

CHARGE TRANSPORT

There are two mechanisms for charge transport

Electric field

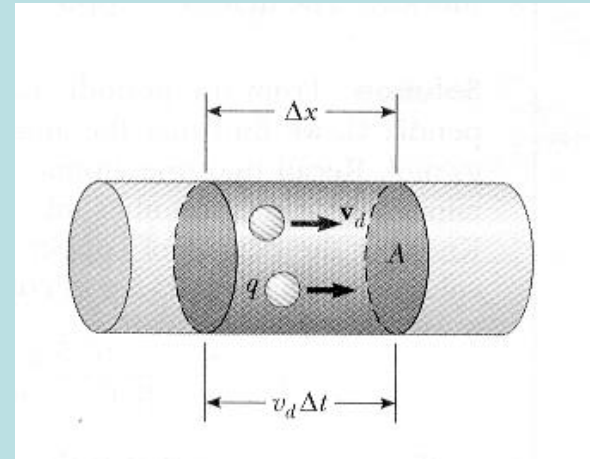
Diffusion

CHARGE TRANSPORT

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = n q v_{drift} A$$

$$j = I_n = n q v_{drift}$$

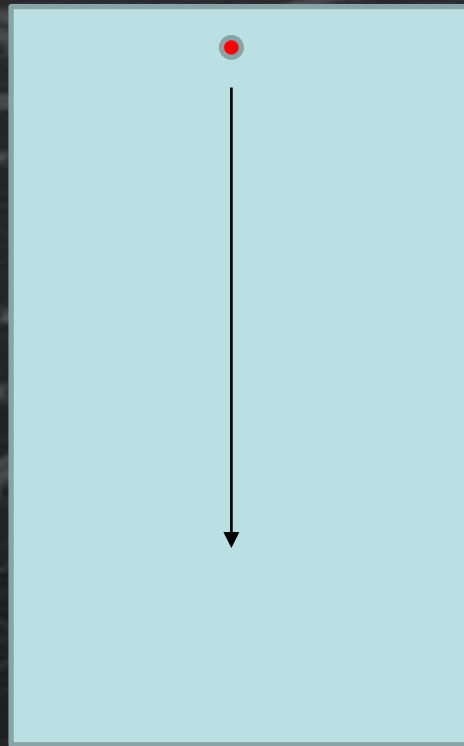


$$n A \Delta x$$

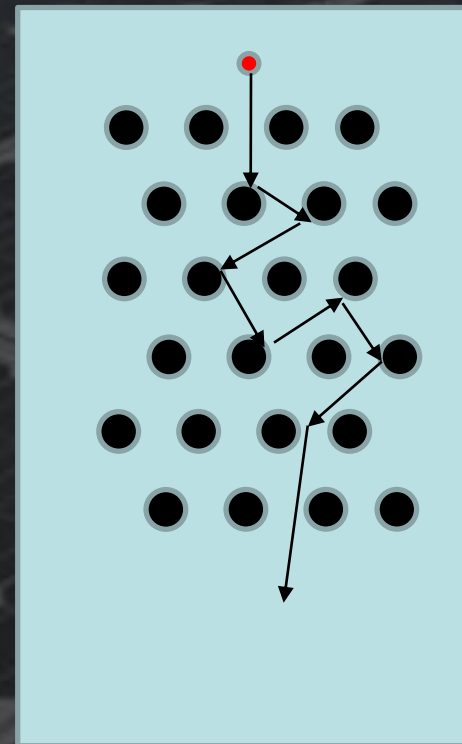
$$\Delta Q = (n A v_d \Delta t) q$$

CHARGE TRANSPORT

