Nanotechnology Research in NIOSH

Vincent Castranova, PhD

National Institute for Occupational Safety and Health

Morgantown, WV

NIOSH Nanotechnology Research Center (NTRC)

I. Strategic Plan for NIOSH Nanotechnology Research and Guidance: Filling the Knowledge Gaps. DHHS (NIOSH) Publication #2010-105

II. Progress towards Safe Nanotechnology in the Workplace: A Report from the NIOSH Nanotechnology Research Center. DHHS (NIOSH) Publication #2010-104

www.cdc.gov/niosh

NTRC Research Program: 10 Critical Topic Areas

1. Toxicology and internal dose
2. Measurement methods
3. Exposure assessment
4. Epidemiology and surveillance
5. Risk assessment
6. Engineering controls and PPE
7. Fire and explosion safety
8. Recommendations and guidance
9. Communication and information
10. Applications

Toxicity and Internal Dose

I. Nanoparticles: TiO_2 (spheres and wires), carbon black, fullerenes, SWCNT (raw and purified), MWCNT (standard and functionalized), silicon nanowires, WC-Co, Ag (spheres and wires), Ni, Zn-O (standard and Fe-doped), quantum dots.

II. Test Systems:

   1. *In vitro* – alveolar macrophages, bronchial epithelial cells, fibroblasts, ketatinocytes, endothelial cells, mesothelial cells
   2. *In vivo* – pulmonary (IT, aspiration, inhalation)
      dermal (topical)

III. Target systems: pulmonary, cardiovascular system, brain, dermal

Measurement Methods

I. Measurement techniques:
   A. Size-selective particle counting
   B. Real time particle surface area measurements
   C. Size-fractionated mass distribution
   D. Elemental carbon for quantification of CNT

II. Practical measurement guidance: Nanoparticle Emission Assessment Technique (NEAT) (J Occup Environ Hyg 7: 127-132, 2010)

Exposure Assessment

I. Types of sites:
   A. Laboratories (Environ Health Perspect 118:49-54, 2010)
   B. Industrial (producers and users) (Ann Occup Hyg 54: 514-531, 2010) (J Occup Environ Hyg 4: D125-D131, 2007)

II. Types of nanoparticles: TiO_2, CNT, carbon nanofibers, Ag, Fe, Ni, quantum dots

Epidemiology and Surveillance

Defining Issues and Obstacles

I. Keystone Conference (July 2010): Nanomaterials and Worker Health: Medical Surveillance, Exposure Registries, and Epidemiologic Research Conference
II. Schulte et al. J Occup Environ Med 50: 517-526, 2008
III. Interim Guidance for Medical Screening and Hazard Surveillance for Workers Potentially Exposed to Engineered Nanoparticles. DHHS (NIOSH) Publication #2009-118.

Risk Assessment

I. Current Intelligence Bulletin: Evaluation of Health Hazard and Recommendations in Occupational Exposures to Titanium Dioxide

   - REL of 0.1 mg/m^3 for nanoTiO_2

II. Current Intelligence Bulletin: Occupational Exposure to Carbon Nanotubes and Nanofibers

   - REL of 7 µg/m^3 for CNT

Engineering Controls and PPE

I. Effectiveness of local exhaust ventilation
(J Occup Environ Hyg 5: D63-D69, 2008)

II. Effectiveness of respirators
(J Occup Environ Hyg 5:556-564, 2008)

Fire and Explosion Safety

- Experiments thus far indicate moderate combustibility

Recommendations and Guidance

I. CIB
   A. TiO2
   B. CNT
II. Medical screening and surveillance
III. Good handling practices
IV. Exposure measurement (NEAT)
V. International and national working groups

Communication and Information

I. Approach to Safe Nanotechnology: Managing the Health and Safety Concerns with Engineered Nanomaterials. DHHS (NIOSH) Publication #2009-125

II. NIOSH eNews

www.cdc.gov/niosh/eNews

Applications

Use of nanotechnology for real time sensors of workplace chemicals