Schottky Barrier

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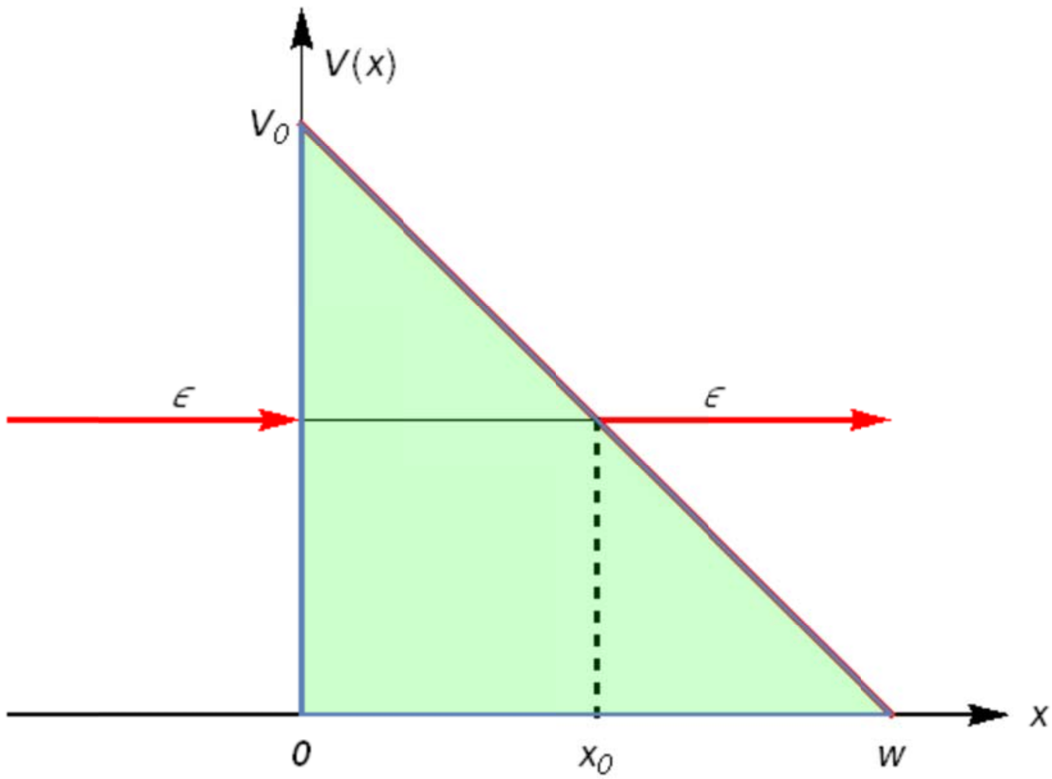
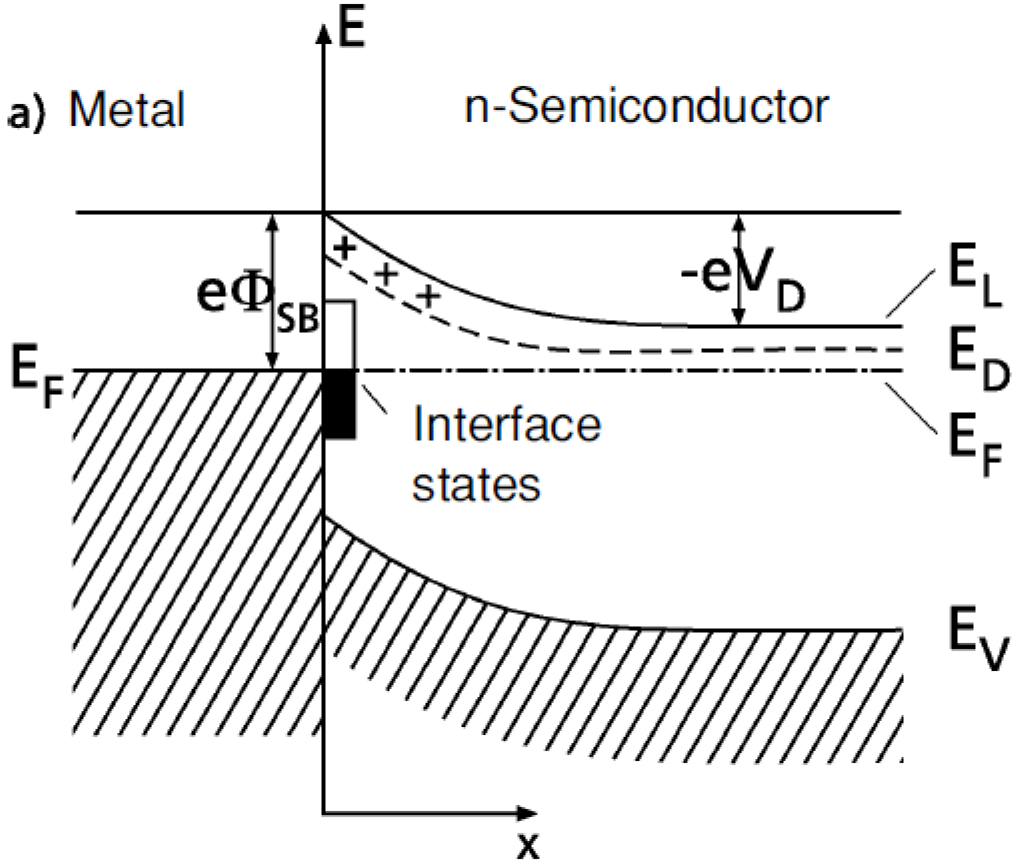
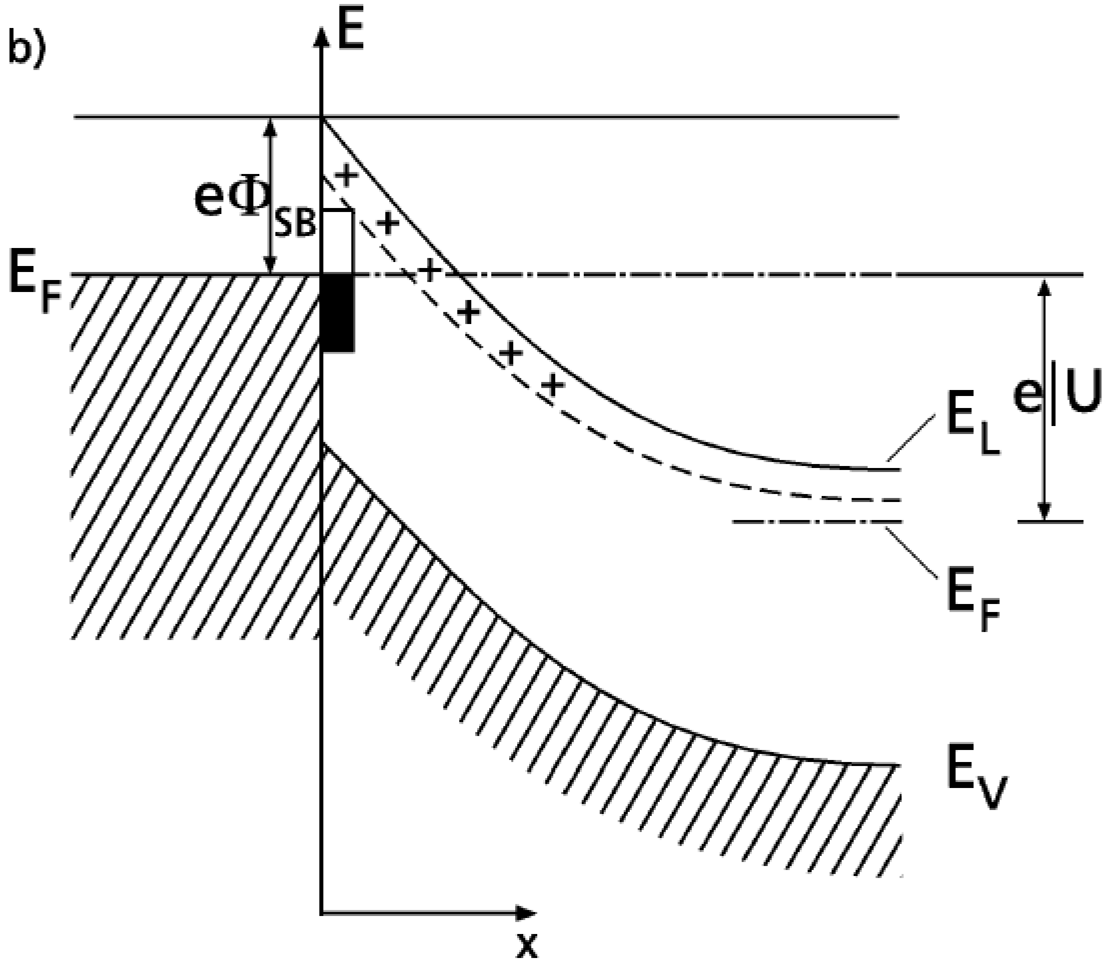
(Date: September 03, 2017)





