

Active Nanostructures and Nanosystems (ANN)

Program Solicitation

NSF 05-610



National Science Foundation
Directorate for Engineering
Directorate for Social, Behavioral, and Economic Sciences

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

November 29, 2005

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Active Nanostructures and Nanosystems (ANN)
FY 2006

Synopsis of Program:

The National Science Foundation (NSF) announces a program on collaborative research and education in the area of active nanostructures and nanosystems, and on the long-term social change associated with these innovations. The goal of this program is to support fundamental research and catalyze synergistic science and engineering research and education in several emerging areas of nanoscale science and technology, including: **fundamental nanoscale phenomena and processes in active nanostructures; nanosystems with improved functionality and new architectures; hierarchical nanomanufacturing; and long-term societal and educational implications of scientific and technological advances on the nanoscale.** This solicitation will provide support for Nanoscale Interdisciplinary Research Teams (NIRT) and Nanoscale Exploratory Research (NER).

A related program solicitation will focus on Nanotechnology Undergraduate Education (NUE) for FY 2006. Other research and education projects in nanoscale science and engineering will continue to be supported in the relevant Programs and Divisions.

Cognizant Program Officer(s):

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

- 47.041 --- Engineering
- 47.075 --- Social, Behavioral and Economic Sciences

Eligibility Information

- **Organization Limit:**

- A. **Nanoscale Interdisciplinary Research Teams (NIRT):** NIRT proposals may be submitted by a single organization or a group of organizations consisting of a lead organization in partnership with one or more partner organizations. Only U.S. academic institutions with significant research and degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization. Principal investigators are encouraged to form synergistic collaborations among researchers, and with private and public sector organizations, government laboratories, and scientists and engineers at foreign organizations where appropriate, though no funds will be provided to those organizations. At least three PIs and co-PIs, all with funded time committed in the budget, must be listed on the cover page or on the budget page of the proposal. The maximum number of PIs and co-PIs is five; other participants may be listed in the project summary and on the budget pages.

Collaborations between university and industry researchers using the approach of the GOALI (Grant Opportunities for Academic Liaison with Industry, NSF 98-142) are encouraged. Primary support for any foreign participants/activities must be secured through their own national sources. For foreign participants, the U.S. organization may provide funds under participant support costs for travel and per diem for visits to the U.S. organization, as consistent with applicable international agreements. No NSF funds may go directly to foreign organizations. For this solicitation, funds for salaries and research expenses of staff of national laboratories, state agencies, and non-NSF Federally Funded Research and Development Centers (FFRDC) may not be requested. However, it is appropriate for students supported by the award to work at an FFRDC or comparable site or for the award to support research expenses incurred when scientists from such entities work at university sites. Federal employees may not receive salaries or in other ways augment their agency's appropriation through grants made by this solicitation, and no funds for equipment at FFRDCs are allowed.

- B. **Nanoscale Exploratory Research (NER):** Proposals may be submitted by U.S. academic institutions with undergraduate and/or Ph.D. programs in disciplines usually supported by NSF. Research may be proposed by individual investigators or by small groups from academic institutions. Synergistic collaborations among researchers, and collaborations or partnerships with private or public sector organizations or government laboratories are encouraged when appropriate. Prospective proposers are encouraged to contact one of the program officers listed in this solicitation for additional guidance on the suitability of their NER submission if there are questions.

- **PI Eligibility Limit:**

Principal Investigators must be at the faculty level or equivalent.