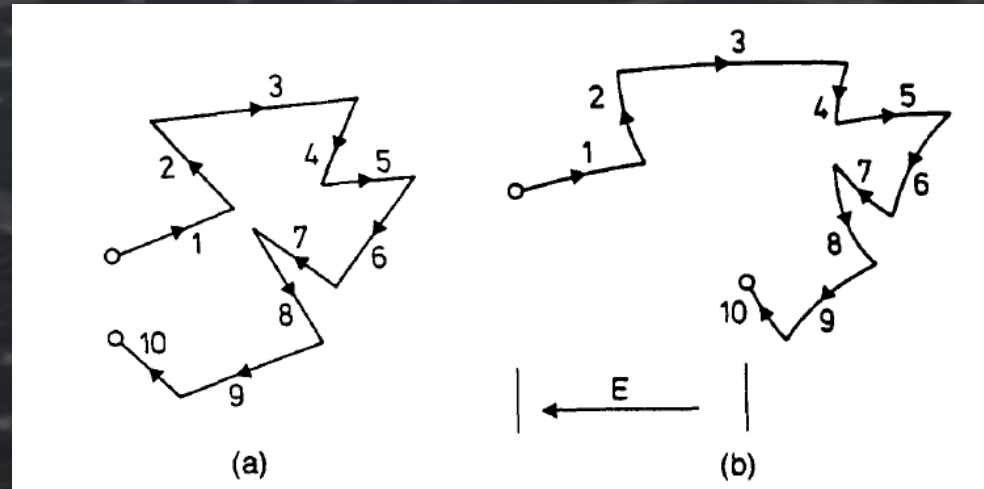
Free vertical surface



vertical surface with nails



CHARGE TRANSPORT



$$F = qE$$

$$F = ma$$

$$a = qE/m^*$$

$$V_{\text{drift}} = v_0 + a t_{\text{med}}$$

T_{med} = average time between collisions

$$V_{\text{drift}} = -\frac{1}{2} \frac{q}{m_n^*} E \bar{t}$$

CHARGE TRANSPORT

$$j = I_n = n q v_{drift}$$

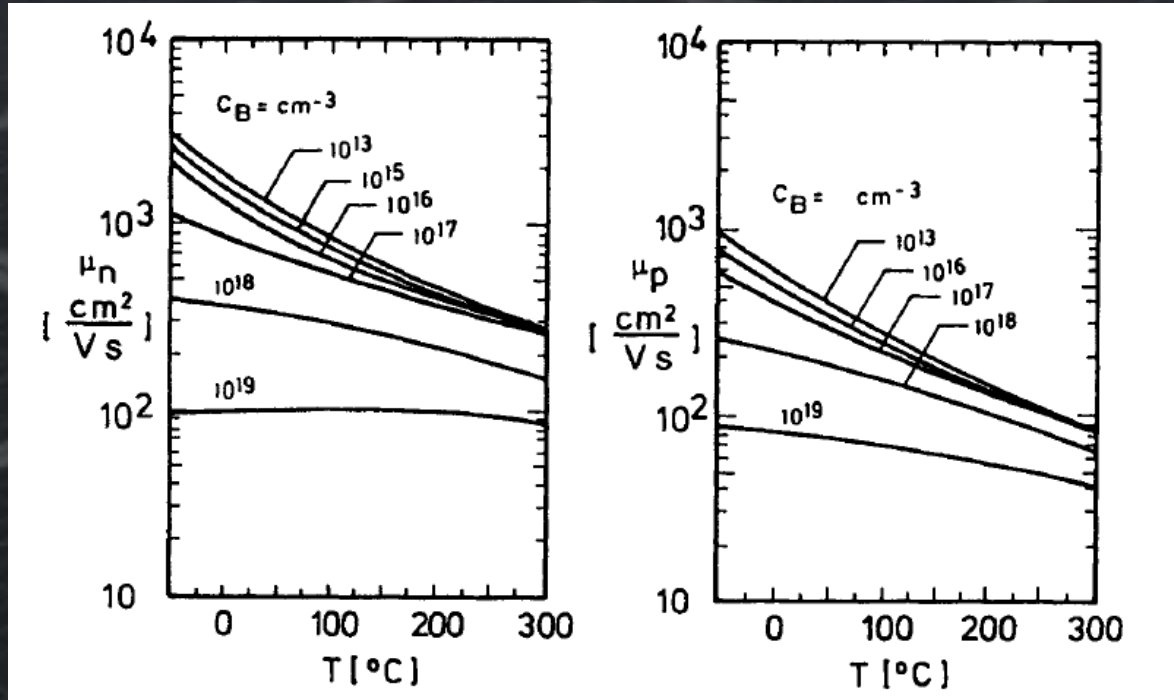
$$\frac{1}{2} \frac{q \bar{t}}{m_n^*} = \mu_n$$

