

ECSE-2210 Microelectronics Technology
Class Activity 18 – Solution

1. Why cannot the detectors for 1.55 μm IR light be made from Si?
 Si will not absorb the 1.55 μm radiation because Si has a bandgap of 1.1eV and 1.55 μm photons have a corresponding energy of 0.8 eV. For a material to absorb any wavelength its energy has to be greater than the bandgap of the material. As a result detectors for 1.55 μm IR light cannot be made with Si.

2. GaAs has a bandgap of 1.4 eV. If an LED is made from GaAs, what will be the approximate wavelength of the light output?

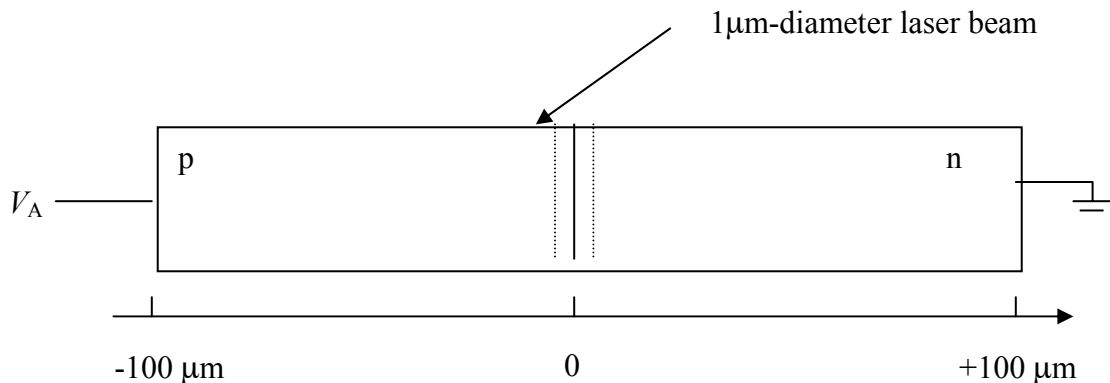
Use $E = \frac{hc}{\lambda}$

$$\lambda = \frac{hc}{E} = (6.63 \times 10^{-34} \text{ J s} \times 3 \times 10^8 \text{ m/s}) / (1.4 \text{ eV} \times 1.6 \times 10^{-19} \text{ J/eV})$$

$$= 0.88 \mu\text{m}$$

The wavelength of light output will be 0.88 μm (this is infrared light. One can add a small amount of Al to get AlGaAs which changes the bandgap and makes the LED emitting in the red region)

3. Consider the p-n junction diode detector shown below. A laser with photon energy greater than the bandgap of the detector is focused such that illuminated area on the detector is very small (about 1 μm in diameter). The hole and electron diffusion lengths are 10 μm and 20 μm respectively. Plot the photo-response you will expect when you scan the laser beam from $x = -100 \mu\text{m}$ to $x = +100 \mu\text{m}$. Make a qualitative plot.



As the hole diffusion lengths are smaller than the electron diffusion lengths, the photo response can be plotted as seen in the figure below.

