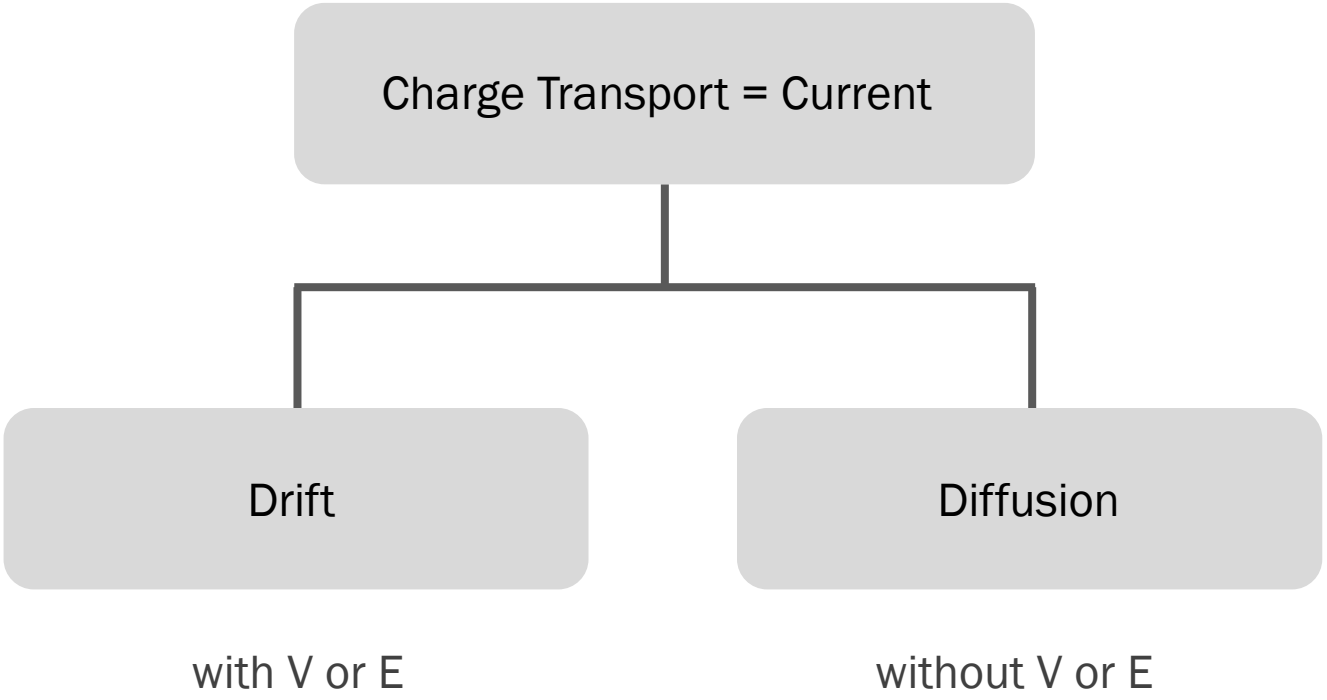
Microelectronics

Lesson. 3 Carrier Transport in Semiconductor (Drift and Diffusion)

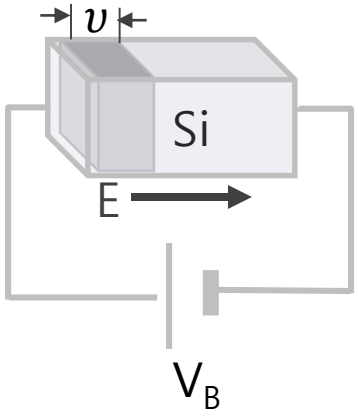
2015. 09.08

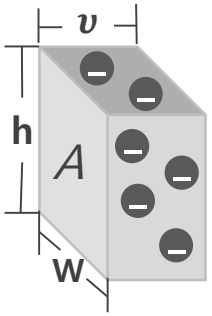
Haena Kim

INDEX


Charge Transport = Current
Drift
Diffusion
with V or E
without V or E

Drift Current conduction due to electric field (just as Basic circuit)





