

## PIRANHA CLEAN

### 1. PIRANHA CLEAN

#### A. MATERIALS

- Dedicated crystallization dishes (3) large enough to hold wafer and stir bar so they do not interfere with each other (pyrex or quartz) or dedicated bench dip slots
- Hot plate with electronic stir
- Magnetic, Teflon coated stir bar
- Thermometer that goes up to 150 °C
- Sulfuric Acid ( $\text{H}_2\text{SO}_4$ )
- Hydrogen Peroxide ( $\text{H}_2\text{O}_2$ )
- DI Water
- Acid safe gloves
- Face shield
- Acid Apron
- Fume hood
- Teflon wafer dipper
- Graduated cylinder (pyrex or quartz)

#### B. PROCEDURE

NOTE: Wear acid safe gear at all times during the Piranha clean.

1. Fill two rinse beakers with DI water.
2. Place magnetic stir bar in bottom of third beaker.
3. Place beaker on hot plate/stirrer.
4. 5:1  $\text{H}_2\text{SO}_4$ :  $\text{H}_2\text{O}_2$  Piranha solution
  - a. Pour sulfuric acid into beaker, enough to cover the top of the wafer in Teflon dipper completely when immersed (Do not put wafer in the solution yet!). For 125 mm crystallization dish use about 100 mL  $\text{H}_2\text{SO}_4$ .
  - b. Heat sulfuric acid to approximately 80°C.
  - c. Measure out  $\text{H}_2\text{O}_2$  in a graduated cylinder so that it is 1/5 the volume of the  $\text{H}_2\text{SO}_4$ . For 125 mm crystallization dish use about 20 mL  $\text{H}_2\text{O}_2$ .
  - d. Very slowly add the  $\text{H}_2\text{O}_2$  to the  $\text{H}_2\text{SO}_4$ .
    - i. **NOTE:  $\text{H}_2\text{O}_2$  reacts with  $\text{H}_2\text{SO}_4$  exothermically. The solution will start to bubble and heat up.**
  - e. Turn on stirrer. Stir the mixture slowly. If the  $\text{H}_2\text{O}_2$  floats on top of the  $\text{H}_2\text{SO}_4$ , use a stirring rod to mix the two. **BE CAREFUL, this will cause the two to react more quickly.**
5. Heat solution to 100 to 110°C. The solution should begin to bubble vigorously as it approaches 100°C. If this does not happen wait a little longer and/or add more  $\text{H}_2\text{O}_2$ .
  - a. **NOTE: The solution can heat up very quickly, even when you think nothing is happening. Watch it carefully so it does not**

**overheat.** If it does overheat, turn off the hot plate or, if safe, remove the beaker from the hot plate until it cools down.

6. Keep solution between 100 to 110°C for the entire clean.
7. Immerse wafer in H<sub>2</sub>SO<sub>4</sub>: H<sub>2</sub>O<sub>2</sub> for 10 minutes.
8. Carefully remove wafer from solution. Be careful of dripping.
9. Immerse wafer in rinse beaker with running DI water for 5 minutes.
10. Immerse wafer in second rinse beaker with running DI water for 5 minutes.
11. Air dry wafer.
12. Piranha solution can be used many times before its efficacy is spent.
  - a. If the solution is still hot and bubbling, just continue using it to clean additional wafers.
  - b. If the solution has cooled and is not more than 12 hour old, it can be refreshed by heating and adding H<sub>2</sub>O<sub>2</sub> until it starts to react again.

#### C. PIRANHA SOLUTION DISPOSAL

1. Allow solution to cool to room temperature.
2. Slowly pour solution into waste acid container.
  - a. **NOTE: One time when I was disposing of Piranha solution it reacted with something in the waste acid container (sometimes people put things in acid waste containers that do not belong there). If this happens, keep the waste bottle cool by running water on the outside and DO NOT seal the bottle. Watch the bottle until the reaction stops and the bottle cools down. Get a new acid waste bottle and dispose of the remaining Piranha solution. Notify the person in charge of the clean room that this happened.**

## 2. THIN OXIDE FILM REMOVAL

This step is to remove the thin oxide film that forms during the Piranha clean. This film can contain a lot of contaminants that the Piranha clean removed from the wafer, so it is important to also remove the oxide film.

**NOTE: HF IS EXTREMELY HARMFUL IF IT COMES IN CONTACT WITH ANY PART OF YOUR BODY. FOLLOW ALL STANDARD CLEAN ROOM PRECAUTIONS FOR HANDLING HF.**

#### A. MATERIALS

- 10:1 H<sub>2</sub>O:HF solution
- HF safe container for dipping wafers
- HF safe tweezers
- DI Water
- Acid Safe Gloves
- Acid safe gloves
- Face shield

- Acid Apron
- Fume hood
- Air gun
- Hot plate or oven set  $>100^{\circ}\text{C}$

B. PROCEDURE

1. Dip wafer in 10:1  $\text{H}_2\text{O}:\text{HF}$  solution until Si portions of wafer dewet.
2. DI rinse for 5 minutes.
  - a. NOTE: After HF dip, the Si portions of the wafer are very sensitive to scratching. I scratched my wafers just by holding them with Teflon tweezers.
3. Dry wafer with air gun.
4. Post bake wafer above  $100^{\circ}\text{C}$  for  $>2$  minutes to remove all moisture.