- **Limit on Number of Proposals:** A. Nanoscale Interdisciplinary Research Teams (NIRT): An organization – a university, or a campus in a multi-campus university -- may submit no more than three (3) 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. An authorized organizational representative of the lead organization will make the selection of the proposals that are submitted. Proposals submitted to other NSF programs are not eligible for consideration by this competition. NIRT proposals involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization. B. Nanoscale Exploratory Research (NER): An organization – a university or a campus in a multi-campus university -- may submit no more than two (2) proposals on which it is the lead organization in response to this NER solicitation. An exception is made for an additional NER proposal that may be submitted in "Societal and Educational Issues Associated with Long-term Research Science and Engineering

Advances" (see Research and Education Themes in Section II). At least one NER proposal submitted by an organization must have a P.I. or co-P.I. at the level of assistant professor or equivalent. An authorized organizational representative of the lead organization will make the selection of the proposals that are submitted. Proposals submitted to other NSF programs are not eligible for consideration by this competition. NER proposals involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization.

Award Information

- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 70
- **Anticipated Funding Amount:** \$42,000,000

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Full Proposal Preparation Instructions:** This solicitation contains information that deviates from the standard Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full text of this solicitation for further information.

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required by NSF.
- **Indirect Cost (F&A) Limitations:** Not Applicable.
- **Other Budgetary Limitations:** Not Applicable.

C. Due Dates

- **Full Proposal Deadline Date(s)** (due by 5 p.m. submitter's local time):
November 29, 2005

Proposal Review Information

- **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:** Standard NSF reporting requirements apply.

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I. INTRODUCTION

One nanometer (one billionth of a meter) is a magical point on the dimensional scale. Nanostructures are at the confluence of the smallest of human-made devices and the largest molecules of living systems. Nanoscale science and engineering here refer to the fundamental understanding and resulting technological advances arising from the exploitation of new physical, chemical, and biological properties of systems that are intermediate in size, between isolated atoms and molecules and bulk materials, where the transitional properties between the two limits can be controlled. Nanotechnology is the creation and utilization of functional materials, devices, and systems with novel properties and functions that are achieved through the control of matter, atom-by-atom, molecule by molecule or at the macromolecular level. During the last few years, novel structures, phenomena, and processes have been observed at the nanoscale (from a fraction of nanometer to about 100 nm) and new experimental, theoretical and simulation tools have been developed for investigating them. These advances provide fresh opportunities for scientific and technological developments in active nanostructures and nanosystems with new architectures and improved functionality. Similarly, continuing advances in nanoscale science and engineering require continuing attention to accompanying societal issues.

The current pace of revolutionary discoveries in nanoscience and technology is expected to accelerate greatly in the next decade. However, formidable challenges remain in the areas of fundamental understanding, device design, system design and architecture, manufacturing, converging technologies, system integration and deployment, and consideration of associated social and ethical phenomena, before the potential of nanotechnology becomes a reality. Key research areas have been identified for advancing nanotechnology in the areas of active nanostructures and nanosystems, as well as societal dimensions of nanotechnology (see the **National Nanotechnology Initiative Strategic Planning II**, December 2004, http://www.nsf.gov/crssprgm/nano/reports/sp_report_nset_final.pdf).

The rudimentary capabilities of nanotechnology today for control and manufacture at the nanoscale are expected to evolve significantly by 2020. The focus of this solicitation is on active nanostructures and nanosystems and on long-term societal issues associated with continuing advances.

An active nanostructure changes its state during its operation. For instance, a mechanical actuator may change its dimensions, and a nanoparticle for drug delivery may change its morphology and chemical composition. The new state may be subject to other successive changes. Such changes are more complex as the structures and systems are larger and involve multiple phenomena. Not much attention has been paid to the organizational and social structures and processes capable of identification, monitoring, and assessment of these changes and the associated ethical, social, psychological and economic implications.

Active nanoscale structures and devices may encompass mechanical, electronic, magnetic, photonic, biological and other effects. Examples of active nanostructures are nanoelectromechanical systems (NEMS), nanomachines, self-healing materials, nanobiodevices, transistors, amplifiers, targeted drugs and chemicals, actuators, molecular machines, light-driven molecular motors, plasmonics, nanoscale fluidics, laser-emitting devices, adaptive nanostructures, energy storage devices, and sensors changing their state during operation. Nanoelectronics would include the area of Silicon Nanoelectronics and Beyond, with structures leading to CMOS scaled to its ultimate limits and possibly beyond-CMOS, integrating nanocomponents and nanodevices (e.g., carbon-nanotube, single-electron and molecular transistors) and/or new devices based on state variables other than electric charge (e.g., electron-spin, nuclear-spin or photonic states). Nanomedicine would include targeted cancer therapies, sensors for in vivo monitoring, localized drug delivery, neural stimulation and cardiac therapies.

