

Nanoelectronics for 2020 and Beyond (NEB)

A Joint Activity between NSF and NRI

PROGRAM SOLICITATION

NSF 10-614



National Science Foundation

Directorate for Engineering
Electrical, Communications and Cyber Systems

Directorate for Mathematical & Physical Sciences
Division of Materials Research
Division of Chemistry

Directorate for Computer & Information Science & Engineering
Division of Computing and Communication Foundations

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

January 19, 2011

IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), [NSF 11-1](#), was issued on October 1, 2010 and is effective for proposals submitted, or due, on or after January 18, 2011. Please be advised that the guidelines contained in [NSF 11-1](#) apply to proposals submitted in response to this funding opportunity. Proposers who opt to submit prior to January 18, 2011, must also follow the guidelines contained in [NSF 11-1](#).

Cost Sharing: The PAPPG has been revised to implement the National Science Board's recommendations regarding cost sharing. Inclusion of voluntary committed cost sharing is prohibited. In order to assess the scope of the project, all organizational resources necessary for the project must be described in the Facilities, Equipment and Other Resources section of the proposal. The description should be narrative in nature and must not include any quantifiable financial information. Mandatory cost sharing will only be required when explicitly authorized by the NSF Director. See the PAPP Guide Part I: *Grant Proposal Guide (GPG)* Chapter II.C.2.g(xi) for further information about the implementation of these recommendations.

Data Management Plan: The PAPPG contains a clarification of NSF's long standing data policy. All proposals must describe plans for data management and sharing of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan. The Data Management Plan will be reviewed as part of the intellectual merit or broader impacts of the proposal, or both, as appropriate. Links to data management requirements and plans relevant to specific Directorates, Offices, Divisions, Programs, or other NSF units are available on the NSF website at: <http://www.nsf.gov/bfa/dias/policy/dmp.jsp>. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement.

Postdoctoral Researcher Mentoring Plan: As a reminder, each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. Please be advised that if required, FastLane will not permit submission of a proposal that is missing a Postdoctoral Researcher Mentoring Plan. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Nanoelectronics for 2020 and Beyond (NEB)
A Joint Activity between NSF and NRI

Synopsis of Program:

The National Science Foundation (NSF), through its Directorates for Engineering, Mathematical and Physical Sciences, and Computer & Information Science & Engineering, together with the semiconductor industry's Nanoelectronics Research Initiative (NRI) plan to jointly support innovative research and education activities on the topic of *Nanoelectronics for 2020 and Beyond (NEB)*. These activities will be supported as interdisciplinary research team awards.

The goal of this solicitation is to advance the forefront of computation, information processing, sensor technologies, and communications infrastructure beyond the physical and conceptual limitations of current technologies. Continuing evolution of electronics beyond the scaling limits of Moore's Law will require broad thinking across multiple disciplines. The program is intended to support proposals by interdisciplinary teams of investigators committed to exploring innovative research concepts in nanoelectronics involving fundamental challenges from novel materials, chemistry, and logic devices, to circuit designs and systems architectures, algorithms, and perhaps entirely new paradigms of computation, sensing, and processing of information. Proposals may also address additional challenges arising from increasing functionality through heterogeneous integration of novel devices and technologies. Proposals should discuss effective ways in which education of the workforce and broadening participation are integrated within the proposed research activities.

Proposals must involve interdisciplinary collaborations by three or more investigators and address aspects of at least two of the research themes:

1. *Exploring New Chemistries and Materials for Nanoelectronics*
2. *Exploring Alternative State Variables and Heterogeneous Integration for Nanoelectronic Devices and Systems*
3. *Exploring Novel Paradigms of Computing*

Cognizant Program Officer(s):

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- Jeff Welser, Director, NRI, telephone: (408) 927-1017, email: Jeff.Welser@src.org

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

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.070 --- Computer and Information Science and Engineering

Award Information

Anticipated Type of Award: Standard Grant

Estimated Number of Awards: 10 to 15 Interdisciplinary research team awards

Anticipated Funding Amount: \$20,000,000 of which \$18,000,000 will be contributed by NSF and \$2,000,000 will be contributed by the Nanoelectronics Research Initiative (NRI), (<http://www.src.org/program/nri/>), depending on the quality of the proposals and availability of funds. Awards will be funded by NSF and in some cases according to NRI interests jointly by NSF and NRI through separate funding instruments of each organization. NSF awards will be made in FY 2011 as standard grants. NRI funds will be provided as unrestrictive gifts, with no overhead or intellectual property requirements.

