

The NIOSH Nanotechnology Research Program

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Commercialization of NanoMaterials 2006

The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy



NIOSH – Introduction

- National Institute for Occupational Safety and Health, *part of:*
Centers for Disease Control and Prevention
U.S. Department of Health and Human Services
- Occupational Safety & Health Act (1970) established OSHA & NIOSH

... *To assure safe and healthful working conditions for all working men and women.*

NIOSH - research & recommendations

OSHA - regulatory & enforcement : Part of the Department of Labor

- NIOSH Nanotechnology Research Center & Steering Committee (since 2004):
Strategic planning on research to fill research gaps on occupational health and safety implications & applications of nanomaterials



NIOSH, Cincinnati

NIOSH Strategic Goals

- **Generate New Knowledge** — Conduct research to reduce work-related illnesses and injuries.
- **Transfer Research into Practice** — Promote safe and healthy workplaces through interventions, recommendations and capacity building.
- **Collaborate Globally** — Enhance global workplace safety and health through international collaborations.

Nanotechnology: The Challenge

- **Nanotechnology has great potential**
 - Revolutionary technology, driver of innovation
 - New material properties may yield great benefits
- **But there is risk**
 - New hazards and risks with heightened reactivity
 - Early results raise concern
- **Moving forward**
 - Minimize the risk
 - Cover the broad extent of exposure: R&D to uses

Scope of the Challenge

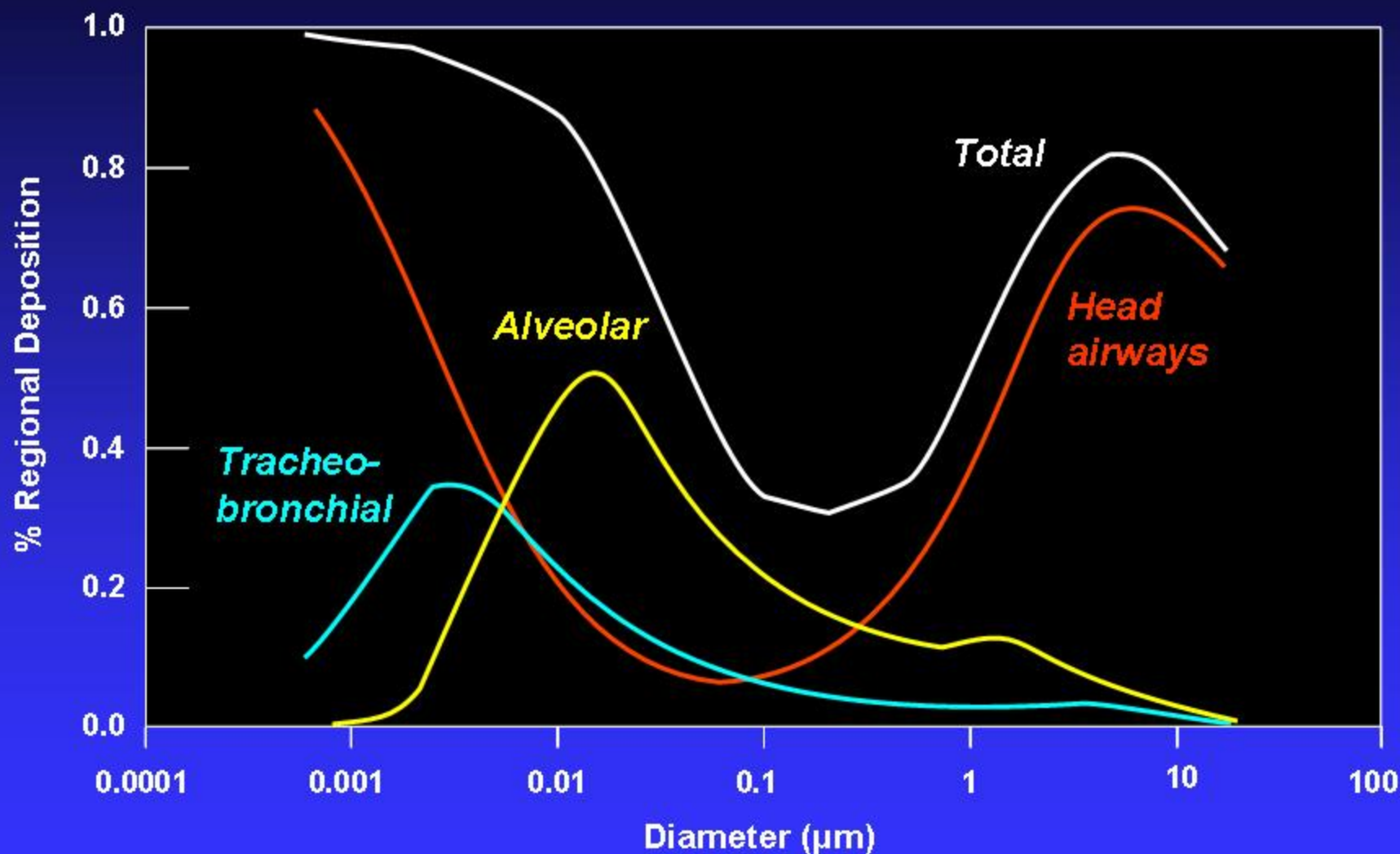
- Nanotechnology is evolving rapidly!
- A \$2.5 trillion business globally by 2014
- An estimated 1 million workers in R&D and production, or using nanomaterials or products.
- The US leads the world in investing and in the number of “Nanotech Companies”
- The global picture is changing!

