The nonlinear absorption coefficient of a strong electromagnetic wave by confined electrons in quantum wells under the influences of confined phonons

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Abstract: The nonlinear absorption coefficient (NAC) of a strong electromagnetic wave (EMW) by confined electrons in quantum wells under the influences of confined phonons is theoretically studied by using the quantum transport equation for electrons. In comparison with the case of unconfined phonons, the dependence of the NAC on the energy (Latin small letter h with strokeΩ), the amplitude (Eo) of external strong EMW, the width of quantum wells (L) and the temperature (T) of the system in both cases of confined and unconfined phonons is obtained. Two limited cases for the absorption: close to the absorption threshold (|kLatin small letter h with strokeΩ - Latin small letter h with strokeω_0| « ε) and far away from the absorption threshold (|kLatin small letter h with strokeΩ - Latin small letter h with strokeω_o| » ε) (k = 0,±1,±2,..., ω_o and ε are the frequency of optical phonon and the average energy of electron, respectively) are considered. The formula of the NAC contains the quantum number m characterizing confined phonons and is easy to come back to the case of unconfined phonons and linear absorption. The analytic expressions are numerically evaluated, plotted and discussed for a specific case of the GaAs/GaAsAl quantum well. Results show that there are more resonant peaks of the NAC which appear in the case of confined phonons when $\Omega > \omega_0$ than in that of unconfined phonons. The spectrums of the NAC are very different from the linear absorption and strongly depend on m. © 2010 VSP.

Index Keywords: Analytic expressions; Average energy; Confined phonons; Linear absorption; Nonlinear absorption coefficient; Optical phonons; Quantum numbers; Quantum transport equations; Quantum well; Resonant peaks; Absorption; Cements; Electromagnetic wave diffraction; Electromagnetic wave scattering; Electromagnetic waves; Electromagnetism; Electrons; Nonlinear equations; Quantum chemistry; Quantum electronics; Semiconductor quantum wells; Phonons

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