

National Nanotechnology Initiative: Facilitating Tech Transfer & Commercialization

Naval-Industrial R&D Partnership Conference 2004
August 5, 2004

E. Clayton Teague

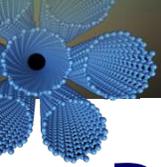
Director

National Nanotechnology Coordination Office

Nanoscale Science, Engineering, and Technology Subcommittee

Committee on Technology

National Science and Technology Council



Please check out the NNI Website

www.nano.gov

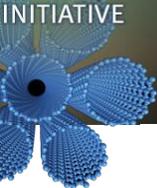
NNCO working to provide access to:

- § **News on NNI activities, workshops, and reports**
- § **Latest news on nanotechnology - subscription to listserve with daily updates**
- § **Ongoing announcements of solicitations**
- § **Up-to-date reporting of nanotechnology workshops and conferences**
- § **Information for educators - K12 to post graduate**



Key Messages About the NNI

- § Successful in assisting American entrepreneurs to take nanotechnology from the laboratory to the marketplace by:
 - § Developing foundation of fundamental R&D
 - § Supporting applied R&D targeted at national priorities
 - § Providing easily accessible, forefront, best-in-the-world user facilities and equipment
 - § Directing part of the SBIR and STTR programs to nanotechnology commercialization
 - § Developing skilled and knowledgeable workforce through funding of education and training opportunities at K-12, technical, undergraduate, graduate, and post-graduate levels
- § Having a growing and significant economic impact in the Federal government and in private industry
- § Ensuring responsible development of nanotechnology by investing in research to understand the social, ethical, health, and environmental implications of the technology



Federal Investments in R&D

Total: \$127 Billion

Requested for FY 2004

by President Bush

A 8% increase over FY 2003

Source: AAAS as of 1/25/2004

For Nanotechnology: \$961 Million

Estimated for FY 2004

A 11% increase over FY 2003

Source: OMB as of 2/4/2004 with corrected DOD funding

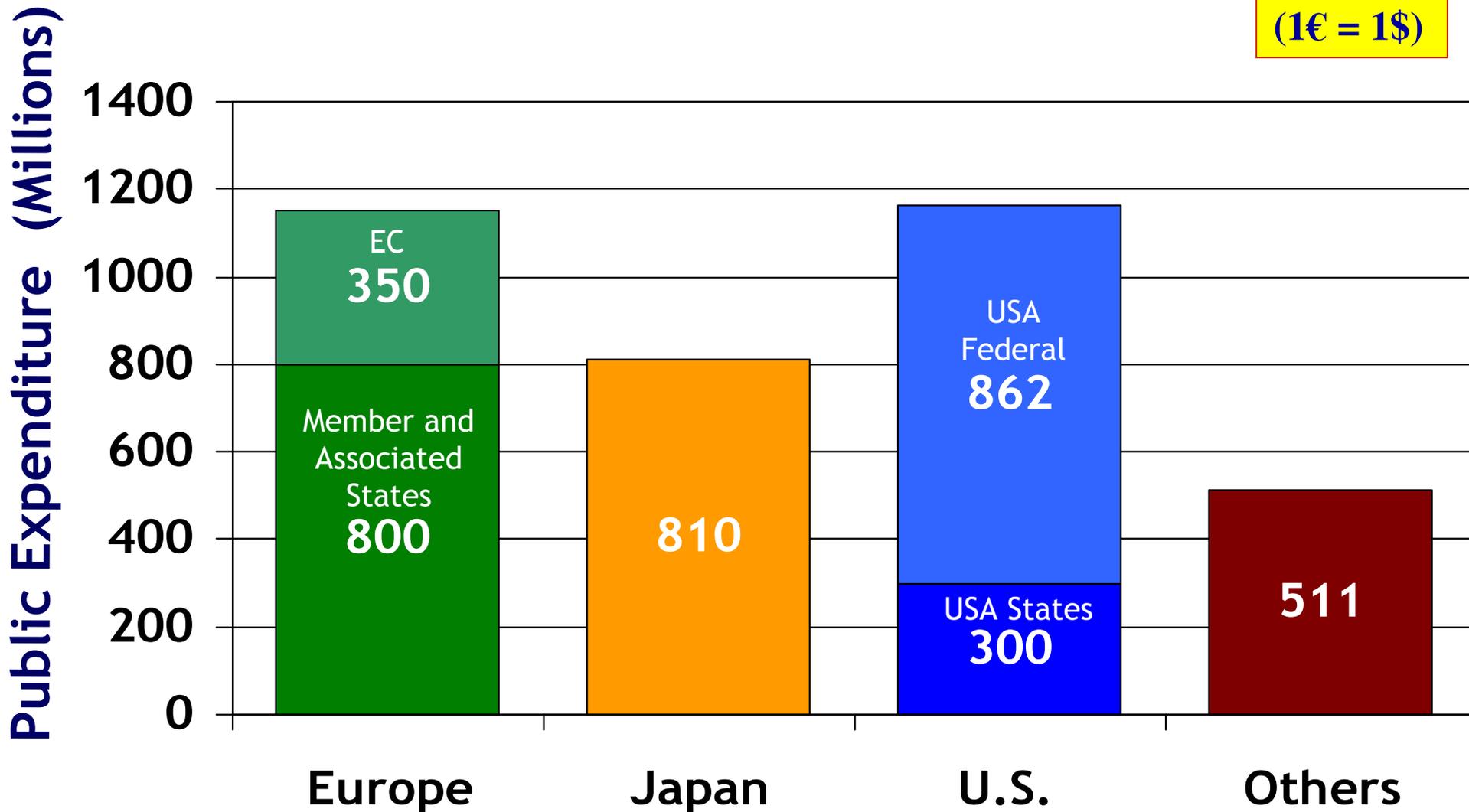
***New 21st Century Nanotechnology Research and
Development Act : Authorizes \$3.7 billion
over FY 05-08 for five agencies***