The Concern: Adverse responses in humans exposed to airborne particles with ultrafine component*

- **Lung cancer:** elevated in some studies; no dose-response
Titanium dioxide, carbon black, diesel exhaust, welding fume
- **Fibrosis**
Beryllium, manganese, welding fume
- **Obstructive lung disease, respiratory symptoms**
Carbon black, air pollution
- **Cardiovascular effects**
Air pollution
- **Immunological response:** sensitization (dermal route)
Beryllium
- **Neurological, psychomotor** (route?)
Manganese

** Role of the ultrafine component is unknown*

Predicted Deposition of Inhaled Particles in the Human Respiratory Tract



ICRP (1994) model: light exercise, nose breathing.
0.1-0.5µm: minimal inertial and diffusion deposition mechanisms.

The Reality: Nanotechnology is 'Now'

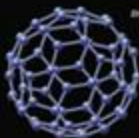
Selected consumer products

Nanoclay Composite



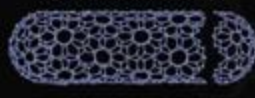
Easton CNT is Real Nanotechnology

The Bucky Ball



Discovered in the eighties, the Bucky Ball derives its name from noted architect Buckminster Fuller. Bucky carbon atoms, each sharing nearest bonds with three other carbon atoms, is similar to the structure of the carbon molecule.

The Carbon Nanotube (CNT)



Easton's Tiny Innovation is Huge

Easton has an eighty-three year history of leading the market by developing new materials and innovative products. Easton has been manufacturing sporting goods using carbon-fiber composites since 1989 and has been the leading brand of composite bicycle handlebars since their introduction in 1991.

Now Easton's research and development team is proud to announce a major breakthrough in composite materials and manufacturing.

The Next Frontier

Nanotechnology is the next frontier in scientific research and manufacturing. Nanotechnology deals with the manipulation of matter on the atomic or molecular scale measured in billionths of a meter (nanometers). Scientists worldwide are spending countless man-hours and billions of dollars on research and development for uses for nanotechnology in the areas of electronics, medicine, and structural reinforcement.

Enhanced Bicycle Systems

Carbon Nanotube Composite

NANotex[™]
Fabric

resists



Filtek[™] Supreme
Universal Restorative

Say goodbye to microfills and hybrids with our revolutionary new nanocomposite based restorative.

