UAH NANOMATERIALS SAFETY MANUAL

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Nanotechnology is the field of science dealing with material specifically engineered to sizes of 100 nanometers (ηm – 10^{-9} m) or less. Nanotechnology is “the understanding and control of matter

Various nanoparticles have been shown to

- Inhibit cell proliferation (iron oxide, nanotubes, TiO_2, silver)
- Affect cell morphology (silver, nanotubes)
- Initiate irritation response (quantum dots, nanotubes)
- Damage cell membrane (fullerenes)
- Induce DNA damage (cobalt chrome alloy)

Researchers are required to wear gloves (nitrile or other chemically impervious gloves) during all handling of nanoparticles and nanomaterials. Researchers are required to wear disposable Tyvek laboratory coats or cloth laboratory coats with disposable Tyvek or vinyl sleeves during all handling of nanoparticles and nanomaterials. Laboratory Attire Guidelines specified in the University Laboratory Safety Manual must also be followed. Consult OEHS for Guidelines.

Ingestion is a viable route of exposure because nanoparticles can translocate throughout the body via the digestive system.

- Ingestion may occur after inhalation exposure when mucus is brought up the respiratory tract and swallowed
- Poor work practice can result in hand-to-mouth transfer
- Ingested nanoparticles do translocate to other organ systems. Single walled carbon nanotubes (SWCNT) delivered into gut for treating Alzheimer's disease was found in liver, brain and heart. Ingestion of colloidal silver can result in permanent discolorationof skin, nails and eyes

Various nanoparticles have been shown to:

- Slightly damage liver (silver)
- Trigger immune response in intestinal dendritic cells (TiO_2 and SiO_2)
- Be cytotoxic to human intestinal cells (TiO_2, SiO_2 and ZnO)
- Damage DNA of human intestinal cells (ZnO)
- Be genotoxic to liver and lungs after oral administration (C_{60} and single-walled nanotubes (SWNT))

Eating, drinking, applying cosmetics, handling contact lenses is not permitted in the laboratory per University Guidelines. Laboratory personnel should remove PPE when work with nanoparticles is completed and wash their hands.

Nanoparticles can be introduced to the body via a needlestick. Standard precautions should be followed when utilizing sharps with nanoparticles or nanomaterials.

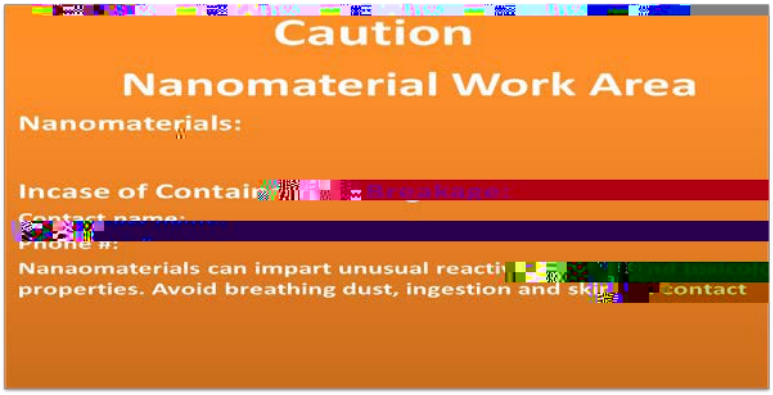
Few occupational exposure limits exist specifically for nanomaterials. Certain nanoparticles may be more hazardous than larger particles of the same substance. Therefore, existing occupational exposure limits for a substance may not provide adequate protection from nanoparticles of that substance. However, some specific exposure limits already exist. For example:

- OSHA recommends that worker exposure to respirable carbon nanotubes (CNT) and carbon nanofibers not exceed 1.0 micrograms per cubic meter (µg/m3) in an 8-hour time-weighted average, based on the National Institute for Occupational Safety and Health (NIOSH) proposed Recommended Exposure Limit (REL).
  OSHA recommends that worker exposure to nanoscale particles of TiO2 not exceed NIOSH's 0.3 milligrams per cubic meter (mg/m3) REL. By contrast, NIOSH's REL for fine-sized TiO2 (particle size greater than 100 nm) is 2.4 mg/m3.
  NIOSH's REL for carbon black is 3.5 mg/m^3, and OSHA's permissible exposure limit for respirable synthetic graphite is 5 mg/m^3.

Because exposure limits for other nanomaterials do not exist yet, UAH researchers and staff should do

During routine maintenance of the facility exhaust system, UAH Facilities staff may have exposures

1. NMs work should be performed within a designated area as outlined in the PI Safety Plan.
2. Work area must have warning signage as shown below.



1. Primary containers should be labeled for laboratory-generated NMs. Primary container information should include “Nano Chemical Name”, solvent name (for dispersed solutions), concentration or quantity and contact person name.
2. At a minimum, reaction flasks and small storage vials, centrifuge tubes, etc., and secondary containers should include the material identity, researcher name, and date ofpreparation.

1. Primary storage containers made of glass are preferred for the storage and transport ofNMs (glass reduces electrostatic charges that can cause dry materials to become easilyairborne when opening the container).
2. Sealed secondary containers should be used to transport NMs/solutions between labs.
3. The use of secondary containers made of shatter proof plastics is recommended to prevent the accidental breakage of primary glass containers during transport betweenlabs.
4. If nanomaterials are required to be shipped off of the University campus via an external shipment company (Ex. UPS or FedEx) then applicable DOT shipping regulations mustbe followed. OEHS should be contacted to assist in the shipment of nanomaterials.
5. If nanomaterials are transported to off campus locations via a personal vehicle, then applicable DOT packaging requirements must be followed.
6. The SDS should be included in packages for NM shipment to outside institutions.

If UAH staff are working with nanomaterials or where they will be potentially exposed to nanomaterials, information and training will be provided so employees can take appropriate precautions to prevent exposures. This information and training will include at least the following:

Identification of nanomaterials and processes in which they are currently being used;
Results from any exposure assessments conducted at the work site;
Identification of engineering and administrative controls and personal protective equipment (PPE) to reduce exposure to nanomaterials;
The use and limitations of PPE; and
Emergency measures to take in the event of a nanomaterial spill or release.

Contact OEHS at 824-