

# Working Safely With Engineered Nanomaterials: A Safety Policy at the NCI- Frederick

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## Why a Policy?

- Concern and need to work with nanomaterials safely
  - A nanomaterial: at least one dimension less than 100nm; engineered at the atomic or near atomic scale to have unique properties
- Consistency with health and safety practices
- Reassurance for employees involved with nanomaterial research



## Published Regulations

- None currently exist
- Engineered nanoparticles may pose unusual risks due to unique composition, size, and ability to cross cell membranes



## It's the Little Things That Matter



- “Magic Nano”: Safety Recall
- A household glass and ceramic tile sealant in an aerosol can; sold in grocery stores in Germany
- 97 people claimed health problems, 6 hospitalized due to pulmonary edema



# Nanotechnology

- Nanoscale particles and devices are similar in size to biomolecules and can easily enter most cells
- Ability to manipulate the properties of these particles affords researchers the ability to engineer and use nanoparticles for drug delivery, as image contrast agents, and for diagnostic purposes



## Nano work at the NCI-Frederick

- The NCL
- <http://nci.cancer.gov/>



## The NCL

- Works in concert with the National Institute of Standards and Technology (NIST) and the U.S. Food and Drug Administration (FDA)
- A national resource and knowledge base for all cancer researchers
- Facilitate the regulatory review of nanotechnologies intended for cancer therapies and diagnostics



## In Search of...

- Other policies/guidelines
- General, e.g. comply with OSHA, CHP, BMBL, etc.
- Argonne Center for Nanomaterials (CNM)
  - Currently working on a specific safety policy





## Policies at other Institutions

DOE Policy P 456.1:

*“DOE will adopt and implement safety and health best practices, national consensus standards, and guidance relating to nanotechnology developed by standard-setting organizations...will identify and manage potential health and safety hazards ...through the use of Integrated Safety Management Systems...”*



## NIOSH Guidance

- H&S guidance: NIOSH
- Approaches to Safe Nanotechnology: An Information Exchange with NIOSH.  
[http://www.cdc.gov/niosh/topics/nanotech/nano\\_exchange.html](http://www.cdc.gov/niosh/topics/nanotech/nano_exchange.html)



# Unknown Toxicity

- Extremely limited tox data thus far
- Must assume nanomaterials are toxic
- Use same precautions when handling materials that are toxic or have unknown toxicity
  - NCI-F Chemical Hygiene Plan



# Control Measures

- EHS reviews all nanotechnology protocols
- EHS determines specific control measures on a case by case basis
- Hierarchy of controls
  - Engineering
  - Work practices
  - PPE
  - Administrative



# Engineering Controls

- Primary control for potential airborne exposures
- Aerosol control methods have not been well-characterized for nanoparticles;
- However, aerosol theory and limited experimental data indicate that conventional ventilation, engineering control and filtration approaches should be effective
  - Lee and Liu 1982, Hinds 1999, Maynard 2005



# Filtration of Nanoparticles

- HEPA filtration – worry about individual nanoparticles or aggregates?
  - Tested at 300 nm sized particles
- NIOSH - not much information available regarding particles in the 3-20nm range
  - Univ. of Minnesota researchers studying commonly used filter materials – effective with silver particles in the 3-20nm range



## Examples of when engineering controls are required

- Liquid media during pouring, mixing, agitation
- Generating nanoparticles in the gas phase
- Handling powders



Photo from Andrew Maynard presentation



## Requirement for HEPA Filtration for Exhausted Air\*

Aerosol Generation Potential	Toxicity of Engineered Nanomaterial		
	Low	Medium	High/Unknown
Low			
Medium			HEPA
High		HEPA	HEPA

\*EHS determines if aerosol generation potential and toxicity is low, medium, or high/unknown





# Work Practices

- Standard practices for labs
  - Prohibit storage/consumption of food and beverages
  - Wash hands after removing gloves
  - Label containers of nanoparticles
- Avoid touching the face or exposed skin with potentially contaminated fingers
- Clean work areas with wet wiping methods or HEPA vacuum pickup



# PPE



- Selection of PPE for prevention of dermal exposure to nanoparticles not available
- Nanoparticles may be able to penetrate the epidermis, possibly beyond to the bloodstream
  - Tinkle 2003, Aitken 2004
- Univ. of Mass.: nanoparticles accumulate in areas where gloves are thinner
- Proper gloves should be worn – select according to the solvent the particles are suspended in
  - Wear two pairs if prolonged contact anticipated



## PPE - Respirators

- Use in most cases not required for research at NCI-F
- N-95s
  - Univ. of Cincinnati - 7% of NaCl particles in the 30-70nm range got through 2 types of N-95s



## Administrative Controls

- Designate areas that use nanotechnology
- Training and communication

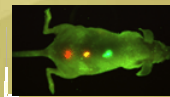
## Spills

- Must consider the potential for exposure during clean-up
- Use wet methods/HEPA vacuums
- Choose appropriate PPE



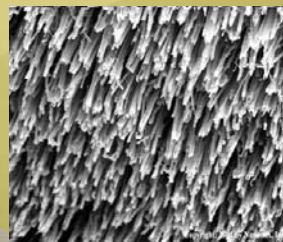
## Animal Studies

- Dosing and necropsies conducted within an exhausted hood
- Unknown how animals dosed with nanoparticles will excrete nanoparticles
- EHS reviews Animal Study Protocols (ASP's); control measures may vary with each ASP
- Histopathology



## MSDSs

- Reviewed as they become available
- Use caution!
  - e.g. MSDSs for CNTs refer to the graphite PEL as a relevant exposure standard
- CNTs are shaped like fibers, have different tensile and conductive properties, and may be more toxic than graphite in the short term
  - (Oberdörster, 2004)



## EHS Responsibilities

- Remain current with the literature, guidance, and other information
- Communicate continually with researchers and those involved in nanotechnology research





# Resources



- Nanoparticle Library:  
<http://www2a.cdc.gov/niosh-nil/>
- Searchable database for occupational health professionals and researchers



# References

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