UNITED STATES GOVERNMENT

# M E M O R A N D U M

**DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES**

**Date:** March 28, 2008
**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 6-8 February 2008 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.

Tony Chan
Assistant Director

Attachment: Response to Division of Materials Research COV Report of 2008

# DMR Update for 2010

Division of Materials Research (DMR) Response to
Findings and Recommendations of the DMR Committee of Visitors
February 6 - 8, 2008

The Committee of Visitors (COV) met on February 6-8, 2008 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 Dr. Michael Witherell, Chair, MPS Advisory Committee, by Dr. Paul Peercy, Chair, DMR Committee of Visitors, on March 5, 2008.
2. The compiled findings of the COV in the form of report templates for the four DMR Program Groups as follows:
    A. Metals, Ceramics, Electronic Materials.
    B. Instrumentation, Facilities, Materials Research Science and Engineering Centers (MRSECs), Office of Special Programs.
    C. Condensed Matter and Materials Theory, Condensed Matter Physics.
    D. Solid State and Materials Chemistry, Polymers, Biomaterials.

## I. Response to the overall comments of the COV

*We are pleased that 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)…" The report also finds that "DMR is one of the leading divisions within NSF in investing in transformative research and in developing new concepts and new management strategies."*

*The Division was also lauded for its positive response to the 2005 COV report, including the addition of staff to relieve an excessive workload. A concern of the 2005 COV was that support for individual investigator programs should not be diminished and the 2008 COV finds that "DMR has also been diligent in preventing the erosion of the fraction of individual investigator grants." The COV applauds the efforts of the Director in implementing diversity strategies for the Division and initiating international programs. The committee notes that "the process that DMR uses for determining which proposals to fund is excellent"…. Also, "DMR program directors do an excellent job of ensuring participation of underrepresented groups in their portfolios."*

*The followings are the key areas in the COV summary where DMR is encouraged to consider new approaches and improvements.*

***1. Staffing and Workload.***

*The COV continues to be concerned about staff workload issues. The COV summary states that "the staff is an enormously valuable resource, but program directors are burdened with an increasing workload without commensurate staff increase". Comparable concerns are raised in most of the separate program group reports.*

**RESPONSE:**

Earlier in the summary the COV lauded DMR for staff increases to reduce workload. Indeed, two new program director and two new administrative support staff positions have been added since 2005. The program director positions cover the new Biomaterials Program and the educational and outreach activities of the Office of Special Programs, respectively. In addition, the MRSEC program staff has been increased to two full-time and two part-time program directors. The administrative staff saw the creation of two new intermediate level staff positions. One administrative staff position is currently vacant and is soon to be filled. However, during this time of increased staffing there was a significant increase in the number of submitted proposals with the result that the workload during the past years remained approximately unchanged and at an unacceptably high level for both program directors and administrative support staff.

11/03/08: We continue working towards reducing DMR staff workload. Due to caps in the allowed number of FTEs (full-time equivalent) for DMR, we have not received approval of our request to fill the technical support level vacancy or to recruit two additional program directors as described above. We have been able to ameliorate the situation at the administrative/program support level by recruiting a STEP (Student Temporary Employment Program) and we hope to recruit a second one very soon.

12/29/09: We were able to secure one additional FTE early in 2009 which allowed us to handle increasing workload in the National Facilities (NAF) program. The position was allocated to a shared position between the Instrumentation for Materials Research (IMR) and the Materials Research Science and Engineering Centers (MRSEC) programs (including the Partnership for Research and Education in Materials – PREM - program). We were also able to secure half an FTE for a shared position with the Division of Chemistry. We were able to hire a second STEP student to assist with administrative work.

12/29/10: Staff workload issues remain a major challenge for DMR (as is true for most of the NSF), due to a shortage of positions at the NSF level. While some positions were filled in the past few years, DMR staff has actually had a net decrease since a peak in 2007 (see chart). One positive step was the increase in the number of permanent staff. DMR will explore options for reducing proposal loads, and will also continue to demonstrate the need for more staff although this approach has not yielded benefit in the recent decade.

| Year* | Scientific (including DD and DDD) | | Administrative | | Total |
|---|---|---|---|---|---|
| | Permanent FTEs | Rotator | Permanent FTEs | Student | |
| 2004 | 12 | 11 | 8.2 | 0 | 31.2 |
| 2007 | 11 | 13.6 | 9.2 | 0 | 33.8 |
| 2010 | 14 | 8.6 | 8.0 | 1.0 | 31.6 |

*the years correspond to those preceding the COV

***2. Support for Instrumentation ($30K to $100K range)***

*The COV summary states: "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."*

**RESPONSE:**

DMR is aware that instrumentation requests less than $100K are not eligible to submit to the Instrumentation for Materials Research (IMR) or the Major Research Instrumentation (MRI) programs. DMR is in agreement with the COV that such requests are not appropriate for stand-alone unsolicited proposals and will look for a solution to fill this funding gap in instrumentation.

11/03/08: We realize that support for instrumentation is critical to advancing materials research and education. For this reason, and in spite of almost a flat budget in FY 2008, DMR ran a solicitation for the Instrumentation for Materials Research (IMR) program in FY08 and is running a solicitation for Mid-Scale Instrumentation (MIP) program in FY09. These programs cover the gaps left by the NSF-wide Major Research Instrumentation (MRI) program at the low (IMR) and high (MIP) ends of the award size spectrum. DMR was fortunate to receive $14.6 M to fund MRI proposals in instrumentation for materials research. We continue to examine the question of support for instrumentation costing less than $100K. The appropriate home for such requests would be in unsolicited proposals, as the nature of the equipment requested is tied to the research project proposed, and current DMR awards often include such support. Routine and extensive inclusion of such equipment requests in unsolicited proposals would translate in an increase in the average award size, which is almost impossible to achieve in times of flat budgets without decreasing the success rates.

12/29/09: Equipment requests for less than $100K are often included in unsolicited research proposals; those requests are granted according to available funds in the program. An increase in the budget of individual investigator programs in FY09, as well as additional funds from the American Recovery and Reinvestment Act (ARRA), potentially allowed for funding more such requests, but this was not a stated NSF priority for ARRA funds.

