TITLE:

GUIDELINES FOR WORKING WITH NANOMATERIALS

1.0 Introduction

1.1 Purpose

This document provides guidelines for Research Investigators regarding work with nanomaterials, including but not limited to nanoparticles, elemental carbon, carbon compounds, metals or metal oxides, ceramics, in the lab and in animal models.

1.2 Scope

This guideline applies to all Emory University investigators. Use of all nanomaterials requires approval by Emory University's Institutional Biosafety Committee (IBC) or Research Health and Safety Committee (RHSC).

1.3 Definitions

Nanotechnology. OSHA defines Nanotechnology as "the understanding and control of matter at the nanoscale, at dimensions between approximately 1 and 100 nanometers (nm)" [1].

2.0 Facts about Nanomaterials

2.1 Known Risks of Nanomaterials

- Animals exposed to titanium dioxide (TiO2) and carbon nanotubes have displayed pulmonary inflammation[2-3].
- Nanoparticles (NPs can translocate to the circulatory system and to brain and induce oxidative stress[4].
- Carbon nanotubes (CNT) can cause pathology in mice similar to asbestos exposure[5].

2.2 Known Exposure Limits

- Currently, no regulatory standard for nanomaterials have been established in the United States. However, Federal agencies recommend the following exposure limits for certain materials [1, 6].
- TiO2. 2.4 mg/m^3 (fine TiO2, 0.1-2.5 µm)
- TiO2.0.3 mg/m^3 (ultrafine TiO2, <0.1 µm, primary particles)
- A reasonable approach in absence of Occupational Exposure Limits or in absence of a Safety Data Sheet is the ALARA, as Low as Reasonably Achievable.

2.3 Potential Routes of Occupational Exposure -Adapted from Yokel and MacPhail[7]

- Inhalation: Primary route of occupational exposure
- Dermal
- Oral
- Ocular
- Injection

3.0 Standard Operating Procedure for working with nanomaterials needs to contain information related to:

- Chemicals/materials being used in the process.
- Source or production methods.
- Procedures using these materials.
- Engineering control used.
- Workers' experience handling these materials.
- Task related exposure potential to nanomaterials.

4.0 Recommended good laboratory practices

- Follow SOP for handling the Nanomaterials.
- Use general laboratory safety practices: remove gloves when leaving the laboratory or when handling common objects (i.e. Phones, door knobs).
- Use appropriate PPE: double nitrile gloves, safety glasses, protective clothing.
- Use appropriate engineering containment: fume hoods, glove box, or Class II biosafety cabinet.
- Avoid handling Nanomaterials in “free particle” state in the open air, use any of the engineering containment options mentioned above.
- If transporting Nanomaterials, ensure that the primary container is sealed, the secondary container should be labeled with PIs name and contact phone number.
- Use respiratory protection if you need to handle the Nanomaterials outside the fume hood, or other containment, or if you know that the Nanomaterials are airborne or non-agglomerated particles.
- Clean work areas, including equipment, at the end of your work using wet wiping methods.
- Store nanomaterials, whether suspended in liquids or in a dry particle form, in closed (tightly sealed) containers whenever possible.
- Wash hands with soap after work has been completed.
- Hazard Communication
- Label all containers with the prefix NANO.
- Know the risks associated with handling the Nanomaterials.
- If leaving operation unattended, post a sign anticipating the use of shared equipment.
- Emergency Response
- Spill: Contact the Spill Response Team (7-2888).
- Exposure
- Stop work.
- Notify a coworker.
- Remove contaminated PPE.
- Follow emergency measures specific for the nanomaterial in use.

- Report in PeopleSoft.
- Waste Management
- All waste generated from in vitro experiments should be disposed of as hazardous waste by contacting the Environmental Safety Team using the electronic form found at http://www.ehso.emory.edu/.
- Waste generated from animal experiments including nanomaterials should be disposed of after EHSO performs a risk assessment and following the Division of Animal Resources Standard Operation Procedures (SOP).

5.0 References

1. OSHA FactSheet. Working Safely with Nanomaterials. https://www.osha.gov/Publications/OSHA_FS-3634.pdf.
2. Chou CC, Hsiao HY, Hong QS, et al. Single-Walled Carbon Nanotubes Can Induce Pulmonary Injury in Mouse Model. *Nano Letters.* 2008;8:437-445.
3. Rossi EM, Pylkkänen L, Koivisto AJ, et al. Inhalation exposure to nanosized and fine TiO2 particles inhibits features of allergic asthma in a murine model. Particle and Fibre *Toxicology.* 2010;7:35.
4. Elder A, Gelein R, Silva V, et al. Translocation of Inhaled Ultrafine Manganese Oxide Particles to the Central Nervous System. *Env Health Perspectives.* 2006; 114:1172-1178.
5. Takagi A, Hirose A, Nishimura T, et al. Induction of mesothelioma in p53+/− mouse by intraperitoneal application of multi-wall carbon nanotube. *J Tox Sci.* 2008;33:105-116.
6. NIOSH Current Strategies for Engineering Control in Nanomaterials Production and Dowstream Handling Processes. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) 2013.
7. Yokel RA, MacPhail R C. Engineered nanomaterials: exposures, hazards, and risk prevention. *J Occ Med and Tox*. 2011;6:7-7.