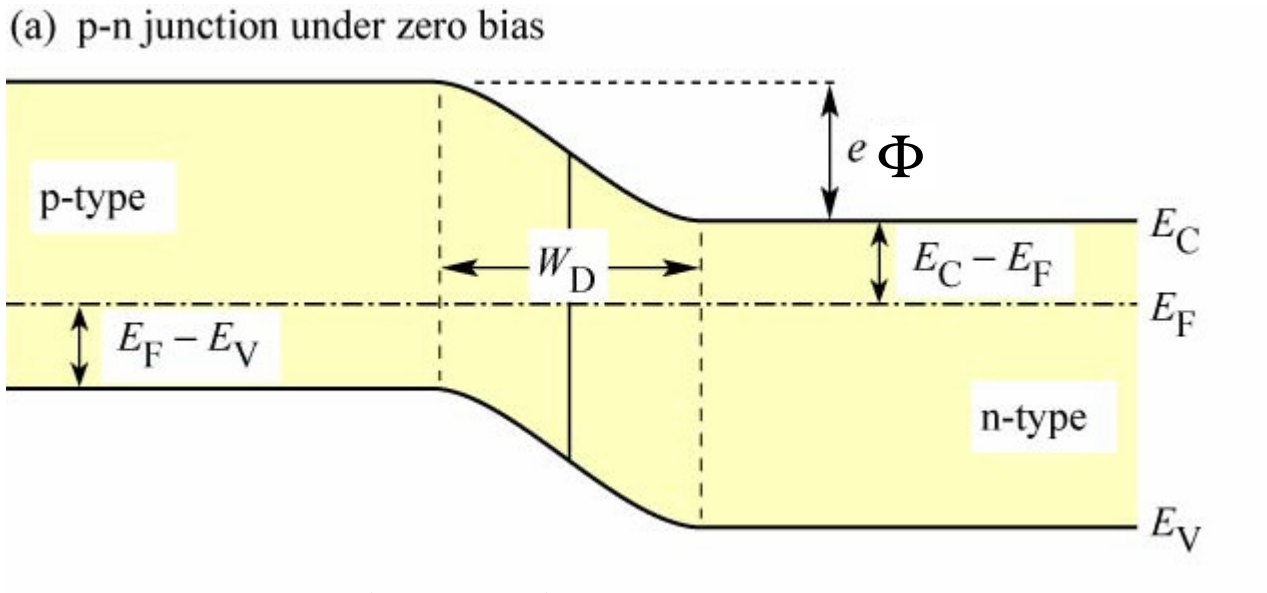
Giunzione p-n all'equilibrio termodinamico