12/29/10: Instrumentation support is concentrated in the Office of Materials Instrumentation and National Facilities (OMINAF), which is roughly 20% of the DMR budget. During this three-year period, a major emphasis was placed on conversion of CHESS/CESR from a partnership with the Division of Physics to sole stewardship by DMR. Also, the Energy Recovery Linac R&D project was started in the instrumentation part of OMINAF. Funds in OMINAF were thus very tight. The Division supported the midscale instrumentation program MIP in all three years FY2008-2010. The smaller instrumentation program IMR was run only in FY2008. For equipment under $100K, the individual investigator programs funded this as possible. With grant sizes in these programs lagging inflation, it has been difficult to achieve any progress on funding equipment of this type. The Division is considering how to budget for this in the future and input from the COV on the importance to the community of such a practice would be helpful.

| Year | $ M Facilities | $ M Instrumentation (IMR, MIP, ERL) | Total |
|---|---|---|---|
| 2004 | 40.04 | 7.09 | 47.13 |
| 2007 | 40.40 | 7.27 | 47.67 |
| 2010 | 55.92 | 10.65 | 66.57 |

***3. Balance Between Funding Modes and Support for Facilities***

*As part of its discussion on the balance between various funding modes in DMR the COV restates its interest for DMR not to reduce the support for individual investigator programs. As the COV notes, DMR has been able to retain current levels of support since 2005 and the Division seeks to do the same in the future. The COV notes that an important aspect of this issue is the degree of DMR support for Facilities. In particular, the COV questions why the operating costs for the National High Magnetic Field Laboratory are born at a 95% level by DMR and recommends that NSF/DMR "evaluate this situation". The issue of not reducing support for individual investigators was also raised in several of the program reports.*

**RESPONSE:**

Balance between funding modes.

The 2008 COV credits DMR with "having been diligent in preventing the erosion of the fraction of individual investigator grants." Because of nearly flat budgets, this implies that the balance between funding modes has not significantly changed during the last funding period. In regard to the balance between funding modes the 2005 COV concluded that *"...the group as a whole views the distribution of funds between these different sectors as roughly appropriate"*. DMR continues to evaluate the balance between funding modes and is committed not to reduce the fraction of funding for individual investigators.

Support for Facilities

DMR is the steward (providing major support) for the National High Magnetic Field Laboratory (NHMFL) and has been a steward of high magnetic field science for a very long time dating back to the Francis Bitter Magnetic Field Facility at MIT. DMR is also a partner, providing partial support for neutron and light source facilities. The NHMFL is currently co-supported by the NSF Chemistry Division at an annual level of $1.5M. Given current budget expectations, DMR is hopeful that it will be able to meet its commitments over the current 5 year award initiated in January 2008. However, it is essential that new partnerships be developed to help meet the increasing costs of running such large major user facilities. DMR has initiated and expects to continue, a dialogue with other NSF directorates (e.g., the Biological Sciences Directorate) about potential co-support of NHMFL. There is precedence for such support for synchrotron radiation light sources that serve both the material and biological science communities. In addition, NHMFL has opportunities for other sources of funding. For instance, it is eligible to compete for large instrumentation grants through the DMR Major Research Instrumentation program (MIP). One large MIP award for magnet construction has already been made at another major user facility.

The COV's recommendations to shift management of NHMFL to the Director's level or to distribute it among NSF Divisions will be also considered. It will be explored among a number of other potential options. The role of construction and support for major research light source facilities is currently a topic of intense discussion at NSF. An expert panel is currently working on advising the Mathematical and Physical Science Directorate on the opportunities and appropriateness for NSF to support the construction and operation of large next generation light source facilities. This panel organized a light source workshop early this year, will be visiting major NSF-funded University-based and DOE-funded light source facilities, and will write a report with its findings and recommendations. This report is due early this summer (2008).

11/03/08: DMR continues to monitor the balance among funding modes very carefully. Such balance is taken into serious consideration when making funding decisions and was a factor in DMR's decision not to provide the anticipated level of support for the NHMFL in FY 2008 when the Division did not receive its expected budget increase. The final report from the expert panel that advises the Directorate for Mathematical and Physical Sciences (MPS) on light source facilities was delayed a bit but was finally delivered a few weeks ago. Upon acceptance by the MPS AC, the report will become public. The conclusions of such report, as well as the participation of potential funding partners to DMR and to MPS, will help guide the future role that DMR should play in terms of support and stewardship of next generation light source facilities.

12/29/09: The balance of various funding modes within DMR remains a challenge in view of increasing operating costs of large existing national facilities such as the NHMFL. In response to the MPS Panel on future light source facilities, which recommended that NSF play an active role in such future light sources, in FY10 DMR assumes stewardship for the Cornell Electron Storage Ring (CESR). As of FY10 CESR phases out high energy physics research and is instead fully dedicated to providing charged particles for the operation of the Cornell High Energy Synchrotron Source (CHESS), also funded by DMR. CHESS/CESR serve as a national user facility for X-ray studies in a wide range of disciplines, as well as a platform for research and development of next generation light sources (energy recovery Linac). At the same time, DMR is phasing out its support for the Synchrotron Radiation Center as the U. of Wisconsin.

12/29/10:
Balance: With the budget increases allotted to DMR in the period under review, and despite the budget pressures associated with assuming the stewardship of CHESS/CESR and starting the ERL R&D, the Division has succeeded in maintaining 50% of its budget for the individual investigator programs.

| Year | $ M Ind. Inv. | $ M Centers | $ M OMINAF | $ M Other | Total |
|---|---|---|---|---|---|
| 2005 | 121.71 | 64.05 | 47.13 | 7.91 | 240.80 |
| 2007 | 125.24 | 74.94 | 47.67 | 6.18 | 254.03 |
| 2010 | 146.58 | 76.88 | 66.58 | 6.63 | 296.67 |

Support for Facilities: DMR is initiating a broad-based study with the NAS on the upcoming needs for tools, instrumentation and facilities for materials research. We expect this study to inform our decisions on current and future facilities and the balance among the various modes listed above. DMR continues to be the major steward of the NHMFL with roughly $30M per year from DMR and $1.5M per year

from the NSF Division of Chemistry. Efforts to find other partners during the present cooperative agreement have not been successful. With the renewal proposal expected in 2011, both the NHMFL and DMR will be actively seeking other partners through joint workshops and other meetings. DMR is now the major steward of CHESS/CESR, with roughly $19M per year from DMR and $0.4M per year from NIH. Efforts to find other partners are also proceeding and have so far been unsuccessful.

