

**PA RapidNanoNet for
Rapid Prototype/Characterization Fund**

A program of
The Nanotechnology Institute (NTI)

2012 Proposal Package

Funding under this program is made possible by the Commonwealth of Pennsylvania under the Ben Franklin Technology Development Authority and The Nanotechnology Institute.

PROGRAM DESCRIPTION

One of the most critical stages of technology commercialization is creating a prototype. When a technology is relatively new and groundbreaking, as nanotechnology is, the ability to secure prototyping/fabrication/characterization services is extremely limited.

The Nanotechnology Institute (NTI) is sponsoring a rapid prototyping and characterization network, the PA RapidNanoNet – focused on transforming early-stage ideas and inventions based on or enabled by nanotechnology into prototypes of commercial products. This network of facilities and experts aim to reduce the time and expense of prototype construction by enabling access to specialized facilities, instrumentation, equipment and expertise required for design, simulation, synthesis, fabrication, and characterization of nanotechnology-based products.

PA RapidNanoNet grants will provide funding to PA companies to use this network of facilities to move their technology towards commercialization. Activities will focus on industry-based developers of nano-innovations using regional providers and experts of advanced nanotechnology instrumentation and capabilities. Where necessary, the NTI will assist companies in identifying appropriate facilities.

NTI has assembled ten facilities that have agreed to participate in this network. Together these facilities represent one of the most comprehensive and extensive facility networks in the country. They occupy over 25,000 ft² of space providing cutting edge services with over 30 expert staff to assist researchers and companies. One is located at the National Institute of Standards and Technology (NIST), and the other facilities are located at six universities across Pennsylvania:

- Carnegie Mellon University
- Drexel University
- Lehigh University
- Pennsylvania State University
- University of Pennsylvania
- University of Pittsburgh

The remainder of this document contains an overview of the PA RapidNanoNet (page 2), post-award procedures (page 3), instructions for PA RNN proposals (page 4-9), and an appendix listing the participating facilities (page 11-13).

OVERVIEW

- Funding Period:** July 1, 2012 – December 31, 2013
- Submission Deadline:** Proposals will be reviewed upon receipt. Decisions will be made within six weeks.
- Eligibility:** Companies in Pennsylvania or willing to re-locate to Pennsylvania to work with one of the network facilities are eligible. Projects should increase the commercial value or alternative use of recent inventions and should show a clear path towards commercialization.
- Size of Award:** Up to \$10,000 per project
- Match:** A 1:1 cash match is required. Proposals that involve higher cash matching funds will be granted higher priority for selection.
- Budgeting:** 100% of the funds will go to the company to be used exclusively for expenditures at the designated network facility or facilities. This program runs on a reimbursement basis.
- Directions for Submission:** Submit one PDF file to:

Khalilah Parham Mangum, Program Administrator, BFTP/SEP
khalilah@sep.benfranklin.org
- Selection Criteria:** Projects must demonstrate the progression of a technology towards commercialization, i.e., products. They must also show why a specialized facility of the Pennsylvania RapidNanoNet (PA RNN) is needed and how the results will move the technology towards commercialization.

Questions: If you have any questions, please check our website first for the most up-to-date and complete information: <http://nanotechinstitute.org>. In addition, you may contact any member of the NTI Operating committee: <http://nanotechinstitute.org/about-nti/administration/operating-committee>

POST-AWARD PROCEDURES

Funding Availability: The funding detailed in this section is subject to the availability of state funds for NTI.

A. Funding Agreement

BFTP/SEP, as fiscal and administrative agent for the NTI, will enter into a contractual agreement with the company (the awardee) that will involve funds being contracted to participating research institutions.

B. Funds Disbursement

1. After execution of the contract agreement, invoices for reimbursement by BFTP/SEP to the company, along with supporting documentation that details the expenditures within the designated facility may be submitted on an as-needed basis to BFTP/SEP.
2. The final 10% may be invoiced together with the company's final project report which is required at the end of the project period.
3. Properly documented invoices are normally processed and checks mailed to companies within three (3) weeks of the receipt of the invoice by BFTP/SEP.

C. Reporting

Award recipients are required to submit a semi-annual progress report to BFTP/SEP. In addition, a final project report must be submitted to the Nanotechnology Commercialization Group (NCG). The final project report is a brief narrative description of the project accomplishments as per the milestones described in the proposal, and future project plans.

The Commonwealth of Pennsylvania requires a semi-annual performance survey of all funded projects. The survey includes information on the number of jobs created, the number of products commercialized, annual revenues, and the amount of private and/or other non-state funding raised. Awardees are required to keep accurate and verifiable records which can be submitted annually for three years.

