

Radioactive Materials Standard Operating Procedure

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Section 1: Purpose

This document describes the Standard Operating Procedures for radioactive materials, particularly consistent procedures to establish safety. Although the Lewis group does not typically work with radioactive materials, they are occasionally of use. The lab is not equipped to work with highly radioactive materials so **only slightly radioactive materials are permitted**, i.e. depleted uranium and long lived isotopes.

Section 2: Application

Currently radioactive materials are only used to produce heterogeneous catalysts as thin metallic films on graphite substrates. (3/21/2016).

Section 3: Materials

List of Materials Currently Employed:

Thorium (IV) Acetylacetonate (3/21/2016)

Section 4: General Group Policies

- Only users who have received both the group safety training and radiation safety training are permitted to use radioactive materials.
- All purchases of radioactive materials must have Nathan S. Lewis's permission.
- No volatile radioactive materials are permitted anywhere in the Lewis group laboratories.
- All loose, liquid, and powder samples containing radioactive materials must be kept away from sensitive instrumentation such as SEM, XRD, TEM, and XPS.
- Radioactive materials are not currently permitted within the glove or snuff boxes.
- Radioactive materials are not permitted in the evaporator or wire growth furnaces.

Section 5: Engineering Control and Operational Procedures

Due to the poisoning potential of radioactive materials—mostly due to them being heavy metals—and their ability to interfere with sensitive instruments, stringent engineering controls and operational procedures are required.

- Upon receipt of radioactive materials, a Geiger counter (Noyes 227) must be used to calculate approximate exposure dosages from handling the bottle and or samples. As most users will only

be handling radioactive materials with their hands and the samples should be small, the most appropriate exposure limit is the extremity exposure limit of 50 rem per year. If the user calculates their approximate exposure to be above half this limit, the experiment should be considered dangerous and further consultation with more experienced groups is needed. For more information please read:

https://www.nde-ed.org/EducationResources/CommunityCollege/RadiationSafety/safe_use/exposure.htm

- All radioactive materials must be kept in a closed and labelled secondary containment such as a box.
- Tools such as spatula, vials, other containers, etc. that are used with radioactive materials must only be used with that material in order to avoid the spread of the radioactive material in the labs. These tools must be labelled and kept with the material in its secondary containment.
- All measurement, reactions, and experimentation with radioactive materials must be carried out within a fume hood. The acid-hoods in Noyes 221 are never appropriate for radioactive materials.
- With all measurements, reactions, and experiments with radioactive materials, the amount used must be minimized. No preparative scale syntheses or scaling up of reactions is permitted until vetted by Nathan S. Lewis or another lab manager. It is never permitted to use enough radioactive material that if it were to spill the user could not clean it up easily without assistance.
- Experiments and massing out of reagents must be performed on paper towels or cotton wipes in case of spills.
- All solid waste must be placed into plastic bags separated from other chemical waste and labeled as radioactive. All liquid waste must be placed into bottles separated from other chemical waste, particularly strong oxidizers and acids, and labelled as radioactive.

Section 6: Appropriate Personal Protective Equipment

Due to the poisoning potential of radioactive materials—mostly due to them being heavy metals—and their ability to interfere with sensitive instruments, stringent engineering controls and operational procedures are required.

- Standard PPE including **closed-toed shoes, long pants, lab coats, gloves, and safety goggles** are always required within Lewis group facilities.
- After gloves have been used, they are to be disposed of **immediately** in a labelled solid waste container. No gloves may be disposed of in a trash can.
- If radioactive material contaminates lab coats or clothing, the items must be disposed of in a labelled solid waste container.
- While filtration masks and rebreathers are tempting and have a place in the laboratory, they are never permitted with the use of radioactive materials. If the procedure requires masks or rebreathers, it is not permitted.

Section 7: Primary Hazards

- Heavy metal poisoning: Most radioactive materials are heavy metals and as such should be treated with caution and not ingested or inhaled under any circumstances.

- Radiation: Care should be taken to ensure that the radiation dosage does not approach the exposure limit of 50 rem to extremities.
- Flammability: Organic salts of radioactive isotopes may be flammable. A fire of these materials would lead to the dispersal of radioactive materials throughout the lab and researchers' lungs. Avoid placing such materials near open flames.
- Corrosives/Oxidizers: Many radioactive isotopes exhibit a number of oxidation states. Exposure of these materials to easily reduced or oxidized materials such as skin may lead to burns.

Section 8: First Aid and Emergency Procedures

- Eye contact: Immediately flush eyes with plenty of running water for at least 15 minutes. Speed is extremely important. Obtain medical attention as soon as possible.
- Skin contact: Immediately flush affected areas with water, removing contaminated clothing while under the safety shower. Continue washing and get medical attention.
- In case of a spill: Minor spills can be cleaned with cotton cleaning pads or paper towels. Large spills should be contained and EH&S notified. Please note that no one should use an amount large enough to create a large spill.
- In case of fire: Extinguish with either a chemical extinguisher or water.
- In case of hospital visitation: Bring a copy of the SOP and MSDS for the material to the hospital. A person familiar with chemistry should accompany the victim in order to explain what the hazards are to emergency personnel.