

Lecture 10

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1 Drift-Diffusion Current

$$J_n = q\mu_n NE - qD_n \frac{dn}{dx}$$

and similar for p . This is the sum of drift and diffusion current, where $\frac{dn}{dx}$ is the gradient.

2 PN Junctions

When n type and p type materials love each other very much, a pn junction is born. We find a carrier depletion region formed by diffusion near the junction. However, an internal electric field is formed to preclude further diffusion, called a barrier voltage.

3 Maxwell-Boltzmann Distribution

The distribution is proportional to $\exp\left(\frac{E}{kT}\right) = \exp\left(\frac{qV}{kT}\right)$. The free electrons that overcome the potential barrier due to an applied voltage is then proportional to $\exp\left(\frac{qV}{kT}\right) - 1$ as derived. A more detailed derivation can be found by consulting an EngSci ECE.