It's good to be king!

3M ESPE

Nanosilica Composite

...ed an iced latte in your lap, but you don't mind. ...a made with NANO-TEX[™] spill-resistant fabric, ...ids up and rolls right off.

...e conventional fabric ...l seen before, ...-Tex builds ...the very fibers ...s keeps the ...soft, and ...they should be.

...abric, you're looking good ...mplications roll away like water ...perience the breakthrough and ...er's next.



Nano fibers

What do we know?

What don't we know?

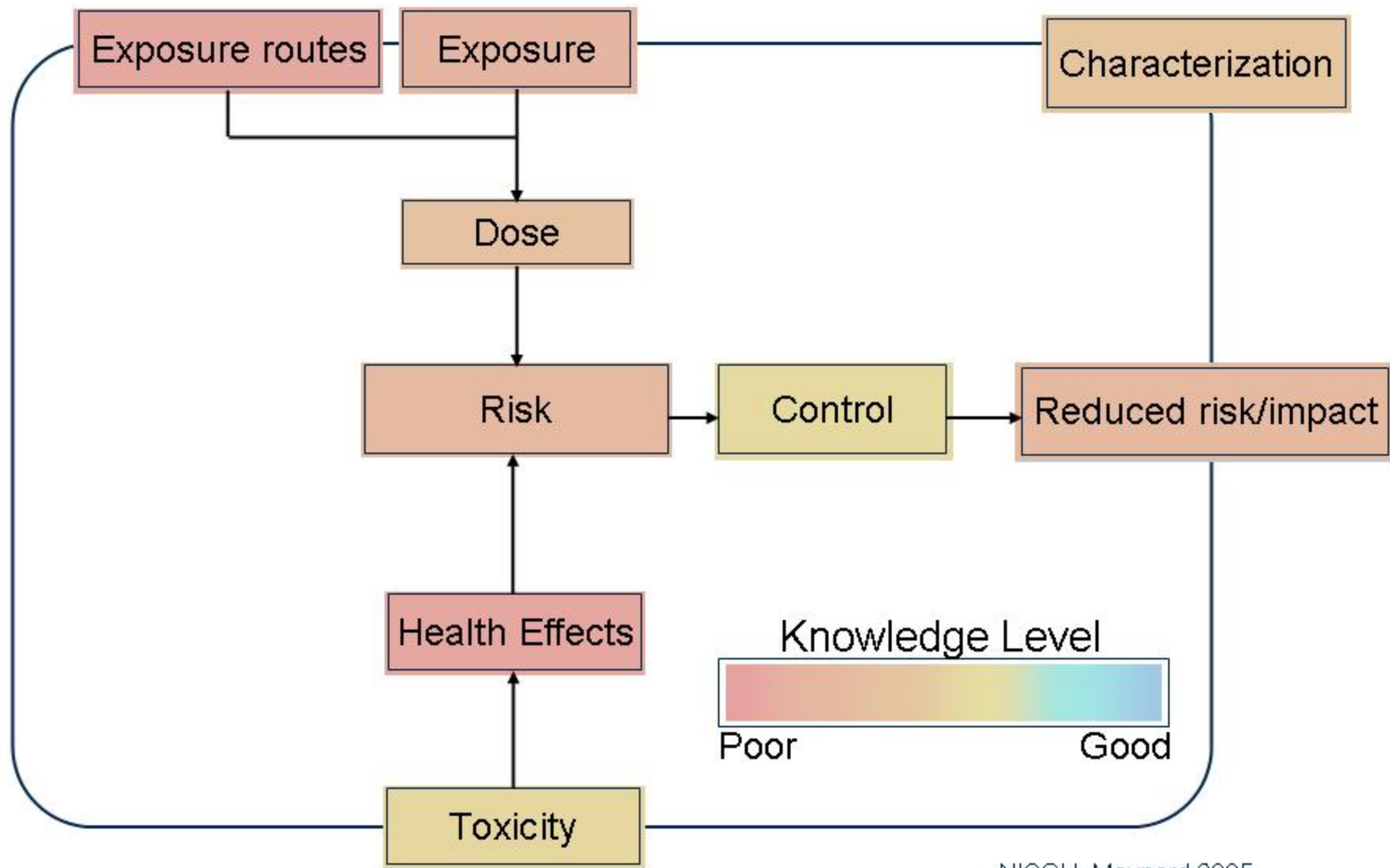
What Do We Know?

