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Materials Innovation Platforms (MIP)

PROGRAM SOLICITATION

NSF 15-522



National Science Foundation

Directorate for Mathematical & Physical Sciences
Division of Materials Research

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

March 02, 2015

IMPORTANT INFORMATION AND REVISION NOTES

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) ([NSF 17-1](#)), which is effective for proposals submitted, or due, on or after January 30, 2017.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Materials Innovation Platforms (MIP)

Synopsis of Program:

The Division of Materials Research (DMR) seeks to significantly accelerate advances in materials research and engineering through the rapid discovery of new materials and phenomena by developing a new midscale user facility program - Materials Innovation Platforms (MIP) program. MIPs embrace the paradigm set forth by the Materials Genome Initiative (MGI) which strives to "discover, manufacture, and deploy advanced materials in half the time and at a fraction of the cost." Platforms respond to the increasing complexity of conducting materials research that requires the close collaboration of multidisciplinary teams who have access to cutting edge tools. To accelerate research outcomes, Platforms conduct research through iterative "closed-loop" efforts among the areas of materials synthesis, characterization, theory, and the application of theory through modeling and/or simulation. The in-house research conducted by a MIP is transformational and focuses on a targeted materials grand challenge and/or a technological outcome (e.g., understanding complexity, discovery of new phenomena and materials, etc.) that addresses a national priority.

MIPs push the frontiers in materials research by advancing the capabilities of current state-of-the-art experimental tools through the development of new techniques and the next generation of instrumentation that will lead to understanding and discovering new phenomena as well as the discovery of complex functional material systems. In addition, it is expected that open access to these cutting edge tools will strengthen collaborations among scientists and enable researchers to work in new ways, while fostering new modalities of multidisciplinary education and training. The user facility aspect of a Platform accounts for approximately 50% of the collaborative effort, where a MIP provides access to unique high-quality, state-of-the-art instrumentation and technological services through a staff of experts that are accessible to external researchers and all types of institutions. Due to this convergence of expertise, MIPs will serve as focal points that promote cross-fertilization of ideas between internal and external researchers.

The Platform, the tools and techniques developed, and the resulting new materials are themselves meant to be transformative. The US, once a global leader in materials synthesis, has fallen behind in the science of crystal growth. **To rebuild technical strength in this area, the initial MIPs will focus on developing new bulk and thin film crystalline hard materials.** The scientific focus of the MIP program is subject to change from competition to competition. MIPs are anticipated to be five year awards totaling \$10,000,000 to \$25,000,000 for the award period. MIP awards are eligible for a one-time five-year renewal, subsequent to a rigorous and favorable review by NSF. To cover the breadth of this endeavor, it is expected that proposed projects will be directed by a team of at least three Senior Personnel with complementary expertise. Equipment acquisition is expected in the first few years, but yearly budget should not exceed \$7.0M.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Z. C. Ying, 1065 N, telephone: (703) 292-8428, email: cying@nsf.gov
- Guebre X. Tessema, telephone: (703) 292-4935, email: gtessema@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.049 --- Mathematical and Physical Sciences

Award Information

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 1 to 3

Awards totaling \$10,000,000 to \$25,000,000 over a five year period are anticipated. The budget must be commensurate with the scope of the project and thoroughly justified in the proposal.

The number of awards will depend on the availability of funds and the quality of the proposals.

Anticipated Funding Amount: \$10,000,000

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Proposals may be submitted by academic institutions in the US with broad programs in materials research and education. Academic institutions, as defined by the PAPPG, are universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 1

One (1) per organization. Potential PIs are advised to contact their institutional office of research regarding processes used to select proposals for submission.

Limit on Number of Proposals per PI or Co-PI: 1

Individuals may appear as Senior Personnel (Co-PI, Faculty, or Other Senior Associate) on only 1 MIP proposal.

