

Interface Optical Phonon Modes and Fröhlich Electron-Phonon Interaction Hamiltonian in a Multi-shell Spherical Nanoheterosystem

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Abstract: Under dielectric continuum approximation, interface optical (IO) phonon modes and the Fröhlich electron-IO phonon interaction Hamiltonian in a multi-shell spherical nanoheterosystem were derived and studied. Numerical calculations on three-layer and four-layer CdS/HgS spherical nanoheterosystems have been performed. Results reveal that there are four IO phonon modes for the three-layer system and six IO phonon modes for the four-layer system. On each interface, there are two IO phonon modes, the frequency of one is between $\omega_{\text{TO, CdS}}$ and $\omega_{\text{LO, CdS}}$, and that of the other is between $\omega_{\text{TO, HgS}}$ and $\omega_{\text{LO, HgS}}$. With the increasing of quantum number l , the frequency of each IO mode approaches one of the two frequency values of the single CdS/HgS heterostructure, and the potential for each IO mode is more and more localized at a certain interface, furthermore, the coupling between the electron-IO phonons becomes weaker.

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Key words: phonon modes, multi-shell spherical nanoheterosystem

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