ECEn 555 – Optoelectronics Devices Lab

Week 5

"Solar Cell Construction"

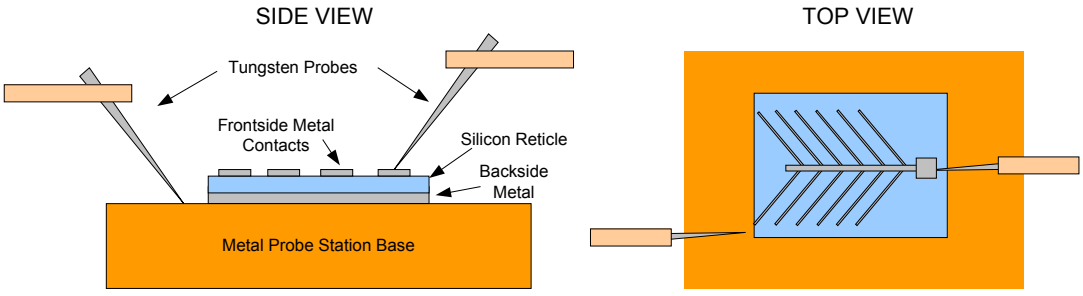
In this lab you will take the photovoltaic structures you have been fabricating at the same time you were making your photodiode structures, and will complete their processing by doing some annealing. You will then combine individual photovoltaic cells both in parallel and series in preparation for testing.

Major Objectives

1. Wafer Cleaving. Have a supervisor demonstrate the correct procedure for cleaving silicon wafers (the nick and press method). When you are confident in your cleaving skills, cleave your photovoltaic wafers so that you have at least one entire photovoltaic cell on a piece of silicon. Cleave up at least twenty of these pieces for each group.

2. Metal Annealing. After the deposition of metal onto a semiconductor surface, typically an annealing step is done. This anneal is done by placing a wafer into a high temperature furnace for a given amount of time, usually with a specific gas environment inside the furnace. The purpose of the anneal is to decrease the contact resistance between the metal and the semiconductor by causing a small amount of metal and semiconductor to go into "solution." Using the annealing furnace, anneal all your photovoltaic cells. Use a nitrogen atmosphere in the tube and anneal at the temperature that gave you the optimal conditions for your photodiodes.

3. Diode Measurements. You are now ready to measure the electrical characteristics of your photovoltaics using the probe station in the cleanroom and HP4145 parameter analyzer. To test your diodes you will need to make contact to the metal pads on your diodes using the probes as illustrated in the diagram below:



These devices should behave like diodes, so sweep them from a negative voltage to a positive and determine how "diode-like" they are. Measure the reverse bias saturation current or "dark current". Also measure the series resistance of the photovoltaics the same way you did with the photodiodes in the previous lab.

4. Photovoltaics in Parallel Using silver paint and thin wire, wire a number of photovoltaic cells in parallel – at least five. A prototyping board and glue will be provided so that you can mount the cells to a firm platform. Use your engineering intuition and creativity when putting them together. Try to get the cells as close together as possible so that when you shine a light source on them they will all be illuminated at the same time.

5. Photovoltaics in Series Using silver paint and thin wire, wire a number of photovoltaic cells in series – at least five. A prototyping board and glue will be provided so that you can mount the cells to a firm platform. Again, use your engineering intuition and creativity when putting them together. Try to get the cells as close together as possible so that when you shine a light source on them they will all be illuminated at the same time.

In the next lab you will test your photovoltaics individually and when wired together. For now place your circuits in a safe place for storage.