ECEn 555 – Optoelectronics Devices Lab

Week 9

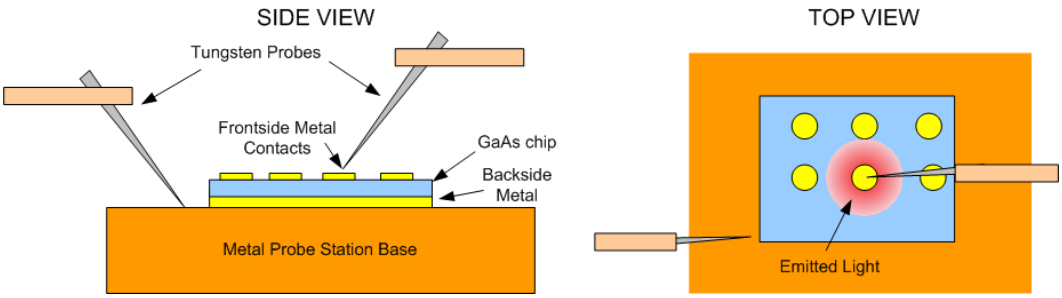
"LED Measurements"

In this lab you will take the LED structures you have been fabricating and will complete their processing by doing some metal annealing. You will then measure their diode characteristics and their light emission characteristics.

Major Objectives

1. 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." Since your LEDs are constructed of GaAs and Al is used as a metal – we don't want to contaminate the tubes used for silicon annealing. Instead use a hot plate and anneal at around 350C for 5 minutes.

2. Diode Measurements. You are now ready to measure the electrical characteristics of your LEDs 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 LEDs the same way you did with the photodiodes and photovoltaics in the previous lab. When you forward bias these diodes, you should see light emission from around the contacts.

3. Emission Measurements. You are now ready to test the emission characteristics of the LED using the Optics Probe Station in the room adjacent to the cleanroom. Again place your chips on the probe station and hook up a power supply to the probes so that you are forward biasing your LEDs. Use the commercial silicon detector you have used in the previous labs to measure the light output from your LEDs. You may have to dim the lights in the room. Assuming that the LEDs are emitting at 650 nm, use the spectral response curve for the detector to determine the amount of light

power measured by the detector. Take into account the detector's area and distance from the LED and also assume that the LED is emitting equally at all angles – as in the figure below. How much total light power is being emitted by the LED? Compare this to the electrical power being used to drive the LED to come up with an efficiency for the device. (η = Light Power Out / Electrical Power in). Repeat your measurements for LEDs with different contact pad sizes. Do your results change? Why or why not?