Overwhelming support by both houses of Congress

Signed by President Bush on 12/3/03



2003 Public Expenditure in Nanotechnology



From "Towards a European strategy for nanotechnology" Published May 12, 2004
- USA Federal updated by NNCO

NNI Centers of Excellence

Provide opportunities & support for multi- & inter-disciplinary research
Encourage collaboration among academia, industry & government researchers
Foster relationships that enhance transition from research to applications

9 NSF Nanoscale Science and Engineering Centers (NSECs)

- § Nanoscale Systems in Information Technologies - Cornell
- § Nanoscience in Biological & Environmental Engineering - Rice
- § Integrated Nanopatterning and Detection - Northwestern
- § Electronic Transport in Molecular Nanostructures - Columbia
- § Nanoscale Systems and Their Device Applications - Harvard
- § Directed Assembly of Nanostructures - Rensselaer Polytechnic Inst.
- § Nanobiotechnology Science and Technology Center - Cornell
- § Center for Scalable and Integrated Nanomanufacturing- UCLA
- § Nanoscale Chemical Electrical Mechanical Manufacturing Systems Center- UIUC

3 DOD centers

- § Institute of Soldier Nanotechnologies - MIT
- § Center for Nanoscience Innovation in Defense - UCSB
- § Nanoscience Institute- NRL

4 NASA centers

- § Institute for Cell Mimetic Space Exploration - UCLA
- § Institute for Intelligent Biomaterials & Structures for Aerospace Vehicles - Texas A&M
- § Bio Inspection, Design, and Processing of Multifunctional Nanocomposites - Princeton
- § Institute for Nanoelectronics and Computing- Purdue

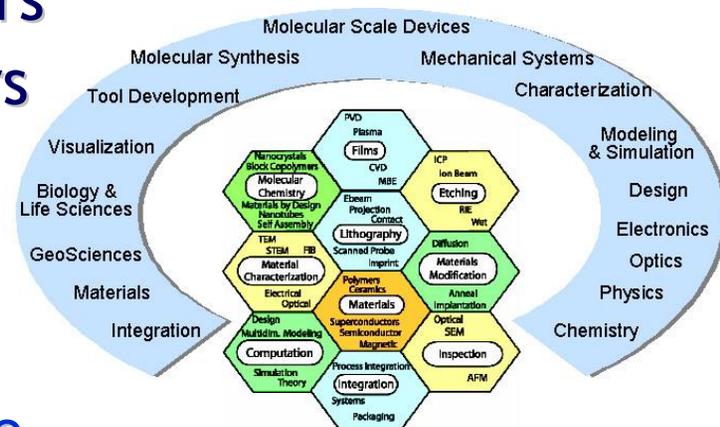
NNI Research Infrastructure

Forefront, best-in-the-world instrumentation and **user** facilities for nanotech researchers

