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The effect of electron-phonon interaction on the phonon transmission coefficient of an atomic nanostructure

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Abstract

In this paper, we study the phonon transmission coefficient of an infinite atomic chain in a small part of it there is electron-phonon interaction, with the help of Green's function. From the electronic viewpoint, the system is considered in the nearest neighbor tight-binding approach and for phonons in the interacting region, it is investigated within the next nearest neighbor harmonic approximation. In the suggested model, we assume that the electronic cloud of the localized atomic orbitals causes the variation of the force constant between the neighbor atoms in the interacting part of the chain. The variation in these force constants makes changes to the elements of the dynamic matrix of the system and consequently, the phonon transmission coefficient will be changed. Therefore, the present formalism gives the phonon transmission coefficient as a function of electronic and phononic parameters of the system as well as the strength of electron-phonon interaction. Finally, we also tried to address the physics of the problem by presenting some numerical results.

Keywords: phonon transport, Green's function, harmonic approximation, electron-phonon interaction, tight-binding

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