

Exploratory Research. Information on NSF-supported nanotechnology research is available at NSF's NNI Web Site, <http://www.nsf.gov/nano>.

## Discussion

A participant asked whether NSF-supported nanotechnology research is available on the NSF Web Site. Dr. Ekstein responded that it is available on the NSF Web Site under "Awards."

### ***The National Institute for Occupational Safety and Health Nanotechnology Program*** **Vladimir Murashov, Office of the Director, NIOSH**

NIOSH is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In 2004, NIOSH created the Nanotechnology Research Center in response to public concern over nanotechnology implications. The NIOSH Nanotechnology Program has developed four strategic goals. The first goal is to understand and prevent work-related injuries and illnesses potentially caused by nanoparticles and nanomaterials. NIOSH is addressing this goal via research on risk assessment and risk management of nanotechnology in the workplace, including toxicology, metrology, control technology, exposure assessment, medical surveillance and guidance, and safety research. The report, *Progress Toward Safe Nanotechnology in the Workplace*, released in 2007, addresses research progress in 10 key areas, research gaps, continuing project plans, and opportunities for collaboration. The second strategic goal of the NIOSH Nanotechnology Program is to promote healthy workplaces through interventions, recommendations, and capacity building. NIOSH is addressing this goal in a number of ways. For example, the NIOSH field team partners with employers to assess exposures in the workplace and the effectiveness of control technologies in the mitigation of those exposures. In addition, NIOSH has developed best practice guidelines for the workplace in the regularly updated report, *Approaches to Safe Nanotechnology: An Information Exchange with NIOSH*. The third strategic goal is to enhance global workplace safety and health through national and international collaboration on nanotechnology. To achieve this goal, NIOSH is engaging in a number of activities, including: (1) collaborations with companies; (2) participation in interagency working groups; (3) participation in the International Organization for Standardization TC 229 Nanotechnology Working Group on Health, Safety, and Environment; (4) collaboration with the Organisation for Economic Co-operation and Development (OECD); and (5) collaboration with the World Health Organization. The fourth strategic goal of the NIOSH Nanotechnology Program is to conduct research to prevent work-related injuries by applying nanotechnology products. To achieve this goal, NIOSH is examining the application of nanotechnology and nanomaterials to the development of filters, sensors, and protective clothing for occupational safety.

NIOSH Nanotechnology Program funding has increased to more than \$6 million in 2007; this includes funding for extramural programs, which has remained steady at approximately \$1 million per year. NIOSH engages in intramural activities related to nanotechnology, including: (1) the National Occupational Research Agenda: Nanotechnology Safety and Health Research Program; (2) the NIOSH Nanotechnology Research Center; (3) the Nanotechnology Research Supplement; and (4) Nano-related Division Projects. NIOSH also funds nanotechnology research through research grants, joint RFAs, and contracts to address specific needs. Information on NIOSH extramural programs can be found at <http://www.cdc.gov/niosh/oep/> and at <http://www.grants.gov>. Since 2004, NIOSH has been engaged with EPA, NSF, and NIEHS in the joint RFA, "Nanotechnology Research Grants: Investigating Environmental and Human Health Issues." From this RFA, up to \$8 million has been spent each year to support 15–25 research grants and exploratory grants, with up to \$1 million per year from NIOSH. Research funded by NIOSH addresses the Institute's mission to provide leadership in preventing work-related illnesses and injuries. In FY 2007, NIOSH has worked jointly with the National Institutes of Health (NIH) and EPA on an NIH-led RFA, "Manufactured Nanomaterials: Physico-chemical Principles of Biocompatibility and

Toxicity.” From this RFA up to \$4.1 million per year will support 10–15 research grants and exploratory grants, including up to \$0.5 million from NIOSH.

**National Institute of Environmental Health Sciences Activities on Nanotechnology: Nanoscale Science and Toxicology**

**Nigel Walker, NIEHS, NIH**

Nanotechnology activities at NIEHS include research conducted or funded by NIEHS. Researchers in the Division of Intramural Research (DIR), such as those in the National Toxicology Program (NTP), investigate the applications of nanotechnology and characterize nanomaterials. Materials characterized by the NTP are available to researchers for collaborative efforts. DIR investigator-initiated research addresses the application of nanotechnology in EHS. The NTP’s areas of emphasis include: (1) exposure and dose metrics; (2) internal dose–pharmacokinetics in biological systems; (3) early biological effects and altered structure or function; and (4) adverse effects related to exposure to nanomaterials. Some common issues and recommendations regarding experimental strategies emerged from several workshops and reports, including the NTP Workshop on Experimental Strategies in 2004 and the International Life Sciences Institute (ILSI), Risk Science Institute (RSI) report (Oberdorster, et al. *Particle and Fibre Toxicology* 2005;2:8). In particular, it is important to traverse the continuum of human relevance and determine how *in vitro* and *in vivo* work should be integrated and to consider whether the materials being studied are the same materials to which humans ultimately will be exposed. The scientific focus of the NTP Nanotechnology Safety Initiative is to identify key physical–chemical features that govern nanomaterial safety. Materials currently under evaluation by NTP include quantum dots (QDs), titanium dioxide (TiO<sub>2</sub>), carbon fullerenes, nanoscale silver, multi-walled carbon nanotubes (MWNTs), nanoscale gold, and dendrimers. The NTP uses an open process whereby any member of the public can nominate nanomaterials and other environmental agents to be evaluated by NTP for toxicity. More information on NTP’s nanotechnology work can be found at <http://ntp.niehs.nih.gov/go/nanotech>.

