520.495/530.495/580.495 Microfabrication Laboratory

Flow Cytometer **Lab 4: Silicon Oxidation**	

This week we will continue the Flow Cytometer process by growing oxide over the fabricated channels. This oxide is necessary to electrically isolate the metal electrodes that will be deposited next week. But first we will strip all oxide from the wafers so that we have fresh silicon surface.

Preliminaries:

1. Transfer wafers with tweezers, try to grasp the wafer at the same place each time, usually at the flat edge.

2. Turn on the water supply to cooling coils of the furnace before turning it on. Check for proper flow of water at the drain. Turn it off when done and after the temperature has dropped to below 200°C. Have Nitrogen gas running through the furnace tube while furnace is running without wafers inside, set float tube to 10.

3. Using the spin/rinse/dryer: Turn on nitrogen gas (50 psi). Test the spin/rinse/dryer to make sure that the door seals after pressing start. Line the wafers in the blue wafer holder so that the wafers are far apart. After rinsing and drying, do not open washer door until wafer holder has automatically turned right side up.

4. All the cleaning procedures (except using spin/rinse/dryer) should be done in the hood. Aprons, protective sleeves, gloves, face shield, lab coat, and goggles must be worn during cleaning procedures. Wear plastic disposable gloves at all times.

I. PRELAB ASSIGNMENT:

1. Based on the design requirements/specifications of 0.1 micron thick oxide, confirm that the the amount of time necessary to perform dry oxidation at 1100° C, is **60 minutes**.

II. LAB WORK:

Task #1: Buffer HF Oxide Etch:

1. Make up buffered oxide etch in a 1000 ml plastic beaker. Weigh out 296 g NH_4F, and add to 425 ml of de-ionized water with stirring. Then add to this mixture 106 ml HF. Or, if already prepared and stored in a Teflon bottle, carefully pour 700 ml of buffered oxide etch into a 1000 ml plastic beaker.
2. Fill a 2000 ml beaker with de-ionized water for rinsing.
3. Do a BHF etch until the wafers are free of silicon dioxide (they do not wet in water). Rinse the wafer by first immersing the wafer in the beaker of DI water, then again under running de-ionized water at the sink for 30 seconds. Dry the wafer using the filtered nitrogen gun, and inspect the wafer under the microscope.
4. Use the calibers to carefully measure the thickness of the wafers.

Task #2: Wafer oxidation:

1. Before performing the dry oxidation step, make sure that:

- The furnace is at 1100° C and all 3 sections in the furnace are stable
- The tube for the oxygen supply is connected to the furnace tube.
- The oxygen is turned on and the float set at 20

2. Transfer wafers from the single carriers into the quartz wafer "boat". Place the wafer “boat” into the quartz carrier. Remove the end cap of the furnace and slide the boat into the furnace with the quartz push rod. (Don't touch any part of the rod that will go in the furnace so as not to introduce any contamination.) To prevent the wafers from breaking due to a rapid temperature change, push the boat in slowly (approx 5 inches every minute for 5 minutes, use red tape marks on the floor). Oxidize for 60 minutes.

3. Remove the wafers from the furnace with the quartz push rod (again over 5 minutes time) and set wafers under the hood until completely cooled about 15 minutes.

4. When wafers cooled place them carefully in plastic wafer carriers and mark the carriers with your section and names. This is how wafers will be stored from one laboratory session to another.

III. Postlab Assignment:

1. Note the colors of the wafers before and after oxidation. What color is your wafer? Can we estimate the thickness of the oxide from the change in color? Explain why? Based on the color of the wafer how thick is the oxide? Are you sure? (see page 55 of the book).

2. Why is the thickness of the wafers different from the one that we started (do a calculation to show what should the predicted thickness be, based on the processing steps so far).

3. Make suggestions of how to improve the lab procedures (this handout).

Lab procedure prepared by A.G. Andreou, Fall 2003.