WFUSM ENVIRONMENTAL HEALTH & SAFETY			
WFUSM General Guidelines for Handling and Working Safely with Nanomaterials			
Approved by:		*Effective Date:*	July 2009
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GENERAL GUIDELINES FOR HANDLING AND WORKING SAFELY WITH NANOMATERIALS AT WFUSM

WFUSM Researchers are urged to use procedures that prevent inhalation and dermal exposures to nanoparticles. While extensive toxicological studies regarding the health effects are limited, there is evidence to suggest cautionary procedures are warranted. The following eleven guidelines below will aid in reducing exposure to nanoparticles.

The guidelines will be updated as new information becomes available.

1. Know the existing toxicity information available for your nanomaterial.

- When purchasing commercially available nanoscale materials, be sure to obtain the Material Safety Data Sheet (MSDS) and to review the information in the MSDS with all persons who will be working with the material. Please forward a copy of the MSDS to WFUSM EH&S.
- Be aware that many MSDSs currently shipped with nanomaterials refer to the bulk material toxicity information, which is inappropriate for the nanomaterial. If no information is available for your materials or the toxicity information is limited or uncertain, handle the material as if it is toxic. The best place to keep up to date is the International Council on Nanomaterials (ICON) database which collects toxicity and environmental information by nanoparticle type. Searches can be run on a specific nanomaterial for a particular time period, so only the most recent references are searched. Pub Med can be searched, but the search results will be much broader than ICON.

2. Prevent Inhalation Exposure during All Handling of Nanomaterials

- Respiratory absorption of airborne nanoparticles may occur through the mucosal lining of the trachea or bronchioles or the alveolus of the lungs. Because of their tiny size, certain nanoparticles appear to penetrate deep into the lungs and may translocate to other organs following pathways not demonstrated in studies with larger particles.

- Thus, whenever possible, nanoparticles are to be handled in a form that is not easily made airborne, such as in solution or on a substrate. When this is not possible, all free particulate nanomaterials should be worked with in exhausted enclosures which may include engineering controls, i.e., (fume hoods, glove boxes, Class II Type A2, B1 or B2 biosafety cabinets.) Procedures involving manipulation of nanomaterials as free particles should be carefully conducted so that no release into the laboratory air occurs.
- Work with suspensions of nanoparticles that are subjected to processes that generate aerosols should be performed in exhausted enclosures.

- Animal bedding should be misted thoroughly to wet the bedding before disturbing for disposal to reduce airborne exposure.
- When cleaning and changing cages, N100 Filtering Face Mask Respirator should be worn if the nanomaterials have an aspect ratio of less than 3/1. If the aspect ratio is greater than 3/1, then a loose fitting PAPR may be required.
- Contact WFUSM EH&S (716-9375) for requirements for wearing a respirator.
  Or before a respirator can be work, medical clearance and fit testing are required under the Respiratory Protection Program.

MANIPULATION OF FREE NANOPARTICULATES ON THE LAB BENCH SHOULD BE AVOIDED.

- Fume Hoods
  - When using a fume hood to contain dust or aerosols of nanomaterials, follow good fume hood use practices such as working 6” back from sash, working with sash at or below the yellow annual certification label height, removing arms slowly from hoods to prevent dragging out contaminants and not blocking the lower back slot with equipment.
  - Due to their design, Constant Volume (CV) fume hoods, found in Gray, Hanes, and PTCRC, have a harder time containing engineered nanomaterials than do Variable Air Volume (VAV) fume hoods, found in NRC, A1 and A1a. If possible, use a VAV fume hood when working with dry or easily aerosolized engineered nanomaterials. WFUSM EH&S should be consulted when considering a CV fume hood for control of nanomaterials.
- Biosafety Cabinets

- Only Class II type A2, B1 or B2 biosafety cabinets (BSCs) which are exhausted into the building ventilation system may be used for nanomaterials research. BSCs that recirculate into the room may not be used. There is recirculation of air inside type A2 and B1 cabinets, so care should be taken not to perform extremely dusty processes in these cabinets as the internal fans of the BSC are not explosion proof. The air in the type B2 cabinet is 100% exhausted and standard amounts of nanomaterials and solvents may be used in this type of enclosure. WFUSM EH&S should be consulted when considering a biosafety cabinet for control of nanomaterials.
- BSCs must be certified semi-annually when they are being used for nanomaterials research.

CHANGING HEPA FILETERS OR PREFILTERS

When HEPA filters are changed or need service, bag in / bag out should be utilized by the vendor. This will minimize personal exposure to any toxic substances that the HEPA Filter may have trapped. The filters should be disposed through WFUSM EH&S as hazardous waste.

3. Prevent Dermal Exposure to Nanomaterials

- In some cases nanoparticles have been shown to migrate through skin and be circulated in the body. If the particle is carcinogenic or allergenic, even tiny quantities may be biologically significant. Skin contact can occur during the handling of liquid suspensions of nanoparticles or dry powders. Research staff should wear gloves to protect themselves from skin absorption.
- Skin absorption is much less likely for solid bound or matrixed nano-materials. Research staff may consider wearing gloves to protect themselves from potential skin absorption, and to protect their research materials from being contaminated.
- The ability of nanoparticles to penetrate the skin is uncertain at this point, so gloves should be worn when handling particulate and suspensions containing particulate. If working with dry particulate, a sturdy glove with good integrity should be used. If the nanoparticulates are in suspension, a glove having good resistance to the solvent should be used.

Nanoparticles suspended in liquid may be more easily absorbed through the skin and represent more of an exposure hazard, so choose gloves appropriate to the solvent.