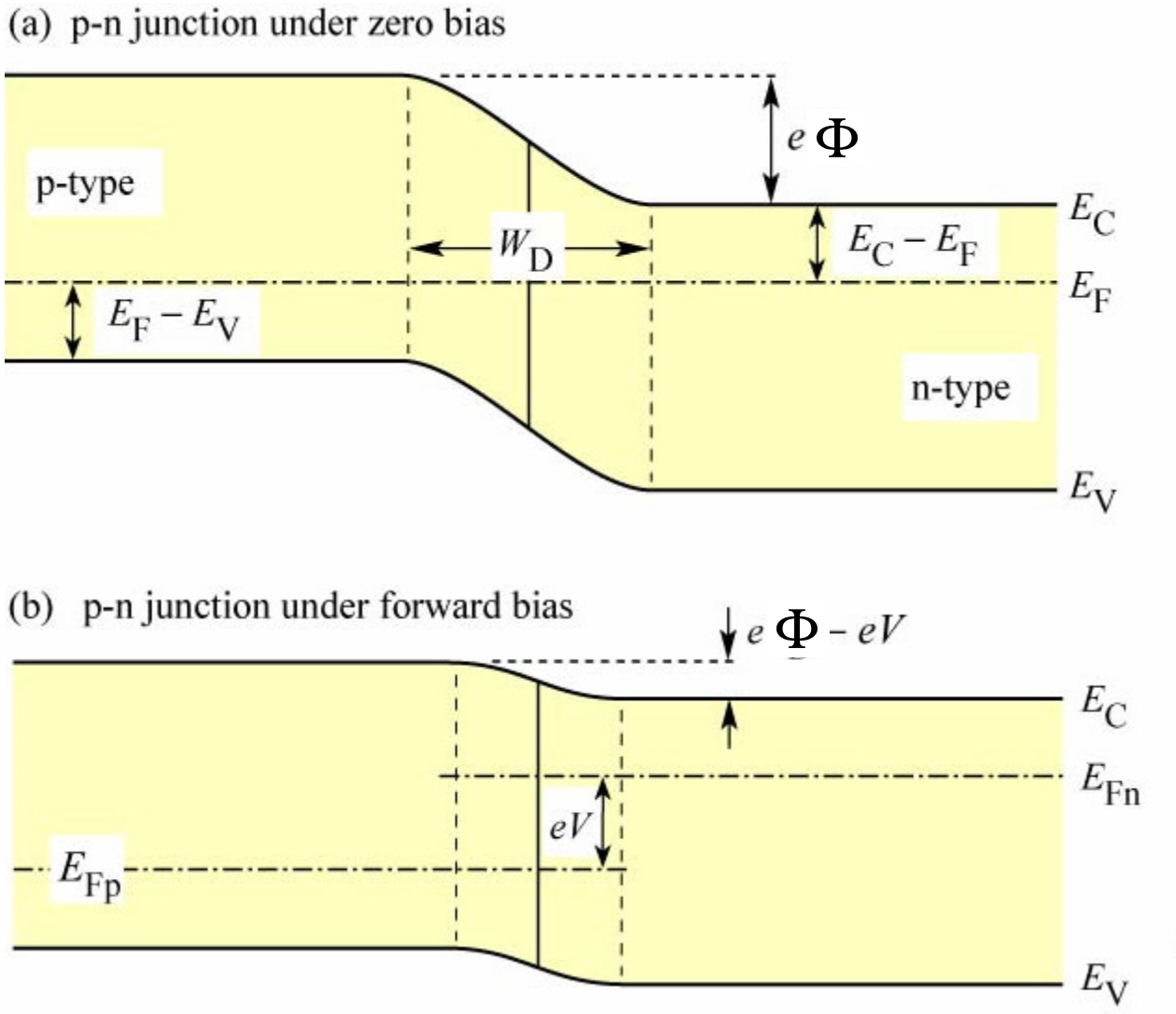


$$\Phi = E_g - KT \ln\left(\frac{N_C N_V}{N_A N_D}\right)$$

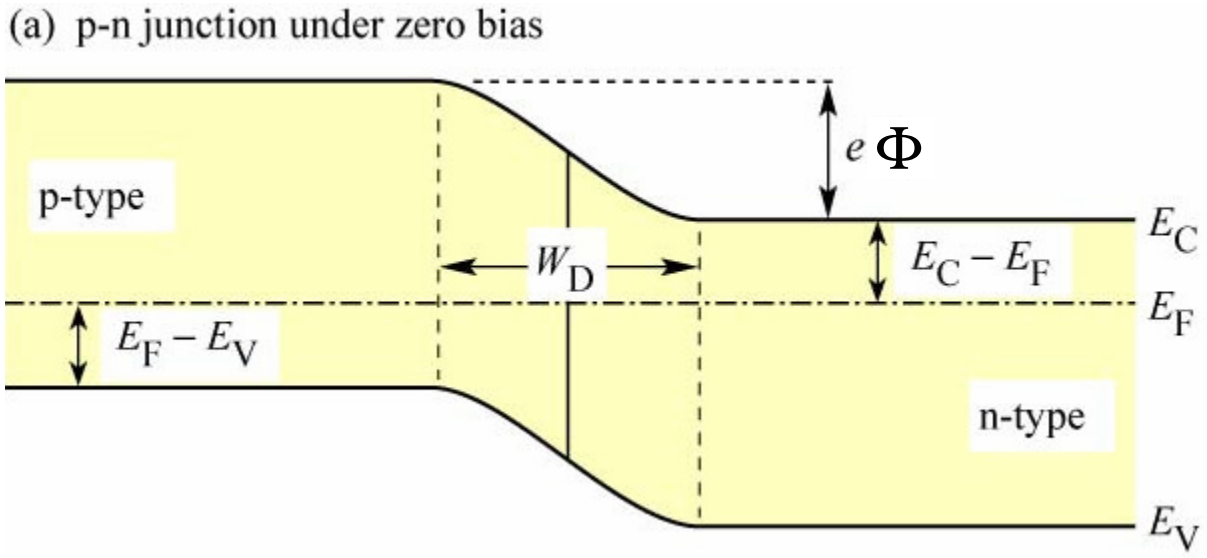
$$W = \sqrt{\frac{2\varepsilon\Phi}{e}\frac{N_D + N_A}{N_D N_A}}$$

