520.495/530.495/580.495 Microfabrication Laboratory

Flow Cytometer **Lab 3: Cavity KOH Etch**	

We continue the process of fabricating the flow cytometer by forming the channels using KOH anisotropic etch. This will form the mask for the anisotropic etch that will follow to make the channels in the silicon. We begin with dilute HF cleaning of the wafers to remove any residual oxide. This is followed by an anisotropic etch in KOH.

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. Assuming that the depth of channel that you need to etch is 20 m, refer to Seidel's paper or some other references (please cite), please calculate the required etching time for a 30% KOH etch at 80°C. (Note: assuming that the crystallographic orientation of the wafer to be used is <100>)

3. With the oxide thickness obtained from previous lab, please confirm that you have adequate masking material to complete the process before beginning to etch away in areas that you did not want to!

4. How would you determine if we have etched enough depth?

II. LAB WORK:

Task #1: Wafer Dilute HF cleaning:

1. Prepare the dilute 30:1 HF cleaning solution by sequentially adding de-ionized H_2O (600 ml) and HF (20 ml) to a Teflon petri dish. Fill a 2000 ml beaker with 1500 ml de-ionized H_2O 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.

3. Rinse wafers first in the 2000ml beaker filled with DI water for 1 minute followed by the running DI, dry using the filtered nitrogen gun, and inspect wafers under microscope.

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 80°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 in a 2000 ml beaker filled with DI water for 1 minute then with running DI water for another minute. 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 in a 2000 ml beaker filled with DI water for 1 minute then with running DI water for another minute. 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. Use the optical thin-film measurement system, the Filmetrics, to measure the remaining oxide thickness at 3 different locations across the wafer.
4. Take a picture of the etched structures.

III. Postlab Assignment:

1. Why did we add the isopropyl alcohol to the KOH etch?

2. How does the measured Si etching rate match with the predicted etching rate? Discuss the major reasons of the mismatch.

3. What is the SiO_2 etching rate determined according the experimental results? What is the selectivity between Si and SiO_2 under your experimental conditions?

4. Attach a picture of etched channel. How is the surface roughness on the bottom of your channel? How can you improve the surface quality?

5. Depending on how well you aligned the flat of the wafer with your mask, you may or may not see undercutting of your channel and not very well defined structures. Explain why?

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