D. Project Tracking & Management

The NTI's NanoCommercialization Group, on behalf of the NTI, will actively monitor the projects during the funding period. A specific NCG member will be designated to awardees for advice and consultation.

PA RAPIDNANONET (PA RNN) PROPOSAL INSTRUCTIONS

Proposals for PA RNN funding should include the following sections:

- I. Proposal Cover Pages (forms provided on subsequent pages)
 - A. Project Title
 - B. Company Information
 - C. Partner Facility Information
 - D. Proposed Budget
 - E. Signatures
- II. Non-Confidential Executive Summary (2 page limit; instructions on page 9)
- III. Technical Description (4 page limit; instructions on page 9)
- IV. Letter from Partner Facility(ies) (example letter on page 10)

NOTE: The Nanotechnology Institute (NTI) maintains the confidentiality of proposals.

The NTI staff and reviewers sign non-disclosure agreements with the NTI. NTI member universities/faculty have existing confidentiality agreements in place with the NTI, as a condition for their participation. Proposals should include enough information for reviewers to make informed decisions on the merits of the proposed work. All proprietary information should be clearly marked.

Questions: If you have any questions, please check our website first for the most up-to-date and complete information: <http://nanotechinstitute.org>. In addition, you may contact any member of the NTI Operating committee: <http://nanotechinstitute.org/about-nti/administration/operating-committee>

I. Proposal Cover Pages

A. Project Title

B. Company Information

Name of Company: _____
Name of Primary Contact: _____
Job Title: _____
Department: _____
Telephone: _____ Fax: _____
Street Address: _____
City: _____ State: _____ Zip: _____
E-Mail: _____
Web Site: _____

C. Partner Facility Information

1. Partner Facility #1

Name of Facility: _____
Name of Primary Contact: _____
Job Title: _____
Department: _____
Telephone: _____ Fax: _____
Street Address: _____
City: _____ State: _____ Zip: _____
E-Mail: _____
Web Site: _____

2. Partner Facility #2 (if needed)

Name of Facility: _____
Name of Primary Contact: _____
Job Title: _____
Department: _____
Telephone: _____ Fax: _____
Street Address: _____
City: _____ State: _____ Zip: _____
E-Mail: _____
Web Site: _____

D. Proposed Budget

Please complete the following proposed budget. Note that the funds will be awarded and paid to the company on a reimbursement basis.

NTI Request / Overall Budget:

NTI (max. \$10,000): a. \$ _____

Company Match (min 1:1 Cash) b. \$ _____

Total Facilities Costs (a + b = c): c. \$ _____

- No overhead may be charged to this award.
- NTI understands that costs in this budget are estimates, and will not exactly match actual costs incurred. Modest changes in the amounts charged are allowed.
- The project must be concluded and all funds expended by 12/31/2013.

Disclaimer: The submission of the proposal shall not create any rights on behalf of the submitter, contractual or otherwise. The submission of a proposal does not constitute or create any legally binding or enforceable agreement or commitment on the part of NTI other than to maintain the confidentiality of proposal information identified as confidential. No past or future action, or course of conduct by NTI, will give rise to or serve as a basis for any legally enforceable duties or obligations on NTI other than to maintain the confidentiality of proposal information identified as confidential.

E. Signatures

Authorized Official at Applicant Company:

Signature: _____ Date: _____

Name and Title: _____

Authorized Official at Partner Facility #1:

Signature: _____ Date: _____

Name and Title: _____

Authorized Official at Partner Facility #2 (if needed):

Signature: _____ Date: _____

Name and Title: _____

II. Non-Confidential Executive Summary (two pages)

Information provided in this Executive Summary may be used as needed by the NTI in public communications about NTI programs and initiatives. Grant applicant and partners acknowledge that information provided in the Executive Summary may be made available to the public at any time by any method.

Provide a two-page (maximum) non-confidential executive summary. Address items 1-5 below.

- 1) Summarize the proposed project, including clearly pointing out how the technology qualifies as pertaining to nanotechnology;
- 2) Describe the anticipated scientific, technological, and commercial impact of the project. The latter must provide the specific market need and opportunity for the technology and the specific commercial application(s);
- 3) Justify the need for access to the specialized facilities of the PA RNN.
- 4) Summarize the anticipated results of the project and next steps.
- 5) Explain the proposed budget. This justification should clearly show how PA RNN funds will be used to achieve project goals.

