

ECEn 555 – Optoelectronics Devices Lab
Week 6
“Solar Cell Testing”

In this lab you will take the photovoltaic structures you have fabricated and assembled in your previous labs and test them. You will find an optimal load and maximum power output for each of your structures.

Major Objectives

1. Power From Light Sources. You will use two different light sources to test your photovoltaic structures. The first is the microscope light you used in Week 5 to test your photodiodes. The second is a large flood lamp. The microscope light can be varied to three different levels. Use the commercial silicon photodiode used in Week 4 and the oscilloscope to estimate the light power coming out of these sources. You will need to use the response curve for the photodiode found on its data sheet. To compute the output power of the sources, you will divide the measured photocurrent produced by the source by the responsivity of the photodiode: $P = I_{ph}/R$. The easiest way to do this will be to estimate some average responsivity and assume that the light coming out of the sources is a flat distribution across all wavelengths. Compute the power for the microscope at three different output intensities and the flood lamp. (Remember to normalize per unit area).
2. Solar Cell Power Curve. Using the probe station in the room adjoining the cleanroom, measure the I-V properties of a single solar cell (one that hasn't been connected in parallel or series with other cells) when you shine light on it. Figure 1 shows how this test should be made. You will vary the load by varying the resistance of the potentiometer. By measuring this resistance as well as the voltage across the resistor (with a voltmeter), you should be able to produce an I-V curve similar to the one shown in Figure 2. Using the single cell, produce these curves for three levels of microscope light and using the flood lamp. What is the optimal load for a single cell? What is the maximum power out of your cell? Based on your calculations from Part 1 on the output power of the light sources, how efficient is your cell at producing electrical power from light power?
3. Photovoltaics in Series. You will now produce an I-V curve for the cells you wired up in series in last week's lab. Again use a potentiometer to vary the load across your cells and produce a power curve illuminating your cells with the flood lamp. You should not need the probe station for this part of the lab. What is the optimal load for your cells in series? How does this compare to a single cell? What is the maximum power your circuit can produce?
4. Photovoltaics in Parallel. You will now produce an I-V curve for the cells you wired up in parallel in last week's lab. Again use a potentiometer to vary the load across your cells and produce a power curve illuminating your cells with the flood lamp. You should not need the probe station for this part of the lab. What is the

optimal load for your cells in series? How does this compare to a single cell?
 What is the maximum power your circuit can produce?

5. Real Solar Power. Take your circuit capable of producing the most power outside in the natural sunlight and again determine the maximum power. (Hope for no clouds). Again bring a potentiometer and a portable voltmeter to optimize the load for the given light power. If you were designing a power system for a portable appliance, how many of your cells would you need to produce 100W? How would you wire them up if the appliance runs on 12V?

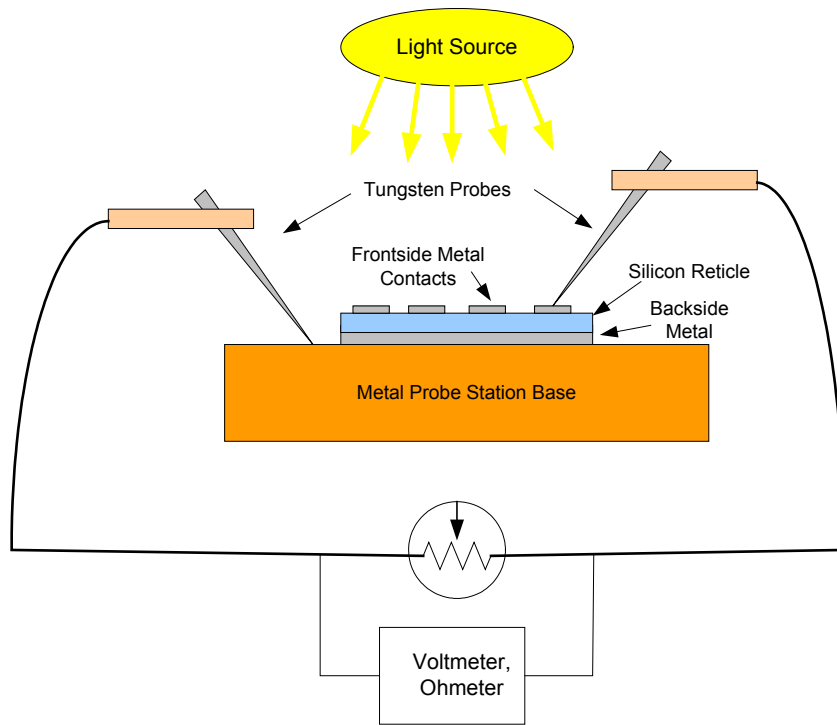


Figure 1

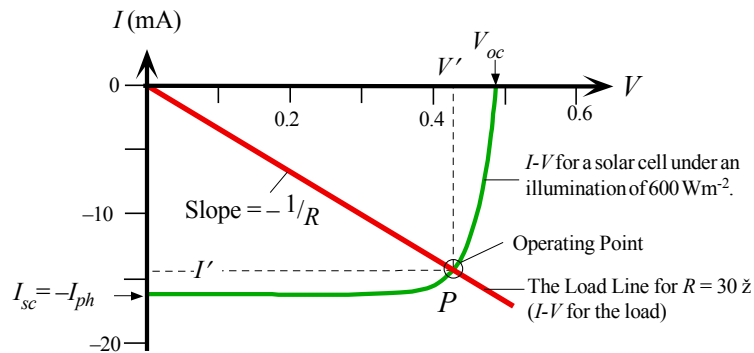


Figure 2