Proposals submitted in response to this solicitation may not duplicate or be substantially similar to other proposals funded or concurrently under consideration by NSF or to proposals previously declined by NSF and not substantially revised. Proposals not satisfying this condition will be returned without review.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide (PAPPG)* guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

Not Applicable

- **Other Budgetary Limitations:**

Not Applicable

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

March 02, 2015

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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I. INTRODUCTION

Recognizing the ever increasing complexity of materials research that requires the close collaboration of multidisciplinary teams with access to cutting edge tools, the Division of Materials Research (DMR) has established Materials Innovation Platforms (MIPs). These

Platforms seek to substantially increase the rate at which new materials and new materials phenomena are discovered. MIPs push the frontiers of energy, spatial, and time resolution by developing next generation technologies, as well as advance the capabilities of current state-of-the-art experimental tools and techniques.

The in-house research conducted in a successful MIP is transformational and focused on a targeted materials grand challenge and/or technological outcome (understanding complexity, discovery of new phenomena and materials, etc.) that addresses national priorities. In addition, Platforms serve as educational focal points for training the next generation of instrument developers and users.

MIPs serve as user facilities with a dual mission. They bring together the scientific expertise required to develop the advanced tools and techniques that drive new science and result in paradigm shifts. They also provide access to existing instrumentation; MIP-developed instrumentation, methods, and techniques; and other resources such as data, codes, and samples. The sharing of cutting edge tools within MIPs strengthens collaboration among the scientists and enables researchers to work in new ways, while fostering new modalities of multidisciplinary education and training. The MIPs develop and provide unique high-quality instrumentation and technological services that are open to external researchers and institutions of all types. MIPs push the frontiers in materials research by advancing the capabilities of cutting edge experimental tools and support the development of the next generation of instrumentation and techniques that will lead to the discovery of new phenomena as well as complex functional material systems.

II. PROGRAM DESCRIPTION

The goal of the MIP Program is to provide national infrastructure in key enabling areas supported by a robust scientific program coupled with vigorous instrument and technique development activities. The MIP Program aligns with the [Materials Genome Initiative \(MGI\)](#), which strives to “discover, manufacture, and deploy advanced materials in half the time and at a fraction of the cost”. A recent Mathematical and Physical Sciences (MPS) Advisory Subcommittee study - [Materials Instrumentation](#) points out the opportunity to advance materials science through targeted, shared, mid-scale infrastructure investments. As highlighted in this report, advancing the field of materials synthesis represents a unique opportunity to reclaim leadership in this domain which could lead to the next generation of breakthroughs in materials science and engineering. The 2009 National Academy report [Frontiers in Crystalline Matter: From Discovery to Technology](#) clearly identifies the development of next generation crystalline materials as a grand challenge, and the Materials Innovation Platforms address the expertise, tools, and techniques required to achieve this goal. This first competition is focused on the synthesis of bulk and thin film crystalline hard materials.

The complexity and challenge of activities addressed by this program require a transformative approach to discovering and developing new materials, predicting and optimizing properties of these materials, and informing the design of material systems. MIPs are driven by the “materials by design” concept with synthesis, characterization, and theory/modeling applied to targeted outcomes. Accordingly, the proposed research program must close-the-loop, i.e. be a collaborative and iterative process wherein theory guides computational simulation, computational simulation guides experiments, and experiments further informs theory. Through this tightly connected iterative process, new discoveries are anticipated to occur at a faster rate than conventional modes of collaboration. In addition, advances in each of the three areas (synthesis, characterization, and theory/simulation/modeling) are also expected. MIPs are inherently interdisciplinary and support efforts that span across the fields of materials science, physics, chemistry, mathematics, computer science, and engineering.

This collaborative and iterative process requires a team of PIs with the requisite expertise in synthesis, characterization, and theory/simulation/modeling. The proposed projects are directed by a team of at least three Senior Personnel with complementary expertise. The team includes scientific experts and technical staff conducting research to develop new instruments: new growth and processing techniques, new characterization methodologies, and novel theory / data / computation / simulation approaches that benefit all aspects of the research endeavor. While the Platforms themselves push the frontiers of materials research through the scientific program, MIPs also serve as a national resource for developing new technologies. In addition, Platforms engage in a limited number of MIP-related education and outreach activities that further the training mission and increase the broader impact. Lastly, the scientific experts assembled at a Platform are also available for collaboration with and consultation by external users of the MIP.

