

Safety Awareness for Work with Engineered Nanomaterials

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Ultrafine Particles

- Nanometer-diameter particles (up to 100 nm) that have not been intentionally produced but are the incidental products of processes involving combustion, welding, or diesel exhaust

Ultrafines - Toxicity

- Equivalent Mass Doses of Insoluble Ultrafine particles (smaller than 100 nm) are more potent than large particles of similar composition in causing pulmonary inflammation and lung tumors in laboratory animals

Engineered Nanomaterials

- Engineered Nanomaterials are Intentionally Produced
- Engineered nanomaterials may exhibit unique properties that are related to their physical size, shape, and structure as well as chemical composition

Particle Size

- Experimental studies in rats have shown that at equivalent mass doses, insoluble ultrafine particles are more potent than larger particles of similar composition in causing pulmonary inflammation, tissue damage, and lung tumors.
- SWCNT have been shown to produce adverse effects including granulomas in the lungs of mice and rats at mass doses at which ultrafine carbon black did not produce these adverse effects.

Surface Area, Structure, Surface Chemistry, Etc

- Experimental animal studies have shown that changes in the chemical composition, structure of the molecules, or surface properties of certain nanomaterials can influence their potential toxicity.

Health Effects and MSDS

- In the case of nanomaterials, the uncertainties (health effects) are great because the characteristics of nanomaterials may be different for those of the larger materials with the same chemical composition.
- Many (most ?) MSDS do not recognize the differences between nano and larger size particles

Deposition and Translocation

- Human and Animal Studies – Airborne Nanomaterials can deposit in the respiratory tract
- Animal Studies – Nanoparticles can enter the bloodstream and translocate to other organs

Routes of Exposure

- Inhalation
- Ingestion
- Skin Absorption / Penetration

Potential for Exposure

- Working in Liquid Media without gloves
- Working in Liquid Media where agitation may form respirable droplets
- Generating nanoparticles in the gas phase in non-enclosed systems
- Handling powders/ fibers where aerosolization may occur
- Equipment Cleaning and Maintenance
- Cleaning of Dust Collection Systems

Work Practices

- Keep work area clean – wet wipe or HEPA vacuum
- Wash hands – before eating / drinking / smoking
- Respiratory protection (N-95) may be needed for certain operations (cleanout of chamber used to grow carbon nanotubes)
- Use Gloves
- Handle in exhausted enclosures – Filter Exhaust if Significant Usage
- Disposal as hazardous waste

Recommendations for Achieving Hazard Awareness

- All Persons Working with Engineered Nanomaterials Should Complete Awareness Module
 - Short Powerpoint Presentation
 - Review of NC State Handling SOPs
 - Convey Requirement for Safety Awareness Module Completion to Those with Whom You Share Nanomaterials

Potential Funding Opportunities

- Characterization of Engineered Nanomaterials
- Characterization of Exposure to Engineered Nanomaterials
- Air Sampling, TEM, Particle Counters, Detailed Process Description

Reference

- Approaches to Safety Nanotechnology – Draft for Public Comment – NIOSH – 6/2006