- ⌘ make accessible to virtually all researchers
- ⌘ fabrication & characterization
- ⌘ measurements, standards, & data
- ⌘ simulation and modeling capabilities

- fi NSF National Nanotechnology Infrastructure Network (NNIN)
- fi NSF Network for Computational Nanotechnology (NCN)
- fi DOE Nanoscale Science Research Centers (NSRCs)
- fi NIST Center for Neutron Research (NCNR)

NNIN - 13 Universities



NCN - Purdue - Central Node

National Nanotechnology Infrastructure Network



- § Cornell Nanoscale Science and Technology Facility (CNF)
- § Stanford Nanofabrication Facility (SNF)
- § Nanotech at UC Santa Barbara
- § Materials Science Research Center of Excellence at Howard University
- § Solid State Electronics Lab at U. Michigan Ann Arbor
- § Penn State Nanofabrication Facility
- § Microtechnology Lab at U. Minnesota
- § Center for High Technology Materials at U. New Mexico
- § Center for Nanotechnology at U. Washington
- § Microelectronics Research Center at Georgia Tech
- § Center for Imaging and Mesoscale Structures at Harvard University
- § Microelectronics Research Center at U. Texas Austin

Network for Computational Nanotechnology (NCN)

To help
move nanoscience to nanotechnology
by connecting experiment, theory, simulation,
and computation in a new way *and* to
become a resource to the NNI

nanoHUB

Online Simulation and More

- Nano Electronics
- Nano Bio
- NEMS

an initiative led by the Network for
Computational Nanotechnology

NSF

NCN

~ 400,000 simulations to date

Purdue University
Northwestern University
Morgan State University
Stanford University

University of Florida
University of Illinois
University of Texas at El Paso

On-Line Simulation

- Electronics
- NEMS
- Materials
- Chemistry
- ECAD
- Devices
- Process
- General Productivity
- Tool Index