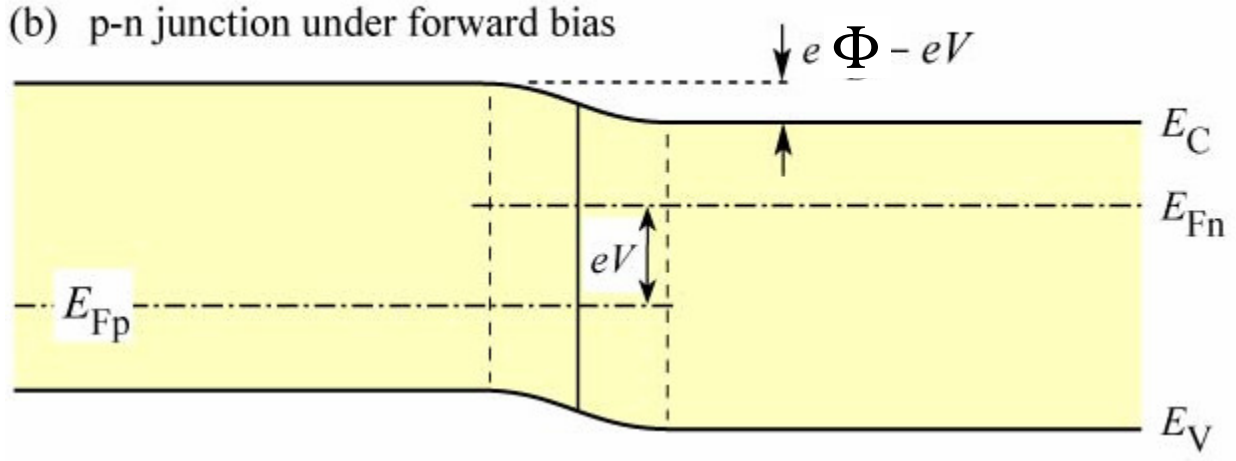
$$E = \Phi/W = 1V/1\mu m = 1\,MV/m$$

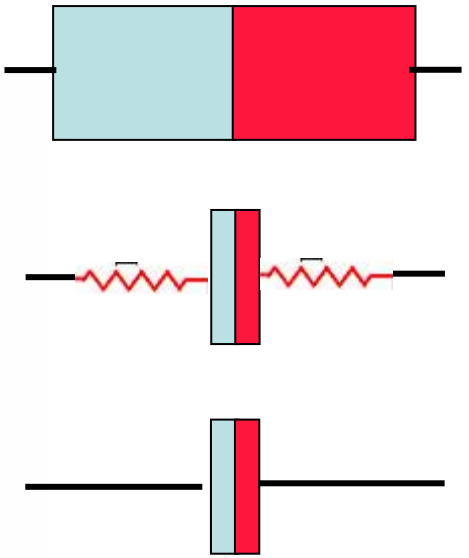
Giunzione p-n polarizzata



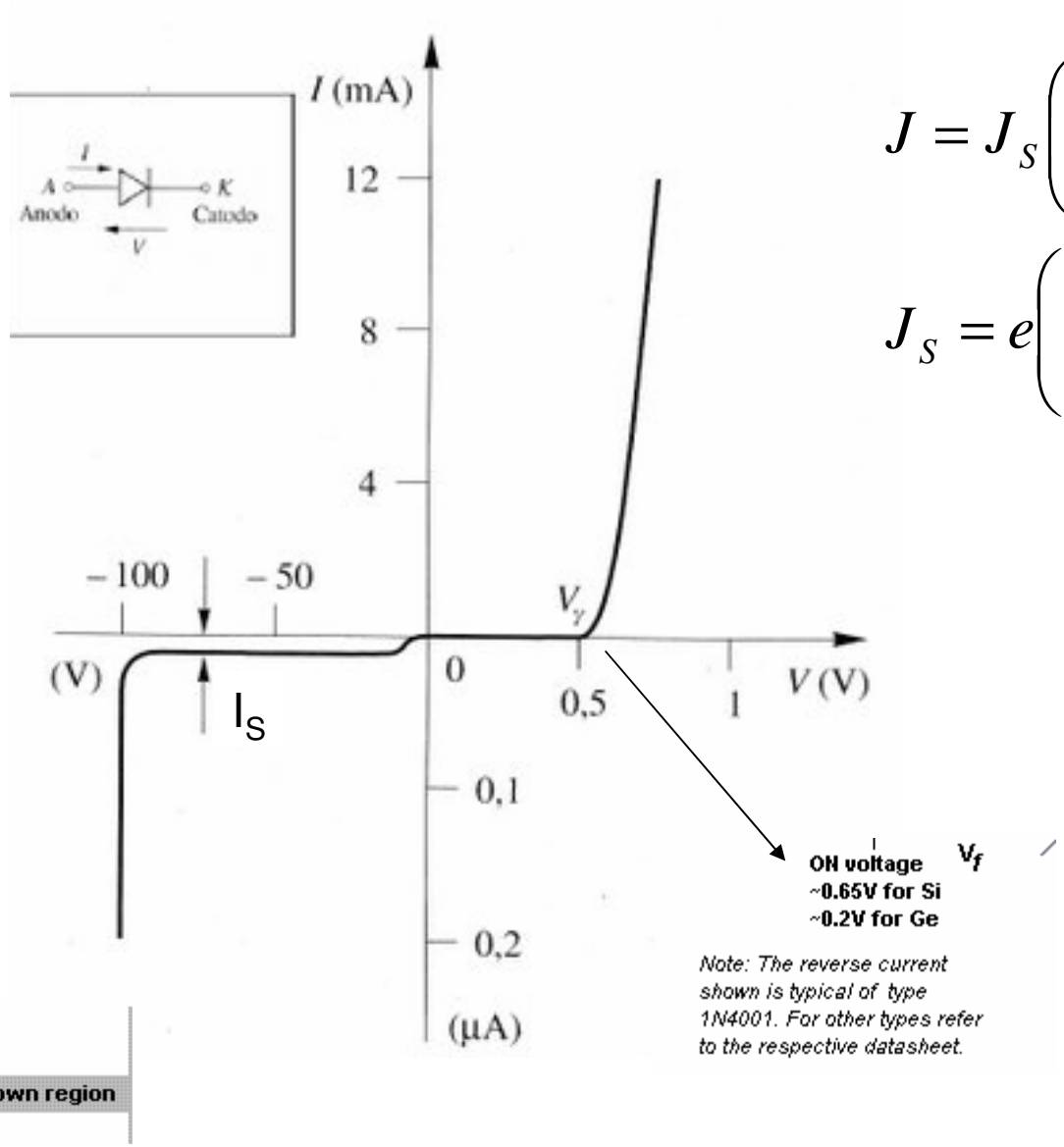
Giunzione p-n polarizzata







Legge di Shockley



$$J = J_S\left(\exp\left(\frac{eV}{KT}\right)-1\right)$$

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

Valori numerici

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

$$n_i = 10^{10}\,cm^{-3} = 10^{16}\,m^{-3} \quad N_D = 10^{15}\,cm^{-3} = 10^{21}\,m^{-3} \quad N_A = 10^{17}\,cm^{-3}$$

$$D_h = 25\,10^{-4}\ m^2/s \quad L_h = 5\,10^{-5}\ m$$

$$\frac{D_h}{L_h} = 50 ms^{-1} \quad \frac{D_h\tau}{L_h\tau} = \frac{L_h}{\tau} = \frac{5\,10^{-5}\ m}{10^{-6}\,s}$$

$$J_S = e\left(\frac{n_i^2}{N_D}\frac{D_h}{L_h}\right) = 1.6\,10^{-19}\,10^{11}\,50 Amp\,m^{-2} = 8\,10^{-8}\,Amp\,m^{-2}$$