$I = charges\ through\ A\ per\ sec.$

$\upsilon = velocity\ of\ elctrons$

➡ $I = Total\ charge$ in volume$(\mathrm{w} * \mathrm{h} * \upsilon)$

$$\therefore Total\ charge = \underbrace{\upsilon \cdot w \cdot h}_{\text{volume}} \cdot \underbrace{n}_{\text{\# of electrons}} \cdot \underbrace{q}_{\text{quantity of charge}}$$

$$= |I|$$

$$= \mu_n \frac{V_B}{L} whnq \rightarrow \frac{1}{R}$$

$$\therefore \mathrm{R} = \frac{L}{\mu_n whnq}$$

$$= \frac{1}{\mu_n nq} \cdot \frac{L}{A}$$

$\rightarrow \rho$

$V = IR$ $\quad \upsilon = \mu_n E$

$\mathrm{R} = \rho \frac{L}{A}$ $\quad E = \frac{V_B}{L}$

Find I to calculate R

$$I = \mu_n \frac{V_B}{L} whnq$$

$$J_n = \frac{I}{A}$$

$$J_n = \mu_n \frac{V_B}{L} nq$$

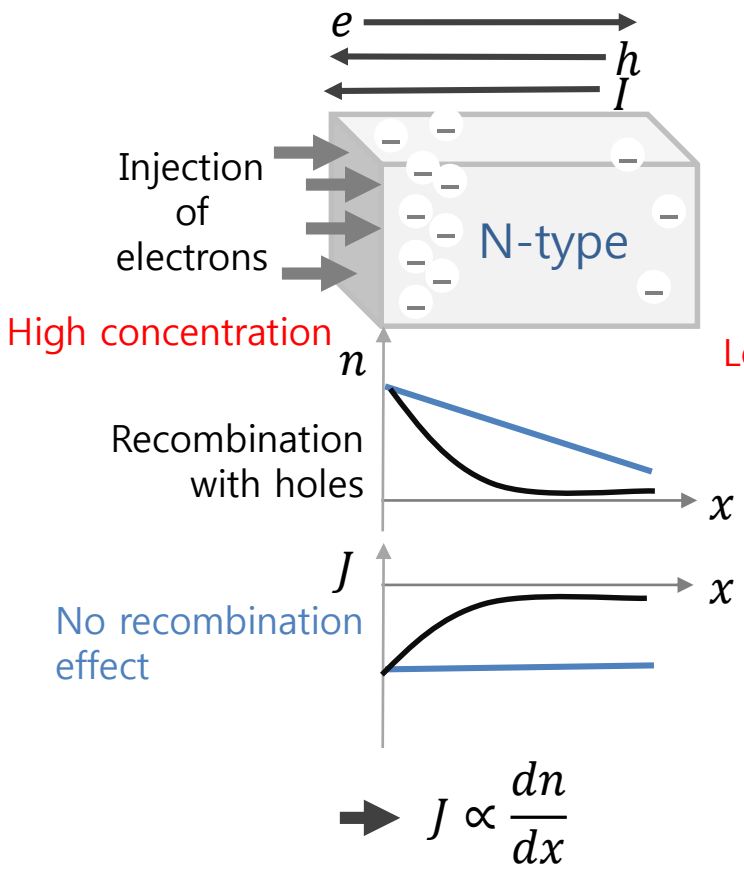
$$= \mu_n Enq \left[{}^{A}/_{cm^2} \right]$$

$$J_p = \mu_p Epq \left[{}^{A}/_{cm^2} \right]$$

$\mu_n = 1350\, cm^2/V \cdot s$
$\mu_p \approx 400\, cm^2/V \cdot s$

$$\therefore Total\ J_{drift} = (\mu_n n + \mu_p p)E \cdot q$$

Diffusion Movement of charge carriers from a region of high concentration to a region of low concentration



$$J_n = Dn\frac{dn}{dx}q < 0$$

$$J_p = -Dp\frac{dp}{dx}q > 0 \quad (\because \frac{dp}{dx} < 0)$$

$$\therefore Total\ J_{diff} = \left(D_n\frac{dn}{dx} - Dp\frac{dp}{dx}\right)q$$

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

$Thermal\ volatge$

$26mV\ at\ T = 300k$

Drift	Diffusion
Electric field	Difference of concentration
μ	D
$J_n = \mu_n E n q$	$J_n = Dn \frac{dn}{dx} q$
$J_p = \mu_p E p q$	$J_p = -Dp \frac{dp}{dx} q$
$J_{drift} = (\mu_n n + \mu_p p) E \cdot q$	$J_{diff} = \left(D_n \frac{dn}{dx} - Dp \frac{dp}{dx} \right) q$

경청해 주셔서 감사합니다.