Piranha Clean (Sulfuric Acid and Hydrogen Peroxide Mix)

Standard Operating Procedure

Faculty Supervisor: Prof. Robert White, Mechanical Engineering (x72210)
Safety Office: Peter Nowak x73246 (Just dial this directly on any campus phone.)
(617)627-3246 (From off-campus or from a cell phone)
Tufts Emergency Medical Services are at x66911.

Revised: January 12, 2007

Warning: Piranha is highly reactive, hot, and attacks organic materials. It will burn you badly if it gets on your skin. Under no circumstances let it get in your eyes. Do not breath the vapors. Work carefully in the hood with full personal protective equipment.

1. Material Requirements:

1.1 Equipment: Three glass beakers (1 chemical, 2 rinse), stainless steel tweezers, PTFE (Teflon) wafer holders or sample holders.

Warning: Piranha attacks organics!! This includes most plastics. It will react violently with polyethylene and polypropylene tweezers, bottles, and containers. The only materials you should use as tools or containers are Pyrex glass, stainless steel, and PTFE (Teflon).

1.2 Chemicals: Sulfuric Acid (H_2SO_4 96%), Hydrogen Peroxide (H_2O_2 30%). Note: These percentages are the dilutions as they arrive in the bottles from the chemical supplier. Just use the solution straight out of the bottle.

- **1.2.1** Hazards associated with chemicals:
  - **1.2.1.1** Sulfuric Acid: Liquid or vapors are serious health hazards; and cause severe burns. Sulfuric acid is much more viscous than water, be prepared for this when you pour it.
  - **1.2.1.2** Hyrdogen Peroxide: Liquid or vapors are serious health hazards; and cause severe burns.

1.3 Engineering Controls: Conduct procedure in ventilated fume hood. Store bottles of chemicals (sealed tightly) in cabinets with secondary containment. Work area should contain an eye wash and safety shower.

1.4 Personal Protective Equipment: Trionic gloves on top of nitrile gloves, apron, goggles, and face-shield. Never work with Piranha without all this equipment.

2.0 Procedure:

Complete all processes in the fume hood.

2.1 Piranha Clean (1:1 96% H_2SO_4: 30% H_2O_2): 10-20 min

Note: Piranha attacks most plastics violently. PTFE (Teflon) is the only safe plastic to use with Piranha. You must do Piranha processing in glass containers using PTFE or stainless steel tools.

2.1.1 Get a water rinse beaker which will fit your samples (A 1000 mL beaker works for a single 4" wafer.**) Do this first**. If something goes wrong, you want the water available to quench the reaction.

2.1.2 Stand the rinse beaker on a few fab wipes in the hood, and fill it 80% full with deionized water.

2.1.3 Place 5 fab wipes in a pile in the hood. Get a second beaker that will fit your samples for processing (you should find one labeled "Piranha" on the shelves). Put it on the fab wipes in the hood. A 1000 mL beaker works for a single 4" wafer.

2.1.4 Put your samples in the empty beaker, and see how much solution you will need to cover them. If the samples come within 10% of the top of the container, get a larger container. The solution will bubble, and you don't want it too close to the top.

2.1.5 Leave your samples in the beaker, and pour in H_2O_2 to cover half your samples.

2.1.6 Cap the H_2O_2 bottle and put it away.

2.1.7 Bring the Sulfuric Acid bottle, and pour in an equal volume of Sulfuric acid. **The solution will heat up and start to bubble.**

2.1.8 Cap the Sulfuric Acid bottle and put it away.

2.1.9 Allow your samples to sit in the Piranha clean for 10-20 minutes to remove all organics.

2.2 DI Water rinse: 15 min:

2.2.1 When the Piranha clean is complete, transfer the sample carefully to the rinse beaker.

2.2.2 If you used tweezers to move the sample, make sure you leave them in the rinse beaker to rinse as well.

2.2.3 Let the sample and tools soak in DI water for 5 mins.

2.2.4 Fill the second rinse beaker with water.

2.2.5 After the 5 mins. are up, transfer the samples to the second rinse beaker. Dump the first rinse beaker into the Piranha waste bottle. (Bring the Piranha waste bottle into the hood to pour it! There is a **glass** funnel you can use if you wish. The Piranha waste bottle must also be made of **glass.** It should be labeled as containing Sulfuric Acid and Hydrogen Peroxide.)

