of the staircase, as a chain of beads in an "atomic necklace." This new technique makes the preparation of nanowires much easier than other methods, especially for the growth of macroscopically long objects.
(Award No. 0244570)

PART C. OTHER TOPICS

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

We did not find any gaps.

C.2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

The program has taken advantage of initiatives such as NIRT, ITR, and Cyberstructure in co-funded inter-disciplinary programs. CAREER has also helped bring PIs who are dedicated to integrate research and education and other activities with broader impact. Some of these grants have been renewed helping CMMT broaden the scope of the program. It is recommended that CMMT continue to embrace such new initiatives, which in the long run help catalyze new developments in materials theory, computational material design, and understanding of materials at the nanoscale.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

A world-wide shortage of helium has developed over the past year. The result has been rationing, and a major increase in the cost of liquid helium. This impacts a very large number of investigators in MPS and in other programs in the NSF. Funding liquefiers and recovery systems, and small systems with closed-cycle refrigerators is a major infrastructure issue for the conduct of a wide range of experimental science. The cost of a small liquefier and recovery system start at $600K. There is a historical precedent (in the 1970s) for NSF support of liquefiers and recovery systems.

A study of the effectiveness of the individual/small group funding mode, similar to the NAS/NRC study of the MRSEC funding mode, could help to elucidate the "right balance" between the individual/small group funding and center-(and solicited) oriented funding.

C.4. Please provide comments on any other issues the COV feels are relevant.

The fraction of funded proposals keeps decreasing with time, undoubtedly due to financial pressure. As a result, the fraction of borderline proposals of very high quality keeps increasing and many of them are turned down. Naturally, a considerable number of opportunities for breakthrough discoveries are thus lost. At the same time, when a majority of proposals become borderline, the PDs are pressed to decide almost "by themselves" on such a large number. This panel wonders if it is appropriate to apply such a large burden on the PDs, especially considering that the reviewing process was originally structured to depend very heavily on the external reviewers.

Colleagues from undergraduate institutions have noted that there appears to be some lack of uniformity in how well RUIs from various disciplines are taken into account during the review process. In other words, some information is not being passed along to the reviewers that the proposal has an RUI tag. Some discussion at NSF on this topic would be helpful. (We emphasize, though, that this is not a comment directed at CMP, CMMT or even DMR as a whole, all of which appear to properly administer RUIs).

The involvement of IPAs in NSF programs helps maintain a smooth link with universities and further facilitates communication with PI's. NSF should continue to support the IPA program. Extended visits (for example, sabbaticals) of PDs to academic institutions would also promote such interactions and are recommended.

The growing practice of academic institutions charging tuition and fees (and in some cases augmented with indirect costs) to grants puts extra pressure on awards that are already financially stressed. The NSF should negotiate with universities to limit the burden on grants.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

The duration of the COV meeting was too short. We are well aware of everybody's time limitations (including our own), but perhaps an extra half day could have been squeezed into the program. If this is not practical, the first two hours of the meeting could be shortened, if not skipped, in future reviews. Although they were very informative about the DMR in general, they were not essential for the COV process we were asked to do.

Given that we are presented with specific questions in the preparation of the report, the statistical information to address some of those questions could have been available to us in a more straightforward way rather than having to search for it through the e-jacket and other available documents.

SIGNATURE BLOCK:

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For the Division of Materials Research COV
Paul S. Peercy
Chair

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2008 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2008 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2008. Specific guidance for NSF staff describing the COV review process is described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) that can be obtained at <www.inside.nsf.gov/od/oia/cov>.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the results generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals.

