



THE OHIO STATE UNIVERSITY

**The Ohio State University
Nanoparticle Safety Program**

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1.0 Introduction

1.1 Nanotechnology is a practice which involves using nanoscale structures in order to create new materials and products. This procedure is advantageous in distinct medical and scientific fields, but could also be hazardous to individuals working with nanoparticles. Studies have shown nanoparticles have the ability to travel into the body through distinct routes of exposure, specifically inhalation, and cause adverse health effects. Therefore, The Ohio State University (OSU) Office of Environmental Health and Safety (EHS) has created a Nanoparticle Safety Program to minimize the risk associated with the hazards known when handling nanoparticles.

2.0 Scope

2.1 In compliance with the rules found in 29 CFR 1910.1450 (Occupational Exposure to Hazardous Chemicals in Laboratories) of the Occupational Safety and Health Administration (OSHA), OSU EH&S has developed this Nanoparticle Safety Program. The program describes the requirements for handling, using, storing, and disposing of nanomaterial and is required for individuals conducting nanoparticle research at OSU.

3.0 Definitions

Nanotechnology – the understanding, manipulation, and control of matter at dimensions roughly 1 to 100 nanometers, which is near-atomic scale, to produce new materials, devices, and structures.

Nanometer – one billionth of a meter or 0.000000001 meter (10^{-9} m)

Nanomaterial – materials that have been purposefully manufactured, synthesized, or manipulated to have a size with at least one dimension in the range of approximately 1 to 100 nanometers and that exhibit unique properties determined by their size.

4.0 Responsibilities

- 4.1 The Office of Environmental Health and Safety is responsible for developing, maintaining, and administering guidelines for university facilities conducting nanotechnology research. EHS also maintains an active list of facilities, departments and colleges using nanoparticles.
- 4.2 University departments and colleges are responsible for implementing and ensuring the compliance of the Nanoparticle Safety Program within their research facilities as well as registering their facility with EHS by completing the Nanotechnology Registration Form, found in Appendix A.
- 4.3 Principal Investigators (PI)/Supervisors
 - 4.3.1 PI's and supervisors are responsible for providing all employees at a minimum, the following information and training regarding nanomaterials:
 - 4.3.1.1 Identification of nanomaterials that employer uses and the processes in which they are used.
 - 4.3.1.2 Results from any exposure assessments conducted at the work site.
 - 4.3.1.3 Identification of engineering, administrative controls, and personal protective equipment (PPE) necessary to reduce exposure to nanomaterials.
 - 4.3.1.4 The use and limitations of PPE.
 - 4.3.1.5 Emergency measures to take in the event of a nanoparticle spill or release.
- 4.4 Employees Working With Nanoparticles
 - 4.4.1 Any employee working with nanoparticles must be appropriately trained to work with the specific nanoparticles used in their facility. Employees are responsible to know the hazards that correlate with the nanoparticles they are handling. Employees are also responsible for ensuring proper engineering controls, administrative controls, and personal protective equipment (PPE) are being correctly utilized as determined by their PI or by the guidelines set by EHS. If any employee feels that their facility may be producing an unsafe work environment when working with nanoparticles, they must notify their supervisor immediately.

5.0 Exposure Assessment

- 5.1 After receiving a completed Nanotechnology Registration Form from the Principal Investigator (PI), EHS will setup an initial meeting with the PI and assess the facility for possible exposure pathways.
 - 5.1.1 The initial meeting will comprise of an interview and walkthrough of the facility, with a thorough explanation of any job processes where workers may be exposed to nanoparticles.
 - 5.1.2 The physical state of nanoparticles (i.e., powder, suspended in liquid) used in the facility will be discussed between the PI and EHS for determining necessary exposure control recommendations.
 - 5.1.3 Possible routes of exposure will be determined based upon the physical state of the nanoparticles, exposure control methods used, and job tasks directly involved with the nanomaterials used in the facility.

- 5.1.4 EHS will determine if any additional controls may be needed based upon the exposure assessment results.

6.0 Hierarchy of Exposure Control Methods

- 6.1 Any facility on campus should follow the established hierarchy of exposure control methods when working with nanoparticles. Figure 1 in Appendix B displays the hierarchy starting from the most preferred method (top) to the least preferred method (bottom).

