Allowed and Forbidden Energy Bands

The Kronig-Penney Model

is simplified model for an electron in a one dimensional periodic potential

The concept of allowed and forbidden energy bands can be developed more rigorously by considering quantum mechanics and Schrodinger's wave equation. It may be easy for the reader to "get lost" in the following derivation, but the result forms the basis for the energy-band theory of semiconductors. The potential function of a single, non interacting, one-electron atom is shown in Figure 1. Also indicated on the figure are the discrete energy levels allowed for the electron.

Figure 1b shows the same type of potential function for the case when several atoms are in close proximity arranged in a one-dimensional array. The potential functions of adjacent atoms overlap, and the net potential function for this case is shown in Figure 1c. It is this potential function we would need to use in Schrodinger's wave equation to model a one-dimensional single-crystal material.

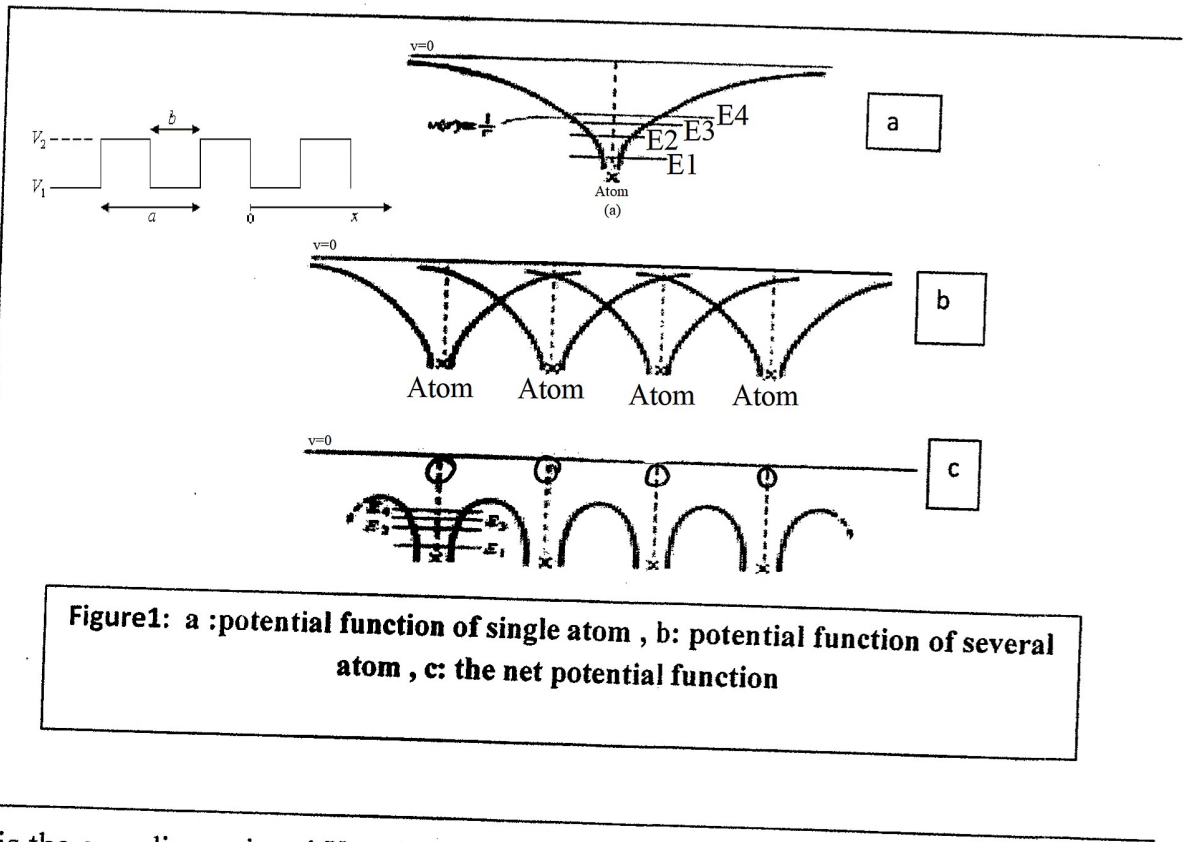

Figure1: a :potential function of single atom , b: potential function of several atom , c: the net potential function

Figure 1 is the one-dimensional Kronig-Penncy model of the periodic potential function, which is used to represent a one-dimensional single-crystal lattice.