Effect of phonons on the position and shape of the exciton absorption band in semiconductor nanofilm

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The method of theoretical studying of the exciton absorption band characteristics in a flat double nanoheterostructure with single quantum well (QW) – nanofilm, is proposed. The method is based on the using of Feynman-Pines diagram technique [1], adapted for the studying of exciton-phonon interaction in nanofilm [2], and the effective mass approximation for carriers and model of dielectric continuum [3] – for phonon subsystem. Its use allows make the calculation of temperature changes of the position and shape of the exciton absorption band in nanofilms of different thickness.

Explicit form of the exciton-phonon coupling function, the mass operator of the Green's function of exciton-phonon system and the absorption band shape function with considering self-polarization effects and exciton-phonon interaction were found.

Concrete calculations were performed by using models of rectangular QW with finite ($Ga_{1-x}Al_xAs/GaAs/Ga_{1-x}Al_xAs$) and infinite (E-MAA/$PbI_2$/E-MAA) depth. Interactions with the longitudinal polarization optical (LO) and interface (I) phonons at different temperatures are taken in consideration.

The growth of half-width and long-wave shift of the main exciton line with temperature increasing was shown. Speed and absolute value of specified changes depends on the thickness of nanofilm by cause of different contributions of LO- and I-phonons in magnitude of the shift.

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