Nanosystems include nanostructures and nanodevices as components. The number of components may range from several (such as a sensor and actuator) to large numbers (such as tens of thousand of molecules in a synthetic biology system). Nanosystems may be created by various syntheses and assembling techniques such as a combination of molecular assembling and top-down miniaturization techniques, bio-assembling, networking at the nanoscale and multiscale and hierarchical architectures, robotics on surfaces, modular nanosystems, chemo-mechanical processing of molecular assemblies, and quantum interactions. Nanoelectronics would include possible new system architectures. Nanomedicine would include artificial tissues built from the nanoscale and systems for cell conditioning. Other examples are robotic systems with emerging behavior, evolutionary systems, regenerative medicine, modified viruses and bacteria, and brain prostheses. The convergence of nanotechnology with information technology, modern biology and social sciences will reinvigorate discoveries and innovation in many relevant areas.

The National Nanotechnology Initiative (NNI – www.nano.gov and at NSF – <http://www.nsf.gov/nano>) is a government-wide activity designed to ensure that investments in this area are made in a coordinated and timely manner, and to accelerate the pace of revolutionary discoveries. This ANN solicitation represents one of the NSF's contributions to the NNI. Collaborative research among engineers, physicists, chemists, biologists, materials scientists, geoscientists, mathematicians, computer scientists, social and behavioral scientists, economists, and educators is an integral part of both NNI and ANN.

This solicitation, previous program solicitations, and additional information concerning related activities such as workshops and publications, including the "**The National Nanotechnology Initiative – Supplement to the President's FY 2006 Budget**" (2005) prepared by the National Science and Technology Council, are available on-line at <http://www.nsf.gov/nano> and <http://nano.gov/>. NSF has also prepared the report "**Societal Implications of Nanoscience and Nanotechnology**" (2001) and "**Converging Technologies for Improving Human Performance**" (2003).

II. PROGRAM DESCRIPTION

RESEARCH AND EDUCATION THEMES

This solicitation focuses on four high-risk/high-reward research and education themes, three focusing on active nanostructures and nanosystems and the fourth on societal educational issues associated with continuing advances in nanoscale science, engineering, and technology.

- **Fundamental Nanoscale Phenomena and Processes in Active Nanostructures.** Research in this area supports discovery and development of fundamental knowledge pertaining to new phenomena in the physical, biological, and engineering sciences that occur at nanoscale in active nanostructures and their engineered nanosystems. This includes elucidation of scientific and engineering principles related to nanoscale structures, processes, and mechanisms. Research on multiscale/multiphenomena theory, mathematical methods, modeling and simulation of active nanostructures and systems will include techniques such as quantum mechanics and quantum chemistry, multi-particle simulation, molecular simulation, grain and continuum-based models, stochastic methods, nanoelectronics and nanomechanics. Examples of areas of relevance are the study of biological and biologically inspired systems in which nanostructures play an important role, nanostructured catalysts, novel separation systems with molecular resolution, nanoshells for environmental remediation, advanced drugs, quantum computing, DNA computing, production of two- and three-dimensional nanostructures "by design," nanoscale fluidics, biophotonics, control of surface processes and lubrication
- **Nanoscale Devices and System Architecture.** New concepts, tools and design methodologies are needed to create new nanoscale devices, synthesize nanosystems and integrate them into architectures for various operational environments. These require a profound understanding of the physical, chemical, and biological interactions among nanoscale components, including self-assembling and self-organization of molecular and supramolecular systems. In order to systemize the design of complex nanosystems, multiple layers of abstractions and various mathematical models to represent component behavior in different layers are also required. Research is encouraged in design principles and construction methods of nanoscale processing systems, as well as their energy supply and operation control systems. Research in this area includes development of new tools for sensing, assembling, processing, manipulating, manufacturing and integration along scales, controlling and testing nanostructures, devices, design and architecture of concepts, software specialized for nanosystems, including nanoelectronics, and design automation tools for assembling systems of large numbers of heterogeneous nanocomponents. A special focus is on new architectures and improved functionality of large and complex nanosystems, and their integration with larger scale systems. This includes deterministic, emerging and evolutionary nanosystems, and their integration with large scale systems. One can envision "smart" systems that sense and gather information and analyze and respond to that information, the development of high capacity computer memory chips, and more powerful computing systems and architectures.