6.2 Elimination or Substitution

- 6.2.1 If possible, elimination of using nanoparticles in a research facility and using less hazardous materials would be the most preferred option in order to protect individuals from being dangerously exposed to nanoparticles.
- 6.2.2 If elimination is not feasible, substituting a less hazardous material or process in place of a more dangerous one would be preferred.
- 6.2.2.1 For example, working with nanoparticles suspended in a liquid instead of working with a powder-form would decrease the risk of producing an inhalation hazard.

6.3 Engineering Controls

- 6.3.1 The use of engineering controls in order to isolate nanoparticles from individuals is a feasible option within the research facility. The following outlines acceptable forms of engineering controls, which may be used to control exposure to nanoparticles upon approval by EHS.
- 6.3.1.1 A specialized glovebox or other similar apparatus should be used in order to physically separate individuals from the nanoparticles. Figure 2 in Appendix B shows an example of a sealed glovebox.
- 6.3.1.2 General exhaust ventilation should be in place in the research facility set by the recommendations stated in the OSU Facilities, Operations, and Development's Building Design Standards Appendix W (Laboratory Ventilation Systems). The system should be negatively pressurized from any surrounding room or hallway and have no recirculating systems in place. Exhaust vents should be placed as close to the contamination point as possible while supplied air should be dispersed to the area where contamination is of greatest concern. Individuals working with nanoparticles should be placed in between the supplied air and the contamination source.
- 6.3.1.3 Local exhaust ventilation systems such as fume hoods or Biological Safety Cabinets (BSC) should be used when working with nanoparticles, especially in dry or powdered form.
- 6.3.1.3.1 Class II Biological Safety Cabinet Types B1 and B2 should be the only types used when working with nanoparticles since they protect the environment, product, and operator from contaminants. DO NOT use Class II BSC Types A or B3.
- 6.3.1.3.2 Class III BSC's are also acceptable to use when working with nanoparticles. Class III BSC's are sealed enclosures also known as "gloveboxes."

6.3.1.4 Any facility requesting to use any other type of local exhaust ventilation beyond what is described in the Nanoparticle Safety Program may consult with EHS to see if device is acceptable.

6.4 Administrative Controls

6.4.1 Training

6.4.1.1 In accordance with OSHA 29 CFR 1910.1200 (Hazard Communication), any individual who will work with nanoparticles must be properly trained.

6.4.1.1.1 Training will comprise at a minimum what is stated in OSHA Standard 29 CFR 1910.1200(h)(3).

1910.1200(h)(3)

Training. Employee training shall include at least:

1910.1200(h)(3)(i)

Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

1910.1200(h)(3)(ii)

The physical, health, simple asphyxiation, combustible dust, and pyrophoric gas hazards, as well as hazards not otherwise classified, of the chemicals in the work area;

1910.1200(h)(3)(iii)

The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

1910.1200(h)(3)(iv)

The details of the hazard communication program developed by the employer, including an explanation of the labels received on shipped containers and the workplace labeling system used by their employer; the safety data sheet, including the order of information and how employees can obtain and use the appropriate hazard information.

6.4.1.1.2 An OSU Nanoparticle Safety Program training course is available via the OSU EHS online training database.

6.4.2 Signage

6.4.2.1 Facilities containing nanoparticle research must have designated signage at each entry point into the facility. Sign must indicate possible hazards, personal protective equipment necessary for entry, and administrative control requirements.

6.4.3 Storage

6.4.3.1 All nanoparticles must be stored in properly labeled containers. Appropriate signage must be placed at each entry point where nanoparticles are present.

6.4.3.2 Containers should not be stored above eye level and should be segregated from other chemicals.

6.4.4 Chemical Hygiene Plan

6.4.4.1 As required by OSHA 29 CFR 1910.1450, OSU Chemical Hygiene Plan (CHP) can be located at <http://www.ehs.osu.edu/ResBioSafety/ChemHP.aspx>.

6.4.4.2 Standard Operating Procedures (SOP) for use with nanoparticles should be developed by laboratory personnel and should be included in the laboratory's Chemical Hygiene Plan.

6.4.4.2.1 A sample SOP can be found in Appendix C for reference use.

6.4.4.2.2 Every employee in the laboratory should have access to the CHP and should be trained by the laboratory supervisor or principal investigator for safe handling of nanomaterials.

