Standard Operating Procedure - Aqua Regia

For chemical usage in the Keck Microfabrication Facility, B142

Quick Points

- Aqua Regia is extremely corrosive, and may cause skin burn or explosion.
- Full protection (splash barrier, splash goggle, apron, and safety gloves) is required.
- Use glass containers only. Do not use plastic containers.
- The waste solution must be given sufficient time to stabilize in an open container before transferring to a waste container for pickup by ORCBS.

1 - General information

1. Aqua Regia is a mixture of concentrated nitric acid (HNO3) and hydrochloric acid (HCl). It is most commonly used to remove trace metals and trace organic materials from glassware. The mixing ratio may vary depending on the application.

   Aqua Regia is a strong oxidizer and extremely corrosive. During the preparation of Aqua Regia (mixing of nitric acid and hydrochloric acid) or during metal etching using Aqua Regia, toxic gases (nitrosyl chloride, nitrogen dioxide, and chlorine) are produced. Aqua Regia, along with the fumes it produces can cause destruction of living tissue. Corrosive effects can occur not only on the skin and eyes, but also in the respiratory tract and, in the case of ingestion, in the gastrointestinal tract as well. If Aqua Regia is not handled properly, an explosion, skin burns, or eye/respiratory tract irritation may result.

2. Aqua Regia users must get permission from the facility manager.

3. Any accident regarding the use of Aqua Regia usage must be reported without delay to the facility manager.

2 - Protection equipment

Protective equipment must be used when handling Aqua Regia. The protective equipment include: splash barrier, splash goggle, heavy duty rubber gloves, and an acid apron to wear on top of the cleanroom coverall.

A splash barrier is for face protection. Use the sash on fume hoods as a splash barrier. Keep the sash at the marked position. Do not raise the sash to a higher lever. If for any reason, the sash has be to raised to a higher lever, a full face shield must be worn as the splash barrier.

3 – Handling of Aqua Regia solution

1. Aqua Regia, as well as any corrosive or hazardous substances, can only be used in the facility during normal operational hours and requires at all time the presence of a second knowledgeable user (buddy system).

2. Aqua Regia can only be used only under the acid fume hood, which is the fume hood #2.

3. Whenever handling Aqua Regia, only use glass containers clearly labeled for its use.

4. The user must flip the warning sign on the acid fume hood, and verbally inform other users present in the room that the Aqua Regia solution is in use.
5. Mixing Aqua Regia with organic compounds may cause severe reaction. This includes acetone, photoresist, isopropyl alcohol, and nylon. This practice must be avoided.

6. For removing photoresist on samples, the bulk volume of photoresist on the samples must be removed first using other means, and the samples must be dried. Aqua Regia is used to remove residues of photoresist only, not the bulk.

7. Leave the Aqua Regia in an open container until its reactivity stops completely and cools to room temperature.

8. Never store Aqua Regia in KMF. Aqua Regia stored in a closed container improperly will likely explode.

9. Do not store wash bottles containing organic compounds (such as the spray bottles of acetone, isopropyl alcohol) inside the same fume hood.

4 – Aqua Regia waste disposal

1. The waste of Aqua Regia solution cannot be discharged into sewage system, and must be disposed off through ORCBS.

2. The primary hazard from storage of Aqua Regia solution is the potential for gas generation and over pressurization of the container when the solution is still active. If you store the fresh solution in an airtight container, it will explode!

3. Prior to store the Aqua Regia waste solution, the solution must be left in an open container for its reactivity to stop completely and cool down to room temperature. It is your responsibility to make sure that the open container is very clearly labeled and left in the acid fume hood for cooling down.

4. Once becoming stable, the solution must be transferred into a waste container. The container must be very clearly labeled with the solution name and composition, as required by ORCBS, and must include VERY VISIBLE warning signs not to add any other types of chemicals.

5. For added safety, a poly-lined or plastic coated glass bottle fitted with a vented cap is recommended as a waste container for Aqua Regia solution (?).

6. Waste containers for Aqua Regia solution cannot be kept in the facility. At the end of each work cycle (no longer than a day), the waste container must be transferred to Room B238 for disposal according ORCSB procedure for waste disposal.

5 - Emergency procedure

1. In case of large exposure, the victim should be removed from the contaminated area, placed under a safety shower while emergency personal is contacted (911).

2. All contaminated clothing should be removed immediately with appropriate gloves and safely discarded.

3. In case of contact with the skin, the affected area must be immediately rinsed with large amounts of water for at least 15 min.

4. In case of contact with the eye, irrigate the eye for at least 30 minutes, keeping the eyelids apart and away from eyeballs during irrigation. Place ice pack on eyes until reaching emergency room.
5. In case of inhalation, it may irritate the respiratory tract. Conscious persons should be assisted to an area with fresh, uncontaminated air. Seek medical attention in the event of respiratory irritation, cough, or tightness in the chest. Symptoms may be delayed.

6 - Supply and storage

1. Aqua Regia solution can not be stored in KMF.