$$I_n = n q \mu_n E$$

$$I_n = \sigma E \quad j = \sigma E$$

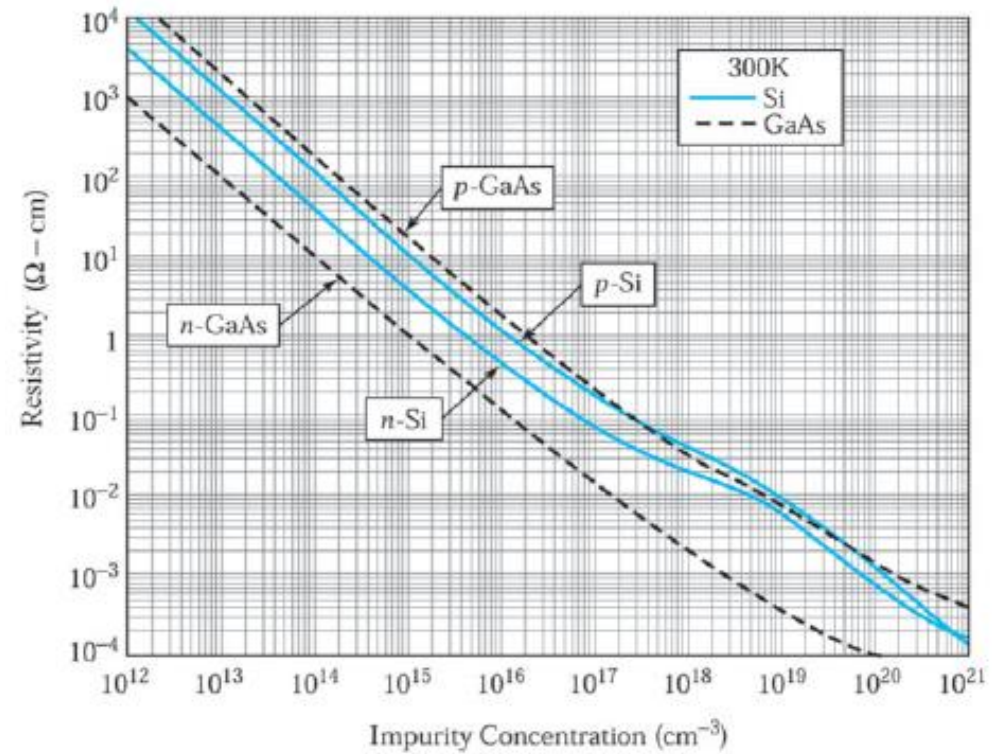
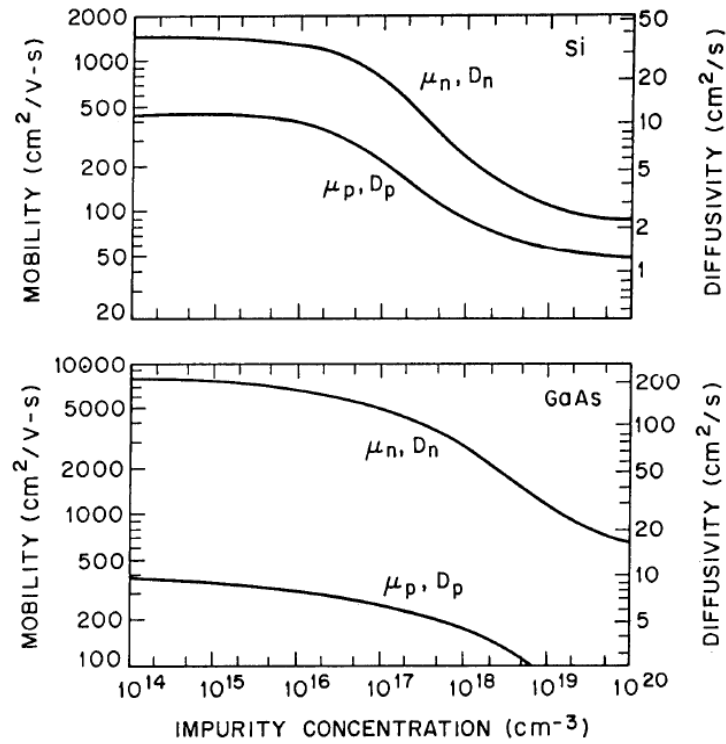
$$\sigma = n q \mu_n$$