6.4.4.2.3 SOP's should be reviewed annually to verify all documents are properly updated to current standards or practices.

6.5 Personal Protective Equipment

6.5.1 Personal protective equipment (PPE) used within a wet-chemistry laboratory would be recommended for a nanotechnology research facility. These articles may include:

6.5.1.1 Closed-toe shoes made with a low permeability material.

6.5.1.2 Impervious laboratory coats (non-cotton).

6.5.1.3 Long pants without cuffs.

6.5.1.4 Safety glasses/goggles.

6.5.1.5 Chemically impervious gloves deemed appropriate for use with nanoparticles used in facility.

6.5.2 An area in the facility should be designated for the donning and doffing of PPE to prevent contamination in common areas.

6.5.3 All contaminated PPE should be placed in a sealed container until disposed of.

6.5.4 If during exposure assessment process, EHS requires respirators to be worn within a nanotechnology facility, the OSU Respiratory Protection Program must be followed. The Respiratory Protection Program can be found at <http://www.ehs.osu.edu/OccHealthSafety/RespProtect.aspx>

7.0 Spill Procedures and Disposal

7.1 In the case of a minor nanoparticle spill, trained individuals within the research facility may clean it up following the established SOP. Be sure to barricade the contaminated area with barrier tape and use proper PPE before attempting to clean a spill.

7.1.1 Powder Spill

7.1.1.1 Minor nanoparticle powder spills may be cleaned by using a HEPA-filtered vacuum, wiping up the powder with a wet cloth, and/or by dampening the powder before wiping up with a cloth.

7.1.1.2 Do not cleanup by using a dry-vacuum or similar device.

7.1.1.3 Follow established site-specific SOP.

7.1.2 Liquid Spill

7.1.2.1 A spill of nanoparticles suspended in liquids may be cleaned by using an absorbent material.

7.1.2.2 Follow established site-specific SOP.

7.2 All materials used for a nanoparticle spill must be placed into a sealed container until properly disposed.

7.3 Contact EHS, OSU Campus Police, or call 9-1-1 if a nanoparticle cleanup is beyond the capabilities of individuals within the facility. Emergency contact information should be posted in the research facility.

7.3.1 Office of Environmental Health and Safety – (614) 292-1284

7.3.2 The Ohio State University Police Department – (614) 292-2121

7.4 Contact EHS for proper disposal procedures and pickup of nanoparticle waste.

7.4.1 All nanoparticle waste should be put in a sealed container and visibly labeled as “nanomaterial waste” until disposal of by EHS.

Appendix A – Nanotechnology Registration Form

NANOTECHNOLOGY REGISTRATION FORM



APPLICANT INFORMATION	
PI:	Department:
Building:	Room #:
Phone	E-mail Address:
Name of Employees	E-mail Address

NANOMATERIAL INFORMATION					
Name of Nanomaterial	Physical State	Shape/Dimension	Approx. Size	Amount Used	Material Type
Will nanomaterials be shipped out of laboratory? YES <input type="checkbox"/> NO <input type="checkbox"/>					
Are nanomaterials being shipped outside of laboratory? YES <input type="checkbox"/> NO <input type="checkbox"/>					
Are nanomaterials being received from outside company? YES <input type="checkbox"/> NO <input type="checkbox"/> If yes, what company?					

Are nanomaterials being synthesized in laboratory? YES NO

EXPOSURE CONTROL METHODS

Describe Engineering Controls Utilized in Laboratory:

Describe Administrative Controls Utilized in Laboratory:

Describe Personal Protective Equipment Available in Laboratory:

PROCESS DESCRIPTION

Briefly describe the procedures used with nanomaterials within the laboratory:

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Appendix B – Figures

Figure 1 – Hierarchy of Exposure Control Methods

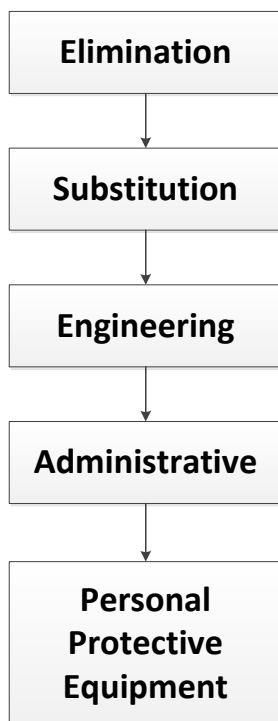


Figure 2 – Biological Safety Cabinet Class III “Glovebox”