Resources

- Courses
- Short Courses
- Seminars

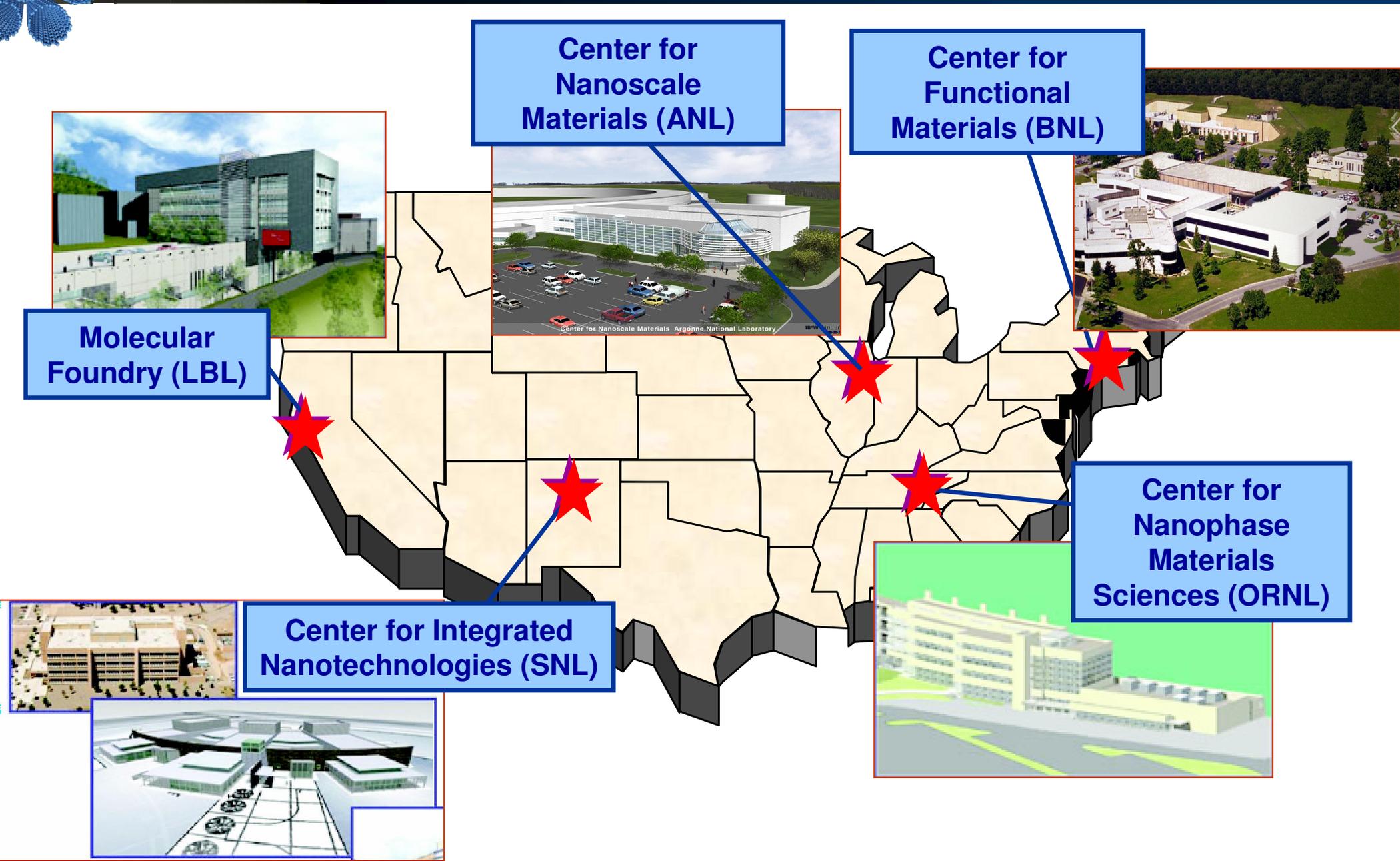
Education

- Nano Curriculum
- Summer Institute
- Summer Schools

Community

- Nanocomputing Debate
- Forums
- Repository

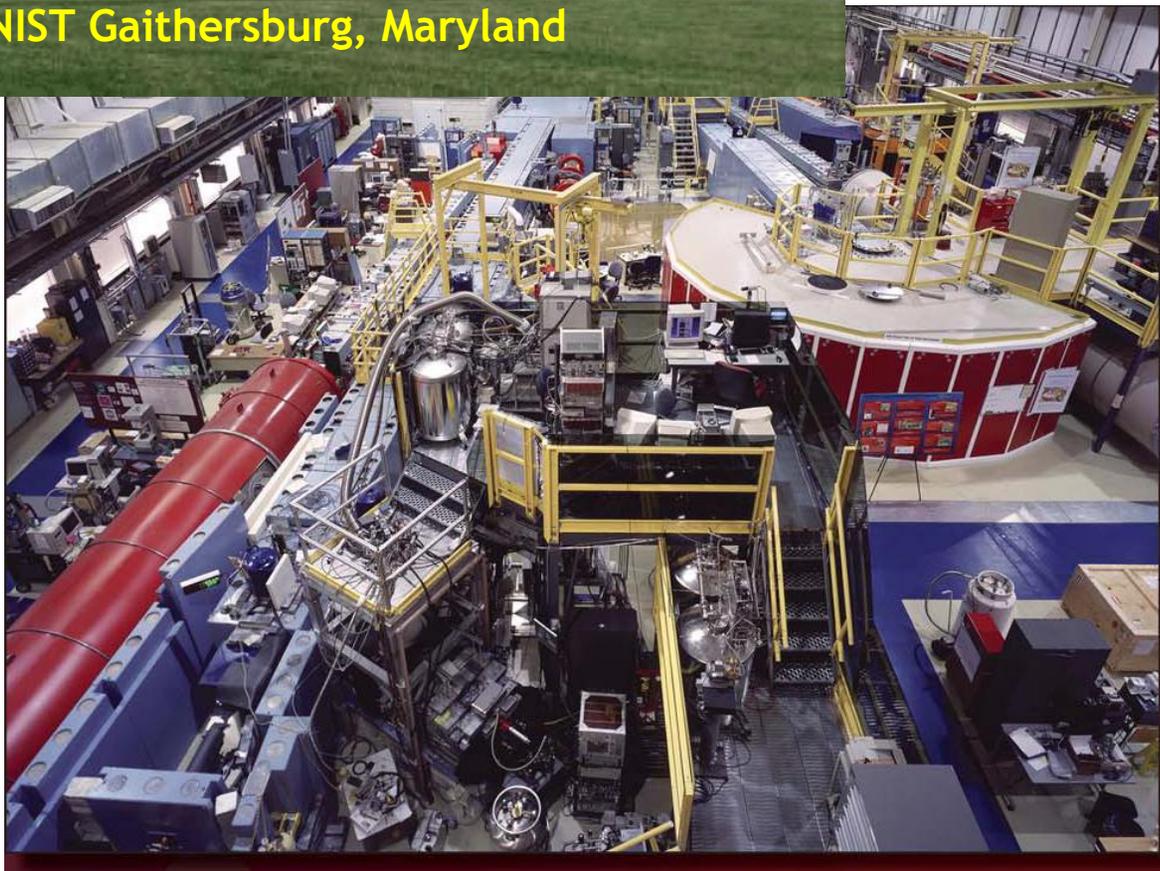
DOE Nanoscale Science Research Centers



NIST Center for Neutron Research



NIST Gaithersburg, Maryland



- § 29 experiment stations
- § www.ncnr.nist.gov
- § Operated as a major national user facility
- § Merit-based access made available to the entire U.S. technological community
- § Each year, over 1700 research participants use the facility for measurements

Small Times Study of Nano "Industry"

- § Nanotechnology Companies and Organizations in the United States
 - § Headquartered in US or with major business activity in US
- § Manufacturing, conducting R&D in "nano space," or equipment suppliers and in compliance with the US NNI definition of nanotechnology - 425
- § Organizations providing supplies, materials, or professional services to companies in this space
- § Industry associations and nanotech-focused economic initiatives
- § Identified 775 companies, organizations and agencies complying with strict selection criteria
- § Identified 23,000 new jobs in nano "pure plays" - that is, companies for whom nanotechnology R&D, manufacturing, and applications is a sole focus



SBIR and STTR Funding for Nanotechnology

- § Phase I and Phase II Grants by NNI Member Agencies
- § For FY2003, funding for nano-related projects was about 3.5% of \$2 billion total for SBIR and STTR awards

	2001	2002	2003
Number of SBIR/STTR Projects	261	300	338
Total Funding in \$millions	47.5	63.2	69.2

