520.495/530.495/580.495 Microfabrication Laboratory

Optical Waveguides

Lab 5: Silicon Oxidation II (Cladding)

This week we continue the fabrication of the Optical Waveguides by fabrication the waveguide cladding out of silicon dioxide. This is going to be a long oxidation and thus the lab assistants will take the wafers out of the furnace. We first remove any residual oxide by performing a BHF etch of the wafers.

Preliminaries:

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

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 4 micron thick oxide, please find the conditions for shortest oxidation time (Note: indicate the temperature and type of gaseous compounds).

II. LAB WORK:

Task #1: BOE 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 deionized water with stirring. Then add to this mixture 106 ml HF.
2. Carefully pour buffered oxide etch into a Teflon Petri dish. Fill a 2000 ml beaker with deionized water for rinsing.
3. Do a BOE 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.

Task #2: Wafer oxidation: (Note: This task will be done by the TA because of the duration of the oxidation.)

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

The furnace is at 1100° and all 3 sections in the furnace are stable
The water temperature inside heating mantle is near 100°C (rheostat set at 20) and water is boiling gently.
The tube from the boiling water flask is indeed connected to the inlet of the oxidation furnace.
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 **30 hours**.

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 storted from one laboratory session to another.

III. Postlab Assignment:

1. What is the purpose of BOE etching before the oxidation process?

2. Why do we use Teflon petri dish during the BOE etching process?

http://www.ece.jhu.edu/faculty/andreou/495/2000/LectureNotes/Oxidation.pdf

Lab procedure prepared by A.G. Andreou, Fall 2003, and revised by H. Vo, T. Yeh, M. Ho and A.G. Andreou, Fall 2007.