Eligibility Information

Organization Limit:

Proposals may only be submitted by the following:

- Academic institutions accredited in and having a campus located in the US are eligible to be the lead organization.

PI Limit:

Principal Investigators must be at the faculty level or equivalent.

Limit on Number of Proposals per Organization: 2

An academic institution may submit no more than two proposals on which it is the lead organization in response to this solicitation. The same organization may be a collaborative partner in any number of other multi-organization group proposals in which it is not the lead. A proposal involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization.

Limit on Number of Proposals per PI: 1

An individual may be listed on only one proposal as PI, co-PI, or senior personnel.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable
- **Preliminary Proposal Submission:** Not Applicable
- **Full Proposals:**

- o Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at:
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
- o 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:
http://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. proposer's local time):
January 19, 2011

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: Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements: Standard NSF reporting requirements apply.

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I. INTRODUCTION

The National Science Foundation (NSF), through its Directorates for Engineering, Mathematical and Physical Sciences, and Computer & Information Science & Engineering, together with the semiconductor industry's Nanoelectronics Research Initiative (NRI) plan to jointly support innovative research and education activities on the topic of *Nanoelectronics for 2020 and Beyond (NEB)*. These activities will be supported as interdisciplinary research team awards.

NEB is one of the Signature Initiatives of the National Nanotechnology Initiative (NNI) (http://www.nano.gov/html/research/signature_initiatives.html). The Initiative is aimed at discovering and using novel nanoscale fabrication processes and innovative concepts to produce revolutionary materials, devices, systems, and architectures to advance the field of nanoelectronics beyond the scaling limits of Moore's Law. NEB is also part of the emerging NSF activity of Science and Engineering Beyond Moore's Law (SEBML), building upon the past decade of support under the NNI and related NSF activities. Shrinking device dimensions has been the primary enabler of increased device density and processing speed, reduced switching energy, increased system functionality, and reduced manufacturing cost. But as the dimensions of critical elements of devices approach atomic size, increasing power density, quantum tunneling and other quantum effects degrade and ultimately prohibit

conventional device operation. To take computation, information processing, sensor technologies, and communications infrastructure beyond Moore's Law will require entirely new scientific, engineering, and conceptual frameworks. The development of novel approaches in nanoelectronics that can circumvent these limitations and maintain the historical scaling of computational power and cost of information processing will have enormous societal impact in such diverse areas as health, transportation, energy, and environment and will be critical to sustaining U.S. leadership and competitiveness in the global semiconductor industry.

II. PROGRAM DESCRIPTION

The goal of this solicitation on *Nanoelectronics for 2020 and Beyond (NEB)* is to advance the forefront of computation, information processing, sensor technologies, and communications infrastructure beyond the physical and conceptual limitations of current technologies. Continuing evolution of electronics beyond the scaling limits of Moore's Law will require broad thinking across multiple disciplines. The program is intended to support proposals by interdisciplinary teams of investigators committed to exploring innovative research concepts in nanoelectronics involving fundamental challenges from novel materials, chemistry, and logic devices, to circuit designs and systems architectures, algorithms, and perhaps entirely new paradigms of computation, sensing, and processing of information. Proposals may also address additional challenges arising from increasing functionality through heterogeneous integration of novel devices and technologies. Proposals should discuss effective ways in which education of the workforce and broadening participation are integrated within the proposed research activities.

Proposals must involve interdisciplinary collaborations by three or more investigators and need to address aspects of at least two of the research themes below:

1. *Exploring New Chemistries and Materials for Nanoelectronics*

Materials research and chemistry at the atomic and molecular scales are enabling sciences that underpin nanoelectronics. Research topics to consider will explore novel functions in chemical structures and nanomaterials encompassing electrical, optical, and magnetic behavior. They include, but are not limited to, emerging areas of electronics at the nanoscale such as room temperature spin behavior, multiferroics, and molecular devices, as well as carbon-based nanomaterials. Utilizing methods of directed or nature-inspired self-assembly and approaches for processing and fabrication of novel materials and device structures are important considerations. To enable new directions in nanoelectronics, continued efforts are needed in fundamental science related to: (i) Developing new synthetic approaches to nanostructures and electronic and photonic materials for nanoelectronics; (ii) Understanding the fundamental physical behavior in these chemical structures and materials; (iii) Improving methods for efficient processing (including purification) and manipulation of these compounds and materials; (iv) Integrating other functionality such as thermal stability and mechanical behavior with nanoelectronics; and (v) Exploring innovative device structures that go beyond the constraints of the current technology.