Appendix C – Sample Standard Operating Procedure



STANDARD OPERATING PROCEDURE

Chemical or Operation Name

According to the Material Safety Data Sheet (MSDS) special precautions must be taken when working with the chemical described above. The following information includes the chemical characteristics of followed by recommendations for handling and any paperwork needed in order to use the chemical in the laboratory. This Standard Operating Procedure will be followed along with the requirements of the Chemical Hygiene Plan.

Classification (if applicable): **List items here.....**

Brief description of proposed chemical work: **This SOP covers all chemicals that range in size between 1-100 nanometers and can be classified as nanomaterials. Laboratories working with these materials should have a specific chemical SOP that clearly defines proper handling, storage, disposal, and emergency procedures.**

****Attach additional pages as needed****

Brief Safety Overview:

- The Principal Investigator is responsible for training employees using the material on site. The training should include a discussion of the known and potential hazards; an explanation of the relevant policies, techniques and procedures including the proper use of personal protective equipment, emergency/spill procedures and containment equipment (engineering controls).
- Limit access to authorized users.
- Minimize the possibility of inadvertent ingestion, inhalation and direct skin or eye contact with the substance.
- Chemical has been placed in the Chemical Inventory (EHS Assistant)
- Require annual training.

Routes of Exposure

Skin - **Routes of exposure - Skin**

Inhalation – **Routes of exposure - Inhalation**

Ingestion- **Routes of exposure - Ingestion**

Injection- **Routes of exposure - Injection**

Toxicological Effects

Acute Effects/ Precautionary Safety Measures: **May be hazardous if inhaled, ingested, or absorbed through skin.**

Chronic Effects/ Precautionary Safety Measures:

Handling and Storage Instructions

Example: (Preparation of the stock solutions): **Preparation can depend upon the laboratory practices. Proper laboratory procedure must be followed and employees must be trained to handle the material.**

Storage: **Nanomaterials should be stored in a sealed container that is properly labeled. Containers should not be stored above eye level and should be segregated from other chemicals.**

Location – Engineering controls

- Ventilation (example: Fume Hood, Canopy Hoods, etc): **Fume hood**
- Designated area (specify): **Specify**
- Bio-Safety Cabinet: **Specify type of Bio-Safety Cabinet**

PPE required:

- Skin/Body Protection (example: Lab Coat) **Lab coat**
- Eye protection
- Face shield
- Respirator (example: N95):
- Hand protection (example: Nitrile gloves): **Chemically compatible gloves.**

Cleanup/Decontamination procedures for work area after use: **Specific to the chemicals used.**

Exposure Response and First Aid Measures

Skin: Wash skin with ample amounts of water and remove contaminated clothing. Seek immediate medical treatment.

Eyes: Flush eyes for at least 15 minutes while holding eyelids open. Remove contacts if they do not flush out. Seek immediate medical treatment.

Inhalation: Remove individual from exposure area and take to fresh air immediately. Seek immediate medical treatment.

Ingestion: Do not induce vomiting. Seek immediate medical treatment.

Emergency Procedure for Chemical Spills and Accidental Releases

Minor Spill:

In the case of a minor spill, trained individuals within the research facility may cleanup a nanoparticle spill. Be sure to barricade the contaminated area with barrier tape and to use proper PPE before attempting to clean up spill. Place all items used for spill cleanup in a sealed container until disposal.

- **Dry/Powder Spill**
 - **May be cleaned by using a HEPA-filtered vacuum, wiping powder with a wet cloth, or by dampening the powder before wiping with a wet cloth**
- **Liquid Spill**
 - **May be cleaned by using an absorbent material**

Major Spill:

Evacuate all personnel from the area and report the spill to Environmental Health and Safety or Ohio State Campus Police.

Disposal Procedures

All nanoparticle waste must be collected and disposed of by Environmental Health and Safety. Waste must be stored in a sealed container and labeled properly. Contact EHS to arrange a nanoparticle waste pickup.

