**Laboratory Safety Guideline**

**Sample staining using uranium solutions for electron imaging** (Uranyl Acetate / Uranyl Nitrate)

**Section 1 – Lab Information**

|  |  |
| --- | --- |
| **Lab location**  |   |
| **Department/Lab:**  |   |
| **Principal Investigator Name:**  |   |
| **Principal Investigator Signature:**  |   |
| **Responsible Person**  |   |

**Section 2 - Responsibilities**

* **Institutional Radiation Safety Committee (IRSC)** reviews experiment protocol and issues the Radiation Use Authorization (RUA) approval letter.
* **Radiation Safety Officer (RSO)** provides technical assistance and guidance on the use of radioactive material and inspects areas of use, storage, and disposal.
* **Principal Investigator** ensures that guidelines for Uranium compounds are followed in all research protocols.
* **Researchers and students** follow the guidelines listed in this document when using Uranium compounds.

**Section 3 – Hazards**

Uranium compounds such as uranyl acetate and uranyl nitrate are naturally occurring radiological materials (NORM) that are water-soluble and commonly used as a contrast agent for staining samples in electron microscopy.  These compounds are toxic, corrosive, and radioactive.  Uranium compounds are not generally considered as a significant external radiation hazard. They consist mostly of Uranium-238 (U238) in powder form with usually a low specific activity (10,000 Bq per gram).

Hazards can vary between Uranium compounds. Consult the chemical’s Safety Data Sheet (SDS) for most accurate hazards.

|  |  |
| --- | --- |
| C:\Users\bahmaima\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\5718209.tmp  |  Acutely toxic if swallowed or inhaled.  |
| C:\Users\bahmaima\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\A3BB79FF.tmp  |  May cause damage to organs through prolonged or repeated exposure.  |
| C:\Users\bahmaima\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\F7C9365.tmp  |  Toxic to aquatic life with long lasting effects.  |
| C:\Users\bahmaima\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\4F66FFBB.tmp  | Increased risk of cancer due to irradiation of the lung and bone cells if inhaled or digested  |

**Section 4 – Engineering Controls and Personal Protective Equipment (PPE)**

Prior to performing this procedure, the following safety equipment must be available, functioning properly and ready to use.

|  |  |  |  |
| --- | --- | --- | --- |
|   | **(Click if Yes)**  |   | **(Click if Yes)**  |
| Designated chemical fume Hood  | [ ]   | Laboratory Coat  | [ ]   |
| Safety Shower  |[ ]  Safety Glasses  | [ ]   |
| Eyewash Station  |[ ]  Disposal Gloves Type  | [ ]   |
| Fire Extinguisher  | [ ]   | Chemical Splash Goggles  | [ ]   |
| Secure storage cabinet  | [ ]   |   |   |

**Exposure Risk and Controls:**

These compounds pose a high risk from internal radiochemical exposure due to ingestion and inhalation.

* Use uranyl compounds in a designated bench and a properly functioning designated chemical fume hood.
* Use the smallest amount of Uranyl Acetate that is consistent with the requirements of the work to be performed.
* It is recommended to use spill trays (metal or plastic) with disposable covering such as bench coat and clean the surface after each use.
* Any designated fume hood or fridge used for temporary or long-term handling or storage of uranyl acetate should be labelled with the Caution - Radioactive Material label.
* Benchtops where uranyl acetate/Uranyl nitrate is used should be marked with radioactive warning tape.
* Any stock vials, tubes, flasks, etc. containing Uranyl acetate/Uranyl nitrate should be labelled with radioactive warning sign."
* After each use/experiment, wipe down the equipment and designated work area (designated fume hood and designated workbench) using a solution of 70 % ethanol in water to prevent the accumulation of chemical residue.
* All aliquots and stocks of uranyl acetate will be stored in the designated location.

**Hygiene Measures:**

* Avoid contact with skin, eyes, and clothing. Wash hands before breaks and immediately after handling the product.
* Upon leaving the designated area, remove any personal protective equipment worn and wash hands, forearms, face, and neck.

