



Animal Care and Use Program

Guidelines: Use of Nanoparticles

Objective:	To describe procedures for handling nanoparticles in the UNCC Vivarium
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Overview

Nanoparticles are ultrafine particles measuring between 1-100 nanometers (nm) in one dimension. In addition to the novel size of nanoparticles or structures, uses are also derived from the composition of the nanoparticles, which can be chemical or biological. Concerns with safety regarding the use of nanotechnology have arisen primarily from the recognition of several unique attributes of nanoparticles:

- The ultra-small particle size permits the particles to be carried deeply into tissues. Particles may be deeply respired into the lungs, may pass through the blood-brain barrier; or translocate between organs.
- The molecular structure of nanoparticles and the relatively greater surface area confer on these particles different chemical and biological reactivities than larger structures made from the same elements or molecules.

Although insufficient information exists to predict the health hazard posed by the exposure to nanoparticles, and such effects will vary depending on the composition of the nanoparticles, current research indicates that exposure via inhalation and skin contact can result in these particles entering the body. Results from human and animal studies show inhaled nanoparticles can deposit in the respiratory tract. Animal studies also show nanoparticles can enter the bloodstream and translocate to other organs. Nanoparticles have the greatest potential to enter the body if they become airborne or come into contact with the skin, eyes or mucous membranes. Some evidence suggests that nanoparticles may be more toxic to tissues than larger molecular structures. Exposure to nanoparticles carrying genetic material may result in genetic or immunologic effects. Exposure to nanoparticles carrying infectious agents may cause infectious diseases.

NIOSH, OSHA, the NIH, and the EPA promote the incorporation of cautionary measures in research to minimize or eliminate exposures to nanoparticles. According to NIOSH, the following workplace tasks may increase the risk of exposure to nanoparticles:

- Working with nanoparticles in liquid media without adequate protection (e.g., gloves, safety glasses) will increase the risk of skin or eye exposure.
- Working with nanoparticles in liquid media during pouring or mixing operations, or where a high degree of agitation is involved, will lead to an increased likelihood of inhalation of respirable droplets which may be formed.
- Generating nanoparticles in the gas phase in non-enclosed systems will increase the chances of aerosol release to the workplace.
- Handling nano-structured powders will lead to the possibility of aerosolization

Following are requirements for users and/or handlers of nanoparticles or resultant products, animals, or waste in which nanoparticles are contained:

- Lab coats must be worn. Lab coats must be laundered using University provided lab coat laundry services. Lab coats may not be taken to private homes and laundered.
- Gloves must be worn when handling nanomaterials. Because skin penetration is a concern, gloves must cover the wrist and any skin on the arm exposed by the lab coat.
- Arm sleeves are required where high levels of exposure or splashes of solutions containing nanoparticles are anticipated.
- Standard safety glasses should be worn.
- Whenever possible, work should be performed in a chemical fume hood or biological safety cabinet. When work with nanoparticles must be performed outside a hood or cabinet, safety goggles instead of safety glasses should be worn to prevent eye exposure. Respirators may be required for activities that cannot be controlled using ventilation.
- Dry nanomaterials must be handled in a fume hood or biological safety cabinet. Work on the open bench with dry nanoparticles is not allowed.
- Aerosol producing activities (such as sonication, vortexing and centrifuging) may not be conducted on the open bench.
- Activities that are likely to release nanoparticles (such as the opening and emptying of tubes, weighing of dry nanoparticles) shall not be performed on the open bench.
- Solutions containing nanoparticles should be handled over disposable bench covers.
- Transport of dry nanoparticles should occur in closed containers.
- Hand washing facilities must be provided in all labs. Hand washing must be performed after handling nanomaterials.
- Bench tops and other surfaces should be cleaned after each work activity using a cleaning solution suitable for the type of nanoparticles being used.
- Administration of nanoparticles using needles/syringes should be done using a safe needle device whenever available. Such devices minimize the potential for a needlestick either by having a sliding sheath or guard that covers needle after use or having a retraction feature which isolates the needle inside the syringe. Only needle-locking syringes or disposable syringe-needle units (i.e., needle is integral to the syringe) may be used for the injection of nanoparticles containing recombinant DNA molecules.
- If not commercially available, PIs must verify that nanoparticles generated are sterile before use in animals.

Personal Protective Equipment (PPE) and Laboratory Protection

General PPE recommendations for working with nanomaterials are consistent with PPE recommendations for working with chemicals in the laboratory. PPE recommendations include:

- Wear latex or nitrile gloves when handling nanoparticle powders and nanoparticles in suspension (glove changes should be performed frequently);
- Wear chemical splash goggles when working with nanomaterials in suspension or dry powdered form;
- Wear lab coats. Lab coats should be laundered on a periodic basis. Do not take lab coats home for laundering;
- Wear commercially available arm sleeves in situations where dermal contact with nanoparticles in powder or in suspension are expected;
- Wear closed-toe shoes (if necessary cover shoes with commercially available booties); and
- Consult with UNCC EH&S at 7-1111 regarding the use of respiratory protection if an inhalation exposure hazard exists. The need for and selection of an appropriate respirator should be determined by UNCC EH&S in accordance with the University's Respiratory Protection Program.

Waste Disposal

All solutions and solid materials must be disposed of as hazardous waste following established University

guidelines.

UNCC Committee Approvals

1. Protocols involving the administration of nanoparticles to animals require UNCC IACUC approval. Standard Operating Procedures (SOPs) for the preparation, administration, and waste management of the nanoparticles must be developed and submitted with the IACUC protocol.
2. Protocols involving the administration of nanoparticles containing genetic material to either animals or humans require IBC approval. SOPs for the preparation, administration, and waste management of the nanoparticles must be developed and submitted with the protocol.
3. Protocols involving the administration of nanoparticles to humans require IRB approval.

The guidelines given in this document are minimum precautions. Because the composition and use of nanoparticles will vary from project to project, additional precautions or procedures may be imposed by these Committees based on the review of the proposal and potential risks identified for that project.

Sources

University of Pennsylvania, The Ohio State University, University of California at Davis, University of Iowa, University of Rochester, University of Oklahoma, Purdue University, University of Texas Health Science Center at Houston.

References

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- National Nanotechnology Initiative: <http://nano.gov/>
- NIOSH Nanotechnology: <https://www.cdc.gov/niosh/topics/nanotech/default.html>
- OSHA Nanotechnology: <https://www.osha.gov/dsg/nanotechnology/index.html>

Revision History

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