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Instructions for the Microfabrication of Self Biased Perovskite Schottky Junction Solar Cells on Silicon-Boron doped Wafers

In this laboratory activity you will modify the properties of a semiconductor silicon wafer by depositing, attaching and spraying metals on small pieces of silicon wafer. Specifically the conductivity of the microfabricated chips will be modified.

Materials:

Five (5) pieces of diced Silicon-Boron doped wafers (about 2 cm X 1 cm)
Bunsen burner
Ring stand
Iron Ring
Crucible's Lid
Clay Triangle
Bunsen lighter
Goggles
Tongs
Multimeter
Stainless Steel Fine Mesh Micro-Perforated Strainers
Copper Tape
Graphite source
Bismuth metal
Tin metal

Pre-lab: Set up the ring stand with the ring clamped on, and the Bunsen burner beneath it. Place the clay triangle on the ring, and the diced silicon wafer on the clay triangle. Place either Bismuth, or Tin (only one metal at a time) on top of the diced silicon wafer. Use the crucible's lid

to cover the wafer with metal. Place the Bunsen burner below the sample at a distance where the blue tip of the flame does not touch the clay triangle; the flame should be just below the clay triangle. The flame should be low intensity; not much energy will be needed. The duration of exposure should be in accordance to the table 1 shown below.

Table 1. Recommended procedure and time to fabricate samples.

Graphite Spray	Spray on and air dry-variable time in minutes-
Bismuth,Tin	Apply and heat in a flame. Check every minute and allow cooling for a minute alternate it for a total of 4 minutes.
Copper Tape	Attach it to silicon wafer with tongs

Objectives:

1) Collaboratively work with your group to microfabricate silicon wafers that will have the following metals attached or deposited separately on each one of the diced silicon wafer:

a) Copper attached by conductive glue

b) Bismuth attached by heat

c) Graphite attached by spray pressure. Use the Fine Mesh to create a pattern on the silicon wafer

2) With the fabricated pieces you will now move to make observations, collect data and make conclusions.

2A) Once the cells have been fabricated then you will use a multi meter to measure the direct current that passes through the Schottky junction. To be efficient at this testing you first must identify and test what should be used as control for your measurements. Also make sure to determine what will be the correct attachment of your negative and positive multimeter probes. You will need to justify why you have selected such position to be tested.

2B) Collaborate with your group to test the fabricated pieces. You must generate a data table which includes the control and your fabricated samples. You must collect data for at least four different light conditions. To provide evidence that these are different sources of emission of

energy you can use a lux app meter on your phone like the Lux meter and a spectrometer like the one from Aspectra mini app. All data must be collected in an organized table and should include data form the direct current voltage, lumens and spectrometry.
2C) Once your data has been collected you will have to identify which fabricated structure functions as a solar cell. Your claim must be justified with cited information.
2D) With the data collected form the multimeter and your spectrometer data you must make a claim that states which wavelength is the most likely to be activating your solar cell. You must include a graph that supports your results and cited information that supports your claims in addition to provide your reasoning to justify that you have fabricated a functional solar cell by creating a Schottky junction.

Testing the Solar Cells

To test your solar cells you will need to learn how the multimeter is used to measure direct current. Once you have figured out how is it done, you will need to measure milli volts.
The multimeter has two probes which need to be connected correctly; therefore, before you use it identify exactly how they should be connected.
Once your team knows how to test direct current you will have to obtain your base data to demonstarte to the teacher that you know what needs to be measured. Use a 9V battery to test for direct current.Once you have demonstrated that you are proficient at testing direct current (DC) then you will need to verify how a solar cell may be tested. Your teacher may provide you with some useful links or you may find information online.

Group Essay

You will conduct research that will further provide evidence that you have understood the principles behind microfabrication of electronic devices. As a team write an essay to provide justification with cited evidence to the following claim: “Nanotechnology has reduced cost, size, and improved the functionality of integrated circuits the microfabrication of electronic chips has allowed faster computer processor units (CPU), more efficient light-emitting diode (LED) lights, greater resolution through complementary metal-oxide semiconductors (CMOS) high pixel number (a minute areas of illumination) cameras, and smarter cell phones”