

# ECE 310- Lecture 6

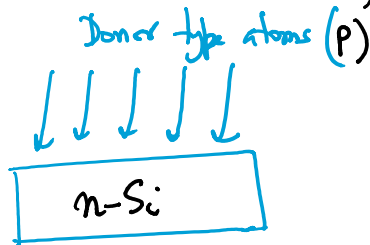
Tuesday, January 23, 2018 3:38 PM

$$q \rightarrow 1.6 \times 10^{-19} \text{ C}$$

Drift:  $J_{\text{total}} = q[n\mu_n + p\mu_p]E$

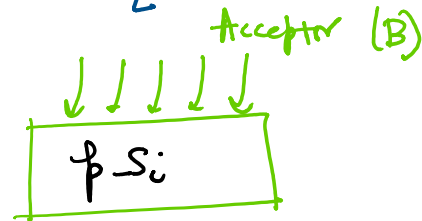
Diffusion:  $J_{\text{total}} = q[D_n \frac{dn}{dx} - D_p \frac{dp}{dx}]$

Einstein's Relation:  $D = \mu \frac{kT}{q} \Rightarrow 26 \text{ mV at } T = 300 \text{ K}$



$$n = N_D$$

$$p = \frac{n_i^2}{N_D}$$

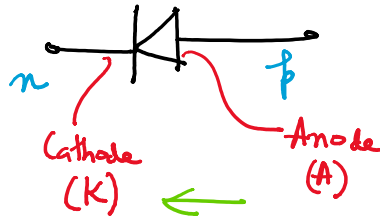
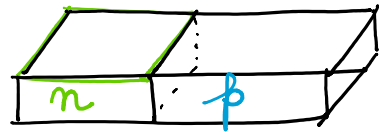


$$p \approx N_A$$

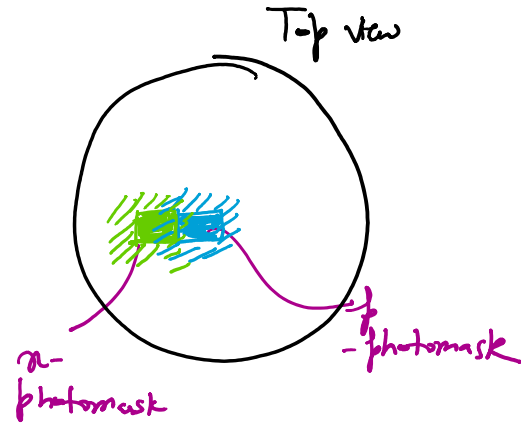
$$n = \frac{n_i^2}{N_A}$$

$$n_p = n_i^2$$

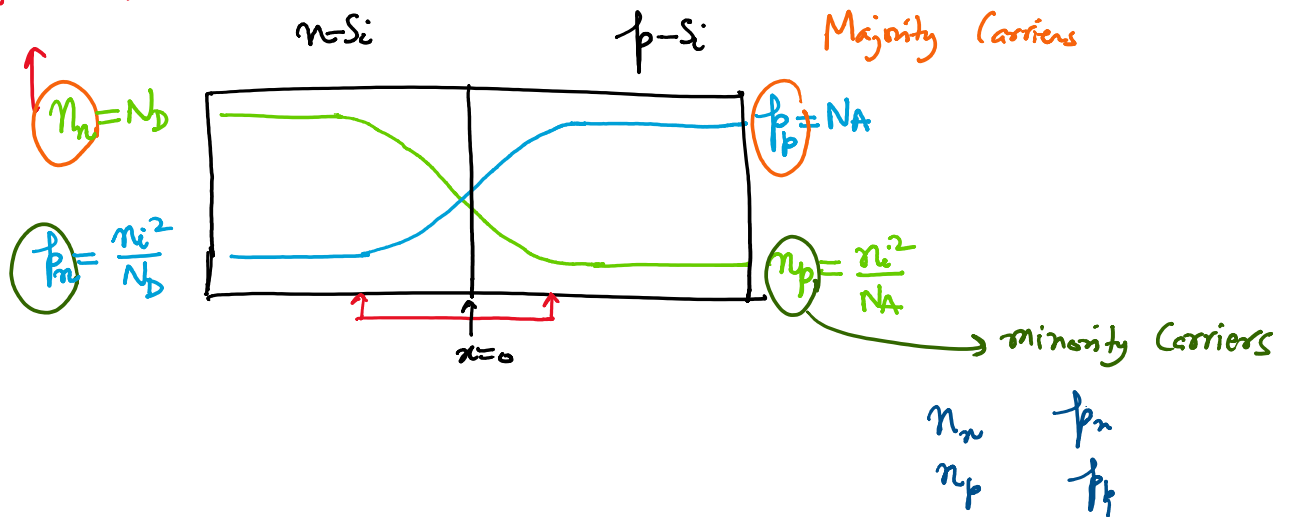
# pn-junction (Diode)

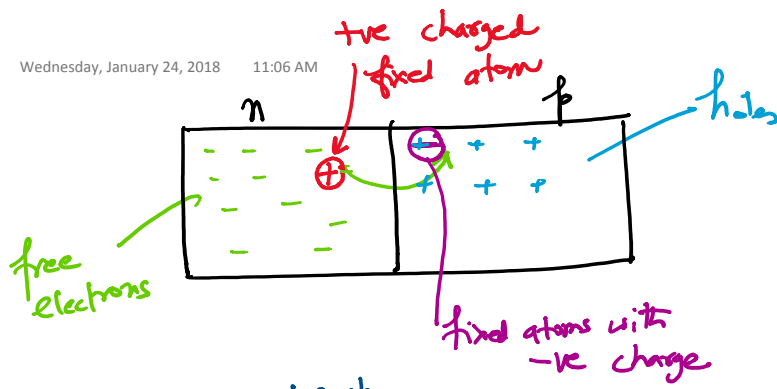


"Valve"



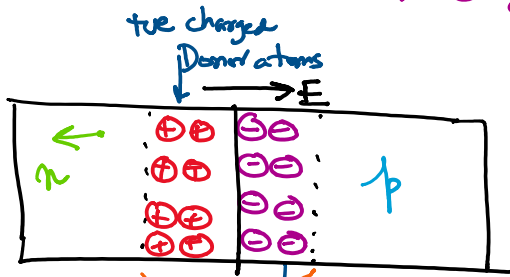
free electron in n-type Si



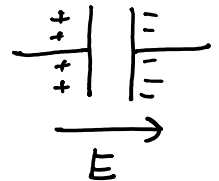
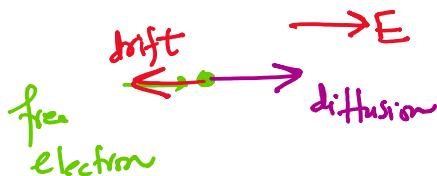


Diffusion of  $e^-$  from n to p side

Diffusion of holes from p to n-side



Depletion Region  $\rightarrow$  it has been depleted of "any" free carriers



In equilibrium, the electric field in the depletion region completely stops the diffusion current.