

Safety guidelines for research with engineered nanomaterials

Definitions

Engineered nanoparticleⁱ means intentionally created (in contrast with natural or incidentally formed) particle with one or more dimensions greater than 1 nanometer and less than 100 nanometers. The following types of nanoparticles are beyond the scope of this definition:

- Biomolecules (proteins, nucleic acids, and carbohydrates),
- materials for which an occupational exposure limit (OEL) or national consensus or regulatory standards exists for the nanoscale particles,
- unbound engineered nanoparticles incapable of becoming airborne or not expected to be generated or released,
- nanoscale forms of radiological materials, and
- nanoparticles incidentally produced by human activities or natural processes, such as diesel engines and forest fires.

Unbound engineered nanoparticle (UNP)ⁱⁱ means those engineered nanoparticles that, under reasonably foreseeable conditions encountered in the work, are not contained within a matrix that would be expected to prevent the nanoparticles from being separately mobile and a potential source of exposure. An engineered nanoparticle dispersed and fixed within a polymer matrix, incapable, as a practical matter, of becoming airborne, would be “bound,” while such a particle suspended as an aerosol or in a liquid would be “unbound.”

Universal Precautionsⁱⁱⁱ is an approach to infection control that assumes human biological materials are potentially infectious. Under this approach, Personal Protective clothing and Equipment (PPE), work practices, and engineering controls are always used.

Health and Safety

Engineered very small particles exhibit properties different from larger particles of the same chemical composition, making them of interest to researchers and of potential benefit to society. Only limited information is currently available on the toxicity of engineered nanomaterials such as carbon or metal nanotubes, nanowires and sheets, fullerenes, quantum dots, carbon and metal-organic frameworks, metal or silica nanoparticles and other compounds. It is believed that exposure to some unbound engineered nanomaterials may result in health effects. Solid or liquid materials that are comprised (in part) of engineered nanomaterials may be sources of airborne

nanoparticles, for example, as a result of abrasion or cutting of solid materials, drying, or agitation of liquid suspensions.

Laboratory research commonly involves handling nanomaterials in liquid suspensions or other forms that do not become easily airborne, and even UNP tend to agglomerate to a larger size. When research involves work with engineered nanoparticles for which toxicity is not yet known, it is prudent to assume the engineered nanoparticles may be toxic, and to handle the engineered nanoparticles using exposure controls that limit inhalation, skin absorption, ingestion and injection.

Standard Operating Procedures

Hazard Communication

Principal Investigators purchasing, growing, or otherwise generating engineered nanomaterials in their laboratories should include these materials on their chemical inventories, note their presence in the Integrated Safety Information System (ISIS) and communicate required precautions and exposure controls to their laboratory workers and others potentially exposed.

Engineering controls

- Exhausted enclosures are required for handling and weighing of UNP.
- Furnaces used for engineered nanomaterials must be connected to dedicated exhaust ventilation.
- Where gram quantities of UNP are utilized in an exhausted enclosure, HEPA filtration of the exhaust air may be necessary.

Work practices

The practices for safely working with engineered nanomaterials are essentially the same as one would use when working with any research chemical of unknown toxicity. Consideration should be taken to:

- Wet wipe work surfaces, such as benchtops where engineered nanomaterials, fibers, or solutions have been handled at the end of each day. Surface contamination with engineered nanomaterials may not be visible.
- Use gloves for handling dry or liquid materials. When nanomaterials are present in a solvent carrier, glove selection should be based on the suitability of the glove for protection against the particular solvent.
- Use universal precautions when liquid phase engineered nanomaterials are used in biological research.
- Utilize NIOSH-approved respirator filters that are rated as N-, R- or P-100 (HEPA) for respiratory protection where airborne exposure to engineered nanomaterials is expected (e.g. cleanout of systems used for growth of carbon nanotubes.).
- Dispose of engineered nanomaterials through the Office for Research Safety (ORS).

- Label engineered nanomaterials waste containers with the full chemical name or name of mixture and “engineered nanomaterials”.
- Decontaminate equipment contaminated with engineered nanomaterials before decommissioning.

For more information on Health and Safety of Nanotechnology visit the following web sites:

Additional Sources

NIOSH - Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials <http://www.cdc.gov/niosh/topics/nanotech/>

National Nanotechnology Initiative <http://www.nano.gov/>

US Environmental Protection Agency (EPA) <http://www.epa.gov/oppt/nano/nano-facts.htm>

ⁱ The definition is adopted from the US Department of Energy Notice N456.1 - THE SAFE HANDLING OF UNBOUND ENGINEERED NANOPARTICLES, Approved 01/05/09

ⁱⁱ See Endnote i

ⁱⁱⁱ The definition is adapted from the Centers for Disease Prevention and Control (CDC) universal precautions designed to prevent transmission of blood-borne pathogens in the work place.

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