**Hand Protection**

Chemical-resistant gloves must be worn; nitrile gloves are recommended for low volume applications. Wearing two pairs of nitrile gloves is recommended.

Gloves must be worn. Use proper glove removal technique to avoid any skin contact. Nitrile gloves layered underneath butyl rubber gauntlet-style gloves are recommended.

**Eye Protection**

ANSI approved properly fitting safety glasses or chemical splash goggles are required. A face shield may also be appropriate depending on the specific application.

**Skin and Body Protection**

Skin contact should be avoided due to the likelihood of dermal irritation, the increased risk of ingestion from contamination, and beta skin dose from Pa234 daughters. Laboratory coats must be worn and be appropriately sized for the individual and buttoned to their full length. Personnel must also wear full length pants, or equivalent, and close-toed shoes. Full length pants and close-toed shoes must be always worn by all individuals that are occupying the laboratory area. The area of skin between the shoe and ankle must not be exposed.

**Inhalation and Ingestion Hazard**

Inhalation and ingestion are the primary radiological and chemical hazards. The inhalation of soluble U238 is a lung carcinogen and irritant from Alpha decay, as well as toxic to kidneys and blood as heavy metal.

**Section 5 – Special Handling and Storage Requirements**

* Do not over purchase; only purchase what can be safely stored in the laboratory.
* Avoid all direct contact with uranyl compounds; always handle in a properly functioning chemical fume hood and always wear appropriate PPE.
* Keep containers tightly closed and store in a secure cool, dry, and well-ventilated area that is protected from sunlight.
* Any stock solution or powder must be labeled with the radioactive warning sign and stored in a locked cupboard.
* Storage conditions are intended to provide control and security; therefore, access should only be given to authorized users who have been made aware of the safety requirements. These conditions are part of the safeguards legislation and further information can be obtained from the Radiation Safety Officer.
* A designated chemical fume hood should be established for work with uranyl compounds. Ensure that the hood sash is positioned at the proper operating height as indicated by the operating sash label.
* Before work begins, line the work activity area (i.e., fume hood deck) with disposable absorbent pads to ease cleaning or capture material in the event of a spill. Make sure the work area is free from unnecessary equipment and/or chemical containers, beakers, flasks, etc. The work area should be smooth, non-porous, and easily decontaminated.
* Routinely decontaminate the container, equipment, and surfaces using techniques to minimize airborne substances. Decontamination should be accomplished by wet-wiping surfaces with soap and water.
* Due to toxic hazards, uranium stain liquid waste must not be poured down a sink for disposal.
* Uranyl compound waste liquids must be collected in the radioactive liquid waste carboy
* A current copy of the safety data sheet must be made available to all personnel always working in the laboratory. This SDS must be reviewed by all personnel working with the compound before work begins. Special consideration should be given to the toxicological information included in the SDS.

**Section 6 – Spill and Emergency Procedures**

**First Aid**

SKIN CONTACT

* Flush skin with tepid water and soap for 15 minutes using the closest available sink, portable drench hose or safety shower.
* Call 911 on a landline phone or 0128080911 on a mobile phone for medical assistance.

EYE CONTACT

* Using eyewash, flush eyes while hold eyelid open and away from exposed eye for 15 minutes.
* Call 911 on a landline phone or 0128080911 on a mobile phone for medical assistance.
* Continue flushing with water until emergency medical personnel arrive.

INHALATION

* If dust or vapors are inhaled, immediately move to get fresh air. If possible, force coughing and blowing of the nose.
* If respiratory irritation occurs call 911 on a landline phone or 0128080911 on a mobile phone for medical assistance

INGESTION

* Rinse mouth with water.
* Call 911 on a landline phone or 0128080911 on a mobile phone for medical assistance

**Spill Response**

For major spills or personnel contamination:

* Alert others and evacuate to a safe distance and prevent entry.
* Contact the radiation Safety officer or dial 911 from a campus phone or 012 808 0911 from a mobile phone.
* Remain in a safe location until the RSO, HSE or other response personnel arrive.