- There are no exposure limits specific to nanoparticles
- Health concerns exist
- Nanoparticles can be measured
- HEPA filters are efficient for nanoparticles
- N-95 respirators should provide protection
- A Risk Management Approach and current control approaches should work

What Don't We Know?

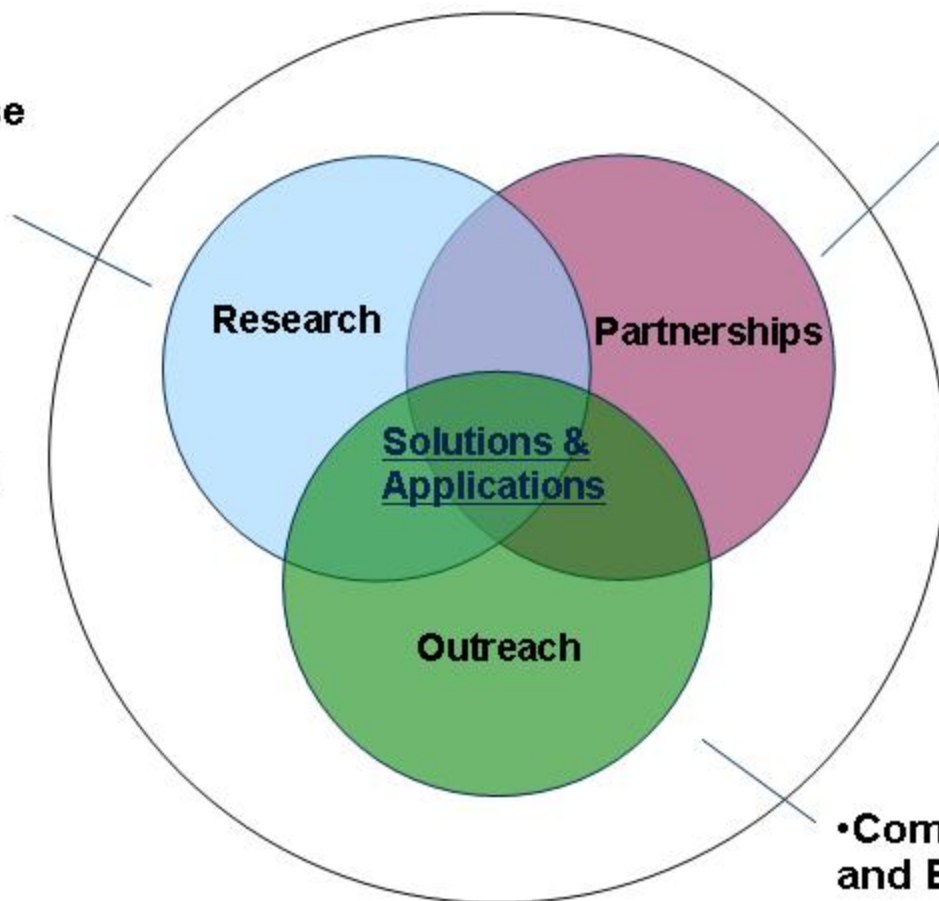
- Actual exposure experience
- Scope of potential exposure
- Specificity of measurements
- Effectiveness of controls
- Actual risk based on hazard (toxicology) and dose (exposure)

Nanotechnology: What Do We Know for Risk Management ?



