



# Standard Operating Procedure

## PIRANHA SOLUTION

---

Piranha solutions are used to remove organic residues from substrates, particularly in microfabrications laboratories. The traditional piranha solution is a 3:1 mixture of sulfuric acid and 30% 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 should never be used for routine cleaning.

### Potential Hazards

Skin or eye exposure to piranha can cause severe burns. The vapor is highly corrosive and can be destructive to mucosal membranes and lungs. Piranha solutions are extremely energetic and may result in explosion if not handled with extreme caution.

**This solution must not be handled while working alone.**

### Personal Protective Equipment (PPE)

The University's Personal Protective Equipment Policy can be found here: <http://ehs.yale.edu/PPEPolicy>

#### Eye Protection

Safety goggles and a face shield must be worn.

#### Hand Protection

A utility style nitrile or neoprene glove, worn over an exam-style nitrile glove, must be worn when handling this solution.

#### Skin and Body Protection

A rubber apron must be worn over a lab coat. Long pants or clothing that covers the body to the ankles and closed-toe solid top shoes must be worn as well.

### Engineering Controls

Fume hoods, with the sash lowered to 12" to provide splash protection, must be used when handling piranha solution.

### Handling/Storage

- Prepare the solution immediately prior to using. Never store piranha for long periods of time.
- Slowly add the hydrogen peroxide to the sulfuric acid.
- Keep away from all organic materials, especially solvents.
- Piranha should only be kept in Pyrex glass containers. An acceptable alternative is PTFE/Teflon containers. Do not use plastic containers as they will react with the solution.
- The substrate should be rinsed and dried before placed in piranha bath.

- Adding anything to the piranha solution, such as a substrate that may have organic residue, must be done slowly, giving the solution time to stabilize.
- Adding any acids or bases to piranha or spraying it with water will accelerate the reaction. This also includes Photoresist, which is a strong base.
- Piranha solution is very energetic and potentially explosive. It is very likely to become hot (up to 100°C). Handle with care.
- Piranha solution that is no longer being used should never be left unattended if hot.
- Never use air tight/capped containers. Piranha stored in a closed container will explode.
- Allow solution to cool down to room temperature in an open container before transferring into a clean and dry waste container for disposal. Be sure to use a DOT-approved vented cap on the waste container (these can be purchased in the Chemistry Dept stockroom).
- Keep all containers of Piranha in secondary containment at all times.

## **Emergency Procedures**

### **Eyewash/Safety Showers**

An ANSI approved eyewash station that can provide quick drenching or flushing of the eyes must be immediately available in the laboratory where aqua regia is used. An ANSI approved safety drench shower must also be available within 10 seconds travel time from where this solution is used. Ensure the locations of the eyewashes and safety showers, and how to activate them, are known prior to an emergency.

## **First Aid Procedures**

### **If inhaled**

Remove to fresh air. Call 911 for immediate medical attention.

### **In case of skin contact**

Go to the nearest emergency shower if contaminated. Yell for assistance and rinse for 15 minutes, removing all articles of clothing to ensure contaminate is completely removed. Call 911 for immediate medical attention or follow up with Acute Care of Employee Health if skin contact was limited.

### **In case of eye contact**

Go to the nearest emergency eyewash. Yell for assistance and rinse for 15 minutes. Call 911 for immediate medical attention.

## **Spills**

### **Small Spill**

If a small spill occurs inside a fume hood, lab personnel should be able to safely clean it up by following these spill clean up procedures:

- Alert people in immediate area of spill
- Wear personal protective equipment
- Use acid spill neutralizer to clean/neutralize spilled solution
- Collect residue, place in container, label and dispose of as hazardous waste

### **Larger Spill or Spill Outside a Fume Hood**

- Call EHS for emergency assistance (203-785-3555)

- Evacuate the spill area
- Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering
- Stay nearby until emergency personnel arrive and provide them with information on the chemicals involved

### **Waste Disposal**

- Allow solution to cool down to room temperature in an open container before transferring into a clean and dry waste container for disposal. Be sure to use a DOT-approved vented cap on the waste container (these can be purchased in the Chemistry Dept stockroom).
- Label the waste container with not only "piranha solution", but also the identity of the chemicals (i.e., hydrogen peroxide and sulfuric acid).
- Keep the waste container in secondary containment at all times.

### **Lab Specific Protocol/Procedure:**

---

Principal Investigator's Signature/Date