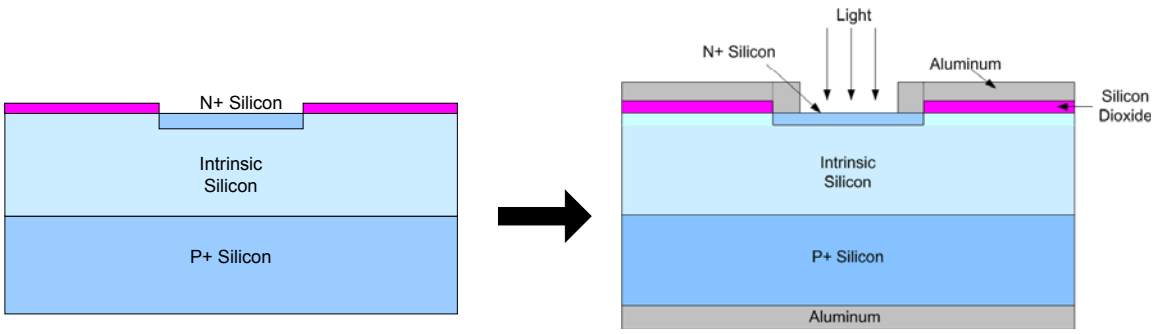
ECEn 555 – Optoelectronics Devices Lab

Week 3

"Metal Contacts"

In this lab you will take the structure you made in week two which involved doping of a silicon structure, and add contacts to the top and bottom of your substrate. The figures below show what you will begin with and then hopefully end up with:



The main tasks for this lab will be the deposition of aluminum in the evaporator, alignment of the second mask to the structure, and aluminum etching.

Major Objectives

1. Spin-on-glass removal. After the dopant drive in steps completed in Week 2's lab, you will now have to remove the spin-on-glass exposing the now highly doped silicon. To do this you will place your wafers into Buffered HF until the spin-on-glass is gone while keeping the thermally grown oxide underneath. In general spin-on-glass should etch faster than oxide, but be careful because you want to make sure your original oxide is still in place for the construction of photodiodes. Dip your wafers in BHF in 30 second intervals and then inspect your wafers under a microscope to ensure that the spin-on-glass is gone. Another way to check is when you dip your wafers in Buffered HF. If the portions that are supposed to be silicon come out dry, you know there is no spin-on glass left.

2. Blanket Aluminum Evaporation. Immediately before loading your wafers into the metal evaporators, dip them in BHF to remove any native oxide and dry them completely using nitrogen. Place your wafers in the e-beam or thermal evaporator for aluminum deposition. After pumping down to a reasonable pressure, deposit 500 nm of aluminum on the wafer surface. The lab supervisor will assist you with all the details involved in using the evaporator.

3. Lithography - Top Metal Mask - Apply AZ3330 photoresist to your wafers. Be sure to use HMDS as an adhesion promoter when using AZ3330. You will now need to align the second mask for these devices to your wafers. This mask should form a ring around the original holes you etched into the silicon dioxide. Expose

and develop the pattern and inspect under the microscope to ensure that the resist is completely developed.

4. Aluminum Etching- Place the patterned wafers in heated aluminum etchant to etch away the metal from undesired areas. The aluminum etchant is usually heated to about 70C to achieve appreciable etch rates. Inspect your wafers under a microscope to ensure all the aluminum is gone in the desired areas.

5. Photoresist Stripping. Remove the photoresist from your wafers using Acetone and Isopropanol. Dehydrate the surface at 120C for 10 minutes.

6. Blanket Photoresist Application. After the contacts are defined on the top of your wafers you will also want to put a coating of aluminum on the backside of our wafers to make contact to your p-type silicon. To do so you will need to etch off all the oxide on the back-side of the wafer. In order to protect the features on the front, spin on a layer of AZ3030 and bake it as you would normally.

7. Blanket Aluminum Evaporation. Place your wafers in BHF to remove all the oxide from the backside. Place your wafers in the e-beam or thermal evaporator for aluminum deposition. After pumping down to a reasonable pressure, deposit 500 nm of aluminum on the back-side of the wafers. The lab supervisor will assist you with all the details involved in using the evaporator.

8. Photoresist Stripping. Remove the photoresist from the front of your wafers using Acetone and Isopropanol.

The metal contacts that will form the anode and cathode of your diode are now complete. In the next lab you will anneal these contacts and test the optical response of your photodiodes. Because this lab involves two evaporations which are time consuming, lab groups can work together or split up the work amongst themselves to make sure everything can be completed.