

PHONONS INFLUENCE ON THE ELECTRON SPECTRUM IN SUPERLATTICE CONSISTING OF QUANTUM DOTS.

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The ordered arrays of quantum dots have been experimentally created recently. As a result there have been opened the possibility to fabricate and study the physical properties of superlattices consisting of quantum dots with different spatial shapes. The theory of quasiparticles (electron, hole and phonons) in such nanoheterosystems is developed only now [1].

In the proposed paper the influence of the polarizational phonons on the electron spectrum is studied for the superlattices of two types, namely: a) cubic superlattice of spherical QDs, b) superlattice of cylindrical QDs (Fig.1).

The electron spectrum in superlattices is obtained within the modified augmented plane waves method. Herein there are used the approximations of different effective masses for the electron in QD and in the matrix and the finite skip of the potential in the interface between QD and matrix. As a result, there are obtained the waves functions and the spectrum of the electron which is characterized by the system of three-dimensional (over the quasimomentum) minibands in case (b).

The phonon spectrum is obtained in the framework of the dielectric continuum model. In case (a) there are the three-dimensional longitudinal and transversal phonons in the system. In case (b) there are the three-dimensional longitudinal and transversal polarizational vibrations of the matrix, and confined and interface quasi two-dimensional vibrations, arising in quasiplane shells of cylindrical QDs. Using the Green functions method there were obtained the dependences of electrons dispersion laws renormalized due to the interaction with phonons on the geometrical and physical parameters of the superlattices for the superlattices of both types.

The numerical calculations were performed for the superlattice of GsAs QDs in $Al_xGa_{1-x}As$ matrix.

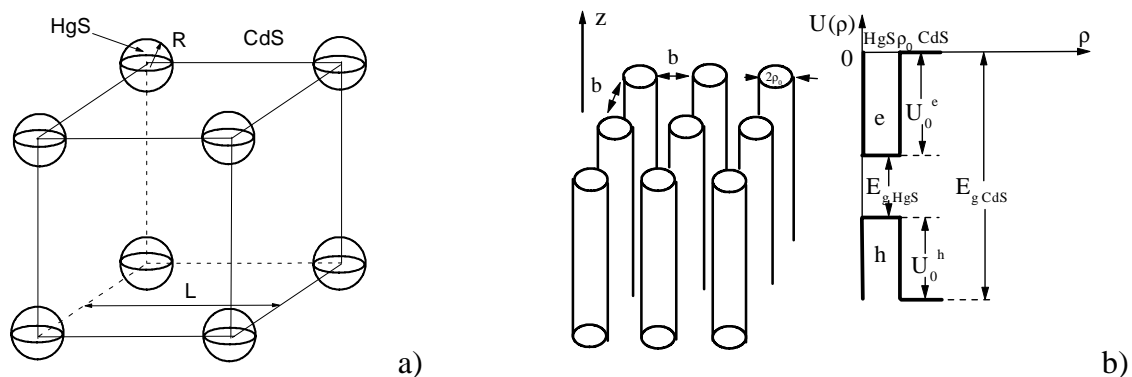


Fig.1. Schemes of a) cubic superlattice of spherical QDs, b) superlattice of cylindrical QD.