$$\sigma = q (n \mu_n + p \mu_p)$$



$$\rho = \sigma^{-1} = [q(n\mu_n + p\mu_p)]^{-1}$$

CHARGE TRANSPORT



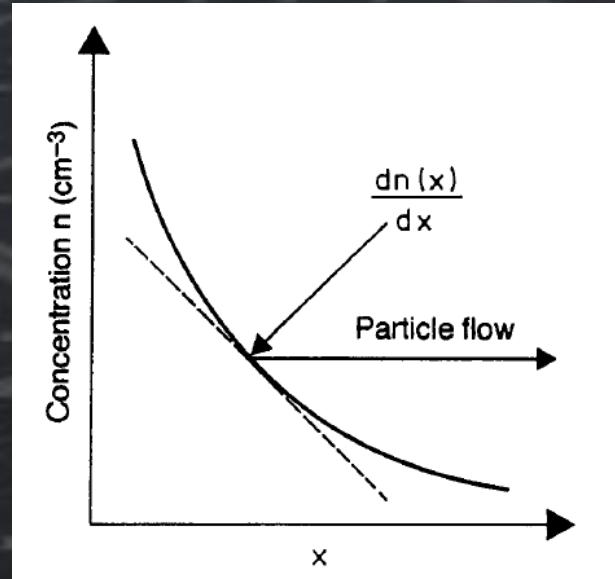
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CHARGE TRANSPORT



$$\frac{dN}{dt} = -D_n \frac{dn(x)}{dx}$$

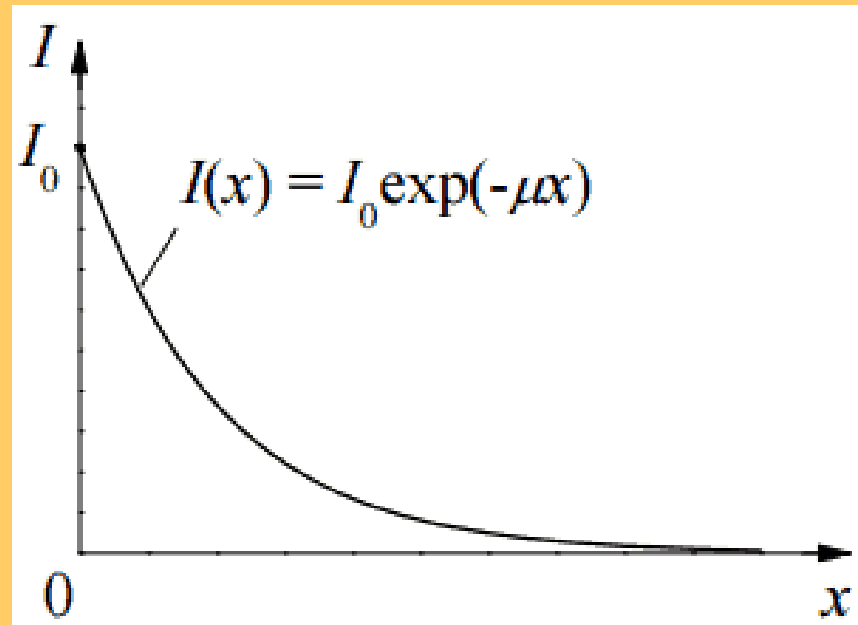
$$I_n = -q \frac{dn}{dt} = qD_n \frac{dn(x)}{dx}$$

