

Lab 8 - The Light Emitting Diode

Score _____ / 10

Red light emitting diodes (LED's) are commonly made from the semiconductor alloy $\text{GaAs}_{0.6}\text{P}_{0.4}$. In this lab you will use an optical spectroscope (the same thing that you used to measure the hydrogen spectrum at the beginning of this semester) to measure the band-gap for this material.

When the $p - n$ junction of an LED is forward biased, electrons and holes recombine and emit photons with an energy $h\nu$ equal to the band-gap energy E_g . So when we measure the wavelength of light emitted by the diode, we are also measuring the band-gap energy.

To measure the wavelength of the light, you will be using a spectroscope with a diffraction grating having 600 lines per mm. First, calculate the spacing between lines in the grating d and record it below. Next look through the eyepiece of the spectroscope and line up the eyepiece tube with the other tube. You should see the "zereth" diffraction order. Now move the eyepiece until you see the first diffraction order on the left side, and write the angle in the space below. Then move to the right of the zeroth order line and find the angle for the -1 order.

The angle of θ which we plug into the grating equation is the angle between the zeroth and the ± 1 orders. Calculate this by taking the difference of the two angles you measured and dividing by 2. Enter the result below. Now plug the average angle into the grating equation to find the wavelength: $d \sin \theta = m\lambda$. Then use the measured wavelength to calculate the band-gap energy E_g in eV, and record it below. Finally, write down the voltage drop across the diode, as measured by the multi-meter. They should be close (there is some voltage drop due to resistance before the junction, but E_g/e should be fairly close to V).

$$d = \underline{\hspace{2cm}} \quad \theta_1 = \underline{\hspace{2cm}} \quad \theta_{-1} = \underline{\hspace{2cm}}$$

$$\bar{\theta} = \underline{\hspace{2cm}} \quad \lambda = \underline{\hspace{2cm}} \quad E_g = \underline{\hspace{2cm}} \quad V = \underline{\hspace{2cm}}$$