Distribuzione portatori

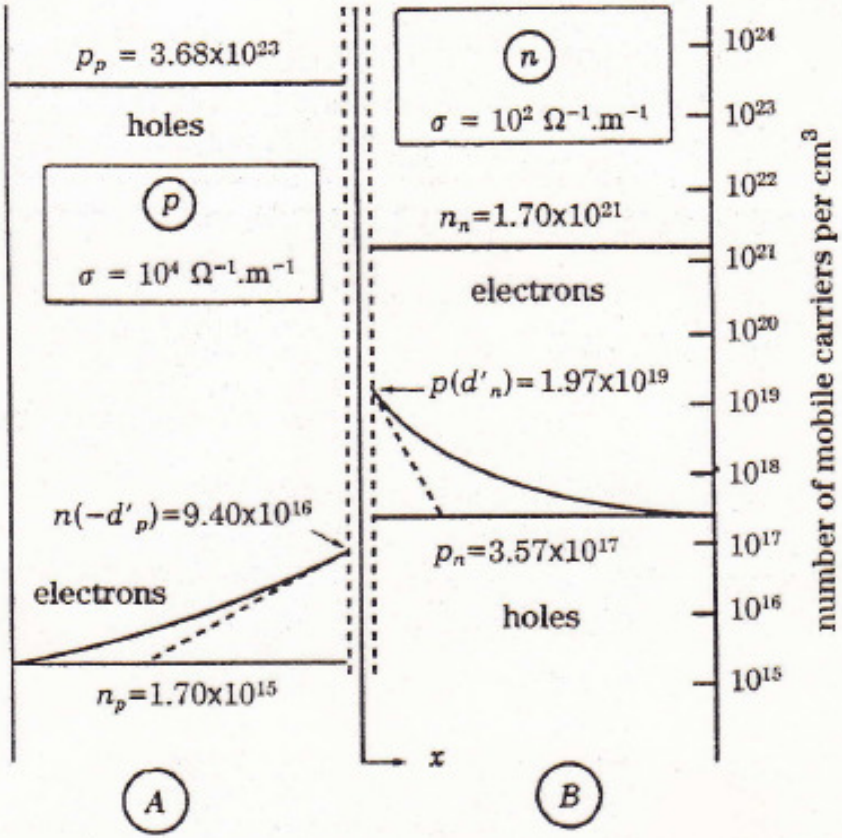
