ECE 235: Introduction to Solid State Electronics

Discussion

Week 9

Md Mobinul Haque

Drift and Diffusion Current

$$J_e(drift) = n\, e\mu_e E$$

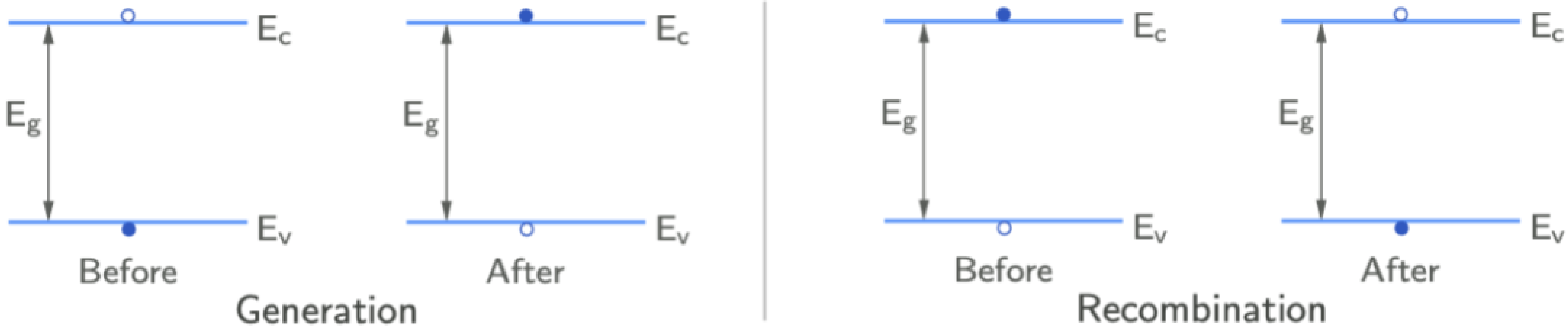
$$J_h(drift) = p\, e\mu_h E$$

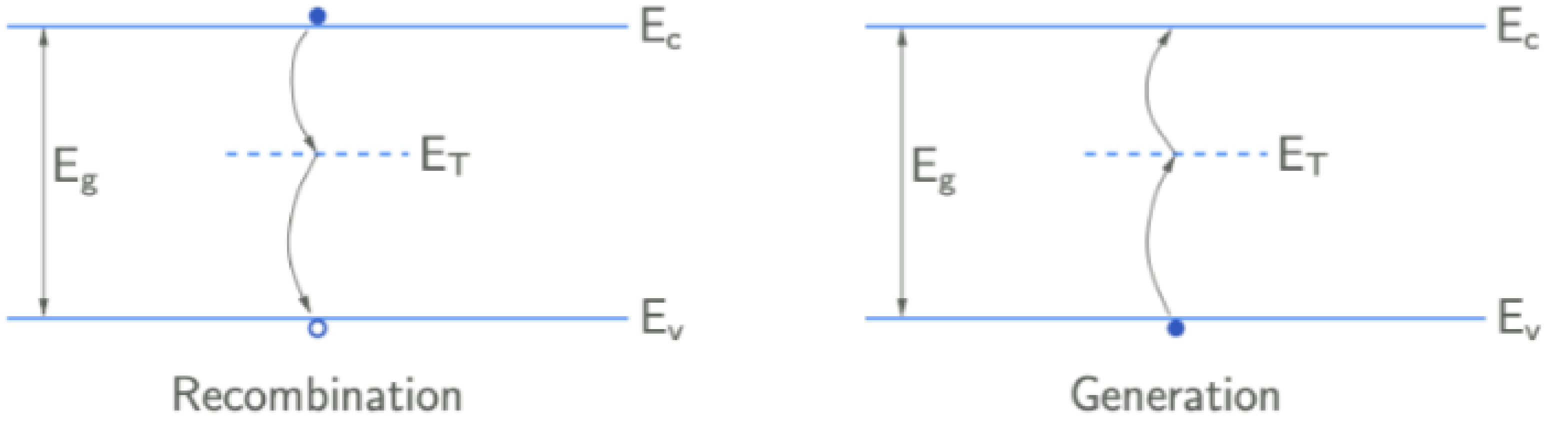
$$J_{e(diffusion)} = e\, D_e \frac{dn}{dx}$$