Many of the Core Questions are derived from NSF performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several subactivities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the subactivities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

Suggested sources of information for COVs to consider are provided for each item. As indicated, a resource for NSF staff preparing data for COVs is the Enterprise Information System (EIS) –Web COV module, which can be accessed by NSF staff only at http://budg-eis-01/eisportal/default.aspx. In addition, NSF staff preparing for the COV should consider other sources of information, as appropriate for the programs under review.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the ***processes*** related to proposal review; and (B) the quality of the ***results*** of NSF's investments that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future. Discussions leading to answers for Part A of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. *COV reports should not contain confidential material or specific information about declined proposals.* Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. The reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. Since material from COV reports is used in NSF performance reports, the COV report may be subject to an audit.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see http://www.nsf.gov/od/oia/activities/cov/covs.jsp.

FY 2008 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: Feb 6-8, 2008
Program/Cluster/Section: **Solid State & Materials Chemistry, Polymers, Biomaterials**
Division: **Division of Materials Research**
Directorate: **Mathematical and Physical Sciences**
Number of actions reviewed: **Awards: 49** **Declinations: 33** **Other: 6**
Total number of actions within Program/Cluster/Division during period under review: **Awards: 237** **Declinations: 592** **Other: 265**
Manner in which reviewed actions were selected: **Mix of panel and individual reviewers.**

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process. Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[1]
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: The methods for reviewing proposals are appropriate. Panels are formed based on the topical focus of proposals and co-funding possibilities with other departments. Otherwise, proposals are mainly reviewed by ad hoc mail reviews. Source: Jackets and the EIS. Select the "Type of Review" module.	Yes
2. Are both merit review criteria addressed a) In individual reviews? In most cases both criteria are addressed. In very few cases the broader impact was not addressed. b) In panel summaries? Yes c) In Program Officer review analyses? Yes Comments:	Yes

[1] If "Not Applicable" please explain why in the "Comments" section.

Often individual reviews lack both review criteria, with emphasis on intellectual merit and insufficient detail in broader impact. During the panel discussion both criteria are usually addressed and balanced. Program officers always provide an extensive analysis of both review criteria. Source: Jackets	

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals? Comments: There is a variation in the quality, but for the most part they are substantive. Source: Jackets	Yes
4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Comments: The ranking of proposals reflects individual reviews and panel consensus. We did not see obvious discrepancies. There are fewer panels in SSMC, but the summaries reflected the consensus of the panel members. Source: Jackets	Yes
5. Does the documentation in the jacket provide the rationale for the award/decline decision? (Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.) Comments: These were excellent and decisions were well explained. Ratings from individuals that fell well outside of the norm were carefully and thoroughly dealt with. Source: Jackets	Yes

6. Does the documentation to PI provide the rationale for the award/decline decision? (Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.) Comments: For mail reviews the individual reviews are provided to the PI and a standard context statement from NSF. When the reviews are all very positive it is difficult to understand the decline funding decision based on the documentation. This is mitigated in the statement at the end of the context statement that more information should be obtained by contacting the appropriate DMR program officer. This means that the PIs need to be proactive if they wish to understand reasons for denial of funding when it is not obvious from the reviews. Panel summaries provide additional information to justify the award/decline decision. Source: Jackets	Yes
7. Is the time to decision appropriate? Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals. Comments: All the groups fell within the goal. Some like Polymers were well above at 95%. Source: Jackets and EIS-Web COV module. Select "Report View", then select "Average Dwell Time," and select any combination of programs or program solicitations that apply.	Yes

8. Additional comments on the quality and effectiveness of the program's use of merit review process: The expertise and experience of the program officer is extremely important here. Since there is not enough money to fund all excellent proposals the program officers have to make very difficult decisions when investing NSF monies.

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	**YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE**[2]
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: The pool of reviewers was outstanding. Source: Jackets	Yes
1. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups? Note: Demographic data is self reported, with only about 25% of reviewers reporting this information. Comments: The reviewers selected reflect the necessary diversity on types of institution and underrepresented groups. Source: Jackets and EIS-Web COV module. The "Report View" has reviewers by state, institution type, minority status, disability status, and gender	Yes

[2] If "Not Applicable" please explain why in the "Comments" section.