- **Hierarchical Nanomanufacturing.** Research in this area will focus on creating nanostructures and assembling them into nanosystems and then into larger complex structures of at least two length scales where the principles of manufacturing or operation are different. This research should address understanding nanoscale processes, developing novel tools for measurement and manufacturing at the nanoscale, developing novel concepts for high-rate synthesis and processing of nanostructures and nanosystems, scale integration, scale up of nanoscale synthesis and processing methods, and constructing nanoscale systems. Examples are synthesis of nanostructures for various functions, fabrication methods for devices and nanosystems, design concepts for manufacturing, simulation of the manufacturing methods at the nanoscale, and evaluation of the economic and environmental implications of manufacturing at the nanoscale. Possible benefits include improving understanding of manufacturing processes in the pre-competitive environment, generating a new group of nanoscale manufacturing methods for nanoelectronics, and nanomedicine, increasing the performance and scale up of promising techniques, and establishing the physical and human infrastructure for measurements and manufacturing capabilities.
- **Societal and Educational Issues Associated with Long-Term Nanoscale Science and Engineering Advances.** Research proposals submitted in this thematic area are expected to increase understanding, assessment and management of long-term social change associated with nanoscale science, engineering, and technology. Subjects for examination can include a.) the educational, economic, social, organizational and ethical changes associated with support for, design of, and results from inventions and innovations involving active nanostructures and nanosystems; and b.) the development and assessment of potentials for applications in health care and human and artificial cognition. These proposals can focus on any social or behavioral phenomena, alone or in combination, and should relate to research emphases and findings in the areas of active nanostructures and nanosystems. Thus, they should include experts in the relevant social, behavioral, or economic sciences and nanoscale science and engineering. Proposals that include the potential for enhancements to social or behavioral science infrastructure, instrumentation or tools are especially welcome. For instance, research teams developing deliberative workshops or interview and survey projects might design or amend and test in several iterations a module focusing on public perception of converging developments in bioscience, cognitive science, information science, and nanoscale science and engineering. In conjunction with designing new instruments with the potential for cognitive assessment, teams could examine the potential benefits to and consequences for privacy, human identity, or social understanding. This theme aims at a long-term vision for addressing societal and ethical implications of nanotechnology with special reference to active nanodevices and nanosystems.

Proposals with focus on active nanostructures and nanosystems that incorporate elements of more than one scientific theme are welcome. Given NSF's strong focus on developing the infrastructure for nanoscale science and engineering, all proposals should address integration of research and education, including course development, appropriate to the nature of the project.

In FY 2006, consistent with NNI emphases and the four themes described above, NSF encourages proposals involving novel instrumentation, manufacturing processes, nanoelectronics and challenges faced by conventional CMOS technology, energy conversion and storage, and devices for chemical, biological, radiological, or explosive agents detection that involve nanoscale processes. (See list of NSF and NNI sponsored workshops on line on <http://www.nsf.gov/nano>). However, research on converging science and technology integrated from the nanoscale for revolutionary products and improving human performance also is encouraged (see "Converging Technologies for Improving Human Performance" on line at <http://www.nsf.gov/nano>).

