2.57/2.570 Homework #8, Due 12:30, April 25, 2012

2.57 Problems 6.1, 6.2, 6.3, 6.7, 6.9

Read the following paper and write a one page report:

J. Callaway, Model for lattice thermal conductivity at low temperatures, Phys. Rev., 113, 1046-1051, 1959.

Keivan Esfarjani, Gang Chen, and Harold T. Stokes, "Heat Transport in Silicon from First Principle Calculations," Physical Review B, Vol. 84, 085204 (1-11), 2011.

2.570 Problems 6.1, 6.2, 6.3, 6.7

Additional Problem:

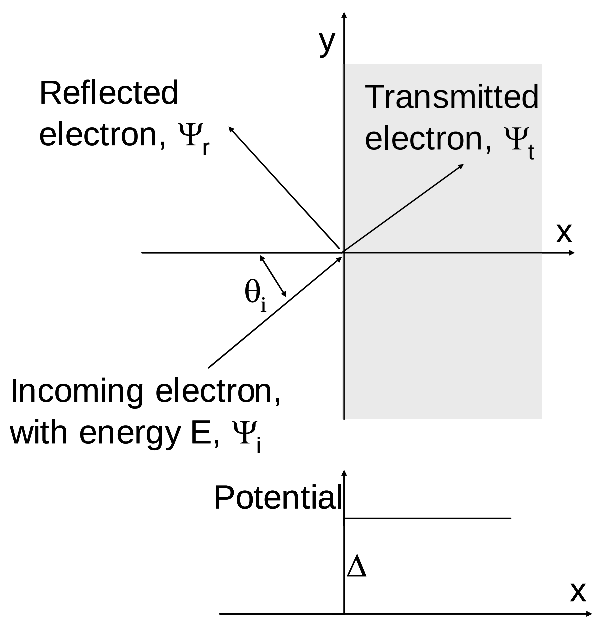
1. Consider a plane electron wave in one material, with an energy E, coming towards an interface with a potential barrier height Δ, at an angle θ_i, as shown in the following figure. Assume that $E > \Delta$. The electron will experience reflection and transmission into the other material, in which electron has same effective mass. At the interface, one boundary condition is that the wavefunction must be continuous. Based on the requirement that the particle flux across the boundary must be continuous, the other boundary condition should be

$$\left.\frac{\partial \Psi_1}{\partial x}\right|_{x=0-} = \left.\frac{\partial \Psi_2}{\partial x}\right|_{x=0+}$$

where Ψ_1 and Ψ_2 are the total wavefunction on each side.

(a) Derive an equivalent Snell's law between the angles of incident and transmitted electron wave.

(b) Derive an expression for the electron transmissivity and reflectivity as a function of incident angle θ_i.



2.57 / 2.570 Nano-to-Macro Transport Processes
Spring 2012