### ***4. DMR Program Taxonomy***

*The COV recommends that "DMR examine the program taxonomy of the division to see how well-aligned it is with the changing materials community."*

**RESPONSE:**

During the last 20 years DMR has tried to stay current, and align itself with the changing world of materials research and education. As a result, the following restructuring and changes occurred:

(1) the creation of the Condensed Matter and Materials Theory (CMMT) Program. This was made possible by collecting current awards and future proposal submissions from other DMR programs into the current CMMT Program.
(2) the creation of the Condensed Matter Physics (CMP) program, which was possible by combining the former Solid State Physics and Low Temperature Physics programs.
(3) the creation of the Materials Research Science and Engineering Center program from the former Materials Research Laboratory and Materials Research Group programs.
(4) the creation of the Biomaterials program, which was started from existing awards in related programs as well as from new unsolicited proposals.
(5) the expansion of the Solid State Chemistry program to Solid State and Materials Chemistry.
(6) the grouping of programs into "clusters" that proved useful for management and COV oversight purposes.
(7) the scope and focus of the programs, often guided by National Academy of Sciences studies and reports from NSF held workshops, were changed. In addition, other changes and emphases were implemented by newly hired program directors that brought novel ideas and energy to DMR.

The key purpose for a taxonomy review of DMR is to determine the following:
(1) Does the taxonomy of DMR reflect the 21st century world of Materials Research & Education?
(2) Based on this taxonomy, is DMR supporting frontier, cutting edge areas in Materials Research & Education? Are there any missing important areas of Materials Research & Education not supported by DMR?
(3) To what extent does the DMR structure serve or does not serve the needs of the changing world of Materials Research & Education, and its community?

The DMR research and education community is very broad and extends from the traditional materials science and engineering disciplines to the frontiers of condensed matter chemistry and physics, to novel nanostructured and hybrid materials, and to new inter- and multi-disciplinary areas at the interfaces of the physical, chemical and biological sciences.

DMR will try to seek advice in this regard and will engage in a dialogue and discussions with its research and education community as well as members of the MPS Advisory Committee. The

recommendations that the biomaterials, polymers and, solid state and materials chemistry Programs need to maintain their individual homes within DMR will be honored.

11/03/08: We will be examining the DMR taxonomy in the next few years. We have already started by eliminating the four clusters that grouped several programs together. Those clusters were not well balanced since three encompassed all the individual investigators' programs and one very large cluster included the activities of the office of special programs, and the programs on centers, facilities and instrumentation. The latter cluster created quite an imbalance since it had programs with over 50% of the Division's budget. We also started looking into the content and description of several programs and made some changes. The synopsis of the new Biomaterials program has been modified to make it more current with state of the art areas of research in this field. Similarly, the Metals program's description has been greatly modified to bring it to the 21st century and has been renamed as the Metallic Materials and Nanostructures program. Likewise, the synopsis for the Electronic Materials program has been modified and the program has been renamed as the Electronic and Photonic Materials program.

12/29/09: We continue to examine the DMR taxonomy. The program descriptions of each of the eight DMR individual investigator programs in the NSF web page have been updated to more closely reflect the status of the respective fields. The Metallic Materials and Nanostructures program was renamed Metals and Metallic Nanostructures to further clarify the program connection with metals and metallic materials.

12/29/10: DMR initiated a study with the NAS on the fields of metals and ceramics to identify the grand challenges and opportunities in these areas in the next decade. The results of this study will help inform DMR's thinking about the development of these areas and the program taxonomy.

### ***5. The Role of "Theory" in DMR***

*The COV summary recommends that "the Director examine the accessibility of theory to all areas of the DMR portfolio."*

**RESPONSE:**

The Condensed Matter and Materials Theory (CMMT) Program supports primarily proposals that are entirely theoretical or computational in nature, with a broad portfolio representing all areas of materials theory, and extends, through co-review, with other divisions and directorates. Proposals that have a theoretical component, but are based primarily on experimental research, are generally supported by other DMR programs, which include single and multi-investigator's projects, research groups, MRSECs, user facilities, and institutes.

The DMR Director will review the theory program and seek potential improvements if needed in this regard. Renaming the Condensed Matter and Materials Theory Program to just Materials Theory will be considered. DMR will also ensure that this program portfolio will include areas such as biomaterials, polymers and, solid state and materials chemistry. DMR will look into hiring a program director, with both experimental and theoretical expertise. In addition, the possibility of co-review and co-funding between CMMT and other DMR programs will be re-examined and encouraged.

11/03/08: Considering that the CMMT program was earlier named Materials Theory program and the name was changed to Condensed Matter and Materials Theory in 2006, we are examining very

carefully the suggestion of changing the name back to Materials Theory. We are initiating a NAS study on this program.

12/29/09: We continue looking into the matter of accessibility of theory to all areas of the DMR portfolio, and strongly encourage co-review and co-funding between the theory and experimental programs in DMR.

12/29/10: At the NSF and within DMR, there is increasing interest in computational science and engineering, as well as so-called data-enabled science, usually associated with very large data sets and algorithms for handling them. The MPS Advisory Committee has been very active in producing white papers as leads for new NSF initiatives. DMR is sponsoring a study through the NAS to examine these areas, and we look forward to the report to inform the CMMT program and how theory, computation and data are handled in DMR. DMR participates in a number of cross-cutting efforts at the NSF, such as Cyber-enabled Discovery and Innovation (CDI), Software Infrastructure for Sustained Innovation (SI2), the cyberinfrastructure venture fund (an internal fund through the Office of Cyberinfrastructure that helps to fund DMR proposals.) DMR contributes funds to CDI and SI2, and also contributes personnel to help manage these wider competitions.

## II. Response to specific additional issues raised in the program group reports

**Issues raised in several program groups:**

***6. Broader Impacts***

*A.1.2 Are both merit review criteria addressed? (In MCEM and SSMC)*
*Even though the COV response is YES, there is a recommendation to further clarify what constitutes broader impacts. This same recommendation is repeated in section C.3.*

**RESPONSE:**
In the summary statement the 2008 COV complimented DMR on "educating their community of reviewers 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." DMR will continue to educate and mentor, in particular, new reviewers and principal investigators in the area of "broader impacts." The DMR division director has reviewed and updated the "Dear Colleague Letter," and included a more detailed description of the broader impact themes. This letter has been posted on the DMR website.

