P-n Junction breakdown and hetero Junction

if we change the material How the reverse saturation current change

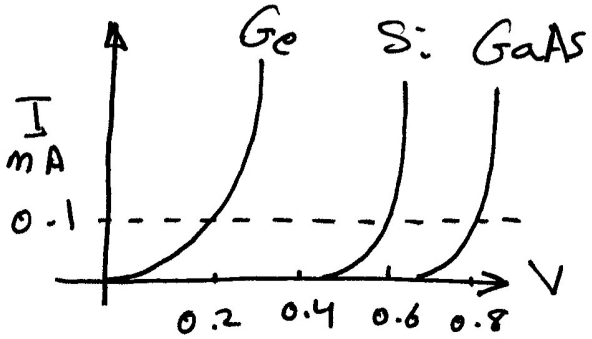
$$J_{so} = n_i^2 e \left(\frac{D_h}{L_h N_D} + \frac{D_e}{L_e N_A} \right)$$

Reverse saturation current density

$$n_i^2 = N_c N_v \exp\left(\frac{-E_g}{KT}\right)$$

$$J = J_{so}\left\{\exp\left[\frac{eV}{KT}\right] - 1\right\} \qquad \frac{eV}{KT} \gg 1 \qquad \boxed{V_g = E_g/e}$$

$$J = \left(\frac{e D_h}{L_h N_D} + \frac{e D_e}{L_e N_A}\right) N_c N_v \exp\left[\frac{e(V - V_g)}{KT}\right]$$



Ge < Si < GaAs

E_g ⇨ 0.7 < 1.1 < 1.43

Pn Si $\quad n_i = 10^{10}\ cm^{-3}$

$N_A = 10^{17}\ cm^{-3} \qquad N_D = 10^{16}\ cm^{-3}$

$$V_o = \frac{KT}{e} \ln \frac{N_A N_D}{n_i^2} = 0.775\ V$$

when we apply a forward bias $V = 0.5$ volt $\quad J = ?$