III. Technical Description (4 pages)

Describe the proposed project. Figures and references are included in the four page limit. Include the following items.

1. The goals and objectives of the proposed project.
2. The technological application(s) that form the basis of the project, including the commercial relevance and context of the proposed work.
3. The proposed scope of work planned in the partner facility(ies).
4. Specify the role of each partner facility, why access to the facility is required, specific resources of that facility to be utilized, and who will perform the work.
5. List the key personnel in the project. Summarize the relevant qualifications and experience of the project participants.
6. References should include literature publications and intellectual property (patents, disclosures, etc.) associated with the proposed project.

APPENDIX

NTI has assembled ten facilities that have agreed to participate in the PA RapidNanoNet. Together this network of facilities and experts represent one of the most comprehensive and extensive facility networks in the country. They occupy over 25,000 ft² of space providing cutting edge services with over 30 expert staff to assist researchers and companies. After this listing of facilities, each facility is described and contact information is provided.

Carnegie Mellon University

Nanofabrication Facility (<http://www.nanofab.ece.cmu.edu/>);

Drexel University

Centralized Research Facilities (<http://crf.coe.drexel.edu/instruments/>);

Lehigh University

Center for Advanced Materials and Nanotechnology (<http://www.lehigh.edu/nano/>)

Nanocharacterization Laboratory (<http://www.lehigh.edu/~inmicro/>).

National Institute of Standards and Technology

Center for Nanoscale Science and Technology (CNST) <http://www.nist.gov/cnst/>

Pennsylvania State University

Penn State Nanofab [National Nanotechnology Infrastructure Network \(NNIN\)](#);

University of Pennsylvania

Nano-Bio Probe Facility (<http://www.nanotech.upenn.edu/facilities.html>);

Penn Regional Nanotechnology Facility (<http://www.seas.upenn.edu/nanotechfacility/>);

Wolf Nanofabrication Facility (<http://www.seas.upenn.edu/~nanofab/index.html>),

University of Pittsburgh

NanoScale Fabrication and Characterization Facility (NFCF,

<http://www.nano.pitt.edu/facilities>.

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The **Carnegie Mellon Nanofabrication Facility** (<http://www.nanofab.ece.cmu.edu/>) is one of the most well equipped university-based facilities for thin film and nano/micro device development in the United States. The Nanofab includes a cleanroom with 2,600 square feet of class 100 space and 1,200 square feet of class 10 space, as well as three thin film labs. The Nanofab is a self- supporting facility managed by the Electrical & Computer Engineering Department.

Contact:

Chris Bowman, Director, Nanofabrication Facility

412-268-2471

ccbowman@ece.cmu.edu

Drexel University's Centralized Research Facilities (<http://crf.coe.drexel.edu/instruments>) housed within the Bossone Research Enterprise Building include instrumentation for scanning and transmission electron and focused ion beam microscopy and lithography, X-ray photoelectron spectroscopy, electron-beam and polymer imprint lithographies, and state-of-the-art X-ray diffraction facilities. The CRF represents the only user facility in the region for the study of ultrafast and terahertz science and technology, with major instruments acquired through the support of the National Science Foundation. With the support of a recently awarded \$1.2M NSF infrastructure grant, a renovation of the Drexel cleanroom for nano- and micro-fabrication is underway. Occupying ~6000 ft² on Drexel's main campus, instruments, training activities and analytic services are supported by three full-time PhD staff scientists to a regional user base of hundreds of users from academia and industry.

Contact:

Jonathan E Spanier
Associate Professor of Materials Science & Engineering
Associate Dean | College of Engineering
215.895.2301
spanier@drexel.edu

Lehigh University's Center for Advanced Materials and Nanotechnology (CAMN) supports companies in need of expertise or laboratory resources (<http://www.lehigh.edu/~inmicro/>). **Lehigh University's Nanocharacterization Laboratory** contains one of the largest electron microscopy facilities in the U.S., with a suite of ten scanning, transmission and scanning/transmission instruments suited for imaging and analyzing nanoscale structures. Lehigh is the only university with two aberration-corrected electron microscopes, capable of imaging on a sub-nanometer scale. These include the world's highest resolution X-ray analytical microscope - a unique instrument custom designed for nanoscale analysis and imaging. The facility also houses a focused ion beam instrument, an electron beam lithography system, and an electron microprobe. There are complete specimen preparation facilities including a Gatan PIPS, plasma cleaner, chemical jet polishers, dimplers, wire saws, diamond cutting wheels and a comprehensive metallographic suite. Extensive software for digital image acquisition, manipulation, and data analysis is available.