MIPs must demonstrate support for a rich national/regional user base with broad accessibility. As the number of Platforms increase through periodic (annual or bi-annual) competitions, they will become a part of a national infrastructure which provides user services, trains the next generation of users, and encourages interactions between different communities. Through the user program, MIPs provide access to existing and new instrumentation, techniques, materials, software, modeling and simulation tools, data, databases and other resources to the broad scientific community. MIPs go beyond traditional user facilities that provide access to instrumentation by also bringing together the scientific and technical expertise required to develop advanced tools and techniques that transform the way materials research is conducted. In addition, due to this convergence of expertise, MIPs will function naturally as focal points that promote cross-fertilization of ideas between internal and external researchers and enable new science that cannot be accomplished otherwise. To promote usage of these unique facilities, MIPs do not charge academic users for time with experts, technicians, or use of equipment acquired through the MIP award. External users may be charged for consumables that are expensive and not routine or that academic researchers cannot bring to the facility. Platforms will serve as educational focal points for training the next generation of instrument developers and users. Since accelerated discovery and dissemination is a primary goal of a MIP, collaboration and use of the facility by industry and other types of organizations, such as centers, facilities, and national laboratories are encouraged, as appropriate. Platforms leverage university and other resources to grow the number of external users. The user facility accounts for approximately 50% of the effort of a Platform, with a significant fraction devoted to external users.

Platforms reside at institutions where the appropriate infrastructure, including laboratory, common space, and sharing of equipment already exists to assist in the proposed research and add value to the MIP user facility. MIPs also have plans for acquisition of new equipment, tools, and supporting technologies that will position and maintain the facility at the frontier of the proposed materials research. Tools (or the suite of tools) acquired or developed through a MIP award are novel and/or unique and go beyond the scope and scale of those tools that are acquired through other NSF modes of support, such as the Major Research Instrumentation (MRI) program.

The MIP program will NOT support proposal requests for any of the following:

- Construction, renovation or modernization of rooms, buildings or research facilities;
- General purpose and supporting equipment. Supporting equipment refers to basic, durable components of a research facility that are integral to its operation (e.g., fume hoods, elevators, laboratory casework, and cryogen storage systems); -Sustaining infrastructure and/or building systems. This category may include: electrical and plumbing systems, routine multi-purpose computer networks, standard safety features, and other general purpose systems (e.g., HVAC, electrical generation and distribution systems, toxic waste removal systems, and telecommunications equipment); or
- General purpose platforms or environment. This category may include (but is not limited to) general purpose fixed or non-fixed structures or manned vehicles whose role is to host or transport an instrument.

Service contracts and warranties on purchased equipment over the award period are allowed.

DMR will manage the MIPs through the National Facilities program. The MIP Program will support equipment purchases, instrument and software development, and professional staffing including support for the PIs, scientific experts, technicians, and a limited number of students and post-docs. Five year awards totaling \$10,000,000 to \$25,000,000 for the award period are anticipated. MIP proposals are expected to be front loaded with equipment, however the annual budget should not exceed \$7,000,000. MIPs are awarded as cooperative agreements with an initial commitment of five years, with the possibility of one five-year renewal, subsequent to a rigorous and favorable review by NSF. The scientific focus of the MIP program is subject to change from competition to competition.

III. AWARD INFORMATION

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 1 to 3

Awards totaling \$10,000,000 to \$25,000,000 over a five year period are anticipated. The budget must be commensurate with the scope of the project and thoroughly justified in the proposal.

The number of awards will depend on the availability of funds and the quality of the proposals.

