Contribution ID: **13** Type: **Poster Presentation**

TRANSFER MATRIX METHOD FOR ELECTRON-IO-PHONON INTERACTION IN MULTI-INTERFACE HETEROSTRUCURE SYSTEMS

Tuesday, 2 October 2018 17:01 (1 minute)

In a conventional solid state physics teaching material, the optical phonon mode and its interaction with electrons is an important problem[1, 2]. It is usually used to solve the optical phonon model by using the Born-Huang equation[3] and obtain the Hamiltonian of electron and phonon interaction for bulk material. But multi-layer systems of polar semiconductors, it is well known that the electron-optical-phonon interaction in heterostructures is strongly affected by the presence of heterointerfaces, which give rise to new modes of optical phonons localized in the vicinities of interface and called the interface optical (IO) phonon modes. A detail investigation for the IO phonons and their coupling with electrons is more complicated in multi-layer systems, and students have difficulty in learning.
In the present paper, we study the electron-IO-phonon interaction in multi-layer systems of polar semiconductors in solid state physics teaching. Within the framework of the dielectric continuum model we use a transfer-matrix method[4] to obtain the electrostatic potentials, dispersion relations of IO-phonon modes in the systems and then derive the corresponding electron-phonon interaction Hamiltonian. It is found that there are two branches of interface phonon modes in each interface, and coupling with the electrons traveling in the system besides the confined longitudinal optical (LO) phonon modes. The dispersion relation and the electron-IO-phonons coupling functions for several typical systems are given and discussed. The advantage of transfer-matrix method is discussed in solving the physical problems of multilayer heterogeneous materials, It is clear seen that more complicated problem is easy to solve, and the physical meaning is clear, and convenient for the teaching. Such as semiconductor multi-barrier quantum tunneling can also be solved well.

Reference:

1. Ch.Kittel (1996), Introduction to Solid State physics, 7th Ed., J.Wiley and Sons, New York.
2. O.Madelung (1978), Introduction to Solid State Theory, Springer-Verlag Berlin Heidelberg, New York.
3. M.Born, K.Huang(1954), Dynamical Theory of Crystal Lattices, Oxford University Press, Oxford.
4. Y. Ando and T. Itoh(1987), J. Appl. Phys. 61, 1497.

Primary author: Prof. YAN, ZUWEI (College of Science, Inner Mongolia Agricultural University, Hohhot 010018, PR China)

Presenter: Prof. YAN, ZUWEI (College of Science, Inner Mongolia Agricultural University, Hohhot 010018, PR China)

Session Classification: Poster Session

Track Classification: Track A - Physics at University