2. Did the program recognize and resolve conflicts of interest when appropriate? Absolutely Comments: Source: Jackets	

4. Additional comments on reviewer selection:

A.4 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE[3], OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: The quality was exceptionally high. If anything, due to a shortage of funds, some very good proposals could not be funded. In BMAT the research funded is not uniformly high-risk innovative research. However, this is a new program in a state of evolution and its quality will certainly improve in time, given the number of investigators interested in the subject. Because of the vitality of the field, it is important to pay specific attention to funding cutting edge, novel ideas and reduce support of incremental improvements on biomaterials systems that are well known and even utilized.	Appropriate

[3] If "Not Appropriate" please explain why in the "Comments" section.

Source: Jackets and program information	
2. Does the program portfolio promote the integration of research and education? Comments: There are multiple examples in this program where this integration is clearly manifested. The educational component is very strong and rewarded by reviewers. Source: Jackets and program information	Appropriate
3. Are awards appropriate in size and duration for the scope of the projects? Comments: The problem with size and duration is mostly connected with severe constraints on the NSF budget and increasing costs of student support. The size of the grants is barely sufficient to support one graduate student and the cost of a graduate student increases faster than the size of grants. This is a national problem that needs urgent attention from our Congress. Source: Jackets and EIS-Web COV module has a "Report View" that gives average award size and duration for any set of programs or program solicitations you specify.	Appropriate
4. Does the program portfolio have an appropriate balance of: • Innovative/potentially transformative projects? Comments: This is a natural result of the highly competitive nature of the DMR programs which emphasize materials and processes and with limited funds projects are chosen that have potential for the highest impact in materials research. Source: Jackets and program information.	Appropriate

5. Does the program portfolio have an appropriate balance of: • Inter- and Multi- disciplinary projects? Comments: This is possibly the most interdisciplinary and multidisciplinary program at the NSF, combining materials science with biology, chemistry, physics, and engineering. Note that projects funded in FY07 were co-reviewed and co-funded with other programs (e.g. CHE, ENG, EM). Also, through NIRT and FRG multi-investigator awards are encouraged. Source: Jackets, program information, and some people use as a proxy data on jointly funded projects. See EIS-Web COV module, "Report Review" and select "co-funding from" and "co-funding contributed to" to find jointly supported awards.	Appropriate

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program? Comments: Source: Jackets, program information, and EIS-Web COV module for information on award size.	Appropriate
7. Does the program portfolio have an appropriate balance of: • Awards to new investigators? NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant. Comments: POL has 21% awards to new investigators. In SSMC there are a healthy number of CAREER grants, some are jointly funded with other programs. Source: EIS-Web COV module on "Funding Rate," filtered by PI Characteristic (use the pop-up filter).	Appropriate
8. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments:	Appropriate

Source: EIS-Web COV module, using “Proposals by State”	
9. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: The portfolio of awarded grants covered a wide range of institutional types including undergraduate and underrepresented universities. Source : EIS-Web COV module, using ‘’ Proposals by Institution Type‘’	Appropriate
10. Does the program portfolio have an appropriate balance: • Across disciplines and sub-disciplines of the activity? Comments: This is possibly the most interdisciplinary and multidisciplinary program at the NSF, combining materials science with biology, chemistry, physics, and engineering. The various sub-disciplines are balanced appropriately. Source: Jackets and program information	Appropriate
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: The DMR program directors do a particularly excellent job ensuring the participation of underrepresented groups in their portfolio. One of the program directors was given the 2006 Director’s Equal Opportunity Achievement Award for his outstanding efforts to enhance diversity. Source: EIS-Web COV module, using “Funding Rate” with the pop-up filter (this allows you to see female and minority involvement, where involvement means being PI or co-PI).	Appropriate
12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports. Comments:	Appropriate

