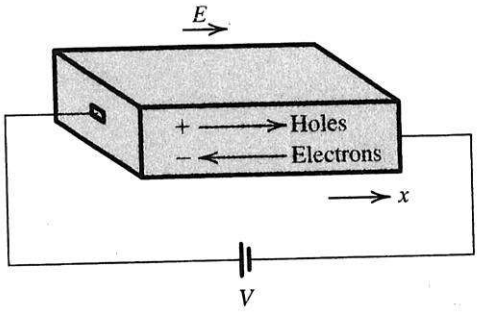
3.3 Current Flow in Semiconductors.

Drift Current – Due to electric field

Diffusion Current – Due to concentration gradient.

Drift Current

Under the influence of an electric field holes and electrons are accelerated in opposite directions and



$$v_{p\,drift} = \mu_p E$$

μ_p - Hole mobility, $\mu_p = 480\ cm^2/V.S$ for intrinsic Si

$$v_{n\text{-}drift} = -\mu_n E, \quad \mu_n = 1350\ cm^2/V.S \text{ for intrinsic Si}$$

↑ Explain why negative sign is there, see fig. above

Hole Current

$$I_p = A q p v_{p\text{-}drift}$$

$$I_p = A q p (\mu_p E)$$

Current density J_p

$$J_p = \frac{I_p}{A} = q p \mu_p E$$

Electron Current

$$I_n = -A q n v_{n\text{-}drift}$$

$$I_n = -A q n (-\mu_n E)$$

$$J_n = \frac{I_n}{A} = q n \mu_n E$$

Total Current $J = J_n + J_p = q(p\mu_p + n\mu_n)E$

Also $J = \sigma E$ or $J = E/\rho$ σ – Conductivity

$\rho \rightarrow$ Resistivity

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

$$\rho \equiv \frac{1}{\sigma} = \frac{1}{q(p\mu_p + n\mu_n)}$$

$$\rho = \frac{E}{J}$$ Units of ρ are $\Omega.cm$ $\Omega cm = \frac{V/cm}{A/cm^2} = \frac{V}{A}\,cm = \Omega cm$