NANOMATERIAL SAFETY

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Environmental Health & Safety
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PURPOSE

At MSU, a growing number of Spartan innovators are harnessing the diverse properties of nanomaterials into their research. These engineered nanomaterials, 1-100 nanometers in size, have cutting-edge applications in advanced pharmaceutical delivery, materials science, environmental remediation, and a multitude of other ventures.

Their small size makes them both promising and challenging. Nano-sized particles can enter the human body through inhalation, ingestion and through the skin. However, few occupational exposure limits exist specifically for nanomaterials—and those that do may not provide adequate protection for long term health effects.

The Office of Environmental Health & Safety has tools and information to mitigate the potential health effects and safety hazards of nanomaterials. This document provides general safety practices that will mitigate potential exposure.

If you are currently using nanomaterials, or considering their use, please contact Tyler McCord for a safety assessment at mccordty@msu.edu or 517-432-5631.

Successful safety assessments will result in the following outcomes, where possible:

1. Handled and stored in solution: Acquire nanoparticles in dispersion or in bulk solids, and handle in powder form only when no other options exist.
2. Minimum quantities handled and stored: Limit the amount of nanomaterials stored and handled in the laboratory to minimize potential exposure and hazards.
3. SDSs have been reviewed: Safety Data Sheets (SDSs) for all nanomaterials must be available and accessible to all laboratory personnel. All employees should review the SDSs for the nanomaterials they will be handling.
4. Equipment marked where appropriate: Clearly label all equipment, containers, and designated areas where nanomaterials are stored or handled to ensure awareness of potential hazards.
5. Handling restricted to trained personnel: Only individuals who have received the appropriate training, as outlined in the "Training" section of this policy, are permitted to handle nanomaterials.
6. Proper written policies and documents: Written documentation such as SOP documents and procedure instructions are developed, as appropriate to the particulars of your experiments.

By adhering to these guidelines and following the safety measures outlined in this policy, MSU aims to provide a safe working environment for researchers and staff working with nanomaterials. This policy aims to mitigate potential exposure risks and protect the health and safety of all individuals involved in nanomaterial research.

Risk Assessment

Labs using nanomaterials require an EHS assessment to determine appropriate safety controls and if a Standard Operating Procedure document is appropriate. Templates can be found on the EHS Nanomaterials webpage (https://ehs.msu.edu/lab-clinic/chem/nanomaterials.html).

The assessments involve an in-person visit by a representative from the Office of Environmental Health & Safety. During the visit, the EHS representative will closely examine the lab's equipment setups, quantities of materials used, Safety Data Sheets (SDSs), and any other relevant information. This thorough evaluation will help ensure the safe handling and usage of nanomaterials in the laboratory environment.

Laboratory Design

- Set up a designated area for work with nanomaterials and suspensions away from entrances and high traffic areas. A designated area may be an entire laboratory, a section of a laboratory, or a containment device such as a laboratory hood or glove box.
- Handle dry nanomaterials in a fume hood, biological safety cabinet, glove box or a vented filtered enclosure. Do not work on the open bench with dry nanomaterials.
- Aerosol producing activities (such as sonication, vortexing and centrifuging) should not be conducted on the open bench. Perform these activities in a fume hood, glove box, or a vented filtered enclosure.
- Nanomaterials should be stored in labeled containers.
- Liquids or dry particles should always be stored in unbreakable, tightly sealed containers.
- Secondary containment should be used when appropriate.
- Clean areas where nanomaterials are prepared and/or administered immediately following each task and each day after work with the nanomaterials is complete.
- Daily vacuuming of benches and floors with a HEPA vacuum should be performed in labs that handle dry nanomaterials. **Only use HEPA-rated vacuums; using non-HEPA vacuums can release nanomaterials directly into the surrounding atmosphere. HEPA vacuuming is not recommended for reactive materials, as they may react with other materials collected in the vacuum, or with components of the vacuum itself.**
- Use wet wiping or HEPA vacuuming to clean large surfaces (i.e. floors, benches).
- Periodically clean containment device interiors, equipment, and laboratory surfaces where there is potential for nanomaterial contamination.

Work Practice Controls

The following practices should be observed in all labs using nanomaterials:

- When possible, acquire nanoparticles in dispersion or in bulk solids, and handle in powder form only when no other options exist.
- Do not store or consume food or drink in areas where nanomaterials are handled.
- Do not apply cosmetics in areas where nanomaterials are handled.

- Wash hands before leaving the work area and after removing protective gloves.
- Avoid touching the face or other exposed skin when working with nanomaterials.
- Change gloves regularly (at least every two hours) and wash hands at the time of the glove change.

Engineering Controls

Activities that are likely to release nanomaterials should not be performed on the open bench. This can include weighing dry materials, preparing suspensions, or cutting, sawing, drilling, and sanding bulk solids containing nanomaterials. These activities should be performed in a fume hood (or other vented enclosure), biological safety cabinet, glove box or a vented filtered enclosure.

Controls beyond those described above are warranted when aerosol generation of nanomaterials will be extensive, or will involve acutely hazardous parent materials. These controls might include a higher level of containment and/or HEPA-filtration or other cleaning of exhaust.

Personal Protective Equipment (PPE)

All workers handling nanomaterials should wear the following Personal Protective Equipment:

- Always wear long pants and closed toe shoes when working in the lab.
- Always wear disposable nitrile gloves and lab coat when handling nanomaterials, with the gloves covering the cuff of the lab coat.
- Only launder lab coats using University laundry services. Do not take lab coats to private homes.

Transport & Shipping

Complete dangerous goods declaration or shipping papers for offsite shipments of nanomaterials in accordance with the IATA and DOT regulations. Contact EHS for instruction on shipping potentially hazardous materials.

Materials sent offsite must also include a prepared document that describes known and suspected properties likely to be exhibited and notification of potential hazards. The institution may be required to create a Safety Data Sheet (SDS) for the material.

Nanomaterial Disposal

- All waste should be kept in hazardous waste containers and labeled for pickup from EHS within 90 days of waste generation.
- All equipment that contacts nanomaterials during work processes should be disposed of as hazardous waste.
- Waste should never be poured down the drain or placed in trash bins.
- Visit the EHS Safety Portal to request hazardous waste pickup (https://ehs.msu.edu/safety-portal.html).

Emergency Procedures

- In the event of a spill, safety always comes first.
- Alert and clear everyone in the immediate area where the spill occurred.
- Always wear appropriate PPE when cleaning up a spill.
- If you are unable to contain the spill yourself, call EHS at 517-432-5631 for assistance.
- If you are able to clean up the spill yourself, you may visit the EHS website to request hazardous waste pickup for the cleanup materials.
- For liquid suspension spills, absorb using appropriate sorbents.
- For dry spills, clean with a HEPA vacuum or moist sorbent pads, or wet the material with an appropriate solvent and wipe with a dry cloth. **Only use HEPA-rated vacuums; using non-HEPA vacuums can release nanomaterials directly into the surrounding atmosphere. HEPA vacuuming is not recommended for reactive materials, as they may react with other materials collected in the vacuum, or with components of the vacuum itself.**
- Collect the residue, place in a container, and contact EHS for disposal at 517-355-0153.

Safety Data Sheets

Electronic or printed Safety Data Sheets for all nanomaterials should be accessible to lab personnel.

Training

All individuals handling nanomaterials should receive the following training, and training should be documented (topics covered, date, employee names and signatures).

Employees working with chemicals must complete the following training:

- Chemical Hygiene and Hazardous Waste Initial / Refresher
- Laboratory Safety
- Site Specific Training with PI or lab manager