

Nanomaterials

Nanoparticles are ultrafine particles measuring in one dimension between 1 – 100 nanometers (nm). Nanotechnology involves the use of nanoscale structures, devices and systems that may have utility in biological or other systems that require nanoscale applications. Nanotechnology comprises the study of processes, applications and materials related to biological, chemical, electronic, physical or engineering applications. In addition to the novel size of nanoparticles or structures, uses are derived from unique properties related to reactivity or conductivity.

Safety Issues

Concerns with safety regarding the use of nanotechnology have arisen primarily from the recognition of several unique attributes of nanoparticles:

- the ultra small particle size permits the particles to be carried deeply into tissues – particles may be deeply respired into the lungs; may pass through the blood-brain barrier; or translocate between organs
- the molecular structure of nanoparticles and the relatively greater surface area confer on these particles different chemical reactivities than for larger structures made from the same elements or molecules.

Some evidence suggests that nanoparticles may be more toxic to tissues than larger molecular structures. In addition to concerns about toxicity of nanoparticles that are inhaled, ingested, or absorbed through dermal exposure during initial contact, nanoparticle waste may present a hazard in the environment.

The widespread use of nanoparticles in research and development for manufacturing and biomedical purposes has outpaced research of safety issues. The National Institute of Occupational Health and Safety (NIOSH) and other agencies are currently studying this issue, and improved guidelines for handling and disposal are emerging slowly. Currently, agencies charged with providing safety guidelines, including NIOSH, the NIH and the EPA, promote the incorporation of cautionary measures in research, with a view toward minimizing or eliminating exposures to nanoparticles. Effective in November, 2010, the EPA has implemented regulations regarding commercial handling and [disposal of carbon nanotubes \(CNT's\)](#). While these regulations will affect commercial enterprises, researchers should be aware of the requirements for manufacturing that might influence experimental processes that they expect will be utilized by commercial ventures. Contact EH&S for more information.

Nanoparticle Research at FSU:

The Florida State University has developed the following handling protocols to address the occupational health concerns associated with nanoparticle exposure. Safety issues related to individual programs may be evaluated by EH&S staff at the request of the individual researchers or department personnel to determine if alternative exposure control methods may be employed to adequately safeguard the health of FSU employees and students, and mitigate potential adverse impacts on the environment.

Nanomaterial Handling Recommendations:

- Total enclosure of the particle handling process - Nanoparticle stocks that are dry should be handled inside an appropriate glove box. Workers should wear personal protective equipment, including safety goggles, lab coats, and gloves if handling or transporting materials outside of a glovebox. See [AIHA PPE recommendations for work with nanoparticles](#).

- Total enclosure of stored stocks of nano-materials
- Contact EH&S to determine if stocks can be handled outside of a glove box, using local exhaust ventilation with HEPA filtration
- Nanoparticle solutions, or nanoparticles bound in a matrix or to proteins may be handled on the lab bench like any non-volatile chemical once placed in solution. Workers should wear protective equipment, including safety goggles, lab coats, and gloves.
- Transport of nano-materials should employ a sealed secondary containment device
- Limit access in areas where processes are being carried out. Only trained personnel may be permitted to work in these areas while nanomaterials are being used. Training procedures and operating procedures must be implemented before beginning work with nano-materials. EH&S will provide postings for laboratories working with nanoparticles.
- Nanoparticle waste must be contained and labeled for chemical content in compliance with FSU Hazardous Waste Management Plan. Contact EH&S at 644-7682 or 644-0971 for waste pickup or for further information about how to handle specific wastes.
- Nanoparticle spills should be cleaned immediately using spill mitigation procedures developed by the laboratory. Consult EH&S for assistance in developing a spill control and cleanup protocol.
- Regular cleaning of benchtops, floors and other surfaces should be implemented; cleaning schedule should be documented. Cleaning solution should be compatible with the vehicle in which the nanoparticles are suspended. Contact EH&S for assistance with development of a cleaning protocol.
- Equipment used for handling of nanoparticles must be evaluated for safety concerns before it may be repaired, reused for other laboratory purposes or released for disposal.
- The use of respirators is not generally required for worker protection when work is performed in a fume hood or glove box. If the use of respiratory protection is warranted the use of HEPA filtered respirators for protection against nanoparticle exposure must be evaluated by EH&S prior to implementation.
- Prohibition of eating and drinking in laboratories and controlled areas

Contact EH&S for the following information and support by calling the Laboratory Safety Office at 644-8916:

- to request an evaluation of safety protocols or development of safe handling protocols or cleanup protocols in your research program
- to determine if your nanomaterials research is compliant with FSU policies and best practices

Additional Information and Resources

- [CDC](#)
- [OSHA Fact Sheet-Working Safely With Nanomaterials](#)
- [NIOSH-General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories](#)

- <http://www.nano.gov>
- [EPA](#)
- Kelly, Richard J. "Occupational Medicine Implications of Engineered Nanoscale Particulate Matter" J. Chemical Health and Safety Jan/Feb 2009 p. 24-39.
- [Canadian Review of Occupational Exposure to Engineered Nanoparticles](#)
- [Health and Environmental Impact of Nanotechnology: Toxicological Assessment of Manufactured Nanoparticles](#)
- [Research Strategies for Safety Evaluation of Nanomaterials, Part IV: Risk Assessment of Nanoparticles](#)