UNITED STATES GOVERNMENT

M E M O R A N D U M

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Date: March 28, 2005
From: Assistant Director, MPS
Subject: **Response to the Division of Materials Research Committee of Visitors Report**
To: MPS Advisory Committee

Please find attached the MPS response to the Committee of Visitors (COV) report from the 16-18 February 2005 COV review of the Division of Materials Research. The review was thorough and insightful, and the findings will be very helpful to me and to the Division of Materials Research in fulfilling our responsibilities to the scientific community and to the nation.

The Division of Materials Research drafted the attached response, and I concur with its content. I therefore adopt it as the official response of the MPS Directorate. I hope the full MPS Advisory Committee finds this COV review and the MPS response useful and acceptable.

Michael S. Turner
Assistant Director

Attachment: Response to Division of Materials Research COV Report of 2005

DMR Updates 2005, 2006, and 2007
Division of Materials Research (DMR) Response to Findings and Recommendations of the Committee of Visitors

February 16-18, 2005

The Committee of Visitors (COV) met on February 16-18, 2005 at the National Science Foundation to assess the performance of DMR in two primary areas: (A) the integrity and efficiency of the processes related to proposal review; and (B) the quality of the results of DMR's investments in the form of outputs and outcomes that appear over time. The COV also explored 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.

The committee's report consists of two parts as follows:

1. A summary of the COV's most important observations communicated to Professor Carl Lineberger, Chair, MPS Advisory Committee, by Dr. Horst Stormer, Chair, DMR Committee of Visitors, on March 6, 2005.
2. The compiled findings of the COV in the form of report templates for the three DMR Program Groups as follows:
    a. Condensed Matter Physics, Polymers, Materials Theory, Solid State Chemistry
    b. Metals, Ceramics, Electronic Materials
    c. Centers, Facilities, Instrumentation, Special Programs

Response to the overall comments of the COV

We are pleased that the COV finds that "…DMR has assembled a portfolio of world-class materials-inspired research, which exemplifies scientific excellence and breadth" and that "Central to these advances is the investment of the Foundation and the Nation in developing and sustaining the scientific workforce." The COV finds that "DMR manages this complex, broad and successful scientific endeavor in an admirably efficient and innovative manner. DMR-funded programs provide the Nation with an exceptionally high return on its investment." We are also gratified that the COV commends the work of the DMR Program Directors, stating that "We were very impressed with the thoroughness and fairness of the reviewing process, the demonstrated technical expertise of the program managers, the level and breadth of the science, technology, and education supported by the program, and the high quality of the research results achieved…"

The COV endorses the past and current use of Division Reserve Funds to raise the average funding level and increase award duration. We will continue to use Reserve Funds judiciously to address NSF policy goals.

10/31/05: We continued to use DMR reserve funds to encourage larger award sizes in FY05. The annual mean DMR award size increased from $130.12 in FY04 to $133.59 in FY05.
12/15/06: The impact of reserve funds on funding levels were less pronounced in FY 06 because of historically low success rates. Nevertheless, the mean award duration

increased from 3.41 to 3.42 years. The final FY 05 funding rate was $135.9K and this decreased to $128.3K in FY06.
12/15/07: The trend of reduced funding rates with increasing years started in FY01 was reversed in FY07. Nevertheless, funding rates in FY07 were still 30 – 40% lower than traditional funding rates for all awards seen in the mid 1990s. Under such low funding rate conditions, use of reverse funds are less likely to be used to increase award size and duration and are more likely to be used to increase the pool of awardees with special emphasis on new investigators or those from underrepresented groups.

The COV noted the increased number and diversity of DMR Program Directors while expressing concern that workloads are still exceptionally high. We will continue efforts to increase the diversity and number of program directors. We plan to address the workload issue by increasing the focus on core DMR programs and reducing the number of special program solicitations in which DMR participates, while continuing to adjust the balance between program director and support staff positions in the Division for optimum effectiveness. DMR will also continue to be a leader in the testing and adoption of more efficient electronic business practices such as e-jacket, and will continue to evaluate the impact of these practices on workloads and the mix of staffing required. We also plan to introduce a fixed window for proposal submission to core programs in order to rationalize the workload and reduce the number of proposals submitted over most of the fiscal year.