Program awards address many of the nations' critical needs including health, the environment, energy, clean and sustainable chemistry and security. The interfaces between biology, physical sciences, materials science and engineering, which find their home in DMR, has been featured in multiple national reports as an area of outmost importance to foster interdisciplinary science development. During the three year review period awardees funded from this cluster have received many national and international awards including the Nobel Prize, the Marie Curie Int'l Medal, an Author Cope Award and a UK Royal Society Medal. Another measure of the relevancy of the program comes from workshops supported by DMR. For example, the goal of the recent Solid State Chemistry Workshop was "to access the current state of solid-state chemistry and explore its impact on allied disciplines as well as industry." The report is in press for Progress in Solid State Chemistry and is titled, "Report from the third workshop on future directions of solid-state chemistry: The status of solid state chemistry and its impact in the physical sciences." The aim of the report is "to identify research directions in solid-state chemistry closely aligned with emerging or potential technologies, as well as areas of original research that could lead to new advances in materials science, solid-state physics, and the solid-state sciences in general." This workshop is just one example how DMR ensures the relevancy of its program to national priorities, agency mission and other constituent needs. The biomaterials program is most relevant to national priorities and agency mission. The potential impact of the field could touch not just health but also energy and environment, as well as technology as a whole in the context of bioinspiration. Source: Program information	
13. Additional comments on the quality of the projects or the balance of the portfolio:	

A.5 Management of the program under review. Please comment on:

1. Management of the program. Comments:

These programs are managed exceptionally well. The Program Directors have outstanding contacts in their respective fields and adjust the portfolio to match emerging and exciting new areas. With the increase in the number of proposals an increase in staff is necessary.

A succession plan to replace the current SSCM program director is in place. Due to current circumstances in SSCM loss of expertise is imminent. However, a plan addressing the transition period for replacing the current program director in the SSCM program needs to be considered immediately. The part-time program officers currently assisting the program are also phasing out of the program. The current program director should spend a good portion of remaining time focused on making funding decisions for the current round of proposals since many of these decisions are based on the expertise and knowledge of the community that cannot be duplicated easily by a temporary person.

Need transition and danger of losing an experienced program director

2. Responsiveness of the program to emerging research and education opportunities.

Comments:

The programs have a good track record of responding to emerging areas such as biomaterials, materials for renewable energy, responsive materials and sensors. The Materials World Network awards in this program are evidence of responding well to educational opportunities. These programs have strong interactions with their respective communities through workshops, conferences, and REU programs. These activities provide the appropriate feedback from the scientific community necessary for program responsiveness.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

Workshops with national and international experts in the field and NRC studies have provided insight on the emerging areas and critical needs. The workshop reports provide direction for the future. This process has worked well.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

The only comment directly applicable was a concern with reviewers not adequately nor uniformly addressing the broader impact criterion. The DMR "Dear Colleague Letter" has defined broad impact better as related to the materials field. This has been an effective method to address the issue.

5. Additional comments on program management:

The active participation of program officers in the research community through the workshops and conferences is an extremely valuable method for the responsiveness of this program. Given adequate funds, Program Officers and support staff should be available to continue such activities in the future even with shrinking budgets. Continuously growing non-program activities and clerical work interfere with the necessity of attending conferences and visiting universities.

PART B. RESULTS OF NSF INVESTMENTS

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The NSF mission is to:

- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship. The COV should look carefully at and comment on (1) noteworthy achievements based on NSF awards; (2) ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcome goals; and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio as it relates to the three outcome goals of Discovery, Learning, and Research Infrastructure. The COV is not asked to review accomplishments under Stewardship, as that goal is represented by several annual performance goals and measures that are monitored by internal working groups that report to NSF senior management.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 OUTCOME GOAL for Discovery: "*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.*"

Comments:

A recently held workshop, which included, many national and international experts in polymer science, identified several areas including processing and assembly, complex polymer systems, novel polymer synthesis, polymers for biosensors and polymer characterization. The Polymer program is currently funding programs in these areas. An example is the novel method for measuring the mechanical properties of thin polymeric films. Since new and emerging devices such as polymer based photovoltaic cells and polymer based solid state lighting are based on an assembly of very thin polymer films, this technique will be critical for providing the insight and fundamental science that will advance material and device design. This is transformational science and the NSF Polymer Program is the world leader. In another example, a new drug delivering polymer has been developed for coating coronary stents (Joseph Kennedy, University of Akron, DMR0243314). Drug delivering stents have contributed to reducing coronary bypass surgery by 85%. Finally, a polymer funded researcher invented a novel polymerization technique (ATRP – atom transfer free radical polymerization) that has been licensed by several US and global companies (Kris Matyjaszewski, Carneige Mellon University, DMR0549353

Our nation's investments in nanotechnology are extensive and have lead to major breakthroughs such as, control and fabrication of nanowires for new technological applications. Investments in nanotechnology research through a 2001 grant to Prof. Peidong Yang for CAREER: Nanoscale Chemistry in One-Dimension (DMR0092086) established him as a world expert in this area which lead to award of NSF's highest honor for a young investigator the Waterman Award given to Prof. Peidong in 2007.

Approximately 20% of the electricity usage in the US is used for lighting. DMR strongly supports research efforts in developing new material solutions for advanced technologies, particularly lighting, which is crucial for energy conservation. The FRG: Transparent Conductors (DMR0245386) lead by Prof. Janet Tate developed a new type of tuneable emissive inorganic materials which has advanced the frontiers of transparent electronics and may generate new approaches to solid state lighting.

Recent NSF awards in biomaterials provide examples of studies on biological materials and biomimetic materials. Research by Pupa Gilbert (CHE-0613972) co-funded by the BMAT provided new insights into the complex structure of mother-of-pearl using synchrotron spectro-microscopy. Qian Wong (DMR-0706431) utilizes biological structures as templates to build composite nanofibers with controlled morphology whereas Gerard Wong (DMR-0409769) studies synthetic analogues of antimicrobial peptides and their self-assembly. There is enormous room for growth into many areas as materials are designed to acquire bioactive properties, have functions based on the sophisticated conjugation of bioorganic and inorganic chemistry, respond to the environment and evolve.

B.2 <u>OUTCOME GOAL for Learning:</u> "*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.*"

Comments:

The research programs conducted through funding from DMR do train a world-class work force. This is evidenced by the number of graduate students and Postdoctoral fellows who have gone on to be faculty members at top universities including MIT, UC-Berkeley and the University of Pennsylvania. The number of Materials World Network programs fosters connections with the global scientific community. Diversity is good and constantly improving. Presently 23% of the active grants in Polymers go to women and 11% to underrepresented minorities. The program also funds many EPScoR states and HBCUs.

The outreach programs are an effective means for expanding the scientific literacy of the nation. For example, one PI is working on an animated PBS program to educate children 6 to 8 years old. A "Strange Matter" exhibit developed in part with funds from this program travels to museums throughout the country. To date 1 million visitors have visited this exhibit. Another particularly impactful example is the Summer Research Program in Solid State and Materials Chemistry for Undergraduate Students and College Faculty implemented by Prof. Hwu at Clemson University (DMR-0303450). This is a national program that rotates around the country and has strong participation from the whole solid state chemistry community. It gives an opportunity to both undergraduate and faculty members from smaller institutions to have exposure, training, and hands-on research experience at universities, industry and national laboratories. It is a long standing program that continues to make a large impact in promoting materials science to the younger research community. In FY07, of 20 participants (4 faculty, 16 undergraduates) in 2005, 6 were female, 14 male (including 5 minorities – 2 Hispanics and 3 African Americans). Over 15 research laboratories jointly hosted the research participants. This is a very powerful venue for creating research excitement at the undergraduate level.