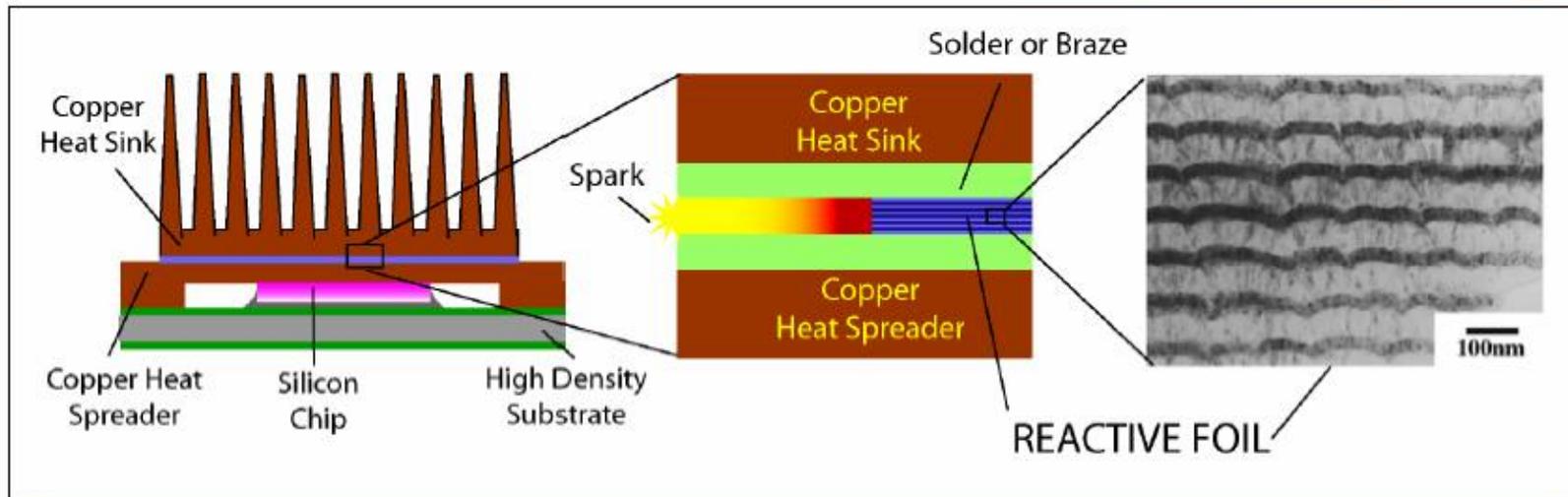
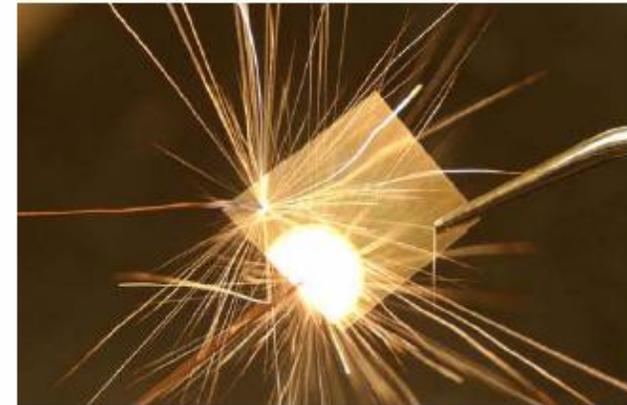
- § Each year 40% of companies receiving SBIR/STTR funding were in Small Times nanotechnology companies* list
- § Currently, 117 of 430 (27%) companies* in Small Times list received SBIR/STTR funding

* Companies conducting manufacturing, R&D, or equipment suppliers

NanoFoil™

A local heat source for soldering and brazing

Thousands of nanoscale layers (Ni and Al)
Layers mix and react to produce heat
Computer designed and patented

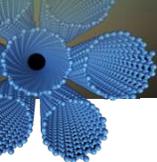


Local heating avoids thermal damage to the chip



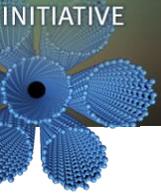
Reactive NanoTechnologies
Hunt Valley, MD

www.rntfoil.com



NSET Industrial Liaison Working Group

- § NNI beginning 2nd cycle of strategic planning - seeking industrial input for this exercise
- § Establishing collaboration with industrial groups representing major industrial sectors
 - § Multi-sector industries - Industrial Research Institute
 - § Electronics sector - Semiconductor Research Corporation
 - § Chemical sector - Council for Chemical Research
 - § Pharmaceutical - Pharmaceutical Research & Manufacturers for America, PhRMA
- § Communication w/industry to achieve greater utilization of Centers of Excellence and Infrastructure
- § Joint announcements with industrial groups
 - § Beyond CMOS with NSF/SRC
 - § Strongly related to agency mission
 - § Co-reviewed by industrial group
- § Primary focus on U.S. industry groups



- § Please check out the NNI Website
www.nano.gov
- § NNCO working to provide access to ongoing announcements of solicitations and up-to-date reporting of workshops and conferences
- § Please take advantage of NNI User Facilities and encourage others to do the same - most are free on a competitive basis for non-proprietary work
- § Be aware and take advantage of small business/tech transfer programs