2. *Exploring Alternative State Variables and Heterogeneous Integration for Nanoelectronic Devices and Systems*

Alternative state variables other than dissipative charge transfer, which is exploited by conventional field-effect transistors, are envisioned as the basis for new logic switches. These alternatives may include electron spin, nanomagnetic domains, multiferroic states, molecular states, nanomechanical motion, phase and interference effects, collective behavior, and other emerging areas of electronics at the nanoscale. Interconnecting devices to build a functional architecture, fabrication/assembly methods, and complex behavior of large nanosystems remain largely unresolved and pose formidable problems at the nanoscale. Future nanoelectronic systems will include increased functional diversity through co-integration of various heterogeneous technologies such as sensors and actuators, energy storage, and bioelectronics to diversify the applications space for semiconductor technology. The severely scaled semiconductor technologies and increased coupling complexity of the densely integrated devices and components may strongly impact innovative design and system reliability. This will require fundamental research innovations in interdisciplinary fields such as nanomaterials, nanoelectronics, thermomechanics, biological and chemical areas as well as new system architectures, algorithms, and embedded highly parallelized software. Self-healing reconfigurable systems and stochastic design approaches including energy efficient systems design may be needed to address reliability and resiliency challenges for future scaled nanoelectronic systems. Innovative approaches are required for modeling system integration at the interface and ensuring compatibility of materials and devices from the processing and integration point of view.

3. *Exploring Novel Paradigms of Computing*

Future materials and devices may have profound implications on computer science research and lead to innovations on novel paradigms of computing. Such paradigms may reach from the lowest levels of circuit design to software and applications in the abstraction hierarchy and could be different from techniques adopted in conventional CMOS technology. Cross-layer architectures and new design paradigms consistent with the constraints imposed by future devices may be part of this research. These architectures include reconfigurable, evolvable, adaptive hardware architectures, possibly using heterogeneous systems that can dynamically change via software mechanisms; robust and possibly highly parallel architectures capable of combating error prone devices at the nano scale; highly connective architectures possibly inspired by the human brain; and architectures amenable to low power implementations. A variety of application specific architectures ranging from those required in niche applications to large scale computations such as those required in high performance computing scenarios will also be given consideration. For each of the above, new design tools, possibly involving hardware-software co-design, will be required as will be the considerations of memory and interconnects. Radical departures from traditional architectural practices are envisioned.

A recent NSF workshop sponsored by the three participating Directorates was held on the topic of *"Interdisciplinary Challenges beyond the Scaling Limits of Moore's Law."* The report may be accessed at: http://www.nnin.org/nnin_nsf_workshop_2010.html.

The Nanoelectronics Research Initiative (NRI) is a consortium of companies in the Semiconductor Industry Association (SIA) that seeks to accelerate research in nanoelectronics for the benefit of the technology industry. NRI is administered by the Nanoelectronics Research Corporation (NERC), a subsidiary of the Semiconductor Research Corporation (SRC) (<http://www.src.org/program/nri/>).

NSF encourages use of the National Nanotechnology Infrastructure Network (NNIN) and the Network for Computational Nanotechnology (NCN) as resources for projects in nanoscale science, engineering, and technology.

NNIN (<http://www.nnin.org/>) is an integrated national network of user facilities at 14 university sites that provides users across the nation with access on-site and remotely to leading-edge nanotechnology tools, instrumentation, and capabilities for fabrication, synthesis, characterization, design, simulation, and integration.

NCN (<http://www.ncn.purdue.edu/>) is a network of seven partner universities supporting the NNI by designing and operating a cyber-resource for nanotechnology theory, modeling, and simulation. Its mission is embodied in *nanoHUB.org* and is driven by research, education, outreach, and support for community formation and growth.

III. AWARD INFORMATION

Interdisciplinary research team awards will be in the range of \$1,000,000 to \$2,000,000 for four years, depending on the scope of the work proposed. The total request submitted to NSF for funding for each project, for all investigators and all organizations, may not exceed \$2,000,000. NSF expects to fund approximately 10-15 interdisciplinary research team awards in FY 2011, depending on the quality of submissions and the availability of funds. The anticipated date of awards is August 2011.

The awards will be funded by NSF and in some cases according to NRI interests jointly by NSF and NRI through separate funding instruments of each organization. NSF awards will be made as standard grants. NRI funds will be provided as unrestricted gifts, with no overhead or intellectual property requirements.