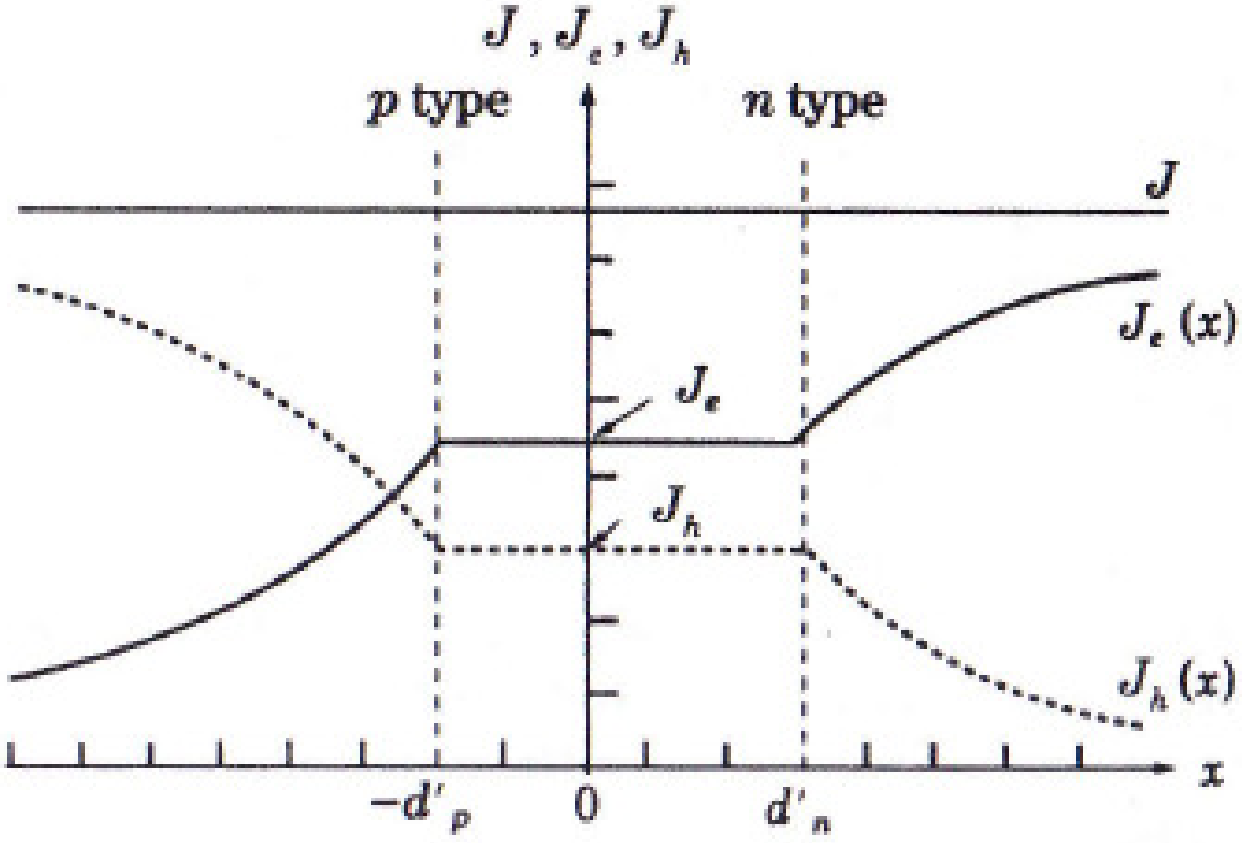
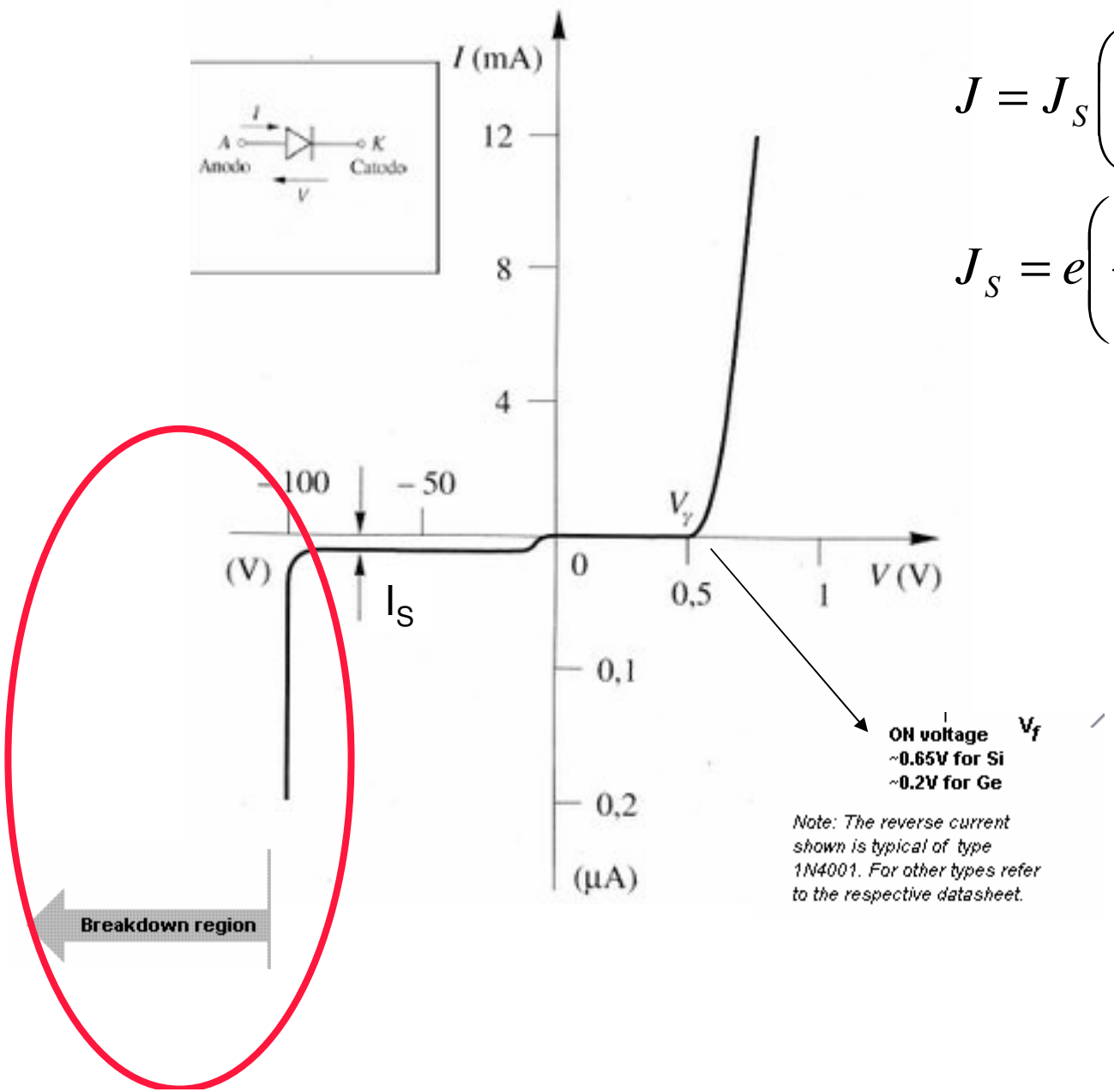