11/03/08: We are making a special effort to further clarify and to provide examples of broader impacts in a proposal in presentations by DMR staff at venues that include workshops, conferences, and panel review meetings.

12/29/09: We continue to clarify and exemplify the broader impacts review criterion in all presentations by DMR staff. The DMR Division Director has participated in sessions exclusively dedicated to this topic at the annual meetings of the Materials Research Society.

12/29/10: All members of the DMR staff continue this effort through their extensive outreach activities at meetings, site visits and panels. With the Division moving to more panel (rather than mail) review, communication with the reviewers on this topic is somewhat easier.

7. ***Representation of underrepresented groups in program portfolios and as reviewers of proposals***

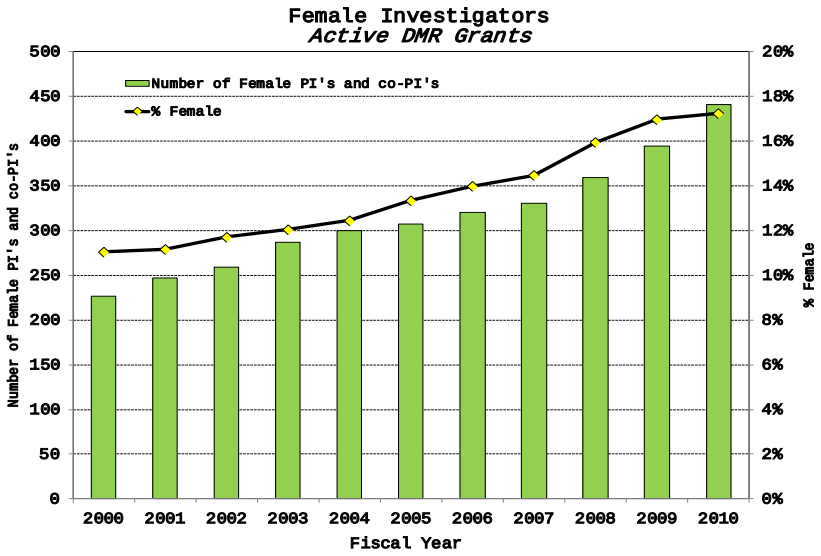
*Although success rates for members of underrepresented groups are generally at or above the DMR average, several COV program reports urge that DMR continue its efforts to promote submissions from these groups. In addition, the COV urges use of reviewers from underrepresented groups, including primarily undergraduate serving institutions.*

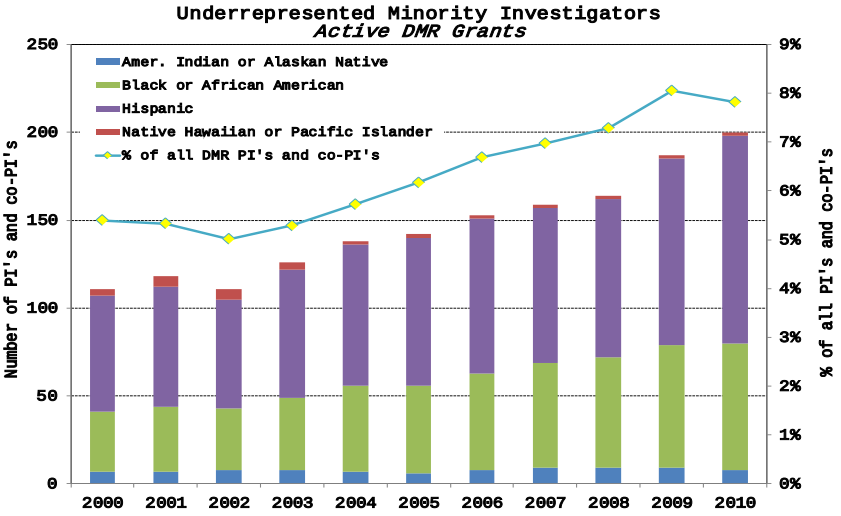
**RESPONSE**:
DMR is committed to enhance in its program portfolios the participation of those groups that are underrepresented in particular women, minorities and scientists with disabilities as DMR PIs, as reviewers, and as program directors. DMR has developed a diversity strategy that impacts all aspects of DMR both within and external to NSF. A working group on diversity was established in 2007, which continues to monitor DMR's progress and approaches. This group recommends alternative practices whenever and wherever appropriate. For instance, a recent recommendation made by this group, and immediately implemented by the DMR division director, was the inclusion of a member of the diversity working group in each DMR search committee for new program directors. In another area, an increase in funding of the PREM program is anticipated. This program has and continues to be a powerful mechanism to increase the pool of potential PIs from underrepresented groups including women, minorities and scientists with disabilities. A PREM competition is planned for 2009. Another tool for enhancing participation from underrepresented groups will be implemented in FY08 which will take advantage of the (American Competitiveness Initiative) ACI Fellows program. The goals of this program include supporting projects that promise transformative research and promoting advancement of underrepresented groups. The creativity extension award mechanism will be utilized for the ACI pilot project in FY 2008, with a vision in 2009 to include other modes of funding.

11/03/08: See the chart below for DMR investments aimed at broadening participation in materials research. DMR encourages its facilities to include participation by under-represented groups. Facilities must develop a plan for broadening participation and report on it yearly, as described in the cooperative agreements. A memorandum of understanding exists between DMR-sponsored Synchrotron Radiation Center and HBCU Xavier University of Louisiana to create a coordinated program in synchrotron science for their students and faculty.

12/29/09: See the chart below for DMR investments aimed at broadening participation in materials research. DMR supported the participation of speakers at a materials research-oriented session at the October 2009 SACNAS (Society for the Advancement of Chicanos and Native Americans in Science) national conference, as well as the attendance of students to the broader meeting. The MRSEC Directors' Meeting (11/2/09, at NSF) and the MRSEC Education Coordinators' Meeting (11/30/09, at MIT) were focused on the topic of Broadening Participation.

