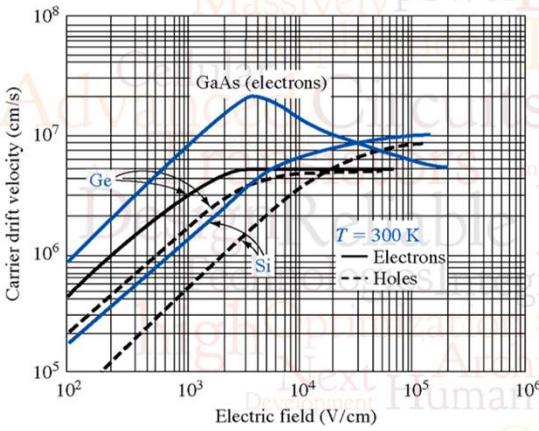
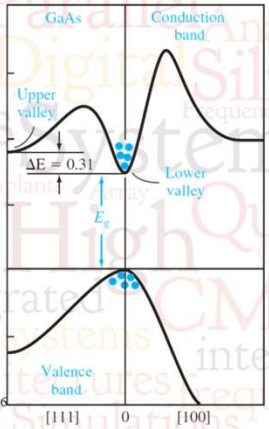
Drift Velocity





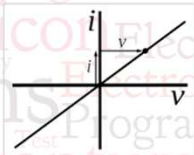


Fig. 1: *I–V* curve of linear or "ohmic" resistance, the common type of resistance encountered in electrical circuits. The current is proportional to the voltage, so both the static and differential resistance is positive

$R_{\text{static}} = r_{\text{diff}} = \frac{v}{i} > 0$

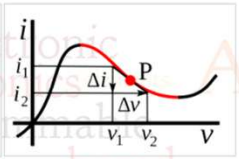


Fig. 2: *I–V* curve with negative differential resistance *(red region)*.[23] The differential resistance r_{diff} at a point **P** is the inverse slope of the line tangent to the graph at that point

$r_{\text{diff}} = \frac{\Delta v}{\Delta i} = \frac{v_2 - v_1}{i_2 - i_1}$

Since $\Delta v > 0$ and $\Delta i < 0$, at point **P** $r_{\text{diff}} < 0$.

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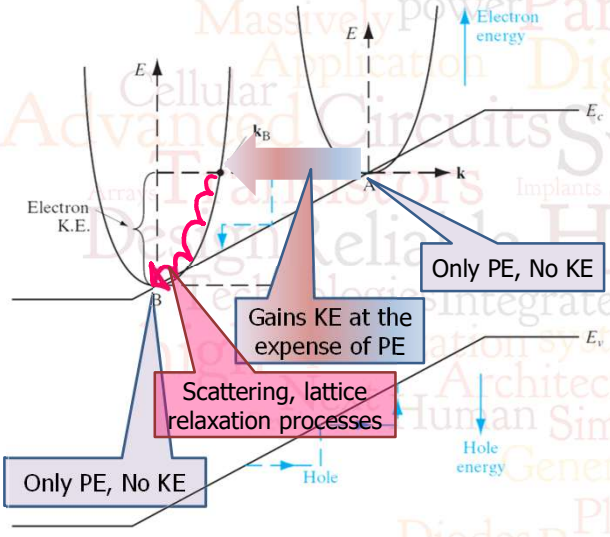
Semiconductor Electrostatics



- An (*E*, **k**) diagram is a plot of the total electron energy as a function of the crystal-direction–dependent electron wavevector at some point in space.
- Bottom of the conduction band corresponds to zero electron velocity or kinetic energy, and simply gives the potential energy at that point in space.

The slopes of the (E, x) band edges at different points in space reflect the local electric fields at those points.

If the electric field between A and B were not constant, the slope of the band edge would also not be constant but vary at each point reflecting the magnitude and direction of the local electric field.

In practice, the electron may lose its kinetic energy in stages by a series of scattering events.

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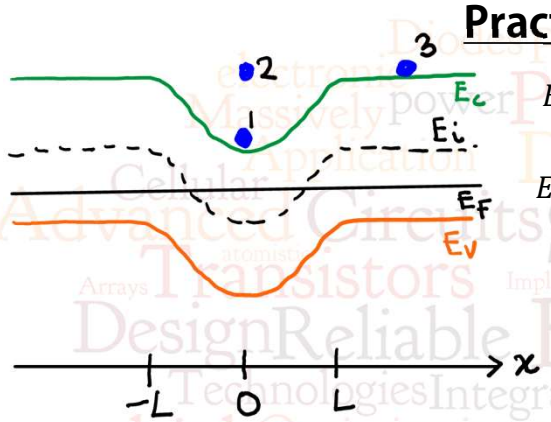
Practice Example



$$E_i - E_F = \frac{E_g}{4} \; at \; x = \pm L$$

$$E_F - E_i = \frac{E_g}{4} \; at \; x = 0$$

(a) Electrostatic Potential V vs x
(b) Electric Field E vs x
(c) KE and PE of the electrons
(d) Resistivity of the SC for x > L

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