Research is funded by NIEHS through the Division of Extramural Research and Training. Extramural research regarding enabling technologies addresses the applications of nanotechnology, including the development of: (1) deployable environmental sensors for a broad range of environmental exposures; (2) biological sensors to link exposure with disease etiology; (3) intervention devices, such as drug delivery devices and other therapeutic nanoscale materials; and (4) remediation devices, including primary disease prevention through the elimination of exposure. Extramural research funded in the area of the fundamentals of biological response has included research funded under the FY 2006 joint solicitation among EPA, NSF, NIOSH, and NIEHS, “Human Health Effects of Manufactured Nanomaterials.” NIEHS funded three applications at \$400,000 per year for 3 years on transmembrane transport, cardiovascular toxicity, and oxidative stress. In addition, NIEHS is the lead agency on the joint solicitation with NCI, National Eye Institute, the National Human Genome Research Institute, the National Institute of Dental and Craniofacial Research, the National Institute of General Medical Sciences, EPA, and NIOSH in FY 2007, “Manufactured Nanomaterials: Physico-chemical Principles of Biocompatibility and Toxicity.” Approximately 10 grants will be funded from this RFA.

Through the NanoHealth Initiative, NIEHS is taking the next step by building on its investment and core competencies and partnering for integrated research success. The scope of the NanoHealth Initiative is to examine the fundamental physicochemical interactions of engineered nanomaterials (ENMs) with biological systems at the molecular, cellular, and organ level, as well as associated pathophysiologic processes. The rationale behind this initiative includes the acquisition of new knowledge of molecular, cellular, and organ system biology and the identification of clinically relevant properties of ENMs. This initiative is critical for the design of ENMs with maximum human and environmental biocompatibility and safety and will establish the scientific foundation of an emerging science.



# National Institute for Occupational Safety and Health

# National Institute for Occupational Safety and Health

# NIOSH Nanotechnology Program

## About NIOSH

*The National Institute for Occupational Safety and Health is:*

the U.S. Federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness



## NIOSH & Emerging Technologies

OSH Act directs NIOSH to "conduct special research, experiments, and demonstrations relating to occupational safety and health as are necessary to explore new problems, including those created by new technology in occupational safety and health."

29 USC 669 Sec. 20(a)(4)

## Concerns Over Nanotechnology Implications



## **NIOSH Goals Involving Nanotechnology**

- Understand and prevent work-related injuries and illnesses potentially caused by nanoparticles and nanomaterials
- Promote healthy workplaces through interventions, recommendations, and capacity building
- Enhance global workplace safety and health through national and international collaboration on nanotechnology
- Conduct research to prevent work-related injuries by applying nanotechnology products

## Understand and prevent work-related injuries and illnesses potentially caused by nanoparticles and nanomaterials

- Toxicology Research
  - Pulmonary effects in mice
  - Nanoparticles enter blood stream
  - Dermal effects
  - Nanoparticle generation system
- Metrology Research
- Control Technology Research
- Exposure Assessment
- Medical Surveillance and Guidance
- Safety Research

**Progress Toward Safe Nanotechnology in the Workplace**  
A Report from the NIOSH Nanotechnology Research Center  
DEPARTMENT OF HEALTH AND HUMAN SERVICES  
National Institute for Occupational Safety and Health  
NIOSH

- Research progress in 10 key areas
- Continuing project plans
- Opportunities for collaboration

[www.cdc.gov/niosh/topics/nanotech](http://www.cdc.gov/niosh/topics/nanotech)

### Promote healthy work places through interventions, recommendations, and capacity building

- NIOSH Field Team
- Approaches to safe nanotechnology: An information exchange with NIOSH
- NIOSH Topic Page
- Nanoparticle Information Library
- National and International Conference



[www.cdc.gov/niosh/topics/nanotech](http://www.cdc.gov/niosh/topics/nanotech)

**Approaches to Safe Nanotechnology:**  
An Information Exchange with NIOSH  
Draft for Public Comment  
DEPARTMENT OF HEALTH AND HUMAN SERVICES  
National Institute for Occupational Safety and Health  
NIOSH

- Recommendations from NIOSH
- Summary of issues
- Approaches to consider
- Basic Guidance
- Updated as new information comes on-line
- Input requested

[www.cdc.gov/niosh/topics/nanotech](http://www.cdc.gov/niosh/topics/nanotech)