11/06/05: The number of full time DMR scientific staff members on 11/06/05 was 18, with an additional 3 full time IPA appointments, as well as another 3 part time program directors. MPS has authorized one additional position for a full-time DMR program director beginning in FY06. DMR plans to increase its overall investment in nanoscale science and engineering (NSE) in FY06 via awards in core programs, but will no longer participate formally in the special program solicitation for NSE. DMR continues to test and adopt electronic business practices as they become available, and is participating in the joint MPS-HRM Service Team pilot program in FY06. DMR introduced a proposal submission window in FY06 for the first time, limiting proposal submission for unsolicited proposals to the period 3 October 2005 – 4 November 2005.
12/15/06: The number of DMR scientific staff on 11/13/06 was 18 full time, 3 IPAs, and 3 part time. The division lost two of its members: Tom Weber, the DMR Division director moved out of DMR to head the Office of International Science and Engineering, and Bruce Taggart, who retired as the long time PD for the CMMT program. DMR gained one new scientific staff member: David Brant, the program director for the new Biomaterials program.
12/15/07: DMR has made a concerted effort, starting in 2005 and continuing to the present, in balancing and reducing the workload for both DMR program directors and support staff. New staff positions have been added and several more are in the planning stage. Since FY06 DMR has added the following administrative staff positions: (a) Financial Operating Specialist; (b) Program Analyst; (c) Program Specialist. Other support staff positions are being examined to create an effective cohesive team consistent with the NSF modern proposal and management practices. In addition, two new program directors have been added to consolidate existing activities and reduce overall program director workload. The new program directors include a second position for the Office of Special Programs (OSP) focusing on educational activities, and the third program director for the Materials Research Science and Engineering Centers (MRSEC) program. The latter position had been filled on a part time basis by Charles Ying, who is also assigned to the Electronic Materials program. The total scientific staff count on

9/30/07 was as follows: 20 full time, 3 IPAs, and 5 part time scientific staff members, including one part-time IPA.

We concur strongly with the COV's statement that DMR-funded research "covers very fundamental aspects of matter and creates the basis for future technologies".
The COV expresses concern about the relatively slow growth of the DMR budget compared with those of MPS and NSF as a whole. We will continue to make the strongest possible case to NSF management for adequate support of this critical area of science and engineering.

11/1/05: The DMR budget request for FY06 is 2.16% higher than the FY05 current plan, compared to an average requested increase of 1.52% for all MPS divisions (excluding OMA) and 2.7% for all NSF Research and Related activities.
12/15/06: The DMR budget request for FY 07 is 6% higher than the FY 06 actual expenditures. Budget expectations for FY 07 are dependent on congressional action on a continuing resolution.
12/15/07: The DMR budget request for FY 08 is 9.6% higher than for FY 07. This is the second highest among the MPS divisions and represents a reversal of past budget outcomes. The requested increase is also substantially higher than the requested increase for MPS and NSF. However, as of this date, the actual NSF and MPS budget increases appear to be very small requiring fiscal constraints comparable to the 2005/2006 periods and will likely affect all NSF divisions.

The COV also urges that budget reductions should not disproportionately erode the fraction of individual investigator grants in the DMR funding spectrum, while stating that "...the group as a whole views the distribution of funds between these different sectors as roughly appropriate". In a difficult funding environment we will continue to carefully assess the balance among the various funding modes used across DMR (individual investigators, groups, centers, instrumentation, and user facilities), and we will adjust the balance of support if necessary.

11/1/05: DMR continues to monitor the balance among funding modes very carefully. From FY04 to FY05, support for the seven disciplinary individual-investigator programs in the Division fell by 2.6% on average (actual expenditures), while the overall DMR budget fell by 4.0%.
12/15/06: For FY 05 to FY 06 support for the seven individual investigator (IIA) programs increased by 0.5%, which equals the DMR budget increase for FY 06.
12/15/07: The improved budgetary situation in 2007 allowed increases in individual investigator budgets that were comparable or higher than the overall DMR budget increase. This was achieved even as the $2.8M REU site program was shifted from the IIA programs to the Office of Special Programs (OSP). The shift allows improved oversight of the REU site awards. OSP is already overseeing the DMR portion of NSF wide annual REU site competition.

