STANDARD OPERATING PROCEDURE-PIRANHA SOLUTION

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| **CONTACT INFORMATION** | | | |
| **Location** | Building: | | Room: |
| **Street Address:** |  | | |
| **Lab Safety Contact:** | Name: | | |
| Lab Phone: | Office Phone: | |
| **Emergency Contact** | Name: | Phone: | |
| **TYPE OF STANDARD OPERATING PROCEDURE** | | | |
| Indicate which type of Standard Operating Procedure applies  Specific Process or Equipment  Specific Hazardous Chemical  Hazard Class for a Group of Chemicals | | | |
| **DESCRIBE PROCESS/EQUIPMENT, HAZARDOUS CHEMICAL or HAZARD CLASS** | | | |
| **Piranha solution**  **Formula: a mixture of sulfuric acid (H2SO4) and hydrogen peroxide (H2O2)**  **Other Names: Piranha etch** | | | |
| **HAZARD SUMMARY** | | | |
| Piranha solution is used to clean organic residues off substrates. Because the mixture is a strong oxidizer, it will remove most organic matter, and it will also hydroxylate most surfaces (add OH groups), making them extremely hydrophilic (water compatible). Piranha solution is used frequently in the microelectronics industry, e.g. to clean photoresist residue from silicon wafers.  Piranha solution is very dangerous, being both strongly acidic and a strong oxidizer. Before using Piranha, a chemist should attempt more stable methods of removing stains, tars or clogs. Often, glassware will "clean itself" if simply left with a rinse of a cleaning solution present. An immediate example for a suitable substitute, prior to using Piranha, is 98% sulfuric acid.  Piranha solution can be an explosive. Mixing the solution is exothermic. The resultant heat can bring solution temperatures up to 120°C. One must allow the solution to cool reasonably before applying any heat. The sudden increase in temperature can also lead to violent boiling, or even splashing of the extremely acidic solution. Also, explosions may occur if the peroxide solution concentration is more than 50%. 30% peroxide in water solution is more reasonable.  Many different mixture ratios are commonly used, and all are called piranha. A typical mixture is 3:1 concentrated sulfuric acid to 30% hydrogen peroxide solution; other protocols may use a 4:1 or even 7:1 mixture. A closely related mixture, sometimes called "base piranha", is a 3:1 mixture of ammonium hydroxide (NH4OH) with hydrogen peroxide. Base piranha is also known under the name of TL1 cleaning.    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 solutions are extremely energetic and may result in explosion or skin burns if not handled with extreme caution.  **Inhalation:** Remove person to fresh air and loosen tight clothing if needed. Give artificial respiration if necessary. Consult a doctor/medical service.  **Skin Contact:** Wash immediately with water (15 minutes)/shower. Remove contaminated clothing and shoes. Continue to rinse for at least 10 minutes. Get medical attention.  **Eye Contact:** Rinse cautiously with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Consult a doctor/medical service immediately.  **Ingestion:** Immediately consult a doctor/medical service. | | | |
| **SPECIAL HANDLING AND STORAGE REQUIREMENTS** | | | |
| **Precautions:**  Always use glass (preferably Pyrex) containers – Piranha will melt plastics  Mix the solution in a fume hood with the sash between you and the solution  When preparing the piranha solution, always add the peroxide to the acid  Piranha solution is very energetic and potentially explosive  It is very likely to become hot, more than 100 degrees C. Handle with care.  Leave the hot piranha solution in an open container until cool, then close  Piranha solution that is no longer being used should never be left unattended if hot  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.  Mixing hot piranha with organic compounds may cause an explosion. This includes acetone, photoresist, isopropyl alcohol (other organic solvents), and nylon.  Adding anything to the piranha solution (such as a substrate that may have organic residue), must be done slowly and carefully, giving the solution time to stabilize.  Oxygen given off during the self-decomposition, as well as the oxidation products of organic compounds can cause the container to rupture.  Waste solution should only be stored for short periods of time. Waste pick-up should be promptly requested  Immersing a substrate (such as a wafer) into the solution should be done slowly to prevent thermal shock that may crack the substrate material.  It is important to remember that the solution, whilst susceptible to aging, will remain a significant hazard as it drips off the item being cleaned.  **Storage:**  Due to the self-decomposition of hydrogen peroxide, piranha solution should be used freshly-prepared. Piranha solution should not be stored. | | | |
| **ENGINEERING AND VENTILATION CONTROLS** | | | |
| Use in a chemical fume hood. The room where the chemical is being used should be equipped with proper exhaust ventilation to keep the airborne concentration below the allowable exposure limit. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. | | | |
| **PERSONAL PROTECTIVE EQUIPMENT** | | | |
| **PPE Requirements:**  Long pants or clothing that covers all skin below the waist  Shoes that cover the entire foot  Gloves; indicate type: Neoprene  Inspect gloves before use. Use proper glove removal technique to avoid skin contact with outer surface of glove. Wash hands after removing gloves.  Safety goggles  Safety glasses  Face shield  Lab coat  Flame-resistant lab coat  Other: Click here to enter text.  If the use of an N95, half mask, or full face respirator is requested, the individual and/or their supervisor must first contact Environmental Health & Safety for a consultation to determine if respirator use is necessary. If EH&S determines the use of a respirator is necessary, the individual must participate in the University’s respirator program. This includes a medical evaluation; respirator fit test, and training. | | | |