NSF does not normally support technical assistance, pilot plant efforts, research requiring security classification, and the development of products for commercial marketing or market research for a particular project or invention. Research in bioengineering, with diagnosis or treatment related goals, however, that apply engineering principles to problems in biology and medicine while advancing engineering knowledge is eligible for support. Bioengineering research to aid persons with disabilities is also eligible. However, research with disease-related goals, including work on the etiology, diagnosis or treatment of physical or mental disease, abnormality or malfunction in human beings or animals, is normally not supported. Animal models of such conditions or the development or testing of drugs or other procedures for their treatment also are not eligible for support.

Other research and education projects in nanoscale science and engineering will continue to be supported in the relevant Programs and Divisions.

III. ELIGIBILITY INFORMATION

- A. **Nanoscale Interdisciplinary Research Teams (NIRT):** NIRT proposals may be submitted by a single organization or a group of organizations consisting of a lead organization in partnership with one or more partner organizations.

Only U.S. academic institutions with significant research and degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization. Principal investigators are encouraged to form synergistic collaborations among researchers, and with private and public sector organizations, government laboratories, and scientists and engineers at foreign organizations where appropriate, though no funds will be provided to those organizations. At least three PIs and co-PIs, all with funded time committed in the budget, must be listed on the cover page or on the budget page of the proposal. The maximum number of PIs and co-PIs is five; other participants may be listed in the project summary and on the budget pages.

Collaborations between university and industry researchers using the approach of the GOALI (Grant Opportunities for Academic Liaison with Industry, [NSF 98-142](#)) are encouraged. Primary support for any foreign participants/activities must be secured through their own national sources. For foreign participants, the U.S. organization may provide funds under participant support costs for travel and per diem for visits to the U.S. organization, as consistent with applicable international agreements. No NSF funds may go directly to foreign organizations. For this solicitation, funds for salaries and research expenses of staff of national laboratories, state agencies, and non-NSF Federally Funded Research and Development Centers (FFRDC) may not be requested. However, it is appropriate for students supported by the award to work at an FFRDC or comparable site or for the award to support research expenses incurred when scientists from such entities work at university sites. Federal employees may not receive salaries or in other ways augment their agency's appropriation through grants made by this solicitation, and no funds for equipment at FFRDCs are allowed.

B. Nanoscale Exploratory Research (NER): Proposals may be submitted by U.S. academic institutions with undergraduate and/or Ph.D. programs in disciplines usually supported by NSF. Research may be proposed by individual investigators or by small groups from academic institutions. Synergistic collaborations among researchers, and collaborations or partnerships with private or public sector organizations or government laboratories are encouraged when appropriate. Prospective proposers are encouraged to contact one of the program officers listed in this solicitation for additional guidance on the suitability of their NER submission if there are questions.

- **PI Eligibility Limit**

Principal Investigators must be at the faculty level or equivalent.

- **Limit on Number of Proposals:** **A. Nanoscale Interdisciplinary Research Teams (NIRT):** An organization – a university, or a campus in a multi-campus university -- may submit no more than three (3) 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. An authorized organizational representative of the lead organization will make the selection of the proposals that are submitted. Proposals submitted to other NSF programs are not eligible for consideration by this competition. NIRT proposals involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization. **B. Nanoscale Exploratory Research (NER):** An organization – a university or a campus in a multi-campus university -- may submit no more than two (2) proposals on which it is the lead organization in response to this NER solicitation. An exception is made for an additional NER proposal that may be submitted in "Societal and Educational Issues Associated with Long-term Research Science and Engineering advances"(see Research and Education Themes in Section II). At least one NER proposal submitted by an organization must have a P.I. or co-P.I. at the level of assistant professor or equivalent. An authorized organizational representative of the lead organization will make the selection of the proposals that are submitted. Proposals submitted to other NSF programs are not eligible for consideration by this competition. NER proposals involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization.

