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Angular dependence and mode distribution of acoustic phonon emission by hot 2D electrons in GaAs/AlGaAs heterojunctions and quantum wells

Dietmar LEHMANN
Institut für Theoretische Physik,
Technische Universität Dresden, D-01062 Dresden, GERMANY
Czeslaw JASIUKIEWICZ
Institute of Theoretical Physics,
University of Wroclaw, PL-50204 Wroclaw, POLAND

Abstract: We report a detailed theoretical study of the angular dependence and mode distribution of the acoustic phonon emission by hot two-dimensional electron gases in GaAs/AlGaAs heterojunctions and quantum wells and compare the results with some recent heat pulse measurements for carrier temperatures below 50 K. Common to all the experimental results was the strong dependence of the ratio of emitted longitudinal acoustic (LA) phonons to transverse acoustic (TA) phonons from the width of the quantum well and the absence of LA phonons propagating in a direction close to the 2DEG normal for GaAs/AlGaAs heterojunctions. To explain these phenomena and to understand the process of electron-phonon coupling and its dependence on electron confinement we use a model which includes the dynamical screening of the electron-phonon interaction in the 2D electron gas (2DEG), the confinement of the electrons in the direction normal to the 2DEG plane and the strong acoustic anisotropy of the phonon emission and propagation process. Our numerical results show clearly the importance of including all of these factors.

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