E
a) Metal
n-Semiconductor
$e\Phi_{SB}$
$-eV_D$
E_L
E_D
E_F
E_F
Interface states
E_V
x



b)
E
$e\Phi_{SB}$
E_F
E_L
$e|U|$
E_F
E_V
x

Fig. 12.22. Electronic band scheme of a metal/semiconductor (*n*-doped) junction; pinning of the Fermi-level E_F in interface states near the neutrality level causes the formation of a Schottky-barrier $e\phi_{SB}$ and a depletion space charge layer within the semiconductor. V_D is the "built-in" diffusion voltage. (**a**) In thermal equilibrium, (**b**) under external bias U

Electronic band scheme of a metal/semiconductor (n-doped) junction: pinning of the Fermi-level E_F in interface states near the neutrality level causes the formation of a Schottky-barrier $e\phi_{SB}$ and a depletion space charge layer within the semiconductor. VD is the built-in diffusion voltage. (a) In thermal equilibrium, (b) under external bias U.

Schottky barrier

$$V(x) = V_0(1 - \frac{x}{w})$$

When $V(x) = \varepsilon$,

$$x = x_0 = w(1 - \frac{\varepsilon}{V_0})$$

The transition probability is

$$T = \exp[-2\int_0^{x_0} \kappa(x)dx]$$

$$\kappa(x) = \sqrt{\frac{2m}{\hbar^2}[V(x) - \varepsilon]}$$

Using the Mathematica we get the integral as

$$\begin{aligned}
\int_0^{x_0} \kappa(x)dx &= \int_0^{x_0} \sqrt{\frac{2m}{\hbar^2}[V(x) - \varepsilon]}dx \\
&= \sqrt{\frac{2m}{\hbar^2}} \int_0^{x_0} \sqrt{V_0 - \varepsilon - V_0 \frac{x}{w}}dx \\
&= \sqrt{\frac{2m}{\hbar^2}} \frac{2(V_0 - \varepsilon)^{3/2}}{3V_0} w
\end{aligned}$$

Then we have

$$T = \exp[-\sqrt{\frac{2m}{\hbar^2}} \frac{4(V_0 - \varepsilon)^{3/2}}{3V_0} w]$$