IV. AWARD INFORMATION

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

A. Nanoscale Interdisciplinary Research Teams (NIRT): A NIRT award will be in the range of \$250,000-\$400,000 per year for four years depending on the scope of the work proposed. Grants may be awarded in a variety of sizes and durations. The total request for NSF funding for each project, for all investigators and all organizations, may not exceed \$1.6 million. NSF expects to fund approximately 30 NIRT awards in FY 2006, with a budget of approximately \$37 million depending on the quality of submissions and the availability of funds. Anticipated date of awards: May 2006.

- B. **Nanoscale Exploratory Research (NER):** NER awards will be made as one-year grants. NER awards may not exceed \$130,000 and cannot be renewed. NSF plans to fund about 40 new NER awards in fiscal year 2006. NSF expects to invest approximately \$5 million in this solicitation component in FY 2006, subject to the quality of submissions and availability of funds. Anticipated date of awards: May 2006.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Instructions:

Proposals submitted in response to this program announcement/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 pubs@nsf.gov.

Proposal preparation instructions supplement or deviate from the standard GPG instructions. Each of the major areas has its own set of instruction that are provided in this section:

- A. Nanoscale Interdisciplinary Research Teams (NIRT)
 - B. Nanoscale Exploratory Research (NER)
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A. NANOSCALE INTERDISCIPLINARY RESEARCH TEAMS (NIRT)

NIRT - Proposal Preparation and Submission Instructions

Proposers must identify this program solicitation number in the program announcement/solicitation block on the Cover Sheet and select "**Nanoscale: Interdiscipl Resrch T**" from the FastLane org. unit pull-down list. Proposal title must begin with "**NIRT:**". For administrative purposes, all NIRT proposals must be submitted via FastLane to CTS (contact Alfonso Ortega, aortega@nsf.gov).

Proposers must indicate in order of priority one (or more) of the four research and education themes described in Section II which 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.

NOTE: The Project Summary and Project Description sections must indicate, in separate statements, the intellectual merit of the proposed work and its broader impacts. (See Section VI.)

NIRT proposals must conform to the requirements of the *Grant Proposal Guide* (GPG), with three 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.3.a.) This solicitation encourages team approaches in the belief that a synergistic blend of expertise is needed to make major headway in research, education, and development of the infrastructure. Budgets for any subawards to different organizations must be included.
- The project description is limited to fifteen (15) pages plus one (1) additional page per each co-principal investigator. For example, a proposal with one (1) principal investigator and four (4) co-principal investigators listed on the cover page and budget request would be limited to 19 pages of project description. The maximum number of PIs and Co-PIs is five, so the maximum number of pages in the project description would be 19 pages.
- The project description should include a discussion of the management, education and outreach aspects of the project. The proposal should describe the roles to be played by the participating organizations, the responsibilities of the managing PI and 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. Details on the education,

training, and outreach activities planned as part of the project should be included. Opportunities for students to obtain novel research or educational experiences should be detailed, as well as any specific training activities or workshops.

Proposals that exceed the page limitations described above will be returned without review.

Proposal Deadline Date: Full proposals for NIRT are due by **5 p.m. proposer's local time** on **November 29, 2005**. Proposals must be submitted electronically through the FastLane system by the **lead organization**.

Inquiries regarding NIRT proposals should be directed to Alfonso Ortega (aortega@nsf.gov), Program Director.

B. NANOSCALE EXPLORATORY RESEARCH (NER)

NER - Proposal Preparation and Submission Instructions

Proposers must identify this program solicitation number in the program announcement/solicitation block on the Cover Sheet and to select "**Nanoscale: Exploratory Rsrch**" from the FastLane org. unit pull-down list. The proposal title must begin with "**NER:** ". For administrative purposes, all NER proposals must be submitted via FastLane to BES (contact Leon Esterowitz, lesterow@nsf.gov).

Proposers must indicate one (or more) of the four research and education themes listed in Section II which 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.

NOTE: The Project Summary and Project Description sections must indicate, in separate statements, the intellectual merit of the proposed work and its broader impacts. (See Section VI.)

