ECE 340 Homework XVII Spring 2003

Due: Wednesday, May 7, 2003

1. *A symmetric p-n junction of area 5cm x 5cm has rectifying I-V characteristics such that $I=I_{th}[exp(qV/kT)-1]$, where I_{th} = 12 nA. Assume that the minority carrier diffusion lengths $L_n=L_p=2$ μm in each side of the junction, and the depletion width is 1 μm. Upon solar illumination in a clear day an optical generation rate of $2x10^{18}$ EHP/cm^3 is obtained uniformly at least one diffusion length deep into each side of the neutral region as well as within the depletion region. (a) Calculate the short-circuit current and the open-circuit voltage for this illuminated junction. (b) Plot the I-V curve for this solar cell. Repeat part (a) when some clouds block the sun and the optical generation rate reduces to a half.*

Solutions:

(a) ,

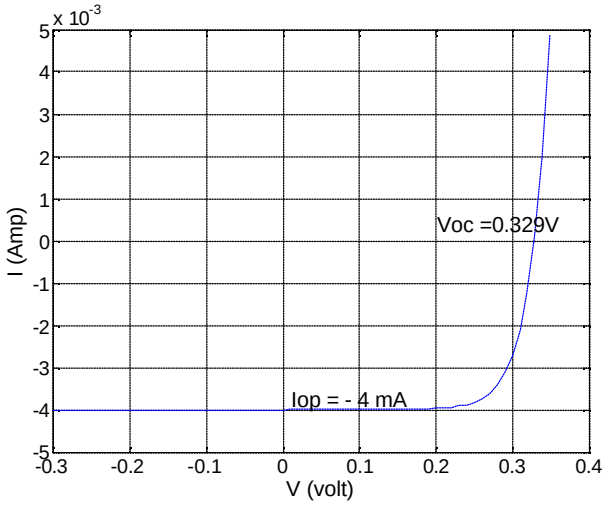
$$I_{op} = qAg_{op}(L_p + L_n + W) = 1.6\times10^{-19}\times5\times5\times2\times10^{18}\times(2+2+1)\times10^{-4}$$

$$= 4mA$$

Short circuit current, V = 0Volt, $I = I_{th}\left(e^{qV/kT}-1\right) - I_{op} = -I_{op} = -4mA$

Open circuit voltage: $V_{oc} = \frac{kT}{q}\ln(I_{op}/I_{th}-1) = 0.0259\ln\left(\frac{0.004}{12\times10^{-9}}-1\right) = 0.329V$

(b),



(c), If g_{op} reduce to half value, then the current reduce to half value:

$$I_{op} = 2mA$$

Short circuit current, V = 0Volt, $I = I_{th}\left(e^{qV/kT}-1\right) - I_{op} = -I_{op} = -4mA$

Open circuit voltage: $V_{oc} = \frac{kT}{q}\ln(I_{op}/I_{th}-1) = 0.0259\ln\left(\frac{0.002}{12\times10^{-9}}-1\right) = 0.311V$