The COV notes "an often heard concern in the DMR science community" about the relative funding level of the programs within DMR. The COV finds that "there have been no major disproportionate shifts in funding between programs over the past seven years". We will continue to monitor the relative funding levels among programs very carefully and adjust budgetary allocations if necessary. We will continue to use Division Reserve funds to assist Program Directors to support young faculty members, members of under-represented groups, high-risk research, and other activities, as needed.

10/31/05: These efforts are continuing.
12/15/06: Approximately 15% of the DMR reserve funds were spent on proposals categorized as "at the margin from new investigators, young investigators, and members of underrepresented groups". The notable increase in the percentage of women and minority awardees continued to increase reaching 18 and 9 % respectively across all DMR programs, approximately doubling during the1996 to 2006 period.
12/15/07: In FY 07 $7.1M were distributed to programs from reserve funds. The topical distribution of these funds were approximately as follows: 20%-Young, new, and underrepresented group investigators; 10%-education related; 12%-small groups; 35%-international; another 15% of the reserve was spent on awards made jointly with other NSF units. In addition, individual programs increased the use of "small grants for exploratory research (SGERs)". Such grants accounted for $560K, $860K, and $1.9M for 6, 11, and 18 grants respectively in 2005, 2006, and 2007. Some DMR reserve support was used for such grants in 2007.

The COV expressed concern that NSF data on proposal success rates in core programs are not easy to interpret. However the COV notes "it is obvious that average acceptance rates have drastically decreased during the past two years". We will pay close attention to these concerns, and will endeavor to provide more easily interpretable data for the next COV review.

10/31/05. Success rates for proposals submitted to DMR continued to decline significantly from FY04 (26%) to FY05 (22%). We attribute this primarily to the reduction in the DMR budget (-4% in FY05). We continue to track these data.
12/15/06: Success rates appeared to be comparably low in FY06 and FY 05. Additional decreases are likely, given the current 2007 budgetary constraints. The current average success rate for all proposals is 22% and is 20% for research grants. Part of the low success rates can be tied to a 15% increase in the number of research grant proposals in FY 06 compared to FY 05.
12.15/07: Success rates rebounded in 2007 partly to an increased budget.

Response to specific additional issues raised in the program group reports

a. Program Group for Condensed Matter Physics, Polymers, Materials Theory, Solid State Chemistry

A.1.3 Are reviews consistent with priorities and criteria stated in the program's solicitations, announcements, and guidelines?
The COV response to this question is "NO", stating that the broader impact criterion is not consistently addressed or weighted by the reviewers.
A.2.4 Discuss any issues the COV has identified with respect to the implementation of NSF's merit review criteria.
The COV comments that "Reviewers do not seem to have a uniform or consistent understanding of the boundaries delimiting "broad impact".

Response: DMR staff members emphasize the importance and scope of Criterion II strongly when charging panels. We will continue to place strong emphasis on this in panel meetings and in presentations at professional society meetings, site visits, and other venues. We have posted an alert to the importance and interpretation of Criterion II on the DMR web page in the form of a Dear Colleague Letter. Attention to and understanding of Criterion II on the part of reviewers improved steadily over the period

addressed by the COV, and we expect this trend will continue provided we give it appropriate attention.

10/31/05 The percentage of DMR reviewers addressing both NSF review criteria continues to increase (87% FY02, 91% FY03, 92% FY04, 94% FY05). We continue to emphasize the importance of Criterion II in a wide variety of forums involving the DMR community.
12/15/06 Comments on Criterion II are now well established and accepted by the reviewing community. More education is needed however to explain to the community on what can be included in this criterion. The DMR web page and reviewer instructions explicitly address this concern.
12/15/07 The percentage of reviewers addressing both review criteria increase to 96% in 2007 from 94% in 2006. Reviewers appear to me more knowledgeable in regard to the second review criterion.

b. Program Group for Ceramics, Metals, Electronic Materials

A.3.3 Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and under-represented groups? The COV responded YES to this question but commented that "more reviewers from industry would be beneficial". There is a similar comment under A.3.5.

Response: The fraction of industrial reviewers increased from approximately 5% to 10% from FY 2001 to FY 2003, as noted elsewhere in the COV report, despite the fact that the number of active industrial researchers in materials-related industries in the US fell significantly over the same period. DMR will continue to make every effort to involve reviewers from industry to an appropriate extent.