$$I_n = q \left(n\mu_n E + D_n \frac{dn}{dx} \right)$$

$$D = \frac{kT}{q} \mu$$

GENERATION OF CHARGE

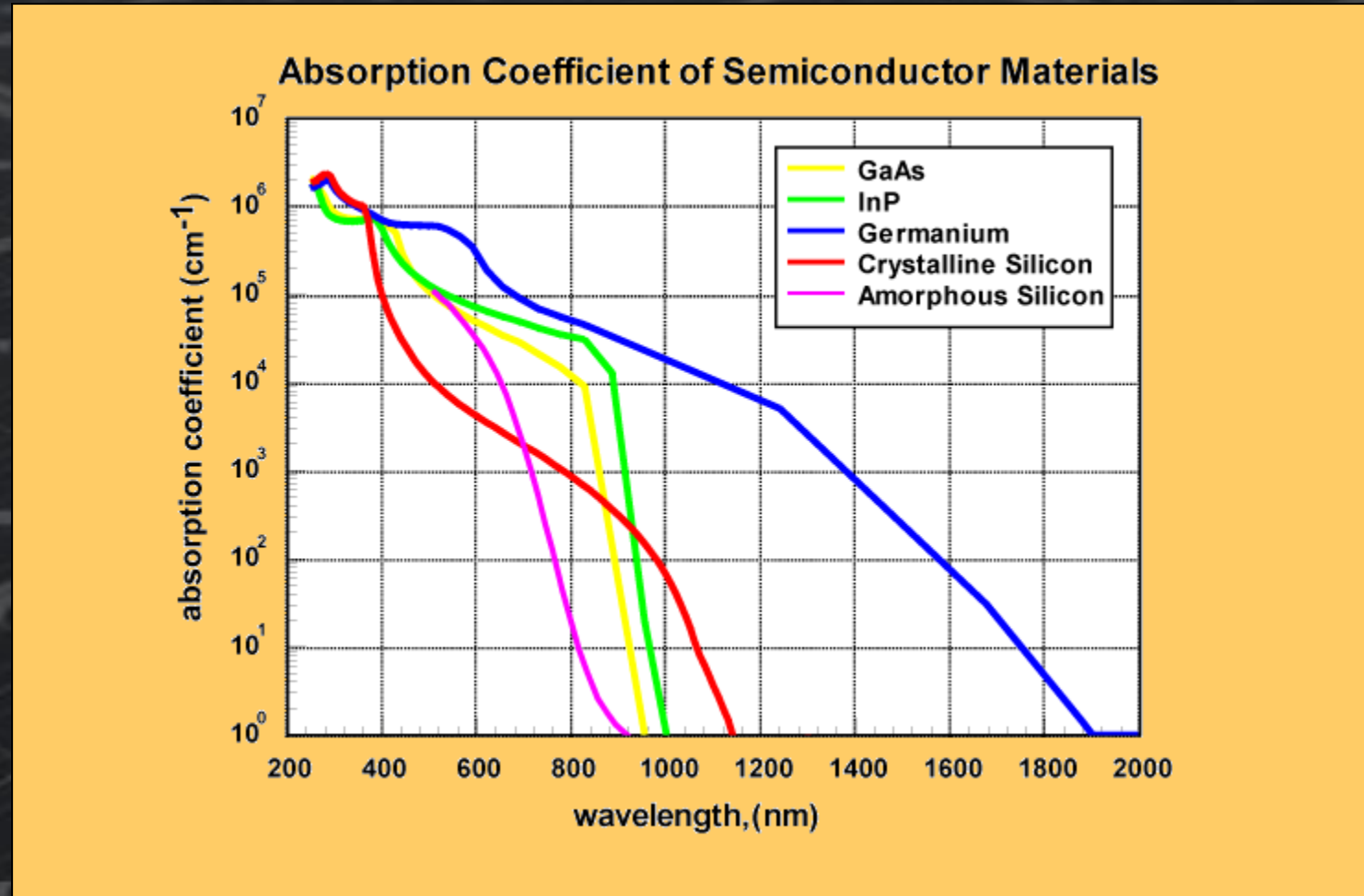
Intensity absorption inside a media



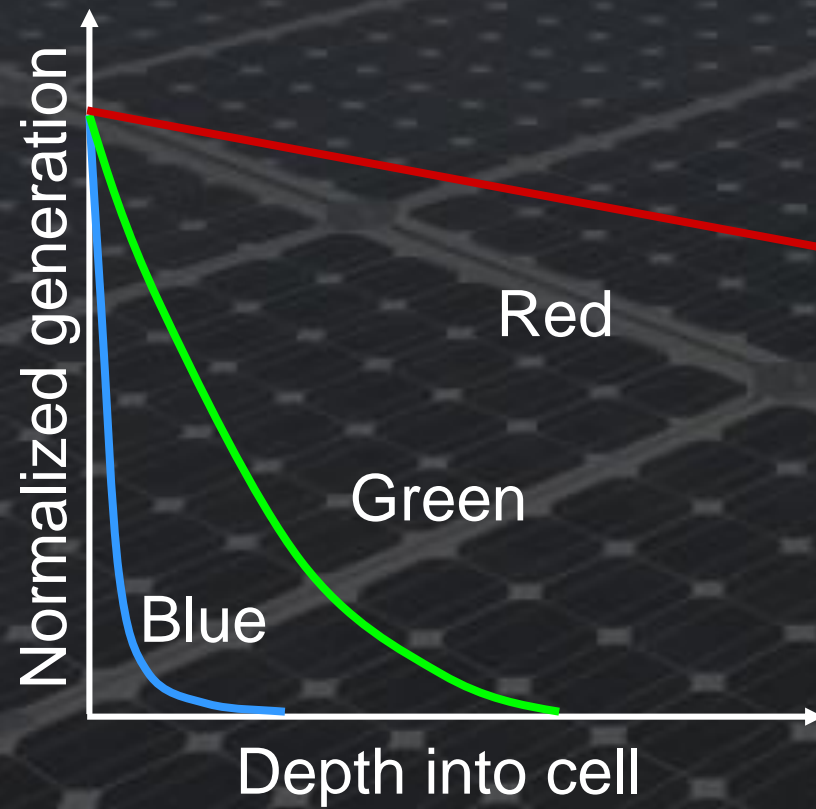
Beers-Lambert Law

GENERATION OF CHARGE

How can charges be created in a semiconductor?