Anticipated Funding Amount: \$10,000,000

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Proposals may be submitted by academic institutions in the US with broad programs in materials research and education. Academic institutions, as defined by the PAPPG, are universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 1

One (1) per organization. Potential PIs are advised to contact their institutional office of research regarding processes used to select proposals for submission.

Limit on Number of Proposals per PI or Co-PI: 1

Individuals may appear as Senior Personnel (Co-PI, Faculty, or Other Senior Associate) on only 1 MIP proposal.

Proposals submitted in response to this solicitation may not duplicate or be substantially similar to other proposals funded or concurrently under consideration by NSF or to proposals previously declined by NSF and not substantially revised. Proposals not satisfying this condition will be returned without review.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nspubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nspubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.C.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

Cover Page

- **Program Solicitation Number.** FastLane users: Select the MIP program solicitation number shown at the beginning of this solicitation from the drop -down menu. Grants.gov users: The program solicitation will be pre-populated by Grants.gov on the NSF Grant Application Cover Page.
- **Proposal Title.** The proposal title must begin with "MIP:" followed by an informative project title.
- **Collaborative Proposals.** While MIPs are encouraged to collaborate with research institutions, proposals submitted as separate submissions from multiple organizations are discouraged. Only one proposal, with subawards, should be submitted. If submitted as a collaborative, all collaborative proposals that are submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.5 of the Grant Proposal Guide provides additional information on Collaborative Proposals. Proposals submitted by different institutions as a collaborative group must have the identical title that begins with the designation "MIP: Collaborative Research:".
- **Senior Personnel.** All MIP proposals must involve at least three Senior Personnel (PI, Co-PI, Faculty or Other Senior Associate) to ensure that all aspects of the project (synthesis/growth/processing, characterization/testing, and theory/data/computation/simulation) are adequately covered by relevant expertise. These partnerships may occur either in a proposal from a single institution or in a Collaborative Research proposal involving two or more institutions.

Proposals that fail to comply with formatting instructions per the Grant Proposal Guide, the Cover Page specifications, or the instructions given below may delay processing or result in the proposal being returned without review.

Project Description (28 pages):

The Project Description must include the following sections and section headers:

1. **Participant List.** Provide a list of participating senior investigators (faculty level and equivalent) by full name, organizational and departmental affiliation, and expected roles in the proposed MIP (e.g., MIP research, instrument development, user facility, or education). Discuss briefly the expertise of the team with respect to the proposed research topics and providing user services. **Limit: 2 pages.**
2. **Results from Prior NSF support.** All PIs and co-PIs listed on the proposal cover sheet who have received NSF funding in the past five years must provide information on their NSF awards; in cases where a PI or co-PI has received more than one award they need only report on the award most closely related to the proposal. Collaborative research and user facility management activities funded by NSF should be an emphasis of this section. There is no need to list awards of all senior investigators of the proposed MIP. **Limit: 3 pages.**
3. **Rationale for the MIP.** Describe the overall vision for the Platform. In separate paragraphs identify the research, user facility, education, and diversity goals of the Platform. **Limit: 1 page.**
4. **Scientific Program.** Describe the targeted outcome of the Platform and how the research closes the loop among synthesis, characterization, and theory/simulation/modeling such that it is iterative and synergistic. This section must also discuss how this loop enhances the scientific impact above and beyond what can be accomplished using conventional approaches as well as how it accelerates new materials discovery. Where more than one institution is involved, mechanisms to ensure distance does not negatively impact the collaborative, interactive "closed loop" nature of the MIP must be clearly described. In addition, discuss how a diversity of people and institutions will be integrated into the research of the MIP and the user program to advance the scientific program. **Limit: 6 pages.**
5. **Description of the Platform.** Describe the capabilities and new science enabled through the tools purchased and developed to engage in the proposed research. This section must provide the scientific justification for instrument development and the critical needs addressed for the broader scientific community. A description of how the Platform advances all three aspects of "closing-the-loop" is required. Discuss how the MIP engages and leverages existing infrastructure, both local and external. The

novel ways in which the Platform will have impact through open access and the sharing of data should be outlined. **Limit: 3 pages.**

