Acousto-optical phonon excitation in piezoelectric wurtzite slabs and crystal growth orientation effects

This paper presents a theoretical investigation of phonon dispersion in piezoelectric slabs of hexagonal crystal symmetry (wurtzite). Specifically, we solve the fully coupled dispersion relations in a GaN free standing quantum well by varying the crystal growth direction from the [001] axis to the [010] axis. Accounting for the Drude model in solving the fully-coupled dispersion relations, phonon modes will generate an additional phonon band, with a high local density of phonon states, close to the plasma frequency. As opposed to cubic crystals with isotropic permittivity, the location of this band varies with crystal orientation. We also find that the phonon mode dependence on the crystal orientation is more pronounced for small in-plane wavenumbers.

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