Fig. 8.12. Concentration profile in a forward biased germanium p–n junction (V_c = 0.1 V). (After Middlebrook, "An Introduction to Junction Transistor Theory," J. Wiley, 1957, 1965.)

Distribuzione correnti



Legge di Shockley



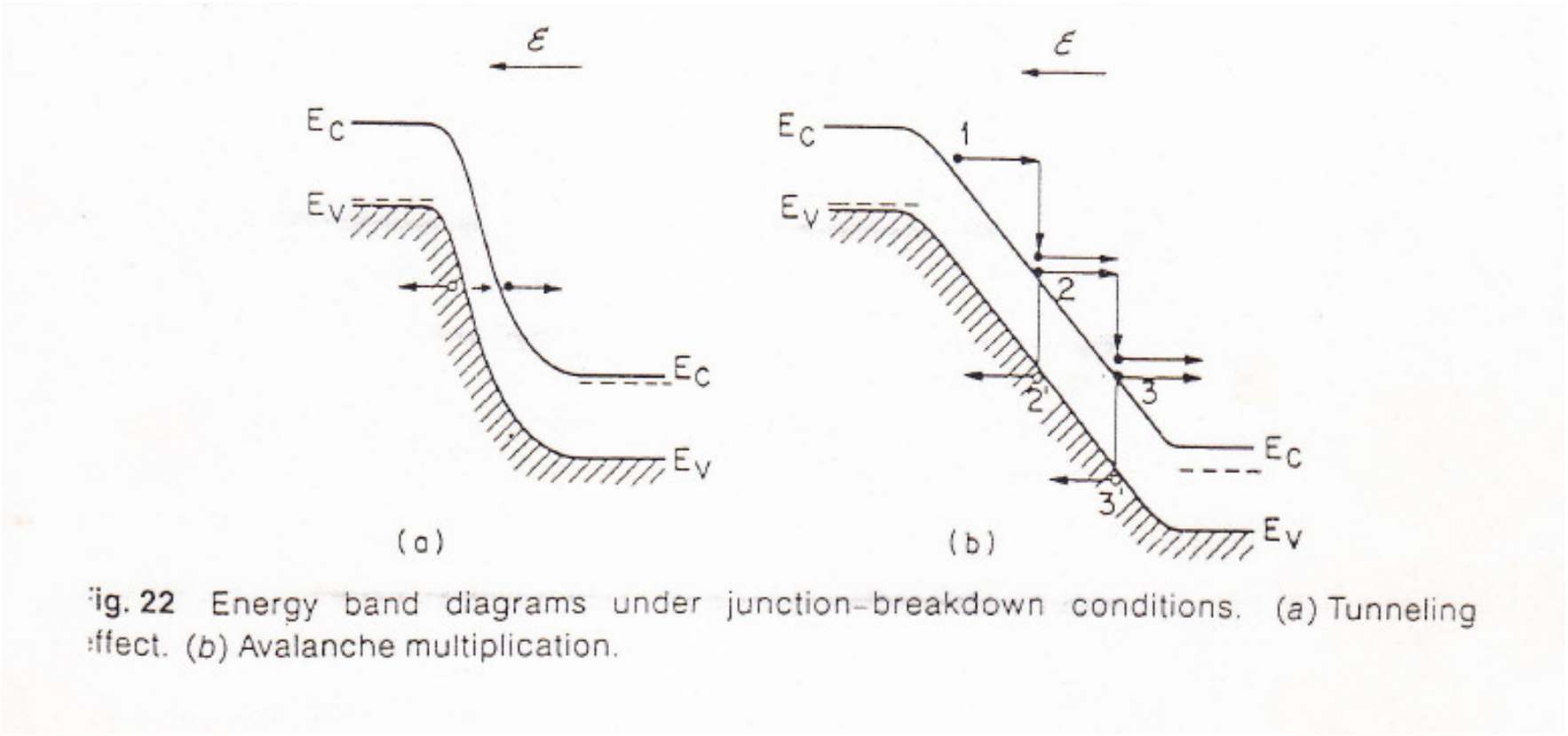
$$J = J_S\left(\exp\left(\frac{eV}{KT}\right)-1\right)$$