IV. ELIGIBILITY INFORMATION

Organization Limit:

Proposals may only be submitted by the following:

- Academic institutions accredited in and having a campus located in the US are eligible to be the lead organization.

PI Limit:

Principal Investigators must be at the faculty level or equivalent.

Limit on Number of Proposals per Organization: 2

An academic institution may submit no more than two proposals on which it is the lead organization in response to this solicitation. The same organization may be a collaborative partner in any number of other multi-organization group proposals in which it is not the lead. A proposal involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization.

Limit on Number of Proposals per PI: 1

An individual may be listed on only one proposal as PI, co-PI, or senior personnel.

Additional Eligibility Info:

Synergistic collaborations or partnerships with industry or government are encouraged when appropriate, though no NSF funds will be provided to these organizations. Researchers from foreign academic institutions who contribute essential expertise to the project may participate as senior personnel but may not receive NSF support.

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 Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@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: (http://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 nsfpubs@nsf.gov.

NEB - Proposal Preparation and Submission Instructions

- FastLane Users: Proposers must identify this program solicitation number in the program announcement/solicitation block on the Cover Sheet and select "Nanoelectronics for 2020 and Beyond" from the FastLane org. unit pull-down list. The project title must begin with "NEB:"
- Grants.gov Users: The program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page. In Field 2, Unit of Consideration, enter 07010000 for the Division Code and 8032 for the Program Code. The project title must begin with "NEB:"

Note: The Project Summary must discuss in separate paragraphs, and explicitly state, the intellectual merit and broader impacts of the proposed work, or the proposal will be returned without review.

Proposers must indicate the NEB research themes described in the Program Description that the proposal addresses. This must be stated in the last line of the Project Summary, and it will be used to assist in assignment of the proposal to the most appropriate

panel.

NEB proposals must conform to the requirements of the *Grant Proposal Guide (GPG)* or the *NSF Grants.gov Application Guide*, with the following modifications:

- Collaborative research activities should be described and submitted in a single proposal in which a single award is requested, with subawards administered by the lead organization to any other participating organizations. (See GPG section II.D.4.a.) Budgets for any subawards to different organizations must be included.
- The proposal should describe the roles to be played by the participating organizations, the responsibilities of the managing PI, the activities of associated partners, and arrangements for networking, exchange, and dissemination of data and results. The managing PI must be from the lead organization.
- Proposals must include three or more investigators and must be interdisciplinary in nature.
- Discussion of the management plan and education and outreach aspects of the project should be included. Opportunities for students to obtain novel research or educational experiences should be detailed.
- The proposal should identify any current awards that are supporting significant aspects of the proposed work.

The project description is limited to 15 pages, and proposals that exceed the page limitations will be returned without review.

Proposals that request funding to support postdoctoral researchers must include a description of the mentoring activities that will be provided for such individuals. Proposals that do not comply with this requirement will be returned without review (see the PAPP Guide Part I: *Grant Proposal Guide* Chapter II for further information about the implementation of this requirement).

Supplementary Documents:

For proposals involving partnership with industry, government, or international organizations, proposers should include a letter from the partner organization that confirms the participation of a co-PI or senior personnel from said organization. The letter, uploaded in the Supplementary Documents section of the proposal, should describe a plan for interaction, the time commitment of the researcher, and the nature of the work.

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. proposer's local time):
January 19, 2011

D. FastLane/Grants.gov Requirements

- **For Proposals Submitted Via FastLane:**

Detailed technical instructions regarding the technical aspects of preparation and submission via FastLane are 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.

Submission of Electronically Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: <https://www.fastlane.nsf.gov/fastlane.jsp>.

- **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. The Grants.gov's Grant Community User Guide is a comprehensive reference document that provides technical information about Grants.gov. Proposers can download the User Guide as a Microsoft Word document or as a PDF document. The Grants.gov User Guide is available at: <http://www.grants.gov/CustomerSupport>. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding 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.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. 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 who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the 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.

A. NSF Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make judgements.

What is the intellectual merit of the proposed activity?

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: <http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>.

Mentoring activities provided to postdoctoral researchers supported on the project, as described in a one-page supplementary document, will be evaluated under the Broader Impacts criterion.

NSF staff also will give careful consideration to the following in making funding decisions:

Integration of Research and Education

One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities

Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- 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.

Additional Review Criteria:

The following additional review criteria will be used:

- Clear benefits of the multi-investigator approach to address a main topic of nanoelectronics and appropriateness of the interdisciplinary expertise.
- Effectiveness of proposed team-work, including plans for management and for self-evaluation in order to maintain a flexible and innovative program.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed as follows.

