Homework 9

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Semiconductor Development Fundamentals

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# For light to be absorbed, what relation between the energy of a photon and the semiconductor bandgap must be satisfied?

The energy of the photon must be larger or equal to the semiconductor bandgap.

# Consider a Silicon p-n junction with 𝑁𝐴 = 1017 cm-3 and 𝑁𝐷 = 1016 cm-3 . The minority carrier lifetime on the p-side is 1 μs, and the minority carrier lifetime on the n-side is 10 μs.

## What is the depletion region width, 𝑊?

3.069843109322047e-05 cm

## What is the reverse saturation current density, 𝐽s?

1.907127968579501e-10 A / cm^2

## What is the current density for 𝑉𝑎𝑝𝑝 = −3 𝑉?

-1.907127968579501e-10 A / cm^2

## What is the current density for 𝑉𝑎𝑝𝑝 = 0.5 𝑉?

0.04617885821490352 A / cm^2

## Using a computer, plot the current density for an applied voltage ranging from -3 V to 0.7 V.

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## Light shines on the semiconductor with uniform illumination. The generation rate is 1018𝑐𝑚−3 /𝑠. What is 𝐽𝑜𝑝?

-0.0019 A / cm^2

## Redo the plot for part e. On the same plot, show the current density when light is applied. Rescale as necessary.

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## What is the short circuit current density and the open circuit voltage from this level of illumination?

Short circuit current density = -0.0019 A / cm^2

Open circuit Voltage = 0.410 V

## Using a computer, plot the power density versus applied voltage ranging from -3 V to 0.7 V. 𝑃𝑑𝑒𝑛𝑠𝑖𝑡𝑦 = 𝑉𝑎𝑝𝑝 𝐽

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## What is the maximum amount of power that may be obtained from this level of illumination?

72.97239659284001 [W]