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

Breakdown

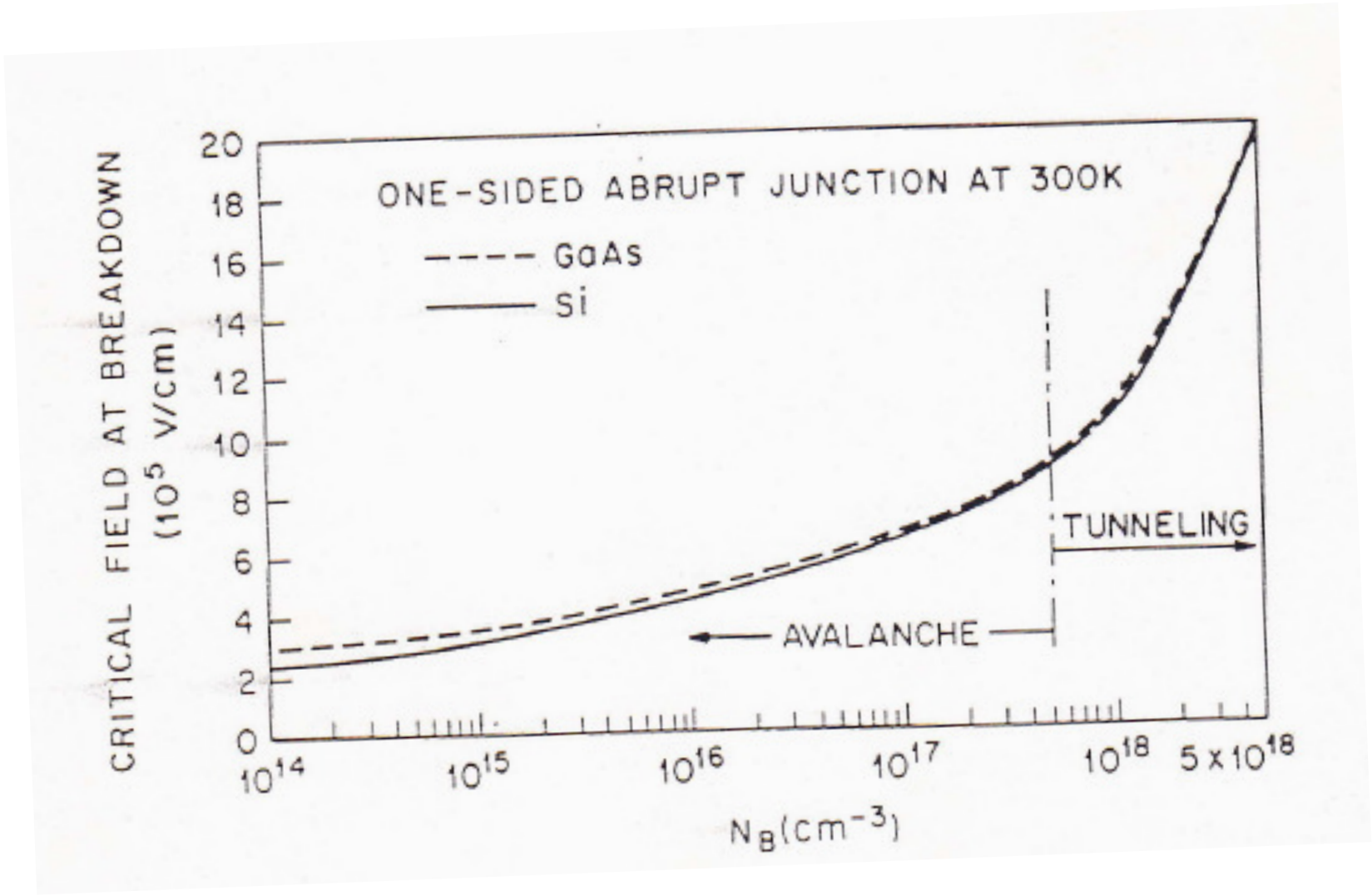
Tunneling

Avalanche



ig. 22 Energy band diagrams under junction-breakdown conditions. (*a*) Tunneling ffect. (*b*) Avalanche multiplication.

Breakdown


ONE-SIDED ABRUPT JUNCTION AT 300K
GaAs
Si
TUNNELING
AVALANCHE
CRITICAL FIELD AT BREAKDOWN
(10^5 V/cm)
20
18
16
14
12
10
8
6
4
2
0
10^{14}
10^{15}
10^{16}
10^{17}
10^{18}
5×10^{18}
$N_B(cm^{-3})$