The NIOSH Response: A Strategic Approach to Addressing Ten Critical Issues

- Toxicity
- Exposure and Dose
- Risk Assessment
- Measurement Methods
- Controls
- Safety
- Epidemiology and Surveillance
- Application



- Partners
Government
Academia
Industry
Labor
International

- Communication and Education
- Recommendations

Current Projects in the NIOSH Nanotechnology Research Center

Toxicity Studies: Pulmonary and Dermal
Aerosol Generation and Characterization
Dosimetry and Risk Assessment Methods
Exposure Methods Development
Filter Efficiency, Respirators, PPE
Ultrafine TiO₂
Web Page Development
Field Research and Medical Teams: Newest Initiative

NIOSH Information Resources

Nanotechnology topic page:

www.cdc.gov/niosh/topics/nanotech

- NIOSH Position Statement – Jan 2005
- NIOSH Nano Strategic Plan – Oct 2005
- Nanoparticle Information Library – Oct 2005
- TiO₂ Current Intelligence Bulletin – Nov 2005
- Approaches to Safe Nanotechnology: An Information Exchange with NIOSH – 2nd version, Aug 2006
- NIOSH exposure field team site visits
- Ongoing research studies and publications

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NIOSH National Institute for Occupational Safety and Health

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NIOSH Safety and Health Topic:
Nanotechnology

Nanotechnology at NIOSH

NIOSH is the leading federal agency conducting research and providing guidance on the occupational safety and health implications and applications of nanotechnology. This research focuses NIOSH's scientific expertise and its efforts on answering the questions that are essential to understanding these implications and applications.

- How might workers be exposed to nano-sized particles in the manufacturing or industrial use of nanomaterials?
- How do nanoparticles interact with the body's systems?
- What effects might nanoparticles have on the body's systems?

As part of this effort, NIOSH is conducting [strategic planning](#) and research, partnering with public and private sector colleagues from the United States and abroad, and making the information and interim recommendations widely available. As observers generally agree, research to answer these questions is critical to maintaining U.S. competitiveness in the growing and dynamic nanotechnology market.

Critical Topic Areas

NIOSH has identified **12 critical topic areas** to guide in addressing knowledge gaps, developing strategies, and providing recommendations.

Each topic provides a brief description of the research that NIOSH is conducting in the area of nanotechnology and the applications and implications of nanomaterials in the workplace.

Interim Recommendations

In "[Approaches to Safe Nanotechnology](#)," NIOSH invites information and comment from stakeholders. This information exchange will advance our shared understanding of the current scientific knowledge related to occupational safety and health issues. This living document also makes recommendations for interim steps to improve the safety of control technologies, work practices, and personal protective equipment demonstrated to be effective with other fine and ultrafine particles. These recommendations will be refined as more data become available.

Nanotechnology

Topic Index:

- Nanotechnology Home
- About Nanotechnology
- Critical Topics
- NIOSH Research
- For Public Comment
- News & Events
- Nanoparticle Information Library
- Other Resources
- Publications

NIOSH Nanotechnology Program Outreach: **Information Exchange**



Duke Energy Center
Cincinnati, Ohio



OHIO
UNIVERSITY



CMPND OH Polymer
PolymerOhio, Inc.

NT Occupational and
Environmental Health and
Safety: Research to
Practice

Cincinnati, OH

Dec 4-8, 2006

www.uc.edu/noehs/



3rd Int. Symposium on
Nanotechnology &
OSH

Taipei, Taiwan,
August, **2007**

VOLUNTEER PARTNERS NEEDED FOR THE NIOSH NANOTECHNOLOGY FIELD RESEARCH EFFORT

The function of the team is to characterize materials, processes, potential worker exposures, work practices, and control procedures in operations where nanomaterials are developed, manufactured, or used; covering the full range from R&D labs to production and use. Information and recommendations will be shared with the business partner being visited and will be used by NIOSH to periodically update the guidance that appears on the Nanotechnology Topic Page. **There is no cost to participate.**

**If your organization is interested in volunteering to participate,
please contact us.**

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