

Correct Evaluation of the Effect of Transverse Effective Charges on Phonons in AIAs Quantum Dots

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Abstract: An improved valence force field model (VFFM) is suggested to calculate the phonon modes in both bulk specimens and quantum dots (QDs) of AIAs taking account of the effect of transverse effective charges (TCs) correctly. The resultant dispersions of AIAs bulk phonons are in accord better with the results carefully fitted to the experimental data by using 11-parameters rigid-ion model, than those got by ordinary VFFM, especially in the region of near Γ point. For AIAs QDs, TCs are evaluated bond by bond for each phonon mode of QD and its effect on the change of the force on atoms is taken into account to modify further the phonon spectrum. The frequency spectra and densities of phonon states of different irreducible representations calculated by using improved VFFM are compared with the results of ordinary VFFM. The correct evaluation of the TCs is not only important in calculating the phonon spectrum of both bulk and QD specimens accurately, but is also in the further discussion of the electron-phonon (e-ph) interaction, which can be directly related to TCs of ions in QD.

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