- Disposable nitrile gloves provide good protection from nanoparticles for most procedures that do not involve extensive skin contact. Two pairs of gloves should be worn if extensive skin contact is anticipated.
- Gloves with gauntlets or extended sleeve nitrile gloves are useful in preventing contamination of lab coats or clothing.
- Research has shown that dry nanomaterials have the ability to pass through the woven fabric typical of lab coats used across WFUSM. If using dry nanomaterials, wear disposable tyvek lab coats or disposable tyvek sleeves.
- Change gloves routinely when using nanomaterials or if contamination is suspected.
- Keep contaminated gloves in plastic bags or sealed containers in your waste collection area until disposal. Wash hands and forearms thoroughly after handling nanomaterials. If contamination of clothing is a concern, use disposable labs coats and dispose of through hazardous waste pickup.

PREVENTION OF INJECTION

Exposure by accidental injection (skin puncture) is also a potential route of exposure, especially when working with animals or needles. To prevent this, wear gloves and lab coats, and apply the standard practices for working with sharps. Use of safer sharps is strongly recommended.

PREVENTION OF INGESTION

As with any particulate, ingestion can occur if good hygiene practices are not followed. Once ingested, some types of nanoparticles might be absorbed and transported within the body by the circulatory system. To prevent ingestion, eating and drinking are not allowed in laboratories.

SIGNAGE AND LABELING

In areas where easily dispersible nanoparticles are in use, post signs indicating the hazards, control procedures, and personal protection equipment that are required. If warranted, use the Chemical

Hygiene Plan "Designated Area" sign available from WFUSM EH&S Office to label the fume hood, lab bench or lab itself. Nanomaterial storage containers should have a designation that the material is "nanoscale" or a "nanomaterial", such as "nanoscale titanium dioxide".

HOUSEKEEPING

- Be aware of possible fire and explosion hazards. Nanoparticulate can be anticipated to have a greater potential for explosivity than micron sized particles, because of their increased reactivity. They may also have greater catalytic potential.
- Prevent contamination of laboratory surfaces, fume hood or enclosure surfaces should be wet-wiped after each use or at the end of the day. Alternatively use of bench liners would also prevent contamination. Bench liners, if contaminated, must be disposed of as hazardous waste via WFUSM EH&S. Do not dry sweep or use compressed air for cleanup.
- Equipment used to create or handle nanoscale materials should be cleaned or evaluated for potential contamination prior to disposal or reuse.
- Laboratory equipment and exhaust systems should be evaluated prior to repair, remodeling or removal and construction/maintenance crews need to be alerted to the potential exposure to nanoparticles. Contact WFUSM EH&S (716-9375) for assistance with this notification.

TRANSPORT

IN THE LAB

- Use appropriate containers. Glass vials are preferable since plastic containers can be electrically charged and instigate nanoparticle instability. Many solvents for nanoparticles also degrade plastic centrifuge tubes.
- Solutions should be placed into a secondary container made of shatter proof plastic for transport between laboratories.

OFF SITE

- Transportation of nanomaterials to off-site locations and other universities or laboratories outside of WFUSM may be covered by DOT regulations. Improper packaging and/or transportation could lead to regulatory action and fines. Contact WFUSM EH&S (716-9375) to enroll in the required training prior to shipping materials.

Exposure Monitoring

- Traditional methods of air sampling that measure mass are not appropriate for nanomaterials. Measurement methods that count nanoparticles or measure surface area are being developed for nanomaterials. The National Institute for Occupational Safety and Health (NIOSH) has established a sampling regimen for nanomaterials and WFUSM EH&S has the ability to follow this regimen. However, the regimen requires sampling the area where nanomaterials will be used PRIOR to beginning any work with nanomaterials. Please contact WFUSM EH&S (716-9375) prior to beginning work with nanomaterials for an evaluation and possible air monitoring.
- There are currently no government occupational exposure standards for nanomaterials. One should also be aware that Material Safety Data Sheets (MSDS) may not have accurate information at this point in time. For example, the MSDSs that are accompanying some commercially available carbon nanotubes are referring to the graphite Permissible Exposure Limit (PEL) as a relevant exposure standard.

SPILLS

- Spills of engineered nanoparticles are to be cleaned up right away. Minor spills or small quantities of nanomaterial can be wiped up using wet wiping for solid material and absorbent wipes for suspensions. The person cleaning up should wear gloves and either vacuum up the area with a HEPA filtered vacuum or wet wipe the area with towels, or combination of the two. For spills that might result in airborne nanoparticles, proper respiratory protection should be worn.
    - Spills, contact WFUSM EH&S Office at 716-9375.

WASTE MANAGEMENT

- All nanomaterials waste should be treated as hazardous waste through WFUSM EH&S. Based on current information, high temperature incineration at a hazardous waste incinerator is the preferred method. Pyrolysis above 500 C will oxidize CNTs completely.

- DO NOT put material from nanomaterial bearing waste streams into the regular trash or down the drain. Before disposal of any waste contaminated with nanomaterial, call WFUSM EH&S (716-9375) for a waste determination.
- Dispose of waste nanoparticles in solution according to hazardous waste procedures for the solvent. All waste engineered nanoparticles should be treated as unwanted hazardous “toxic” materials unless it is known to be non-hazardous.
- Paper, wipes, PPE, animal bedding and other items with loose contamination should be collected in a plastic bag or other sealable container stored in a laboratory hood or in a container in a separate confined area. When the bag is full, close it, and place it into a second plastic bag or other sealable container. This material should be treated as biowaste.
- Animal bedding should be wetted before disturbing for disposal to reduce airborne exposure.
- HEPA Filters and/or prefilters should be disposed as Chemical Waste through WFUSM EH&S.