

Semiconductor Device Processing

Oxidation Procedure

Oxidation of silicon is to be carried out in the silicon oxidation furnace which is set at 1000 degrees centigrade. Both dry and wet oxidation can be carried out in the same furnace. **Check the chart next to the furnace to determine the required oxidation time for desired oxide thickness.** All the precautions listed in the previous handout to prevent furnace contamination must be observed.

1. Change the temperature setpoint controllers from 800 °C to 1000 °C. If performing a wet oxidation, turn on the heating mantle and the DI water.
2. Clean the wafers in ACE and ISO for **1 minute each** and immerse in DI water for 2 minutes.
3. Perform a Piranha clean.
 - a. Very slowly add **1 part of H₂O₂ to 5 parts of H₂SO₄**. The mixture is self heating and attains a temperature of 80 degrees centigrade. When cool, the mixture may be re-used by adding 5 ml of fresh H₂O₂. **Handle the mixture with utmost caution as it is extremely corrosive.** Place the wafers to be doped in the solution for **10 minutes**.
 - b. Rinse the wafers in the DI for **2 minutes**.
 - c. Dip the wafers in 50:1 DI H₂O: HF for **1 minute**.
 - d. Rinse in DI for **2 minutes**.
 - e. Blow dry with N₂ gas.
4. For **wet oxide** growth, start the bubbler by turning on the heating mantle 20 minutes before you plan to start the wet oxidation process. Keep the rheostat at 75. Start the DI drip into the bubbler after 10 minutes and check that the water level is maintained near the height of the overflow outlet. Monitor the water level and adjust the drip rate as needed at ten minute intervals (at most) until you are confident the water level is stable.

5. Remove the native oxide by etching it in 50:1 HF for **60 seconds**. Rinse the samples in DI water.
6. Turn off the N₂, turn on the O₂, and let the furnace purge for **10 minutes**.
7. Load your samples onto the sample holder in the quartz elephant.
8. Using the elephant, place the sample holder at the mouth of the furnace and wait for **1 minute**. ***Don't touch any part of the glass rods other than the handle end to avoid furnace contamination!!!***
9. Push the boat in to the flat temperature zone over a period of **2 minutes**.
10. Wait **2 minutes** for the sample to warm up to the furnace temperature.
11. For **dry oxide** growth, **start timing the growth** at this stage. For **wet oxide** growth, **turn OFF the O₂ and turn ON the process switch**. Keep the process switch on for the desired wet oxidation time.
12. At the end of the desired oxidation time, for dry oxidation turn off the O₂ and turn on the N₂. For wet oxidation turn off the process switch and turn on the O₂, wait 5 minutes, and then turn off the O₂, DI drip, and heating mantel, and turn on the N₂. Anneal the samples in N₂ for **5 minutes**.
13. Pull the boat out to the mouth of the furnace over a **2 minute** period. Let it cool at the mouth of the furnace for **1 minute**.
14. Load the sample holder into the elephant and remove it from the furnace. Replace the end cap, and turn the temperature setpoint controllers back down to 800 °C. Let samples cool for 10 minutes (you can either leave them in the sample holder or place them on a clean wipe).