**Nanoparticle Information Library (NIL)**

[www.cdc.gov/niosh/topics/nanotech/NIL.html](http://www.cdc.gov/niosh/topics/nanotech/NIL.html)

### NIOSH-sponsored conferences

**3rd International Symposium on Nanotechnology, Occupational and Environmental Health**  
第三屆國際奈米技術與職業及環境衛生研討會  
August 29 - September 1, 2007 [nano-taiwan.sinica.edu.tw/EHS2007/](http://nano-taiwan.sinica.edu.tw/EHS2007/)

**European NanoSH Conference –**  
Nanotechnologies: A Critical Area in Occupational Safety and Health  
3-5 December 2007  
Marina Congress Center, Helsinki, Finland  
The Conference will discuss global safety issues surrounding nanoparticles and nanotechnologies, in occupational safety and health, and will provide a forum for insight into future actions for assuring the safety, and thereby the future success of nanotechnologies.

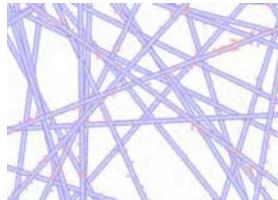
[www.ttl.fi/EuroNanOSH](http://www.ttl.fi/EuroNanOSH)

### Enhance global workplace safety and health through national and international collaborations on nanotechnology

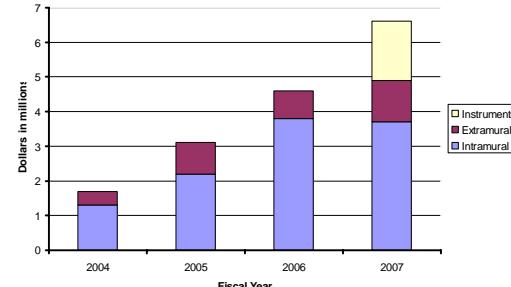
- Collaborations with various companies (e.g. DuPont, Altairnano, Luna Technologies)
- Participation in inter-agency working groups (NEHI, GIN)
- Participation in ISO TC 229 Nanotechnology Working Group on Health, Safety and Environment
- Collaboration with OECD
- Collaboration with WHO

## Conduct research to prevent work related injuries by applying nanotechnology products

- Examine applications for filters, sensors, and protective clothing



Electrospun nanofibers, NIOSH



## **NIOSH Nanotechnology Program Activities In Nanotechnology Research**

## I. Intramural

- i. National Occupational Research Agenda: Nanotechnology Safety and Health Research Program (2004-2008)
- ii. NIOSH Nanotechnology Research Center (2005-)
- iii. Nanotechnology Research Supplement (2006-2010)
- iv. Nano-Related Division Projects

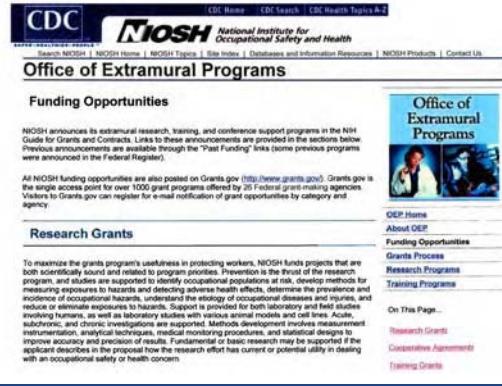
## II. Extramural

- i. Research Grants
- ii. Joint RFAs
- iii. Contracts

[www.cdc.gov/niosh/topics/nanotech/strat\\_plan.html](http://www.cdc.gov/niosh/topics/nanotech/strat_plan.html)

## Extramural Program

<http://www.cdc.gov/niosh/oep/>



## EPA-led Joint Research Solicitation

- Joint Request For Applications with EPA/NCER, NSF and NIH/NIEHS in FY 2004 through FY2006:
  - Nanotechnology Research Grants: Investigating Environmental and Human Health Issues.
- Up to \$8 million to support 15-25 research grants and exploratory grants (per year): up to \$1 million from NIOSH.
- Focus:
  - research to meet NIOSH mission of providing leadership in preventing work-related illnesses and injuries.

## NIH-led Joint Research Solicitation

- Joint Request For Applications with NIH, and EPA/NCER in FY2007:
  - Manufactured Nanomaterials: Physico-chemical Principles of Biocompatibility and Toxicity (R01)
- Up to \$4.1 million to support 10-15 research grants and exploratory grants: up to \$0.5 million from NIOSH.
- Focus:
  - to identify and investigate the relationships between hazardous working conditions and associated occupational diseases and injuries; to develop more sensitive means of evaluating hazards at work sites, as well as methods for measuring early markers of adverse health effects and injuries; to develop new protective equipment, engineering control technology, and work practices to reduce the risks of occupational hazards; and to evaluate the technical feasibility or application of a new or improved occupational safety and health procedure, method, technique, or system.



United States  
Environmental Protection  
Agency

# Proceedings of the Interagency Workshop on the Environmental Implications of Nanotechnology

SEPTEMBER 5 - 7, 2007  
WASHINGTON, DC

