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ECE 3080

PHOTODIODES

Basics

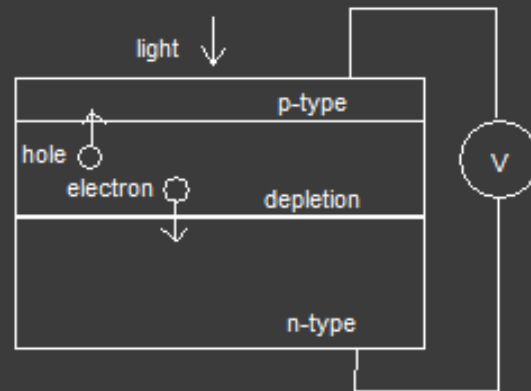
- Photodiodes are photodetectors capable of converting light to current or voltage
- They are most commonly used to measure light intensity
- Often use P-I-N junctions instead of P-N junctions because they are faster and more sensitive

P-I-N Photodiodes

- ⦿ A P-I-N junction is like a P-N junction but with a layer of intrinsic semiconductor separating the p-type and n-type materials
- ⦿ The intrinsic layer extends the width of the depletion region so more electron-hole pairs may be formed
- ⦿ Surface layer is thin so that most optical absorption occurs in the intrinsic layer

Operation

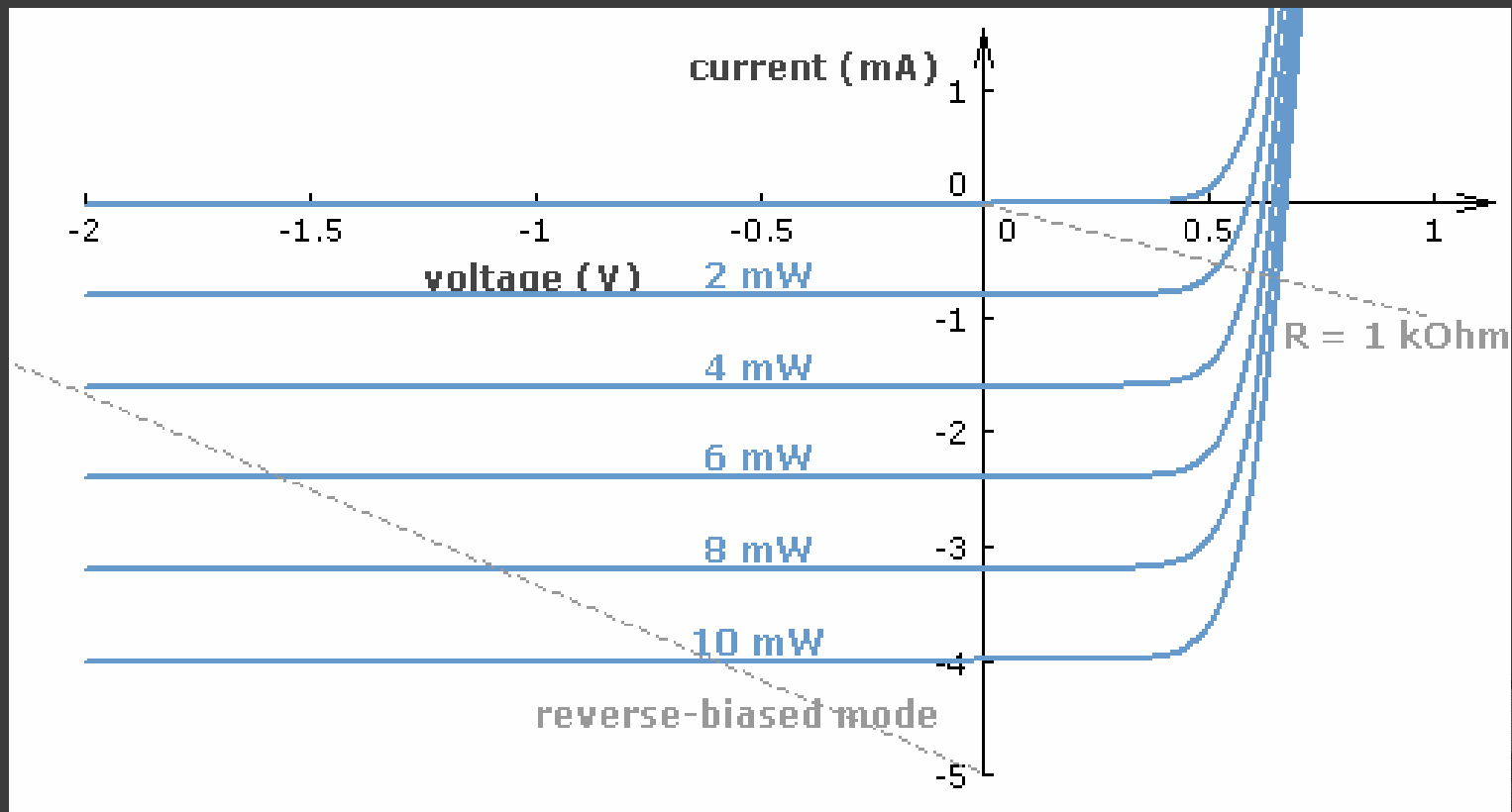
- An electron-hole pair is created when a photon strikes the diode with enough energy to excite the electron
- Because of the built-in field in the depletion region, electrons move toward the N region and holes move toward the P region creating a photocurrent



Modes of Operation

- ⦿ Photovoltaic mode – when no bias is applied to the diode, the flow of current is restricted and voltage builds up
- ⦿ Photoconductive mode – when a reverse bias is applied to the diode, depletion layer width increases and junction capacitance decreases

Current-Voltage Characteristic



Properties

- ◉ Dark current – includes photocurrent from background radiation and saturation current of the junction
- ◉ Responsivity – ratio of photocurrent to incident light power

Materials

- Silicon – low dark current, high speed, good sensitivity between 400-1000nm
- Germanium – high dark current, slow speed, good sensitivity between 600-1800nm
- Indium Gallium Arsenide – expensive, low dark current, high speed, good sensitivity between 800-1700nm