12/29/10: Overall the diversity of DMR's PIs is increasing as can be viewed in the following graphs, however, there is clearly not enough progress and DMR continues to focus on these issues:




While efforts permeate the Division, there are two flagship programs for broadening participation, the Partnerships for Research and Education in Materials (PREM) program and American Competitiveness and Innovation Fellows (ACI fellows) program. Summary data are included in the chart below.

| Year | # PREM awards | # ACI fellows |
|---|---|---|
| 2008 | 10 ($5.08M) (5 HIS and 5 HBCU) | 12 (6 female, 3 minority) |
| 2009 | 14 ($14.8M) (7 HIS and 6 HBCU) | 6 (3 female, 2 minority) |
| 2010 | 14 ($5.52M) (7 HIS and 6 HBCU) | 10 (6 female, 3 minority) |

PREM supports institutions serving underrepresented groups in science and engineering to link with DMR-funded centers and facilities in joint materials research and education projects. ARRA funding in FY 2009 enabled enhanced funding for the PREM program.

Participation of members of underrepresented groups is an important consideration when evaluating Research Experiences for Undergraduates (REU) Site proposals and REU supplement requests to DMR. In FY 2010 for example, the REU program participants (520) were 38% minority and 42% female. There were 20 REU supplements awarded to minority students. In Materials Centers, an additional ~225 REU students were supported, 36% URM and 49% female. One REU site focuses on hearing impaired students, and has received wide publicity.

DMR staff participate in many diversity-related events at NSF and in the community including meetings of the National Organization of Black Chemists and Chemical Engineers, the Society for the Advancement of Chicanos and Native Americans in Science, the National Society of Black Physicists and the Society of Hispanic Professional Engineers (SHPE).

***8. Award Size and Duration***

*A.3.3. Are awards appropriate in size and duration for the scope of the projects?*
*The COV response was NO/YES. One sub-panel concludes that "the size of the awards is often insufficient to carry out many of the projects at a reasonable level….As a result the scope of the project is reduced and/or experiments are limited, thus missing opportunities for important scientific discoveries." Another sub-panel recommends that "DMR should consider longer term awards to reduce the burden on reviewers and DMR staff"*

**RESPONSE:**
The increase in DMR award sizes for research proposals noted by past COVs has leveled off. Although annual median awards sizes for 2005 ($111.7K), 2006 ($110.0K), 2007 ($113.7K) increased modestly, the mean annual award sizes decreased going from 2005 ($133.5K) to 2006 ($127.8K), and 2007 ($125.1K). The severe budget constraints facing DMR during this three-year period most likely account for these results. Over this same time period the overall success rate for research proposals has leveled off at near a historic low of 20%. DMR is committed to increase award sizes and duration periods provided that success rates will not be further reduced. This is only possible with the availability of increased funding.

11/03/08: Our efforts to increase award size and duration are still hampered by essentially flat budgets – the FY 2009 budget request has not materialized so far and under the current continuing resolution we are operating at 90% of our FY 2008 budget level until early March 2009.

12/29/09: An FY09 budget increase for DMR, as well as additional ARRA funds available in FY09, allowed for increases in the mean annual award size from $ 115.2 in FY08 to $151.2 K in FY09. The mean award duration is 3.4 years in FY09, about the same as in FY08. While we continue to be committed to increase award size as well as award duration, budget constraints call for a balance between these two factors. (Note that the ARRA funds were a one-time phenomenon and so the mean award size is not expected to be sustained after FY 2009.)

12/29/10: Data for the Individual Investigator Programs:

| Year | Annual Median Award $K | Average Duration | Funding Rate |
|---|---|---|---|
| 2004 | 396 | 3.9 | 25% |
| 2007 | 398 | 3.5 | 23% |
| (2009) ARRA | 396 | 3.4 | 31% |
| 2010 | 412 | 3.5 | 26% |

The data show that in the past half dozen years, the division has placed a priority on funding rate over award size. The Division is considering focusing on increasing the grant size in FY 2011 even if the success rates decrease.

***9. Support for New Investigators***

*Several sub-panels raise the issue of increasing the support for new investigators. For example, this issue is raised in the context of question A.3.7. Program Group B (centers, etc) responds that "the overall perception … is that there is room for improvement in funding to new investigators." The same sub-panel also praises the use of seed funding in MRSECs to support new investigators.*

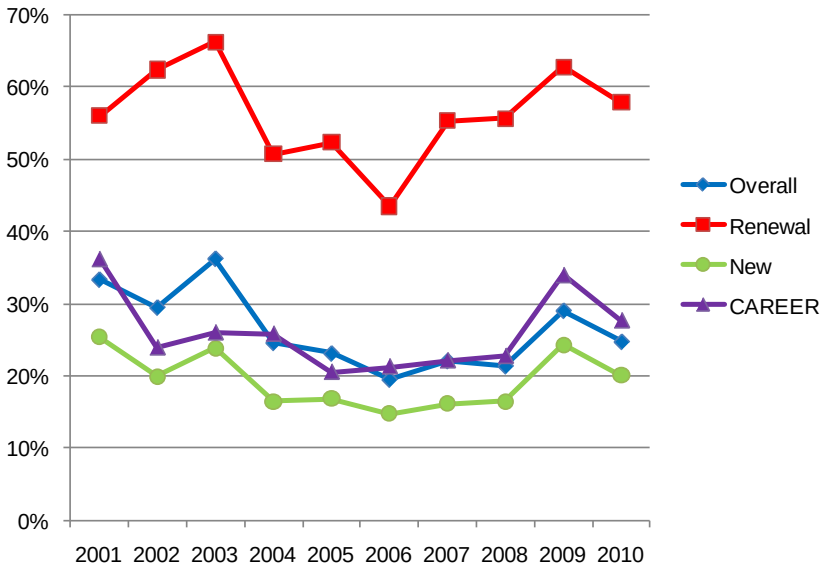
**RESPONSE:**

The success rate (ratio of number of awards to total number of proposal submissions) for new investigators is at historically low levels, and much lower than that for more established investigators. For the period 1998 – 2004 the average success rate for new investigators for all of DMR was 20%. For the past COV reporting period 2005 – 2007, the success rate for new investigators for all of DMR was 13%. DMR is committed to avoid further reductions of average success rates for new investigators, and its program directors will develop novel approaches to mentor new investigators so they can learn to write more competitive proposals.