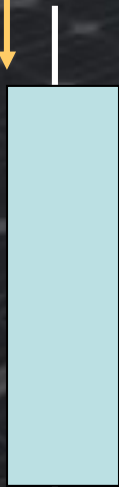


GENERATION OF CHARGE

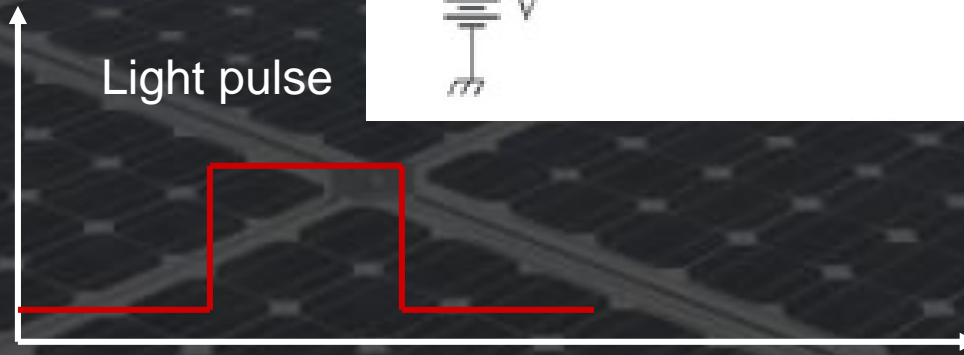


CHARGE RECOMBINATION

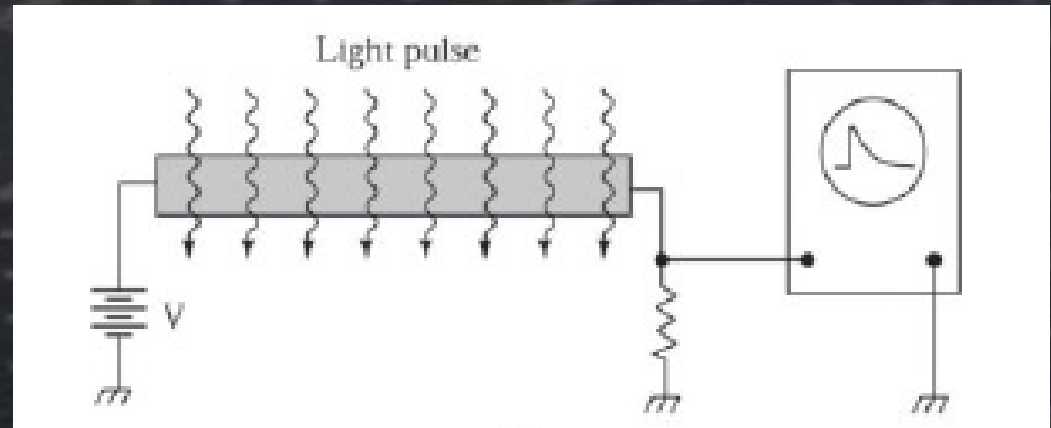
$V = \text{cte}$



Light pulse

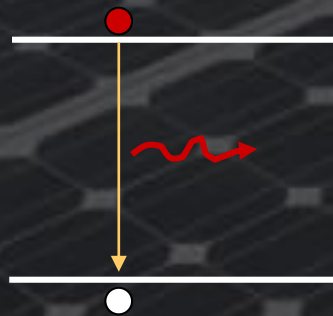


I

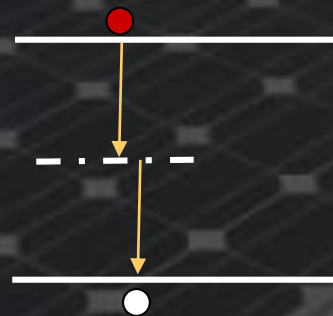


CHARGE RECOMBINATION

Radiative