6. **Education and human resource development.** As a unique national resource, describe a limited number of well-chosen education and outreach activities that advance the educational experiences for graduate and undergraduate students, postdoctoral associates, and others associated with the Platform. Include a brief description of how the education goals integrate strategically with the research activity of the MIP. Potential activities such as hands-on workshops, research experiences for undergraduates, research experiences for teachers, or summer schools should be outlined. The inclusion of underrepresented groups as well as institutions that serve the national interest, such as community colleges, primarily undergraduate institutions, and minority-serving institutions, should also be discussed. Describe outreach plans intended to increase the external user base, to encourage non-traditional users from diverse communities, and to reach potential users from industry, whose work could inform or benefit from instrumentation and technique development activities. **Limit: 2 pages.**
7. **Diversity strategic plan.** MIPs are expected to demonstrate a significant commitment to the involvement of underrepresented groups (e.g., women, underrepresented minorities, persons with disabilities) as Platform participants (faculty participants, scientific experts, technicians, postdoctoral associates, and students). Describe the MIP's strategic plan to broaden participation at all levels, the metrics that will be used to measure progress, and the desired outcome for the 5 year award period. **Limit: 1 Page.**
8. **Knowledge Transfer.** State the specific goals for knowledge transfer activities and the expected impacts of the activities, including the sharing of new materials, instruments, techniques, and processes. Given the anticipated advances from the real time integration of theory with experimentation and characterization, describe methodologies of providing access to existing, acquired, and developed tools for the sharing of data, algorithms, and other products, as well as the creation and utilization of community resources such as databases. As appropriate, describe plans for intellectual and resource exchanges, cooperation, and partnerships with other organizations that may involve academic organizations, industry, national laboratories, non-profit organizations, federal, state, and local governments, and others. **Limit: 2 pages.**
9. **User Facility.** In this section, describe the user facility and modes of collaboration using the sections below. **Limit: 4 pages.**
 - **Table of Major Infrastructure.** Complete and include the following table listing the infrastructure (primarily equipment, but can include novel computer architectures, software, etc.) that will be available to users. Include existing instruments, instruments to be purchased, and instruments to be developed.

Item	When Available (yr 1, 2, etc.)	Fraction of time available to users	Special considerations (limited materials, temperatures, pressures, etc.)	Currently exists at institution? (Y/N)

- **User Access Modes:** Discuss the access to all aspects of the Platform: instrumentation, computational tools, data, and other products from the research. Describe the various user modes anticipated (e.g., independent, collaboration, fee for service, remote access, etc.) and the corresponding user proposal review or selection process, as appropriate.
- **User support.** Describe the scientific experts, technicians, and other support available to users.
- **User fee structure.** Provide detail about the structure and the basis for user fees. List user fees for on-campus, and off-campus academic and non-academic users.
- **User training and safety.** Describe how users will be trained in using the infrastructure and the planned safety program.\

10. Management Plan. **Limit: 4 pages.**

- o Organizational Chart: Show all critical components of the governance structure including the external advisory committee and the user committee.
- o Management Plan for scientific collaborations.
- o Timelines for equipment acquisition and development and the resulting schedules for user access.
- o Management Plan for the User Facility
 - User proposal submission and review process
 - The role of the user community
 - The size and the role of the advisory committee
- o Summary Table of Requested NSF Support. In tabular form as follows, summarize the overall support levels planned for the MIP. For each entry in the table, include direct and indirect costs. Column totals must equal the total budget requested from NSF for the period shown. Include major capital equipment under shared facilities. Equipment acquisition is expected in first few years, but yearly budget should not exceed \$7.0M. Support for graduate students should be included under research, not under education and human resources.