11/03/08: Active mentoring of new investigators was undertaken by several DMR program directors which was extremely beneficial. We are intensifying our efforts towards recruiting and involving new investigators in the review process since their participation is a very good learning experience of the review process and assists in understanding the basic elements of a good proposal.

12/29/09: Support for new investigators is of a high priority in DMR. In FY09 DMR allocated ARRA funds preferentially to CAREER awards, thus increasing the number of CAREER awards by 80% over the previous years.

12/29/10: For the IIA programs, funding rates for New, Renewal and CAREER (for young faculty) are shown in the below graph:




Funding rates of new proposals have increased since the last COV. Further, the restructuring of the Centers program from MRSEC to Centers and Teams (MRCT) has resulted in almost a doubling of the number of institutions submitting preproposals. This broader participation by new awardees was one of the goals of the restructuring.

**A. Program Group for Metals, Ceramics, and Electronic Materials**

***10. Reviewer Balance***

*A.2.2 Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups?*
*The response was YES, but the COV recommends that "to enable a more systematic analysis of diversity, it would be useful to collect data from a larger fraction of reviewers."*

**RESPONSE:**

The available NSF data base is limited because ~70% of the reviewers do not self-identify their gender, minority, and/or type of institution status. The NSF is limited in what it can do due to federal privacy laws. This is not just a DMR issue, but is a problem agency-wide. The NSF-wide Committee on Equal Opportunity in Science and Engineering (CEOSE) has studied this for many years and has not found a satisfactory answer.

11/03/08: DMR sponsored a workshop on Gender Equity in Materials Science and Education (MS&E). A report is due this fall which will include some demographics about gender distribution in MS&E.

12/29/10: Nothing new to report.

***11. Portfolio Balance***

*A.4.6 Does the program portfolio have an appropriate balance considering, for example, award size, single and multi investigator awards, or other characteristics as appropriate for the program?*
*The response is "Appropriate" but the COV subcommittee urges that "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.*

**RESPONSE:**

DMR is fully committed to the balance between individual and group investigators, and other larger programs. The 2008 COV summary states that DMR was successful in this regard during the last review period. However, tight budgets have not allowed a significant increase in success rates across individual investigator programs. The current FY 2009 budget request may lead to a significant increase in the number of awards for individual investigators.

11/03/08: We continue to monitor the balance between single-, multiple-investigator and other large awards. We will be especially careful in doing so under the present budget constraints resulting from the current continuing resolution for FY 2009.

12/29/09: Consistently with our commitment to support research by individual investigators and small groups, the DMR internal allocation of FY09 and ARRA funds raised the funding rate of individual investigators and small groups from an average of 24% in FY08 to an average of 30% in FY09.

12/29/10: see response to question 3.

B. **Program Group for Instrumentation, Facilities, MRSECs, Office of Special Programs**

***12. Partnering in Construction and Operation of Facilities***

*C.1. Comment on any program areas in need of improvement or gaps (if any) within program areas.*
*The COV states: "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 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."*

*C.3. Identify agency-wide issues that should be addressed by NSF to help improve the program's performance.*
*The COV states that "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."*

**RESPONSE:**
The discussion about facilities in the summary of the COV report reflected the perceived need to balance the DMR portfolio, i.e. individual investigator support should not be jeopardized for the need to meet escalating support costs of major facilities. The sub-panel report comes to the same conclusion but highlights the need for facilities as being essential for advancing frontier materials research of individual investigators. Potential solutions have been discussed under the "Facilities" section of this response to the COV summary. This issue clearly extends beyond DMR to other MPS divisions and other NSF directorates. Current expectations are that DMR will need to explore additional partnerships for support of large user facilities such as NHMFL. Initiation of an additional large scale project under DMR

stewardship, such as a major new light source, will require very careful examination of the potential impact on DMR programs and capabilities.

12/29/10: See response to question 3.

***13. Reviewer Selection***

*A.2.4. Additional comments on reviewer selection: The sub-panel recommends that "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. "*

**RESPONSE:**

DMR programs have for some time established informal mechanisms for identifying new reviewers and for mentoring them. Possible new approaches focusing on underrepresented groups have been proposed by the recently established DMR diversity working group. DMR will examine the possibility of reviewer training, further mentoring, and recognition.

11/03/08: We are examining ways to increase the number of new reviewers, especially in panels, as direct participation in the review process is an effective way to develop good reviewing skills. Active mentoring of new reviewers by several DMR program directors has been quite beneficial.

12/29/09: DMR program directors continue to emphasize the recruitment and mentoring of new reviewers through reviewer/panelist selection as well as through presentations and participation in ad-hoc sessions at professional societies meetings.

12/29/10: Evidence of success in this area is apparent from the data showing that the number of new reviewers used by DMR increased each year, as well as the % of new reviewers.

| Year | # of New Reviewers | Total # of Reviewers | % New Reviewers |
|---|---|---|---|
| 2008 | 591 | 5740 | 10.3% |
| 2009 | 644 | 5529 | 11.6% |
| 2010 | 681 | 5214 | 13.1% |

***14. Cost Sharing***

*C.1. Comment on any program areas in need of improvement or gaps (if any) within program areas. This sub-panel of the COV commented on cost sharing: "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."*

**RESPONSE:**

Cost-sharing has had a primary affect on proposals submitted to the instrumentation, facilities, and centers programs. NSF has enacted changes for cost sharing for the Major Research Instrumentation solicitation but these have not been extended to other programs. DMR is providing input when

requested on the perceived impact of the removal of cost sharing and will continue to monitor the situation.

11/03/08: We continue to follow the status of the NSF resolutions on cost-sharing. We agree on the importance of cost-sharing for certain types of large proposals such as those for centers, institutes, large instrumentation, and facilities.

12/29/09: Our limited ability to impose cost-sharing requirements on large projects such as facilities has a negative impact on the vigorous development of those projects.

12/29/10: With new cooperative agreements for several of the DMR facilities in FY2010, cost sharing on these facilities was ended per the NSB policy. The outcomes of this are not yet known.