Proposal Deadline Date: Full proposals for NER are due by **5 p.m. proposer's local time** on **November 29, 2005**. Proposals must be submitted electronically through the FastLane system by the **lead organization**.

Investigators are strongly encouraged to contact the NSF staff members in the program covering the proposal topic before submitting an NER proposal if there are questions. For general questions about NER requirements contact Leon Esterowitz (lesterow@nsf.gov), Program Director.

Proposers are reminded to identify the program announcement/solicitation number (05-610) in the program announcement/solicitation block on the proposal Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

B. Budgetary Information

Cost Sharing:

Cost sharing is not required by NSF in proposals submitted under this Program Solicitation.

C. Due Dates

Proposals must be submitted by the following date(s):

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

November 29, 2005

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

November 29, 2005

for Nanoscale Interdisciplinary Research Teams (NIRT)

for Nanoscale Exploratory Research (NER)

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this announcement/solicitation through the FastLane system. Detailed instructions for proposal 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 announcement/solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this announcement/solicitation.

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. Proposers are no longer required to provide a paper copy of the signed Proposal Cover Sheet to NSF. Further instructions regarding this process are available on the FastLane Website at: <http://www.fastlane.nsf.gov>

VI. PROPOSAL REVIEW INFORMATION

A. NSF Proposal Review Process

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

The National Science Board approved revised criteria for evaluating proposals at its meeting on March 28, 1997 ([NSB 97-72](#)). All NSF proposals are evaluated through use of the two merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

On July 8, 2002, the NSF Director issued [Important Notice 127](#), Implementation of new Grant Proposal Guide Requirements Related to the Broader Impacts Criterion. This Important Notice reinforces the importance of addressing both criteria in the preparation and review of all proposals submitted to NSF. NSF continues to strengthen its internal processes to ensure that both of the merit review criteria are addressed when making funding decisions.

In an effort to increase compliance with these requirements, the January 2002 issuance of the GPG incorporated revised proposal preparation guidelines relating to the development of the Project Summary and Project Description. Chapter II of the GPG specifies that Principal Investigators (PIs) must address both merit review criteria in separate statements within the one-page Project Summary. This chapter also reiterates that broader impacts resulting from the proposed project must be addressed in the Project Description and described as an integral part of the narrative.

Effective October 1, 2002, NSF will return without review proposals that do not separately address both merit review criteria within the Project Summary. It is believed that these changes to NSF proposal preparation and processing guidelines will more clearly articulate the importance of broader impacts to NSF-funded projects.

The two National Science Board approved merit review criteria are listed below (see the [Grant Proposal Guide](#) Chapter III.A for further information). 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 he/she is qualified to make judgments.

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 and original 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?

NSF staff 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:

A. Nanoscale Interdisciplinary Research Teams (NIRT)

B. Nanoscale Exploratory Research (NER)

A. Nanoscale Interdisciplinary Research Teams (NIRT)

In addition, the following criteria will be used:

- Potential for significant contributions to the advancement of nanoscale science and engineering in one or more of the four research and education themes;
 - Strength of the collaborations planned and degree of interdisciplinarity;
 - Value to education;
 - Appropriateness and likely effectiveness of collaborations with public or private sector organizations, national laboratories, and comparable research groups in foreign countries, when applicable. Proposals will be evaluated not by the number of collaborators, but by the quality of the collaborations; and
 - Likely effectiveness of the management plan.
-

B. Nanoscale Exploratory Research (NER)

In addition, the following criteria will be used:

- The likelihood of a significant advance over existing knowledge, level of innovation, or breakthrough as compared to previous work;
- Scarcity of data, tools, information or analysis in new, relevant fields of research and education; and
- The research plan for the demonstration of feasibility.

B. Review Protocol and Associated Customer Service Standard

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Ad Hoc and/or panel review.

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.

