

(m) Effects of Temperature and Doping on Mobility

The two basic types of scattering mechanisms that influence electron and hole mobility are *lattice scattering* and *impurity scattering*. In lattice scattering a carrier moving through the crystal is scattered by a vibration of the lattice, resulting from the temperature (Collective vibrations of atoms in the crystal are called *phonons*. Thus lattice scattering is also known as *phonon scattering*). The frequency of such scattering events increases as the temperature increases, since the thermal agitation of the lattice becomes greater. Therefore, we should expect the mobility to decrease as the sample is heated. On the other hand, scattering from crystal defects such as ionized impurities becomes the dominant mechanism at low temperatures. Since the atoms of the cooler lattice are less agitated, lattice scattering is less important; however, the thermal motion of the carriers is also slower.

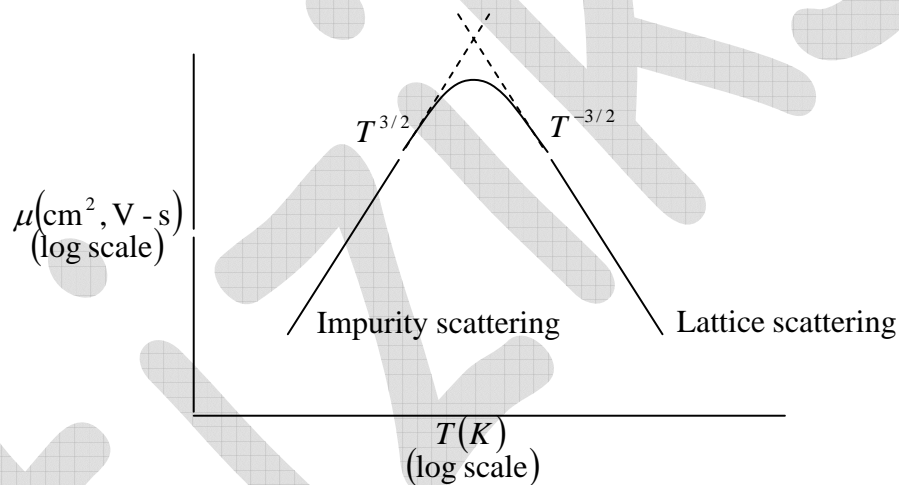


Figure: Approximate temperature dependence of mobility with both lattice and impurity scattering.

Since a slowly moving carrier is likely to be scattered more strongly by an interaction with a charged ion than is a carrier with greater momentum, impurity scattering events cause a decrease in mobility with decreasing temperature. The approximate temperature dependencies are $T^{-3/2}$ for lattice scattering and $T^{3/2}$ for impurity scattering.