***15. International Activities***

*C.1. The COV sub-panel comments on DMR's Materials World Network Program (MWN) as follows: "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."*

**RESPONSE:**

We are pleased with the COV's endorsement of this important and timely activity. The past results of encouraging research connections in Africa and Asia have been limited because of a variety of factors, which have not entirely been under DMR's control. Recent personal contacts made with principals of funding agencies in these regions will be followed up and strengthened. Early numbers on proposal submissions look encouraging, but there is considerable room for improvement. Shortly after assuming her new position, the DMR division director traveled to Asia and later on to North Africa with the sole purpose of promoting collaborations between the USA, and these two continents. As a result numerous funding agencies from Asia and Africa were identified. Several of them agreed to participate in the MWN Program. New international activities such as jointly held workshops and summer institutes are being planned for the near future. For instance, a joint NSF-NSFC (China) workshop will be held yearly and, alternating between the USA and China. These workshops will focus on different hot topics in materials research.

11/03/08: Efforts towards developing a US-Asia materials network include a preliminary discussion among representatives from relevant funding agencies that took place in Australia in the summer of 2008, to be followed up by another meeting/workshop to take place in Singapore in 2009. The first of a series of US-China workshops jointly sponsored by NSF and NSF-China took place in Evanston in September 2008; the topic was nanostructured materials for energy and environmental challenges. The second workshop of the series, on the same topic, will take place in Shanghai in 2009 on New Materials for Renewable Energy. In 2008, JST, NEDO and NIMS from Japan agreed to participate in the MWN joint activity. We continue working with Africa not only through the Materials World Network activity but also by providing support for conferences and workshops held in Africa. We strengthened our cooperation in North Africa and we will be exploring new possible modes in the Middle East.

12/29/09: We continue strengthening our interactions with Asia. A second US-China workshop on materials for energy and the environment jointly sponsored by NSF and NSF-China took place in

Tianmu Lake, China, in October 2009. A workshop of NSF/NSF-China joint grantees is being planned for 2010/2011. The newly created National Research Foundation of Korea joined the Materials World Network activity in 2009. We are planning a US-Africa winter school that will bring together junior researchers from the US and Africa, to be held in sub-Saharan Africa in 2010/2011.

12/29/10: DMR staff and several academic PIs traveled to subSaharan Africa in FY2010 to explore sites for a joint winter school in materials science. DMR made an award to support a network to build research and education relationships with East African nations.

## C. Program Group for Condensed Matter and Materials Theory, Condensed Matter Physics

***16. Annual Performance Goal - Time to Decision***

*A.1.7. The annual performance goal is that for at least 70% of the proposals the applicants are informed about the funding decision within six months of the proposal receipt or deadline date, whichever is later. The COV notes that the CMP program met its goal in 2007 and was very close to the goal in 2005 and 2006. On the other hand, the CMMT program was close to meeting its goal in 2005 but not in 2006 and 2007. The COV attributes the problem with meeting the performance goal in recent years for and to deal with the number of proposals from an increasing broad array of sub-disciplines."*

*A.4.1. Management of the program*
*The COV sub-panel notes that program management is strong but if trend of increasing number of proposals continues "more help will be necessary for both the CMP and CMMT programs".*

**RESPONSE:**
The CMMT program is very complex covering a large amount of the theoretical aspects of essentially all DMR programs and intersects with many other programs outside DMR and MPS. This makes program management inherently more complex and more time is required to handle each proposal. The newly created Cyber-enabled Discovery and Innovation (CDI) initiative required the expertise and participation of CMMT program directors.

In addition, the following occurred within the last three year COV reporting period:
(a) the number of proposals coming to the CMMT program increased dramatically( e.g., nearly 40% in 2006), (b) a long-time permanent program director retired in late 2006, leaving the program with only one person, and recruitment of a replacement took longer than expected.

Better planning to avoid this unnecessary gap will be undertaken in the future, and will also ensure overlap between leaving and incoming program directors in order to maintain continuity within a given program. Currently, there are two full-time (one permanent and one IPA), and one part-time program director. DMR is examining the work load for all programs and expects to make recommendation to MPS management concerning long term staffing needs. The current work load for CMP will also be studied and compared to other programs.

11/03/08: We are examining the workload resulting from not only the number of proposals considered but also their increasing topical breadth within both CMMT and CMP. We are considering ways to more

effectively manage these programs within the constraints imposed by a cap on the number of FTEs in the Division.

12/23/09: Staffing of CMP and CMMT is consistent with staffing of other DMR programs in terms of numbers of proposals handled by a program. On the other hand, as noted earlier, the breadth of these programs brings added complexity to program management. An FY09 search for CMP program directors was unsuccessful. We are conducting another search in FY10.

12/19/10: Staffing of CMMT has been stable now for 2 years FY2010 and FY2011. For CMP, a long-time Program Director retired in FY2009, and an experienced rotator was hired as permanent and a new rotator was recruited. Four PDs for CMMT and CMP are insufficient and management is trying to get permission to hire one more rotator in FY 2011.

***17. Transformative Projects***

*A.3.4 Does the program portfolio have an appropriate balance of innovative/potentially transformative projects?*

*The COV sub-panel answered YES to this question, but pointed out that one panelist recommended "to set aside a small fraction of the budget for high risk/high pay-off projects, labeled that way from the start."*

**RESPONSE:**

DMR currently uses the Division Reserve as a means to encourage the funding of potentially "transformative" proposals on a 50% cost basis to the programs. Other potentially transformative awards can be supported by the current form of Small Grants for Exploratory Research (SGER). NSF has established a working group to study the possible revision of the SGER type grants. Such grants are currently coded and can be tracked over time. DMR will take the sub-panel's recommendation into consideration for a more uniform coding of other potentially transformative awards. DMR will also reexamine the extent of support of present individual investigator projects and MRSECs with regard to transformative and high-risk type research.

11/03/08: We are considering increasing support for high risk/high payoff projects. Mechanisms under consideration include the DMR Division Reserve, aggressive participation in the new NSF EAGER (EArly-concept Grants for Exploratory Research) program, and ACI fellows.

12/29/09: DMR program directors make aggressive use of existing mechanisms to support of high risk-high payoff research, such as EAGER awards and creativity extensions.

12/29/10: In FY2010, the NSF divisions were provided with funds to support potentially transformative research. DMR received $1M. DMR staff coded awards they judged to be potentially transformative research, and the total that the division spent in this category turned out to be $10M.

