Propagation of Acoustic Phonons across the Interfaces in CdTe and Si/CVD-diamond and Quasi-Two-Dimensional Phonon Wind in CdTe/ZnTe Quantum Wells

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Presence of various interfaces in the materials, such as heterojunctions, grain boundaries, twin boundaries, causes the modification of acoustic phonon properties due to their reflection, scattering, dimensionality and mode conversion, and decay.

Using a heat-pulse technique we investigated propagation of acoustic phonons in twinned CdTe, quantum well CdTe/ZnTe, and Si/CVD-diamond structures. Propagation of acoustic phonons in the highly twinned CdTe crystals was described by frequency independent scattering at the twinning planes with the probability of scattering much less than unity.

We studied the effect of phonon wind on the luminescence properties of narrow CdTe quantum wells in ZnTe matrix, and observed an increase in the integral luminescence intensity and the change of the luminescence band shape. The effect is accounted for a quasi-two-dimensional lateral propagation of acoustic phonons in the ZnTe/CdTe structure. This propagation mode may appear presumably due to inerface phonons and a confinement of phonons near the CdTe/ZnTe quantum well.

Recently, a Si/CVD-diamond structure has attracted much attention due to its technological applications. Data on the phonon propagation across this interface will provide an important information to optimize conditions of heat transfer in these promising structures. To reduce the thermal boundary resistance of the interface between the material studied and the phonon detector (e.g., thin-film bolometer), we developed a buried bolometer based on a graphitized layer produced by ion implantation in diamond. Comparison of the bolometer experimental response with that theoretically calculated allowed us to conclude that the thermal boundary resistance is negligible in these structures. The behavior of nonequilibrium phonons in Si/CVD-diamond structures was also studied.