Rice University Nanosafety Guide

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Nanotechnology is a crucial part of the research at Rice University and has been ever since the discovery of buckminsterfullerene in the 1980s. While nanotechnology has been investigated for the better part of forty years, knowledge of the safety of the wide array of these materials is severely lacking.

A nanomaterial is generally defined as any particle or structure in the size range of 1 - 100 nm in at least one dimension. Nanomaterials often have distinct properties from the same material in its bulk form. While there are nanomaterials found in nature, most of the nanotechnology utilized at Rice is synthesized by humans, also called engineered nanomaterials. There is a wide range of nanotechnology used at Rice and the number of materials and applications will likely continue to grow. Everything from metals, ceramics, carbon, semiconductors, and polymers is under investigation, and there are different inherent risks and hazards associated with these materials. The manner in which the nanoparticles are prepared (solid powder, suspended in liquid, embedded in/attached to another material) alters the approach to safe practices. The risk associated with most nanomaterials, particularly new compounds, is often unknown; due to this uncertainty, reasonable precautionary measures are necessary. This document seeks to outline general procedures and practices to minimize environmental, health, and safety risks and promote well-being for those working with nanomaterials. It is advisable for each laboratory to develop standard operating procedures (SOP) that are specific for the scope of research involved.

General Safe Practices For Working With Nanomaterials

- Work in a fume hood or biosafety cabinet or glove box; store nanomaterials in closed and labeled containers; transfer in secondary containment; clean all surfaces with a wet wipe; wash hands frequently; wear proper PPE: eye protection (goggles or face shield), disposable gloves, lab coat, long pants, closed-toed shoes.
    - Can consider respiratory protection -- consult with EH&S
- Working with nanomaterials in order of decreasing safety: glove box > fume hood > biosafety cabinet > lab bench
    - For the highest safety level, use physical separation from the nanomaterials. It is especially beneficial to use glove boxes when handling nanoparticles, which may become airborne. Glove bags should be used when physical separation is advisable but glove boxes are not available.
    - At a lower risk level, work in a well-maintained fume hood with proper airflow (certify fume hoods regularly, use caution for larger items in the hood and keep the sashes open only as much as necessary to perform the task, and the sashes closed when not in use).
- Nanomaterials waste should be handled together with chemical waste. Liquid samples are disposed based on the solvent used (organic or acidic waste); solid waste should be collected into solid waste containers. Cleaning contaminated surfaces should be always done by using wet cleaning papers/sponges and they should disposed with solid waste. Never put nanomaterials into conventional waste collectors or pour them into drains.
- Consult with EH&S if you have questions
- Talk with your PI/advisor about establishing safety precautions

Important Notes

- As a general safety measure, treat “all new compounds, or those of unknown toxicity, as though they could be acutely toxic in the short run and chronically toxic in the long run”
- Exposure Pathways: inhalation, ingestion, injection, dermal contact, eyes
    - Note: breathing in nanoparticles is especially dangerous because they can penetrate deep into the lungs. Fume hoods or glove boxes should be used as much as possible to reduce risk of inhalation.
- Dry, dispersible nanoparticles and powders are particularly dangerous, as they are the most susceptible to dispersal in air, which can lead to inhalation and nanoparticles in unknown locations in the lab or environment. To minimize exposure, try to select nanomaterials bound in a matrix or suspended in a liquid or gel.
- Transfer nanomaterials in closed, labeled containers (label should include “nano”, e.g. “nano zinc oxide”, not just “zinc oxide”, with the particle size range written if known.
- Do not pour nanoparticles down the drain!
- Be aware that SDS usually refer to bulk material properties; nanoparticles of the same material may be more toxic.
- Clean up bench/hood area after working with nanomaterials, wiping them down with a wet wipe or a certified HEPA vacuum. Do not blow air on the surface to clean it and do not use a broom.

LINKS TO MORE NANOMATERIAL SAFETY INFORMATION

- **Nanotoolkit California Nanosafety**
  https://www.ehs.uci.edu/programs/sop_library/Nanotoolkit.pdf

- **NIOSH General Safe Practices for Working with Engineered Nanomaterials**
  https://www.cdc.gov/niosh/docs/2012-147/pdfs/2012-147.pdf

- **Health and Safety Guidelines for Working with Nanomaeterials at Cornell**
  https://sp.ehs.cornell.edu/lab-research-safety/chemical-safety/nanoparticles/Pages/default.aspx

- **Good Nano Guide**
  https://nanohub.org/groups/gng/matrix

- **Protecting Workers During the Handling of Nanomaterials**
  https://www.cdc.gov/niosh/docs/2018-120/pdf/2018-120.pdf

- **Nano.gov EH&S Nano Safety Links and Other Resources**
  https://www.nano.gov/you/environmental-health-safety