This Standard Operating Procedure must be placed in the Chemical Hygiene Plan and the MSDS must be accessible. Also, all laboratory personnel must be familiar with safe handling practices (i.e., training with documentation of training) when working with these chemicals. This must be incorporated into the comprehensive chemical hygiene plan of the laboratory. If you have any questions regarding a comprehensive mandatory laboratory chemical hygiene plan please contact your Representative at Environmental Health and Safety (292-1284). For any other questions or concerns, please contact:

PI contact information

Name: **Brutus Buckeye**

Office Phone: 614-292-1284

Cell phone:

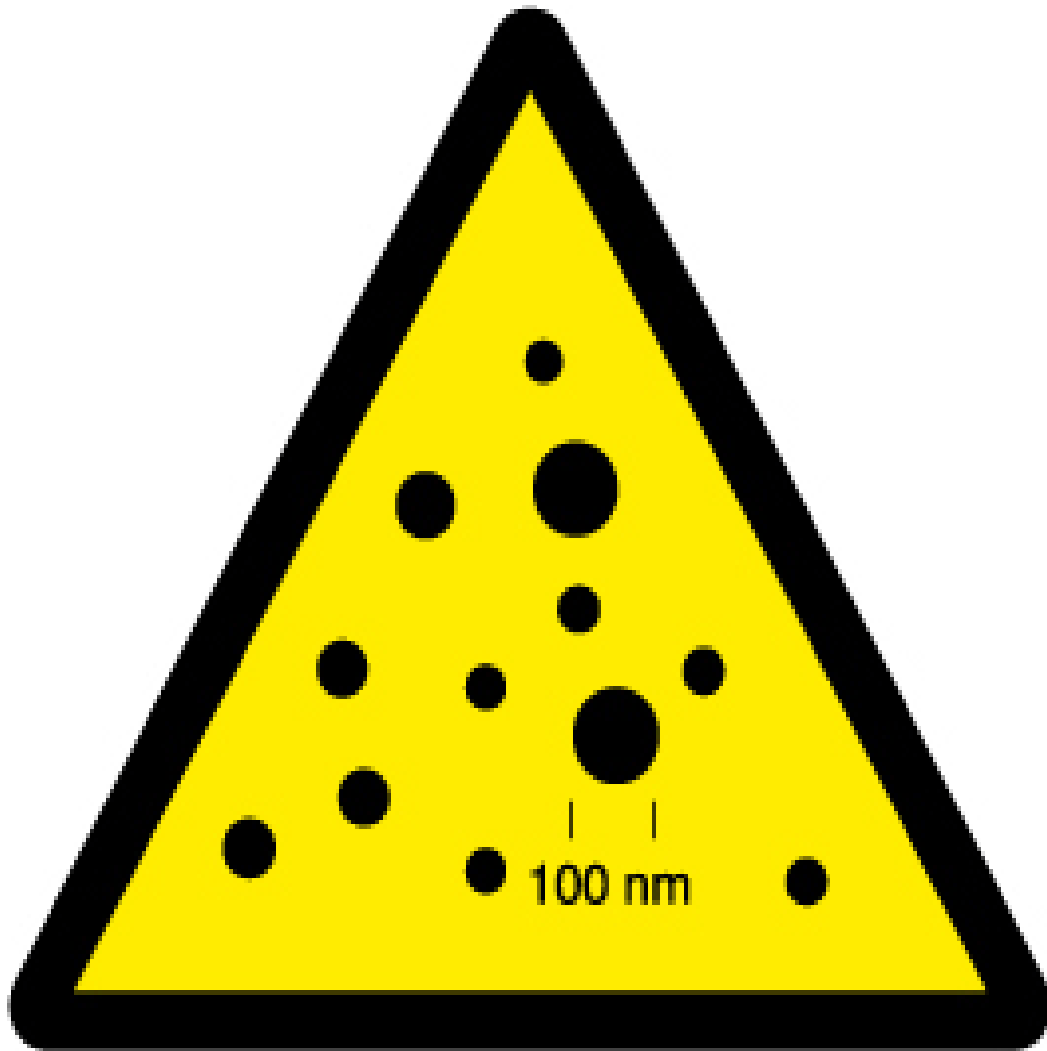
Date:

E-mail:

Home phone:

P.I. Signature _____

Appendix D – Nanotechnology Placard



NANO HAZARD