2.2.6 Refill the first rinse beaker with DI water while the wafers are in the second rinse beaker.

2.2.7 After the samples have soaked for 5 more minutes in the second rinse beaker, transfer them back to the first rinse beaker (which now has fresh DI water in it). Let them soak in there for 5 more minutes.

2.3 Sample dry:

2.3.1 After the third water rinse is finished, remove your samples and blow them dry with the N_2 gun.

2.3.2 After getting most of the water off, you can dry the samples more in an oven at 120 ^oC or on a hotplate at 150 ^oC.

2.4 Cleanup

2.4.1 **<u>Leave the hot Piranha for at least 3 hours to allow it to cool before putting it into the waste container. If it is late, you can label it with your name, the date, and "Piranha", cover it with tinfoil, and dispose of it the next day.</u>**

2.4.2 When the Piranha mixture is cool, dump it into the Piranha waste bottle.

2.4.3 Rinse the beaker once with DI water, and dump it into the Piranha waste bottle.

2.4.4 Rinse all three beakers two more times with DI water. This time, dump them into the "dilute acid/base waste" large plastic waste container.

2.4.5 Return all labware to its proper location. The beakers can drip dry on fab wipes in the hood or on the bottom shelf of the storage shelving.

2.4.6 Wipe up any drips in the area with chemical wipes and dispose in the acid trash

2.5 Storage

2.5.1 Sulfuric acid should be stored in the acid cabinet.

2.5.2 Hydrogen peroxide should be stored in the base/oxidizer cabinet.

3.0 <u>Waste Disposal:</u>

3.1 Piranha waste:

3.1.1 Solid waste should go in the acid waste bin.

3.1.2 Liquid waste should go in the "Piranha" (that is, Sulfuric Acid and Hydroge Peroxide) glass waste bottle in the hazardous waste accumulation area. It should only be added to the waste bottle when it has <u>fully cooled</u> to room temperature.

4.0 <u>Accident Procedures:</u>

4.1 Contact: Read MSDS prior to working with any chemical to familiarize yourself with the symptoms of exposure and recommendations for treatment.

4.1.1 Piranha mixture, straight sulfuric, or straight hydrogen peroxide:

4.1.1.1 Skin contact: Remove contaminated clothing, rinse affected area with water for 10 minutes. **If there is a visible burn, get immediate medical attention. Don't be shy. Call the medical center if you got Piranha on your skin. Tufts Emergency Medical Services are at x66911.**

4.1.1.2 Eye contact: Immediately flush with water for 20 minutes while holding the lids open. **Get immediate medical attention. Call Tufts Emergency Medical Services are at x66911.**

4.1.1.3 Ingestion: Do not induce vomiting. **Get immediate medical attention. Call Tufts Emergency Medical Services are at x66911.**

4.1.1.4 Inhalation: Remove to fresh air. Resuscitate if necessary. Take care not to inhale any fumes released from the victim's lungs. **Get immediate medical attention. Call Tufts Emergency Medical Services are at x66911.**

4.2 Spill:

4.2.1 If a small, contained spill occurs, such as inside the hood, wipe it up with chemical wipes and dispose of in the acid trash container.

4.2.2 If a large spill occurs that you are not comfortable cleaning up:

4.2.2.1 Evacuate the lab and notify the Tufts emergency services (x66911) immediately. Clean up should only be performed by authorized personnel according to MSDS guidelines. Notify the faculty advisor.

If at any time you feel a situation is dangerous, do not hesitate to call the safety office (x73246, Peter Nowak) or the faculty supervisor (x72210, Robert White).

Report all accidents (injuries, major spills, fires) to the safety office at x73246 (Peter Nowak) and the faculty supervisor at x72210 (Robert White). For emergencies, call Tufts Emergency Services at x66911.