Combined influences of the aluminum concentration and the hydrostatic pressure on the magneto-optical properties of the semi-parabolic quantum well

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Abstract

In this paper, we report the comparison of the magneto-optical transport properties of the semi-parabolic potential quantum well with those of the parabolic and rectangular potential quantum wells under the combined influences of the aluminum concentration, the temperature, the hydrostatic pressure, and the Landau levels by using the methods of the quantum field theory for many-particle systems in statistical physics and the profile to calculate analytically the conductivity tensor expression, the magneto-optical absorption power expression of the optically detected magneto-phonon resonance (ODMPR) oscillation, and the full width at half maximum (FWHM) of the ODMPR peak, respectively, in quantum wells with three above different confining potential shapes for typical $GaAs/Al_xGa_{1-x}As$ material. The results obtained from the present study show that (i) the ODMPR peak position undergoes a red-shift as the aluminum concentration and the hydrostatic pressure increase while it experiences a blue-shift as the temperature augments for all three above confining potential shapes; (ii) the FWHM as functions of the barrier's Al-concentration, the system's temperature, and the hydrostatic pressure for all three confining potential shapes is presented to compare; (iii) the dependence of the FWHM on the barrier's Al-concentration and the hydrostatic pressure for the Landau levels for three confining potential shapes also is taken into account in detail; (iv) our present theoretical calculations are found to be consistent with previous experimental calculations.