

520.495/530.495/580.495 Microfabrication Laboratory

Optical Waveguides

Lab 3: KOH Etch

This week we continue the process of fabricating the waveguides by performing an anisotropic etch to define the waveguide structure in silicon.

Preliminaries:

1. Transfer wafers with tweezers, try to grasp the wafer at the same place each time, usually at the flat edge.
2. All processing and 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. Read the paper by Seidel (Can be downloaded from our web site).
2. Given the structure that you need to define determine the time necessary for a 30% KOH etch at 65°C.
3. Confirm that you have adequate masking material to complete the process before beginning to etch away in areas that you did not want to!

II. LAB WORK:

Task #1: Wafer Dilute HF cleaning:

1. Prepare the dilute 30:1 HF cleaning solution by sequentially adding de-ionized H₂O (600 ml) and HF (20 ml) to a 1000 ml beaker. Fill a 2000 ml beaker with 1500 ml de-ionized H₂O for rinsing the wafers following cleaning. If the DHF is already prepared just refill the 2000ml beaker with de-ionized water.
2. Load the wafers into white carrier, and immerse carrier in the DHF cleaning solution for 30 seconds.

Task #2: KOH Etch:

1. Prepare a 30% KOH etching solution. Weight 250 gr of KOH pellets and them to a beaker containing 500 ml of DI water. Agitate gently on a warm plate till the KOH pellets are dissolved. Add approximately 2.5 ml of isopropyl alcohol to the solution. If not used right away, store in a plastic bottle. Make sure that you have your name, date and a label "30% KOH" on the bottle.
2. Pour the KOH etch in the special beaker for the KOH etch. Make sure that the temperature is at the proper setting of 65°C, that the reflux system is working properly and that Nitrogen is flown in the system. Soak wafers in etchant making sure that they are covered up with the solution AND that the KOH does not spill over the container! In a few minutes observe the bubbling of the surface. Time your etch as per your prelab calculation.
3. Remove your wafers from KOH at approximately half time
4. Rinse wafers for 1 minute with DI water, dry using the filtered nitrogen gun, and inspect wafers under microscope. Measure the etched structure and estimate the etching rate. Adjust overall etching time based on your new estimates.
5. Insert wafers back into KOH etch for the remainder of the etching.
6. Rinse wafers for 1 minute with DI water, dry using the filtered nitrogen gun, and inspect wafers under microscope. Measure the etched structure and confirm that you have the desired channel.

Task #3: Characterization:

1. Using the optical microscope measure depth and width and length of etched structures
2. Using the profilometer, take a scan along two or three different areas of the etched structures.
3. Take a picture of the etched structures and notice any problems with undercutting or jagged lines.

III. Postlab Assignment:

1. Why did we add the isopropyl alcohol to the KOH etch?
2. Make suggestions of how to improve the lab procedures (this handout).
3. Depending on how well you aligned the flat of the wafer with your mask, you may or may not see undercutting of your waveguides and not very well defined structures. Explain why?

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