Contact:

Gene A. Lucadamo, M.S.Ch.E.
Industry Liaison
Lehigh University
Center for Advanced Materials and Nanotechnology Whitaker Laboratory
5 East Packer Avenue
Bethlehem, PA 18015-3194
Tel: (610) 758-4855
Fax: (610) 758-3526
www.lehigh.edu/nano
www.lehigh.edu/lmn

The **Center for Nanoscale Science and Technology (CNST)** is a national user facility purposely designed to accelerate innovation in nanotechnology-based commerce. Under the auspices of the **National Institute of Standards and Technology (NIST)**, CNST's mission is to operate a national, shared resource for nanoscale fabrication and measurement and develop innovative nanoscale measurement and fabrication capabilities to support researchers from industry, academia, NIST and other government agencies in advancing nanoscale technology from discovery to production. The Center, located in the Advanced Measurement Laboratory Complex on NIST's Gaithersburg, MD campus, disseminates new nanoscale measurement methods by incorporating them into facility operations, collaborating and partnering with others, and providing international leadership in nanotechnology. (http://www.nist.gov/cnst/upload/CNST_brochure.pdf). The CNST is the only national nanocenter with a focus on commerce. The CNST's shared-use NanoFab gives researchers economical access to and training on a state-of-the-art tool set required for cutting-edge nanotechnology development.

Contact:

Lloyd J. Whitman, Deputy Director
Center for Nanoscale Science and Technology
National Institute of Standards and Technology
100 Bureau Drive, MS 6200
Gaithersburg, MD 20899-6200 USA
Whitman, Lloyd J Dr. <lloyd.whitman@nist.gov>
1-301-975-8002

The Penn State Nanofab facilities, supported through the National Science Foundation's National Nanotechnology Infrastructure Network (NNIN), consists of approximately 6000 square feet of clean room space and over 3000 square feet of supporting non-clean lab space. The facility makes available specialized instruments and technical support in areas that mirror Penn State's faculty research strengths, including chemical and molecular-scale nanotechnology; electronics, optics, and MEMS; materials and physical sciences; and education. The technical staff have made significant progress in transitioning nanoscale materials synthesis, chemical and molecular film patterning and deposition, complex ferroelectric oxide thin film deposition, and device fabrication processes from leading PSU research centers and faculty labs to the open-access user facility.

Contact:

Jaime Reish
814-865-7348
jdr15@psu.edu

The **University of Pennsylvania** hosts several major nanotechnology user facilities served by a total of five full-time staff members. These include: (1) **Wolf Nanofabrication Facility** (<http://www.seas.upenn.edu/~nanofab/index.html>), a cleanroom facility that houses a suite of tools for micro- and nano-fabrication, including optical and electron beam lithography, vapor deposition, etching, packaging, and electrical testing; (2) **Penn Regional Nanotechnology Facility** (PRNF, <http://www.seas.upenn.edu/nanotechfacility>) specializes in nanoscale characterization and fabrication. Staff provide expertise in the analysis of nanotubes, nanowires, polymers, ceramics, composites, metals, electronics, and thin films for a diverse group of academic and regional corporate users; and (3) **NBIC Probe Facility**, a unique instrumentation center serving as an incubator for new probes of nano-structure and behavior. It is equipped with a suite of nine advanced scanning probe systems, electronic transport tools, and optical probes operating in fluid, ambient, or vacuum environments. <http://nanotech.upenn.edu/facilities.html>.

Contacts:

The Wolf Nanofabrication Facility
Helen Anderson, Administrative Director
215-898-2899
anderson@seas.upenn.edu

The Penn Regional Nanotechnology Facility
Dr. Douglas Yates, Technical Director
215-898-2013
dmyates@seas.upenn.edu

The NBIC Probe Facility
Dr. Matthew Brukman
215-746-2373
mbrukman@seas.upenn.edu

The **University of Pittsburgh's** NanoScale Fabrication and Characterization Facility (NFCF, <http://www.nano.pitt.edu/facilities>) is a user facility in a 4,000 ft² cleanroom environment (class 100, 1,000 and 10,000 areas). NFCF is designed to support fabrication and characterization of nanoscale materials and structures, and integration of devices at all length scales. The facility houses advanced equipment with core nano-level (20 nm or below) capability for fabrication and characterization, including an electron-beam lithography system, a dual-beam system, plasma etching, thin film deposition, TEM, multifunctional scanning probe station, and modular XRD.

Contact:

Susheng Tan
Sut6@pitt.edu
412-383-5978