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 Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

In most cases, proposers will be contacted by the Program Officer after his or her recommendation to award or decline funding has been approved by the Division Director. This informal notification is not a guarantee of an eventual award.

NSF is striving to be able to tell proposers whether their proposals have been declined or recommended for funding within six months. The time interval begins on the closing date of an announcement/solicitation, or the date of proposal receipt, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

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 Division 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.A. 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 (NSF-GC-1); * or Federal Demonstration Partnership (FDP) Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreement awards are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

*These documents may be accessed electronically on NSF's Website at <http://www.nsf.gov/awards/managing/>. Paper copies of these documents may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov.

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpm. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Website at <http://www.gpo.gov>.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for the PI and all Co-PIs. 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. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, 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.

VIII. CONTACTS FOR ADDITIONAL INFORMATION

General inquiries regarding this program should be made to:

- Kevin W. Lyons, Program Director, Directorate for Engineering, Division of Design and Manufacturing Innovation, 510 N, telephone: (703) 292-5365, fax: (703) 292-9056, email: klyons@nsf.gov
- Rajinder Khosla, Program Director, Directorate for Engineering, Division of Electrical & Communications Systems, 675 S, telephone: (703) 292-8339, fax: (703) 292-9147, email: rkhosla@nsf.gov
- Lawrence S. Goldberg, Senior Engineering Advisor, Directorate for Engineering, Division of Electrical & Communications Systems, 675 S, telephone: (703) 292-8339, fax: (703) 292-9147, email: lgoldber@nsf.gov
- Sohi Rastegar, Program Director, Directorate for Engineering, Division of Engineering Education & Centers, 585 N, telephone: (703) 292-5379, fax: (703) 292-9051, email: srastega@nsf.gov
- Ken P. Chong, Program Director, Directorate for Engineering, Division of Civil & Mechanical Systems, 545 S, telephone: (703) 292-8360, fax: (703) 292-9053, email: kchong@nsf.gov
- Alfonso Ortega, Program Director, Directorate for Engineering, Division of Chemical & Transport Systems, 525 N, telephone: (703) 292-8371, fax: (703) 292-9054, email: aortega@nsf.gov
- Leon Esterowitz, Program Director, Directorate for Engineering, Division of Bioengineering & Environmental Systems, 565 S, telephone: (703) 292-7942, fax: (703) 292-9098, email: lesterow@nsf.gov
- Rachelle D. Hollander, Senior Science Advisor, Directorate for Social, Behavioral & Economic Sciences, 905 N, telephone: (703) 292-7272, fax: (703) 292-9083, email: rholland@nsf.gov
- Priscilla Regan, Program Director, Directorate for Social, Behavioral & Economic Sciences, Division of Social and Economic Sciences, 995 N, telephone: (703) 292-7318, fax: (703) 292-9068, email: pregan@nsf.gov

For questions related to the use of FastLane, contact:

- telephone: 1-800-673-6188, email: fastlane@nsf.gov

IX. OTHER PROGRAMS OF INTEREST

The NSF *Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The NSF *Guide to Programs* is available electronically at <http://www.nsf.gov/cgi-bin/getpub?gp>. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF *E-Bulletin*, which is updated daily on the NSF Website at <http://www.nsf.gov/home/ebulletin>, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's *MyNSF News Service* (<http://www.nsf.gov/mynsf/>) to be notified of new funding opportunities that become available.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Awardees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities and persons with disabilities to compete fully in its programs. In accordance with Federal statutes, regulations and NSF policies, no person on grounds of race, color, age, sex, national origin or disability shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NSF, although some programs may have special requirements that limit eligibility.

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the GPG Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

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** (703) 292-5111
(NSF Information Center):

- **TDD (for the hearing-impaired):** (703) 292-5090

- **To Order Publications or Forms:**

Send an e-mail to: pubs@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; 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 applicant 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 needing information as part of the review process or in order to coordinate programs; 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," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). 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 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 this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Division of Administrative Services, National Science Foundation, Arlington, VA 22230.

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