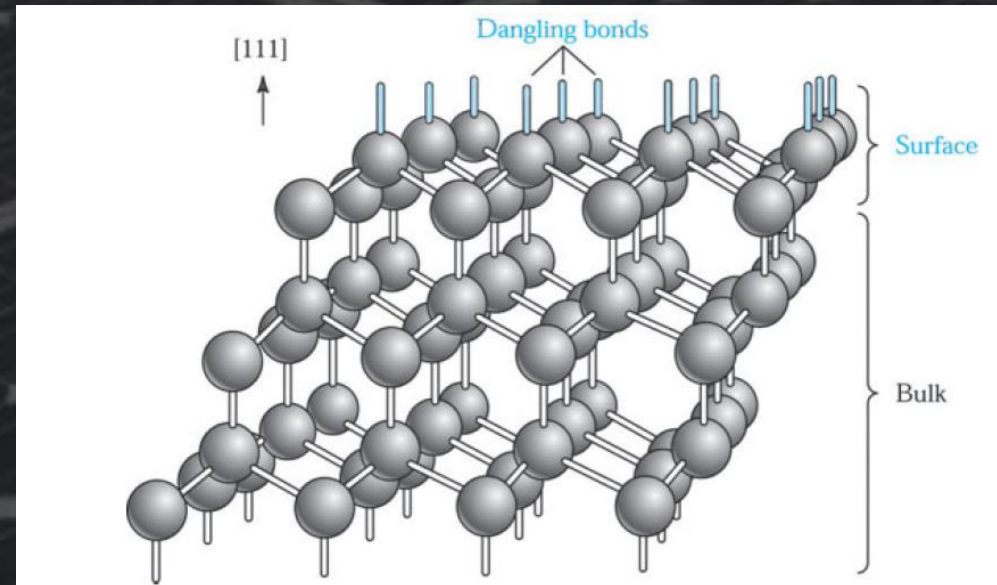
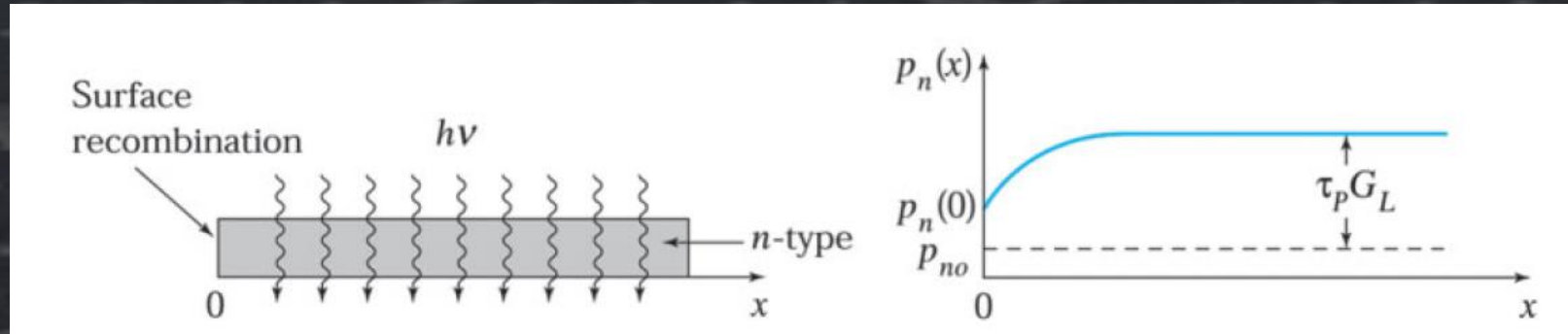
Shockley-Read-Hall



Auger



CHARGE RECOMBINATION



CHARGE RECOMBINATION

$$\tau = \frac{\Delta n}{R}$$

$$\frac{1}{\tau_{\text{total}}} = \frac{1}{\tau_{\text{radiation}}} + \frac{1}{\tau_{\text{Auger}}} + \frac{1}{\tau_{\text{trap}}}$$