The field of biomaterials offers an attractive entry into science for young minds who are fascinated with the breadth of the field and its relevance to health and energy issues. The public understanding is also enhanced by this field given its obvious connection with human beings and their environment. As a result this area has extreme potential to foster learning and cultivate discovery.

B.3 OUTCOME GOAL for Research Infrastructure: "*Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools.*"

Comments:

Infrastructure is primarily covered in other subpanels, but there is a STC run out of the Polymer Program in DMR (DMR0423914). CLiPS, The Center for Layered Polymeric Systems, which is funded at $4M for five years, does contribute significantly to the nation's research capabilities. This center is a premier research center in three areas: enabling process technology, membranes and transport phenomena and electronic systems. The partner institutions include Case Western Reserve, the home institution, the University of Texas at Austin, Southern Mississippi University, the Cleveland Municipal School District and Fisk University, a HBCU. The educational programs and mentoring programs that are run as part of this center are exemplary.

An integrated biochip for the detection of biological materials on the basis of their fluorescence has been developed under the NSF Award #0093758, allowing integration in a broad range of medical and environmental diagnostics. Availability of such integrated devices enhances the research infrastructure, with such new techniques revolutionizing the way research can be carried out.

PART C. OTHER TOPICS

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

Biomaterials is a genuine new frontier that seeks to understand the underlying design and functional principles of biological structures or to use nature's principles to create new materials. These goals will require understanding nature's complexity across the scales, from molecules to organisms. Research in this field will create new opportunities in technological innovation related to health, energy, national security, and protection of the environment. Innovation in these areas will not be possible without our fundamental understanding of the underlying principles in the formation and function of biological materials. The value of this rigorous approach to materials has been widely appreciated in traditional areas of materials science, and must now be extended to biomaterials. The new program at NSF on biomaterials reflects this need, and it is beginning to foster these goals. Global leadership in materials science will not be possible without significant investment in this expanding field.

C.2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

We need significant increases in funding for individual and center grants with particular attention to individual and small group grants. To address this problem, NSF should reconsider DMR's required investment in facilities. DMR is responsible for 95% of the funding for the National High Field Magnet Lab, which is used by a large number of different areas (CHE, BIO, and other agencies). This load should be more widely shared in proportion to use. This will free up money to support the increase more in individual grants and small group grants.

C.4. Please provide comments on any other issues the COV feels are relevant.

- The current distribution of funding within DMR does not always reflect repeated recommendations by National Academy studies. The combined funding of polymers, solid state and materials chemistry, and biomaterials in NSF has not grown as recommended.
- Taxonomy – The subpanel felt strongly that the biomaterials, polymers and solid state and materials chemistry communities need to maintain their individual homes within DMR. The reasoning for separate Condensed Matter & Materials Theory and Condensed Matter Physics was not clear. Perhaps it would be better to rename it Materials Theory and have it cover broadly the DMR portfolio including areas such as biomaterials, polymers and solid state and materials chemistry. A more consistent taxonomy is needed.

- As indicated in National Academy studies including "Rising Above the Gathering Storm" and reports on our competitiveness in chemistry, which included materials chemistry and chemical engineering, the US is still ahead of the rest of the world, but is losing ground rapidly to Europe and Asia. It is the opinion of this subpanel that this also applies to our position in materials science. The reason for the decline in the US position is directly correlated with the decrease in funding of fundamental research. If this situation is not corrected soon the US will not maintain a leading position.
- Within the limits of the budget DMR is addressing our nation's technological needs.
- DMR has been outstandingly proactive in covering the frontier areas in Materials Research and Education through their close coupling with the communities.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

Too much time was spent filling out the template. This interfered with addressing the important issues such as the questions asked in the Director's presentation. For example, "Does the taxonomy of DMR reflect the 21st century world of Materials Research & Education."

SIGNATURE BLOCK:

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For the Division of Materials Research COV
Paul S. Peercy
Chair