$$J_{h(diffusion)} = -e\, D_h \frac{dp}{dx}$$

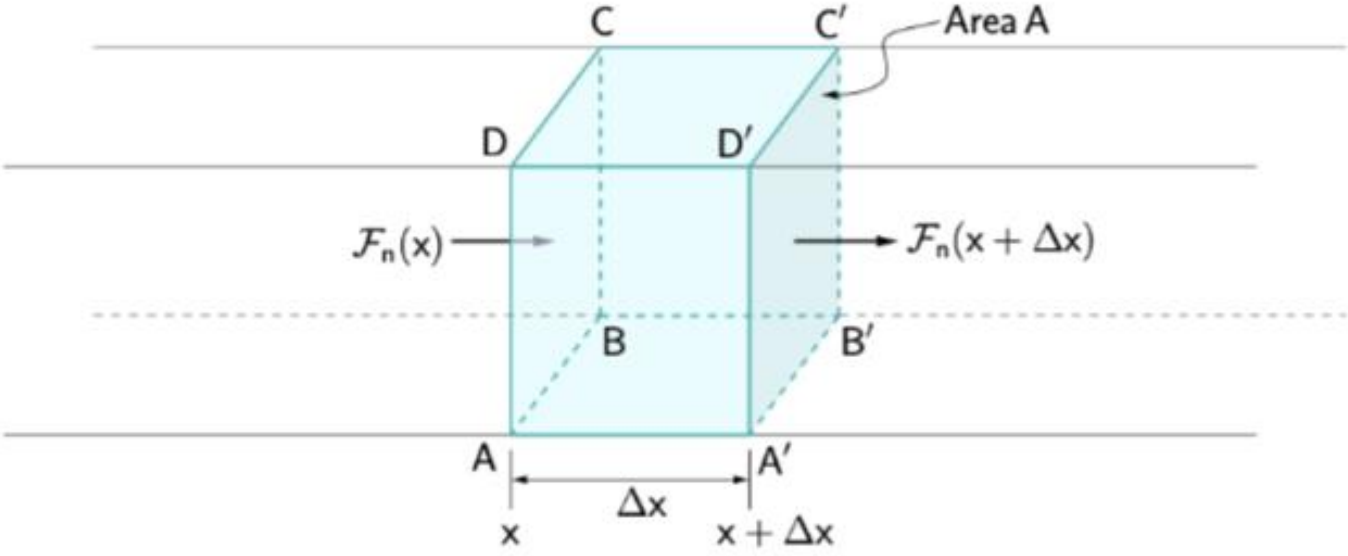
$$J(diffusion) = J_e(diffusion) + J_h(diffusion)$$

Generation and Recombination





Continuity Equations



Practice Problem 1

Consider an infinitely large, homogeneous n-type semiconductor with zero applied electric field. Assume that 10^{14} electron-hole pairs have been uniformly created per cm^3 at $t = 0$, and assume the minority carrier hole lifetime is $\tau_{p0} = 50\ \mathrm{ns}$. Determine the time at which the minority carrier hole concentration reaches (a) 1/e of its initial value and (b) 10% of its initial value.

Practice Problem 2

Consider an infinitely large, homogeneous n-type semiconductor with zero applied electric field. Assume that, for $t < 0$, the semiconductor is in thermal equilibrium and that, for $t \geq 0$, a uniform generation rate $g_0 = 5 \times 10^{21}\ cm^3\ s^{-1}$ exists in the crystal and let po $\tau_{p0} = 10^{-7}$ s. Determine $\Delta p(t)$ at $t = 10^{-7}$ s

Practice Problem 3

Consider a p-type semiconductor that is homogeneous and infinite in extent. Assume a zero applied electric field. For a one-dimensional crystal, assume that excess carriers are being generated at *x* = 0 only. Assume $\tau_{n0} = 5 \times 10^{-7}\ s, D_n = 25\ \frac{cm^2}{s},\ \Delta n(0) = 10^{15}\ cm^{-3}$ (a) Calculate the value of diffusion length. (b) Calculate Δn at $x = 30\mu m$.