***18. Study of Individual/Small Group Funding Modes***

*C.3. Identify Agency wide issues*

*The sub-panel recommends that NSF consider "studying the effectiveness of the individual/small group funding mode, similar to the NAS/NRC study of the MRSEC funding mode". Such a study "could help to*

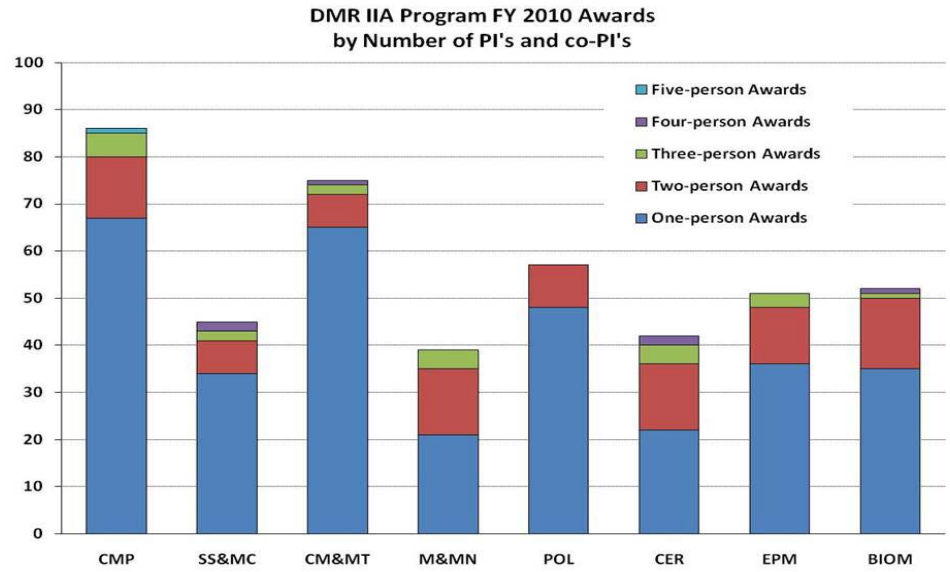
*elucidate the "right balance" between individual/small group funding and center- (and solicited) oriented funding.*

**RESPONSE:**
DMR will explore interest of other divisions in such a study. Some information on the relative impact of center and individual grant support is available from the above cited MRSEC NAS study. It is generally agreed that balanced support for individuals, small groups, instrumentation, centers and facilities is essential for support of a modern research enterprise. The exact balance between funding modes will be reexamined under this light.

11/03/08: We are exploring the possibility of such a study and whether other NSF Divisions are interested in participating. We also have a new joint solicitation on SOLAR between three divisions DMR, the NSF Division of Mathematical Sciences and the NSF Division of Chemistry, which requires three principal investigators with expertise in materials research, mathematics, and chemistry.

12/29/09: Support for unsolicited proposals from individual investigator and from small groups is at the heart of DMR's business philosophy. We continue developing ways of highlighting the outcome of such research, e.g. through dissemination of research highlights, and giving such research its due credit and financial support.

12/29/10: While the Division has not undertaken a formal study, we are aware that the small group funding mode is growing in popularity and occurs throughout its programs, as can be seen from the below graph:




Further, the structuring of the MRSEC program to include smaller teams (inspired by the NAS study on MRSEC) will result in more participation from groups of 5 to 10 PIs. With Materials Research Centers and Teams competitions only triennially, it will take a number of years to see the outcomes of this change.

***19. Liquid helium shortage***

*C.3. The COV sub-panel points out that a world-wide shortage of helium has developed over past several years. The COV is very concerned that this is impacting a large number of investigators. A positive response from DMR to help alleviate the situation would be appropriate.*

**RESPONSE:**
DMR is very much aware of this problem which is primarily affecting the condensed matter physics community. CMP program directors are researching the overall impact on awardees in their portfolio and will make recommendations to the division for possible supportive measures. Other alternatives to liquid He such as closed-cycle refrigerators whenever and wherever appropriate will also be explored.

11/03/08: DMR former acting executive officer, Dr. Ulrich Strom has participated in a discussion on the Helium Reserve at the National Academy of Sciences. Dr. Wendy Fuller-Mora, Condensed Matter Physics program, has provided information on helium usage for the study the NAS is conducting on helium shortage. We are also looking into increasing support for acquisition of closed-cycle refrigerators or helium liquefying and recycling systems.

12/29/09: We continue to work with the NAS and with professional societies to address this issue. We encourage the use of closed-cycle refrigerators whenever possible, as well as the installation of helium recycling systems.

12/29/10: By now there have been Congressional hearings on the helium shortage and DMR has been active in providing information on this topic. The CMP Program Director serves as the liaison.

## D. Program Group for Solid State and Materials Chemistry, Polymers, and Biomaterials

***20. Biomaterials***
*A.4.1. Overall quality of the research and/or education projects supported by the program.*
*The sub-panel responds to the above question as Appropriate and adds that for the overall program group "The quality was exceptionally high". But, the panel recommends that for the BMAT program "the research funded is not uniformly high-risk innovative research." The panel adds that "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".*

*C.1. Comment on any program areas in need of improvement or gaps (if any) within program areas.*
*The sub-panel stresses that "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."*

**RESPONSE:**

We are in full agreement with the COV assessment that the fraction of support of "high-risk innovative research" proposals should be increased. BMAT program directors will work closely with DMR program directors and management, to create and ensure a Biomaterials Program that is noted for its world-class, cutting edge research and education. In addition, DMR has made a commitment to substantially increase the current investment in the Biomaterials program initiated in 2006, and expand the scope of the program to include the frontier, cutting-edge areas of biomaterial research.

11/03/08: BMAT is in its third year of operation as a program. DMR intends to fulfill its commitment to increase support for BMAT to a level that is consistent with those of other DMR programs. DMR is also monitoring the evolution of this new program to make sure that support for high-risk innovative research takes highest priority within the program. For this reason, a new description of the program has been posted on the NSF website.

12/29/09: BMAT is the fastest growing program in DMR in terms of proposals received and we continue to support the growth of its budget. We are aware of the need for this program to address fundamental and cutting-edge research on the underlying principles in the formation and function of biological materials and continue to monitor this aspect of the program.

12/29/10: BMAT staff will meet with counterparts at NIH, DOE and NSF BIO and ENG directorates to refine its program description and "brand" so that it is distinct from and complementary to other federal efforts.