**Standard Operating Procedure**

for work with

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| **Chemical name/class:** | **Nanomaterials (customization required)** | **CAS #:** |  |
| **PI:** |  | **Date:** |  |
| **Building:** |  | **Room #:** |  |
|  | **Designated Work Area:** |  |

1. **Circumstances of Use:**

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| Nanomaterials are materials having one or more external dimensions, or an internal structure of 100 nm or less, which could exhibit novel characteristics compared to the same material without nanoscale features.*Use this section to describe the circumstances of use, including the types of nanomaterials covered by this SOP, the shape and size of particles/fibers, and chemical composition. Include the approximate total mass that will be handled at a time as well as the frequency of use, along with a description of steps (such as synthesis, weighing, etc.) This section should describe if the material will be handled in suspension only, or if dry particulate will be handled, and should indicate if aerosols are likely to be created.*  |

1. **Potential Hazards:**

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| *State route of exposure (skin, inhalation, ingestion, injection) when/how exposure might occur (inhalation of dusts/mists during weighing of powders or agitation of liquids, splashes, cleaning up spills, etc.). Indicate any known hazards associated with the nanomaterial or its parent material (consult the Safety Data Sheet), including whether the parent material is a particularly hazardous substance (PHS) – you can check the* [*PHS list*](http://www.safety.duke.edu/OHS/phs.htm) *on the OESO website. Consult the Safety Data Sheet (SDS) for more information.*Be aware that toxicity of nanomaterials may be greater than for the parent material, and that their greater surface area may make nanomaterials more flammable, explosive, or reactive than larger particles of the same composition. The risks of fire/explosion/reaction increase with the amount of nanomaterial; researchers should bear this in mind if scaling up a process. |

1. **Engineering Controls:**

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| If aerosols may be produced, nanomaterials (and any suspensions of nanomaterials) must be handled in a chemical fume hood, exhausted biological safety cabinet with negative pressure ductwork, or other exhausted enclosure. Aerosols may be produced during any open handling of dry powder, and during open or pressurized manipulations of suspensions. It is recommended that labs post these information sheets on [Working Safely with Nanomaterials](https://www.safety.duke.edu/sites/default/files/nanomaterial%20information%20sheet.pdf) and [Working Safely with Toxic Powders](https://www.safety.duke.edu/sites/default/files/working_safely_with_toxic_powders.pdf). Controls beyond those described above are warranted when aerosol generation of nanomaterials will be extensive, or will involve PHS parent materials or tubular or fibrous-shaped nanomaterials. These controls might include a higher level of containment and/or HEPA-filtration or other cleaning of exhaust. For assistance with risk assessment, contact Occupational Hygiene and Safety at 919-684-5996. For a detailed discussion of risk assessment for work with nanomaterials, see Paik, SY, et al. (2008) Application of a Pilot Control Banding Tool for Risk Level Assessment and Control of Nanoparticle Exposures. *Annals Occup Hygiene* 52(6), 419-428.  |

1. **Work Practice Controls:**

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| * *Laboratory-specific written procedures are required for work with nanomaterials, including a designated work area (at top of template). The SOP may be a combined SOP for all nanomaterials, as long as the materials do not pose other significant hazards (such as flammables, pyrophorics, explosives, water reactives, etc). For nanomaterials with other significant hazards, material-specific SOPs are required.*
* *If animals will be dosed with the nanomaterial, state that* [*the SOP for Handling Animals Dosed with Toxic Chemicals*](https://www.safety.duke.edu/sites/default/files/SOP-Handling-Animals-Dosed-W-Toxic-Chems.docx) *will be followed, including advanced notification of the animal facility and room and cage labeling requirements.*
* Label containers of nanomaterials with particle size along with other standard items required for the label.
* Set up a designated area for work with nanomaterials and suspensions thereof, and label it.
* Wet cleaning or HEPA vacuuming of lab equipment and exhaust systems is required prior to repair, disposal, or reuse.
* If weighing dry powders and the balance cannot be located in a fume hood or BSC, tare a container then add the material to the container in a hood, then seal the container before returning to the balance to weigh the powder.
* Change gloves regularly (at least every two hours) and wash hands at the time of the glove change.
* If using a HEPA vacuum, change the filter inside a chemical fume hood or biological safety cabinet. If the HEPA vacuum may be used for incompatible materials, maintain a log of vacuum use so that collection of incompatible materials can be avoided.
* Keep containers closed as much as possible.
* Once work with nanomaterials is complete, wipe the work area down with a soap and water solution.
* *Determine a means for decontaminating the work area. (Daily wet cleaning (with a compatible solvent) or HEPA vacuuming are required for any work that may generate aerosols. Note that 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.)*
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1. **Personal protective equipment (PPE):**

