



PIRANHA SOLUTIONS

I. Overview

- a. Piranha solutions are used to remove organic residues from substrates, particularly in micro-fabrications labs. The traditional piranha solution is a 3:1 mixture of sulfuric acid and 30 percent hydrogen peroxide. The solution may be mixed before application or directly applied to the material, applying the sulfuric acid first, followed by the peroxide. Piranha solutions are extremely energetic and may result in explosion or skin burns if not handled with extreme caution.
- b. Piranha solutions are OSHA Particularly Hazardous Substances (PHS), and all areas of use must have PHS controls in place including but not limited to:
 - i. A written SOP for the work must be prepared by the individual laboratory.
 - ii. Each employee handling a Piranha solution must have documented training on the written SOP.
 - iii. Review the “Guidelines for use of Particularly Hazardous Substances”.

II. Emergency Procedures

- a. In case of skin contact:
 - i. May cause skin burns. Flush the skin with copious amounts of water for at least 15 minutes. Seek medical attention.
- b. In case of eye contact:
 - i. Piranha 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.
- c. In case of inhalation:
 - i. 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.
- d. In case of ingestion:
 - i. Not a likely route of exposure.

III. Handling

- a. Always use glass (preferably Pyrex) containers. Piranha solutions will melt plastics.
- b. Mix the solution in a fume hood with the sash between you and the solution. Wear appropriate gloves, eye protection, and an acid-resistant lab coat or similar body protection.

- c. When preparing the Piranha solution, always add the hydrogen peroxide to the sulfuric acid.
 - i. If the peroxide concentration is at 50% or greater, an explosion could occur.
 - ii. Do not guess on volumes. Always measure the quantity of hydrogen peroxide and sulfuric acid added.
- d. Piranha solution is very energetic and potentially explosive. It is very likely to become hot or more than 100° C. Handle with care.
- e. Leave the hot Piranha solution in an open container until cool.
- f. Never use Piranha solution alone in the laboratory.
- g. Never store Piranha solutions. Piranha solution stored in a closed container will likely explode.
- h. Adding any acids or bases to Piranha solution or spraying it with water will accelerate the reaction. This includes Photoresist, which is a **strong base**.
- i. Mixing hot Piranha solution with organic compounds may cause an explosion. This includes acetone, photoresist, isopropyl alcohol, and nylon.

IV. Storage

- a. Do not store Piranha solution.
 - i. *Mix fresh solution for each use, preparing only the amount expected for current use.*
- b. Prepare only the amount expected for current use.

V. Disposal.

- a. Excess solutions can be disposed of one of the following ways:
 - i. For <100mL solutions: Slowly dilute <100ml of the Piranha Solution in 1 liter of water. Pour down the drain followed by flushing with copious amounts of water.
 - ii. For 100mL solutions: Slowly dilute 100ml of the Piranha Solution in 1 gallon of water. Pour down the drain followed by flushing with copious amounts of water.
 - iii. Dispose of as Hazardous Waste. Follow the “Hazardous Waste Management and Satellite Accumulation Area Guide”.
- b. The primary hazard from storage of piranha etch waste is the potential for gas generation and over pressurization of the container when the solution is still hot. If you store a hot solution in an air tight container, it will explode!
 - i. Therefore prior to store the Piranha solution, it must be left in an open container in order to cool down for several hours (overnight). It is your responsibility to make sure that the open container is very clearly labeled and left in a safe area for overnight cool down.

- ii. Once cooled down, the solution can be transferred into a closed glass container for waste storage. The container must be very clearly labeled with the solution name and composition and must include VERY VISIBLE warning signs not to add any other types of chemicals.

VI. References

[University of Colorado Boulder: Use and Disposal of Acidic 'Piranha' Solutions](#)

[CSHEMA Laboratory Safety Resources: Piranha Solutions](#)

OSHA 29 CFR 1910.132 Personal Protective Equipment

OSHA 29 CFR 1910.1450 Occupational exposure to hazardous chemicals in laboratories