10/31/05: Program directors are strongly encouraged to make use of industrial reviewers to the extent possible wherever this is appropriate. We do not have complete reviewer data available at this time for FY05.
12/15/06: This continues to be problematic as experienced industrial reviewers are moving to academic positions. A concerted effort is being made in some programs. For example, data are annually collected for the MRSEC program that identifies industrial collaborators in such centers who could be used as reviewers for other programs.
12/15/07: Continued emphasis is placed on programs to recruit reviewers from industry. Statistics for this are not universally available for all DMR programs. The following statistics from the Polymers and MRSEC programs are representative. For FY 05/06/07 the % of reviewers from industry for the polymers program were respectively 6.9%, 7.9%, and 8.4%. In total numbers these are 29, 48, and 45 reviewers, respectively. The total number of reviewers reported by the polymers program over the three year period are 422, 611, and 537. The MRSEC program reports one competition during the COV reporting period. Of a total of 350 panel and mail reviewers, 42 are reported from industry (12%).

C.1 Please comment on any program areas in need of improvement or gaps (if any) within program areas.
The COV noted that "The introduction of undergraduate students to research and the impact that NSF is having through its programs in this area are not sufficiently publicized." and urged that "Approaches should be explored to encourage more

complete reporting from PIs to capture the level of participation and outcomes/impacts of these programs".

Response: We agree that undergraduate participation in research is a significant strength of NSF programs and DMR programs in particular, and should be well publicized. We emphasize the importance and outcomes of such efforts in staff presentations across the nation. The recommended DMR format for research and education highlights or "nuggets" reported by grantees now explicitly includes a section on educational achievements and we will pay particular attention to opportunities for publicizing these achievements.

10/31/05. All DMR highlights for FY05 include a section on educational achievements; these highlights are currently being compiled in CD format for distribution to our research and education community. At NSF we have partnered with CHE to develop a hallway monitor display of selected highlights from both Divisions, updated regularly.
12/15/06: A new DMR staff member is specifically assigned to work with highlights and function as a liaison between DMR and the Office of Legislative and Public affairs, which publicizes NSF achievements.
12/15/07: DMR continues to advertise achievements made by undergraduate researchers through it highlight program. Each investigator submits a research and an education highlight. Many of the latter focus on undergraduate experiences. In addition, the approximately 70 REU sites supported by DMR provided periodic highlights for their programs. Focus on undergraduates is especially pronounced in most of the DMR supported centers and facilities, including the National High Magnetic Field Facility and others. In addition, the PREM awards feature a significant undergraduate component. The PREMs are urged to track these students. A few special awards integrate high school students in teams with undergraduate and graduate students. An example of such an activity was recently highlighted in an article in the MRS Bulletin.

c. Program Group for Centers, Facilities, Instrumentation, Special Programs

A.1.6 Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification for her/his recommendation?
The COV responded "YES" to this question but commented that "Decisions on borderline cases when funds are too limited to support all recommended proposals are difficult for a PI to understand. The decision-making process in this situation needs to be communicated carefully…so that the reasons for borderline rejections are understood by the PIs."

Response: DMR staff will continue to pay very close attention to the need for clear communication of the rationale for funding decisions to PIs, especially in the case of 'borderline' declinations.

10/31/05: This effort continues. In particular, following the FY05 MRSEC competition, DMR PDs have worked assiduously to communicate the rationale for funding decisions as clearly as possible to PIs of declined proposals in borderline cases.
12/15/07: The concerns raised by the COV subgroup on centers, facilities, etc. are applicable to other programs. DMR management has made a concerted effort in FY 06 to establish more uniformity in the description by program directors, and the communication with grant applicants, regarding declination decisions.

12/15/07: With overall success rates for DMR research proposals still in the ~20% range a number of fundable proposals are being declined. DMR program directors are urged to convey to PIs, especially in the case of borderline decisions, the nature of the concerns that led to the final declination decision.

A.4.2 Are awards appropriate in size and duration for the scope of the project?
The COV responded "YES" to this question. However, they suggested that DMR explore the use of small seed grants for new PIs. The COV also commented that the National Facilities Program should try to develop more uniform and quantitative metrics for use in reports to NSF.