SUMMARY TABLE OF REQUESTED NSF SUPPORT (\$k)				
ACTIVITY	YEAR 1	%	5-YEAR TOTAL	%
MIP Research				
Knowledge Transfer to Other Sectors				
Shared Facilities (equipment and operations)				
Education and Human Resources				
Administration				
Total		100		100

Single Copy Documents:

- **Required:** Submit a list of individuals who might be “suitable reviewers” to act as impartial reviewers through the Suggested Reviewers function of FastLane. Include their names, affiliations, phone numbers, e-mail addresses, and areas of expertise. PIs can also include a short list of reviewers to be avoided. In addition, submit a single, alphabetically ordered “list of conflicts” of all persons with whom the Senior Personnel have a Conflict of Interest (COI) and the professional affiliation of each such person. Senior Personnel have a COI (a) with any former graduate or postdoctoral advisee, (b) with any person with whom they have published or collaborated within the past 48 months, (c) with any person with whom they have co-edited a journal, compendium, or conference proceedings in the past 24 months, (d) with any former graduate advisor, and (e) with any person who was a postdoctoral advisor within the past five years.

Single Copy Documents are used by NSF staff, but are not available to reviewers.

Supplementary Documents

- For proposals involving collaborations with researchers not listed as co-PIs, proposers should include letters confirming the collaborations. The letters must be very brief and contain no statements of support or reference. Details about collaborative work to be done under this project should be included within the 28 pages of the Project Description, not in the letter(s) of collaboration.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

March 02, 2015

D. FastLane/Grants.gov Requirements

For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <http://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements,

for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (PAPPG Chapter II.C.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.C.2.d(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to

the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
 - a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
 - b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

- Is the proposal motivated by well-defined targeted outcomes for science? Are these cutting edge and well-aligned with national priorities?
- Does the proposed Platform substantially accelerate materials discovery and development beyond current methods, especially the development of new instrumentation and techniques?
- Does the proposed research use a tightly closed collaborative loop process with iterative feedback between materials synthesis/growth/processing, materials characterization/testing, and theory/data/computation/simulation? How well do these components interact to improve each other and enhance project outcomes?
- Does the proposed Platform meet a critical infrastructure need for the materials community to enable the synthesis of bulk or thin film hard crystalline materials essential for transformative advances in materials research?
- In terms of proposed instruments and technique development leading to new instrumentation and approaches, does the MIP as a whole propose ground-breaking and potentially transformative capabilities as opposed to low risk, incremental activities?
- Are the plans and timelines for equipment acquisitions, development, commissioning, and making the new instrument available to users well thought out?
- For proposals that involve equipment development: are there target specifications, performance and reliability metrics, and credible plans for commissioning?
- To what extent will the proposed platform serve as an educational focal point for training the next generation of instrument developers and users?
- To what extent does the proposal include industrial involvement through shared use of instruments and expertise, and commercialization of new instruments and discoveries?
- Does the proposed work provide access to its outputs, including samples, methods, techniques, data, algorithms, and publications?
- To what extent does the proposal provide access to users/collaborators from a broad range of institutions?

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, or Reverse Site Review.

Proposals will initially be evaluated by ad hoc and panel review. Finalists will be invited for a reverse site visit at NSF. At the reverse site visit, finalists will make oral presentations to a second panel and NSF staff and engage in a question and answer session. NSF reserves the option to conduct a site visit prior to making a final award.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process).

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papppg.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through [Research.gov](https://www.research.gov), for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via [Research.gov](https://www.research.gov) constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using [Research.gov](https://www.research.gov). This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papppg.

Program specific annual and final report guidelines will be provided.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Z. C. Ying, 1065 N, telephone: (703) 292-8428, email: cying@nsf.gov
- Guebre X. Tessema, telephone: (703) 292-4935, email: gtessema@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at <http://www.grants.gov>.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <https://www.nsf.gov>

- **Location:**

4201 Wilson Blvd. Arlington, VA 22230

- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
 - Send an e-mail to: nsfpubs@nsf.gov
 - or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, [NSF-50](#), "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and [NSF-51](#), "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
 Reports Clearance Officer
 Office of the General Counsel
 National Science Foundation
 Arlington, VA 22230

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