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| * Standard nitrile laboratory gloves and a fully buttoned lab coat with sleeves extending to the wrists should be worn when handling nanomaterials. When handling suspensions or solutions, choose a glove that is protective against the solvent.
* If splashes may occur, wear goggles and a face shield. Otherwise, wear standard laboratory safety glasses.
* In cases where the arms or torso may be exposed to liquid suspensions or dry particles, wear Tyvek sleeves and/or gowns (or other air-tight non-woven textile).
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1. **Transportation and Storage:**

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| * Nanomaterials must be in sealed shatter-resistant containers during transportation. If the container is not shatter-resistant, use a secondary container.
* Containers must be labeled with nanomaterial name (or composition) and approximate particle size, along with any known hazard warnings.
* If the material may be flammable, reactive, or explosive, keep away from heat and open flame.
* Keep these powders away from any incompatible materials. *(List any specific incompatibles.)*
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1. **Waste Disposal:**

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| Unwanted nanomaterials (unless fixed in a solid non-friable matrix) must be must be disposed of following your laboratory-specific chemical hygiene plan, Duke University’s [Chemical Waste Policy](https://www.safety.duke.edu/sites/default/files/Q-Chemwastemgt.pdf) and [the Laboratory Chemical Waste Management Practices](https://www.safety.duke.edu/sites/default/files/Lab-Waste-Management-Practice.pdf). Call OESO Environmental Programs at 919-684-2794 with specific questions.  |

1. **Exposures/Unintended contact:**

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| Contact Employee Occupational Health and Wellness (EOHW) at 919-684-3136 for medical advice on occupational chemical exposures. For an actual chemical exposure/injury:* Flush exposed eyes or skin with water for at least 15 minutes, then seek medical attention if needed.
* For situations with risk of inhalation exposure (including dry powder spills outside of a chemical fume hood), remove all persons from the contaminated area and contact the OESO spill team.
* Call 911 from a campus phone or 919-684-2444 from any phone to request assistance if needed. Contact Employee Occupational Health and Wellness at 919-684-8115 for exposure-related advice.

The work-related injury or illness report found at: <https://forms.hr.duke.edu/workcomp/> should be completed within 24 hours. Follow-up medical attention (if needed) should be sought through Duke Employee Occupational Health and Wellness (919-684-3136). |

1. **Spill Procedure:**

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| *Every lab working with nanomaterials in a form that could be spilled or released (dry particulate or liquid suspension) must have a plan for cleaning up spills, and supplies on hand for dealing with small spills. A supply of “Tack Mat” or similar adhesive-coated mats should be kept on hand. If dispersed spills of dry nanomaterials are possible (such as during synthesis reactions), a HEPA vacuum (preferably one with electrostatic-charge-neutralization features) is recommended. If the vacuum may be used for incompatible materials, maintain a log of vacuum use so that collection of incompatible materials can be avoided.* Unless there are other hazards (such as reactivity) associated with the nanomaterials, the following recommendations should be adequate.* If the nanomaterial spilled outside of a contained enclosure, place an adhesive mat at the room’s exit to reduce the likelihood of spreading nanomaterials outside of the room where the spill occurred.
* For small spills of liquid suspensions, absorb the spilled material with a suitable absorbent (determined in advance), then wet-wipe the affected area three times. Place all absorbent and PPE into a bag and seal, then submit as hazardous chemical waste through OESO Environmental Programs (call 919-684-2794 with questions).
* For spills of dry nanomaterials in a chemical fume hood or other enclosure, wipe up the powder using a cloth dampened with a suitable absorbent, (determined in advance) or wet the powder with a suitable absorbent and then wipe with a dry cloth. Consider using electrostatic microfiber cleaning cloths, especially if the nanomaterial is likely to carry an electrostatic charge. Alternately (or in addition), a HEPA vacuum (preferably with electrostatic-charge-neutralization features) may be used for cleaning the spill (note above precautions about incompatible materials). Minimize the fume hood or enclosure opening during this process. Once spill has been cleaned up, wet-wipe the affected area three times to decontaminate the surface. Place any clean-up materials into a bag and seal, then submit as hazardous chemical waste through OESO Environmental Programs (call 919-684-2794 with questions).
* For spills of dry nanomaterials or major spills of liquid suspensions outside of a chemical fume hood or other enclosure, leave the area and request assistance from the OESO spill response team by calling 911 from a campus phone or 919-684-2444 from any phone. Researchers may also contact the OESO spill response team for guidance on whether or not they can safely clean up a spill themselves.
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1. **Training of personnel:**

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| * All personnel are required to complete the online General Lab Safety session thru the OESO website. This session includes an introduction to general chemical safety.
* Training on lab-specific procedures is required for all personnel working with these materials, and must be documented (topics covered, date, employee names and signatures). Laboratory-specific training for work with nanomaterials must include information on the relatively greater hazards of working with nanomaterials, and on the uncertainty of health effects.
* All personnel shall read and fully adhere to the laboratory- and nanomaterial specific SOP, and shall document that they have read it by signing and dating the SOP.
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**“I have read and understand this SOP. I agree to fully adhere to its requirements.”**

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