Response: The use of seed funding for new PIs is explicitly encouraged and implemented in the MRSEC program and this practice will be continued. Elsewhere in DMR seed funding is employed through the use of Small Grants for Exploratory Research (SGER). DMR concurs with the recommendation for use of uniform metrics for the User Facilities and is currently working on an interagency basis with the President's Office of Science and Technology Policy to accomplish this goal.

10/31/05: These efforts continue. The NAF Program Director is working with Facility Directors to develop more uniform, quantitative metrics for reporting purposes.
12/16/06: The efforts in this area are continuing.
12/15/07: A workshop was arranged by NSF with DMR facility directors which developed guidelines for developing a more uniform metric for users of their respective facilities. Although there was considerable agreement in some areas it proved difficult to develop one set of guidelines applicable to all facilities. Another workshop is planned for 2008. In parallel to such activities the program has interacted with each facility on an individual basis to obtain an optimum set of user data. In regard to seed projects, we have earlier provided statistics that show the increasing employment on DMR of SGERs, increasing from 6 in 2005 to 18 in 2007.

A.4.12 Does the program portfolio have appropriate participation of underrepresented groups?
The COV response to the question is "Not there yet, but making good progress".

Response: DMR will continue to make the strongest possible efforts in concert with other MPS Divisions to foster increased participation by members of underrepresented groups, and to build on 'best practices' and current success wherever possible. For example a second round of competition for PREM awards (Partnerships for Research and Education in Materials) is planned for FY 2006. These awards are made to minority institutions to enable them to develop strong working links with currently funded DMR groups and centers at research-intensive institutions.

10/31/05: These efforts continue. A PREM proposal solicitation has been issued with a proposal deadline of 12 December 2005. DMR plans to make 2-3 additional PREM awards in FY06.
12/15/06: Six new PREM awards were made in FY 06. This was possible, in part, because of significant co-funding support from other sources (MPS Office of Multidisciplinary Activities, EPSCoR, Education and Human Resource Directorate) and an increase in commitment by DMR. The PREM program continues to gain in visibility and impact with plans for similar efforts by other NSF divisions.

12/15/07: DMR has developed a multiple strategy for increasing diversity across the board for reviewers, PIs, and NSF staff. An internal working group consisting of program directors and administrative staff made a number of recommendations that are currently being enacted. These include practices for the hiring of program directors and support staff, the mentoring of staff, etc. Other recommendations include increased diversity for the reviewer pool and the awards made. In addition, DMR through its centers and institutes has had a profound and documented effect on making systemic changes at academic institutions. Such changes were instituted in part because of the annual diversity plan now required for all centers and facilities. In addition, the PREM program continues to lead NSF efforts in providing minority institutions with the needed support to be more competitive in research through partnerships. A program patterned after PREM will be initiated in 2008 in the MPS Astronomy division.

B.4 Providing "an agile, innovative organization that fulfils its mission through leadership in state-of-the-art business practices".
Following a series of positive comments, the COV states that "There's an apparent discontinuity in further engaging high school students who respond positively to the (Center) outreach efforts. What is the NSF or DMR funding for high-school internships?"

Response: Although the comment and question appear unrelated to the section in which they appear, they are pertinent to the management of DMR-funded Centers. In general these Centers are encouraged and supported appropriately to provide research experiences for selected high school students when such programs are proposed and positively reviewed. This is not a programmatic requirement for every Center, nor should it be, but the mechanisms are in place, with DMR funding support as needed, to provide the requisite continuity.

10/31/05 During FY05, 20 of the 27 MRSECs supported by DMR included Research Experiences for (pre-college) Teachers in their programs, and the 2 new MRSECs established in September 2005 plan RET programs beginning in 2006. These programs are proving to be a highly effective way of engaging high school students and their teachers in materials research and education. Several MRSECs also provide extended laboratory research experience directly for selected high school students.
12/15/06 RET programs continue to engage high school students. Such activities are now integrated into the REU proposals providing a coherent interactive framework for teachers and students. In addition, a significant new award (~$300K per year) was made in FY 06 that specifically addresses research activities with high school students in a vertically integrated research environment that includes undergraduates, graduate students, postdoctoral researchers, and faculty members.
12/15/07 The high school internship program at the Garcia Center at SUNY Stony Brook was highlighted in a 2007 article published in MRS Bulletin. This program is supported by the award discussed in the 06 update above. The program can serve as a model for other large scale activities that seek to vertically integrate research and education from the high school to post doctoral level.