| **EMERGENCY PROCEDURES** | | | |
| In case of fire or large and/or extremely hazardous chemical releases pull the fire alarm and evacuate the area  If someone is seriously injured or unconscious  **CALL 911 or CAMPUS POLICE AT <enter your campus PD #>**  From a safe place, provide as much information as possible to the emergency responders including chemical name, volume, hazards, injuries, and location.  **Chemical Exposure**: Remove any contaminated clothing, and IMMEDIATELY flush contaminated skin with water for at least 15 minutes following any skin contact. For eye exposures, IMMEDIATELY flush eyes with water for at least 15 minutes. Consult SDS for guidance on appropriate first aid. Where medical attention is required, bring the SDS(s) of chemical(s) to aid medical staff in proper diagnosis and treatment.  **Evacuation Procedure**   * Immediately evacuate the building via the nearest exit when the fire alarm is activated. * If unable to evacuate due to a disability, shelter in the area of rescue / refuge, typically a stairwell landing, and wait for assistance from drill volunteers or emergency responders. * Instruct visitors and students to evacuate and assist them in locating the nearest exit. * Do not use elevators to exit the building during an evacuation as they may become inoperable. * Carry only those personal belongings that are within the immediate vicinity. * Close doors to limit the potential spread of smoke and fire. * Terminate all hazardous operations and power off equipment. * Close all hazardous materials containers. * Remain outside of the building until the building is released for reentry. * Do not restrict or impede the evacuation. * Convene in the designated grassy gathering area and await instruction from emergency responders or drill volunteers. Avoid parking lots. * Report fire alarm deficiencies, (e.g., trouble hearing the alarm) to facilities personnel for repair. * Notify evacuation drill volunteers or emergency responders of persons sheltering in the areas of rescue/ refuge. * **Never assume that an alarm is a “false alarm”. Treat all fire alarm activations as emergencies. Get out of the building!**   **Incident and Near Miss Reporting**: Report any incident that occurs in any University of South Florida affiliated teaching or research laboratory/studio or field research project. An incident means any unplanned event within the scope of a procedure that causes, or has the potential to cause, an injury or illness and/or damage to equipment, buildings, or the natural environment. Due to medical privacy concerns, no personal identifying information of the person involved in the incident shall be entered or submitted with the form.  <http://www.usf.edu/administrative-services/environmental-health-safety/reporting/index.aspx>  **Workers’ Compensation Procedure:** Call AmeriSys at 800-455-2079 to report a work-related injury or illness. Complete the Supervisor’s Accident Investigation Report available at the link above and send it to EH&S within 24 hours. | | | |
| **WASTE DISPOSAL** | | | |
| The gases from the piranha solution must be allowed to dissipate, and the solution must be allowed to cool. Spent piranha solution is mainly concentrated sulfuric acid. Care must be taken not to allow the solution to be mixed with organic solvents (e.g. in waste solvent carboys), as this will cause a violent reaction and might even cause a substantial explosion. Waste pick-up should be promptly requested, as waste should not be stored for long periods of time.  **NEVER MIX PIRANHA SOLUTION WASTE WITH OTHER CHEMICAL WASTES**  All chemical waste generated within USF System laboratories is considered hazardous waste and must be disposed of as hazardous waste in accordance with the USF Hazardous Waste Management Procedure, the U.S. EPA, and the FDEP. The USF Hazardous Waste Management Procedure can be found using the following link, <https://www.usf.edu/administrative-services/environmental-health-safety/documents/hazwaste-managementprocedure.pdf> | | | |
| **TRAINING REQUIREMENTS** | | | |
| All individuals working with chemicals in USF laboratories must take EH&S’s Laboratory Safety Training. To register for Laboratory Safety Training, please use the following link, <https://www.usf.edu/administrative-services/environmental-health-safety/training/course-descriptions.aspx#labsafety>  This procedure may warrant additional safety training per the PI, EH&S, or an authorizing unit such as the Biosafety or Radiation Safety programs. Check training requirements for this activity below:  Research Specific Training from the PI/Lab Supervisor or their designee  EH&S Laboratory Safety Training  EH&S Hazard Communication  EH&S Hazardous Waste Awareness and Handling  EH&S Respirator Fit Test  EH&S Biomedical Waste  EH&S Hazardous Waste Pharmaceutical Training  EH&S Fire Prevention Safety  EH&S Slips, Trips, and Falls  RIC Biosafety Core Course  RIC Shipping Biohazardous Materials  RIC BSL 3  RIC Radiation Safety  RIC Laser Safety  RIC Boating Safety  RIC Scientific Diving  Other:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | | |
| **PRIOR APPROVALS** | | | |
| This activity requires prior approval from the PI/designee.  If this box is checked, working alone is not allowed. | | | |

By signing and dating here the Principal Investigator/ or a designee certifies that the Standard Operating Procedure (SOP) for ***Piranha solution*** is accurate and effectively provides safe standard operating procedures for employees and students in this lab who will handle this hazardous chemical.

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Signature Printed Name Date

I affirm that I have read and understand the Standard Operating Procedure for***Piranha solution*** and have undergone the EH&S Laboratory & Research training and any lab specific training regarding this SOP.

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| Printed Name | Signature | Date |
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