- Proposals will be reviewed by Panel Review and supplemented by ad hoc mail review as needed.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. 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 is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, 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.

In all cases, 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 and 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.

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 letter, 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 letter; (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 letter. 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 http://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 Award & Administration Guide (AAG)* Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

Awards will be funded by NSF and in some cases according to NRI interests jointly by NSF and NRI through separate funding instruments of each organization. NSF Awards will be made as standard grants. NRI funds will be awarded as unrestricted gifts, with no overhead or intellectual property requirements.

Awardees will participate in the NSF Nanoscale Science and Engineering Grantees meeting at NSF in the second year of the award, December 2012.

For projects co-funded by NSF and NRI, both organizations will provide joint oversight, and annual reports of progress required by NSF, as well as publications resulting from the work, will also be submitted to NRI. Awardees of co-funded projects will participate in the NRI annual review, and NRI will set-up industry liaison teams to interact with the awardees.

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 at least 90 days before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after 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 that PI. 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 FastLane, for preparation and submission of annual and final project reports. Such reports provide information on activities and findings, project participants (individual and organizational) publications; and, other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system. Submission of the report via FastLane constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report must be prepared and submitted using 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.

VIII. AGENCY CONTACTS

General inquiries regarding this program should be made to:

- Lawrence S. Goldberg, Senior Engineering Advisor, ECCS/ENG, 525, telephone: (703) 292-8339, email: lgoldber@nsf.gov
- Charles Ying, Program Director, DMR/MPS, 1065, telephone: (703) 292-8428, email: cying@nsf.gov
- Timothy E. Patten, Program Director, CHE/MPS, 1055, telephone: (703) 292-7196, email: tpatten@nsf.gov
- Sankar Basu, Program Director, CCF/CISE, 1106, telephone: (703) 292-7843, email: sabasu@nsf.gov
- Rajinder Khosla, Program Director, ECCS/ENG, 525, telephone: (703) 292-8339, email: rkhosla@nsf.gov
- Usha Varshney, Program Director, ECCS/ENG, 525, telephone: (703) 292-8339, email: uvarshne@nsf.gov
- Andreas Weisshaar, Program Director, ECCS/ENG, 525, telephone: (703) 292-8339, email: aweissha@nsf.gov
- Nadia A. El-Masry, Program Director, DMR/MPS, 1065, telephone: (703) 292-4917, email: nelmasry@nsf.gov
- Daniele Finotello, Program Director, DMR/MPS, 1065, telephone: (703) 292-4676, email: dfinotel@nsf.gov
- Suk-Wah Tam-Chang, Program Director, CHE/MPS, 1055, telephone: (703) 292-8684, email: stamchan@nsf.gov
- Charles D. Pibel, Program Director, CHE/MPS, 1055, telephone: (703) 292-4971, email: cpibel@nsf.gov
- Dmitry Maslov, Program Director, CCF/CISE, 1115, telephone: (703) 292-8910, email: dmaslov@nsf.gov
- Daniel De Kee, Program Director, EEC/ENG, 585, telephone: (703) 292-8769, email: ddekee@nsf.gov
- Jeff Welser, Director, NRI, telephone: (408) 927-1017, email: Jeff.Welser@src.org

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, National Science Foundation Update is a free e-mail subscription service 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 Regional Grants Conferences. Subscribers are informed through e-mail when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the [NSF web site](#).

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

Grant Opportunities for Academic Liasion with Industry (GOALI), NSF 10-580
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf10580. Grant Opportunities for Academic Liaison with Industry (GOALI) aims to synergize university-industry partnerships by making funds available to support an eclectic mix of industry-university linkages. Special interest is focused on affording the opportunity for:

- interdisciplinary university-industry teams to conduct long-term research projects;
- Faculty, postdoctoral fellows, and students to conduct research and gain experience with production processes in an industrial setting; and
- Industrial scientists and engineers to bring industry's perspective and integrative skills to academe.

This solicitation, previous program solicitations, and additional information concerning related activities such as workshops and publications, including "*The National Nanotechnology Initiative - Supplement to the President's FY 2011 Budget*" (2010) prepared by the National Science and Technology Council, are available on-line at <http://www.nsf.gov/nano> and <http://nano.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 40,000 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 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 provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 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 <http://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
Division of Administrative Services
National Science Foundation
Arlington, VA 22230

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