SV GUIDELINES

Aqua Regia - Royal Water - Eau Régale

1. Overview

Aqua regia ("Royal Water" ou Eau régale) is a solution of nitrohydrochloric acid. The solution is comprised of a 3:1 mixture of hydrochloric acid and nitric acid, respectively. It is commonly used to remove noble metals such as gold, platinum and palladium from substrates, particularly in microfabrications and microelectronics labs. Glassware may also be washed with aqua regia to remove organic compounds only in trace amounts. Aqua regia solutions are extremely corrosive and may result in explosion or skin burns if not handled with extreme caution.

2. Emergency Procedures

In case of skin contact: May cause skin burns. Flush the skin with copious amounts of water for at least 15 minutes. Seek medical attention.
In case of eye contact: Aqua Regia is corrosive and irritating to the eyes. Flush contaminated eye(s) immediately with copious quantities of water for at least 15 minutes. Seek medical attention immediately.
In case of inhalation: 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.
In case of ingestion: Seek medical attention immediately.

3. Handling

3.1. Always use glass (preferably Pyrex) containers. Aqua regia will melt some plastics and corrode most metals.

3.2. Preparation

When preparing Aqua Regia, always add the nitric acid to hydrochloric acid, never vice versa.

Never store aqua regia solutions. **Mix up only what you need, then destroy after each use.**
Mix the solution in a fume hood with the sash between you and the solution, (sash should be pulled down to your shoulders). Wear chemical splash goggles, face-shield, labcoat and Butyl gloves:

Glove selection guide for chemicals

Glove: Butoject
Ref. store BCH: 103986
Brand: KCL
Glove material: Butyl
Use: Reusable
Thickness (mm): 0.700
EN standard: EN 374-2,EN 374-3/BCI,EN 388/0111,EN 421

Wearing an apron on top of the labcoat is highly recommended.
Aqua regia solution is very energetic and potentially explosive. It is very likely to become hot, more than 100 degrees C. Handle with care.
Adding any acids or bases to aqua regia or spraying it with water will accelerate the exothermic reaction.
When preparing the aqua regia solution, **always add the nitric acid to the hydrochloric acid slowly** and, from time to time, shake the receiving bottle slowly to homogenise the mixture.

3.2.1 In an open glass (Pyrex) bottle, pour the necessary amount of hydrochloric acid.

3.2.2 Add portion wise the required amount of nitric acid. After each small addition, shake the receiving bottle slowly to homogenise the mixture and wait until temperature has dropped.

3.2.3 Once addition and homogenisation finished, put the bottle in a secondary glass container (crystallizer - crystallisoir) and leave the hot aqua regia solution in an open container until cool.

Never store aqua regia in a closed container. It will oxidize over time to form toxic nitrosyl chloride, nitrogen dioxide and chlorine gases. This will pressurise the container, likely causing an explosion.
Dissolving metals in aqua regia releases toxic gases, when working with aqua regia always work in a fume hood.

Mixing aqua regia with organic compounds may cause an explosion.

4. Storage

- Never store a stoppered bottle of Aqua Regia. Explosion may result!
- Aqua Regia should be made fresh before every use and then excess amounts neutralized shortly after use.
- Aqua regia quickly loses its effectiveness due to oxidation of its reactive components. Mix a fresh solution for each use.
- Excess solutions should be neutralized (pH=7) by pouring it **very cautiously** into cold water. Then add to it **very cautiously** a cold solution of sodium hydroxide (NaOH) or sodium bicarbonate ($NaHCO_3$).

5. Disposal

- As large volumes will be generated, work out the size of the final container(s).
- Neutralize Aqua Regia by pouring it slowly into a large quantity of ice (500 grams of ice per 10 mL of Aqua Regia). To the Aqua Regia/Ice mixture, add portionwise (and stir from time to time) an aqueous basic solution (10% sodium hydroxide (NaOH) or saturated sodium bicarbonate (NaHCO3) solution) until pH is neutral (pH= 7).
- The neutralized mixture should be labelled and disposed of properly through the chemical waste management system.