For incidental powder spills:

* Cover the area with a moist paper towel to prevent dispersal of the powder.
* Wearing the proper PPE, sweep up the powder using paper towels or wipes and dispose of in the radioactive solid waste container.
* Survey the area with a Geiger counter and notify the RSO if the count rate is significantly higher than background.

For incidental liquid spills:

* Wearing the proper PPE, absorb the spill into the benchtop liner or other absorbent material and dispose of in a clear plastic bag designated for uranyl acetate/nitrate waste.
* Foaming soap cleaners may be used to clean liquids that have dried onto a benchtop.
* Survey the area with a Geiger counter and notify the RSO if the count rate is significantly higher than background.

**Section 7 – Waste Disposal Procedures**

**Solid waste:**

* Dispose of the solid waste such as filter paper, paper towels, pipettes, bench liner, grids and plastic ware in contact with UA as radioactive waste and place them inside a solid designated radioactive waste container.
* Discard gloves if not contaminated as regular chemical waste.

**Liquid waste:**

Uranyl Acetate and Uranyl Nitrate liquid waste disposal are regulated as radioactive waste. Refrain from mixing staining compounds, hazardous chemicals, or solvents with Uranyl Acetate or Uranyl Nitrate.

* **DO NOT dispose of liquid wastes by dumping them down a sink.**
* Liquid waste should be poured into a labeled radioactive liquid waste containers and stored in the designated fume hood. Keep level below fill line.
* Keep lids on when not filling.

 **Disposal**

* All radioactive waste containers must be labeled with a Radioactive Waste Tag (Figure 1);
* Once your waste container is full and ready to be disposed of, please fill in the *Radioactive Waste Pick-Up Form* (Appendix 2) and raise a general request for radioactive waste disposal on SALUTE system (attach the form with the request).
* The RSO will arrange a time to meet to collect the waste at your laboratory.



Fig.1 Radioactive waste tag

**How to request a waste pick-up?**

1. Radioactive waste pickup requests must be submitted to the RSO through HSE SALUTE general request via *Salute Community Portal (salutesafety.com).* Please attach the signed radioactive waste pickup form with your request.
2. Log-on to SALUTE community portal and select request/report**;**
3. Click on new request/report tab and ***select*** *General Request****;***
4. Enter the required requester and location details;
5. Under Also Notified field, select the name of the RSO (Mohammad Bahmaid).
6. Under Describe your Request field, enter “Radioactive **waste pick-up request**”.
7. Upload the radiation waste pick-up form as an attachment.
8. Click ***Submit*** Request, this should send an email to the RSO requesting a waste pick-up.
9. The RSO will schedule a pick-up of the radioactive waste with *the Site Services Team* and notify the lab about the date and time of waste collection.

**Section 8 – Protocol (Brief description of process, operation, activity)**

**NOTE:** Any deviation from this protocol requires approval from the IRSC.

**Section 9 – Documentation of Training (signature of all users is required)**

Prior to conducting any work with uranyl compounds, the Principal Investigator must ensure that all authorized users have completed the required HSE Radioactive Material Safety Training on SALUTE and receive training on the content of this safety guideline. In addition, the following training is also required:

* *Chemical Spill Training*
* *Laboratory Safety Training*
* *Safe Fume Hood Use Training*
* *Hazardous Waste Training*

Furthermore, all personnel shall read and fully adhere to this safety guideline.

**Section 10 – Safeguards Regulations**

KAUST is required by the National Competent Authority NRRC (Nuclear and Radiological Regulatory Commission) to report annually on all Uranium compounds present in the university. All use and storage of any material containing uranium is to be limited to areas that have been approved by the university Institutional Radiation Safety Committee (IRSC) as an authorized Location. Each storage and use area will be inspected frequently by the RSO.

**Further Information**

Contact the Radiation Safety Officer (RSO) at Health, Safety, and Environment at 0128087843 or email: mohammad.bahmaid@kaust.edu.sa

**I have read and understand the content of this safety guideline:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **KAUST ID** | **Signature** | **Date** |
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**Appendix 1. Radioactive waste pick-up form**

