Eur. Phys. J. Plus (2021) 136:1174
https://doi.org/10.1140/epjp/s13360-021-02180-7

THE EUROPEAN PHYSICAL JOURNAL PLUS

Regular Article

Combined effects of electric, magnetic, and intense terahertz laser fields on the nonlinear optical properties in GaAs/GaAlAs quantum well with exponentially confinement potential

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Received: 17 August 2021 / Accepted: 15 November 2021

Abstract We are presenting a theoretical investigation on the effects of applied electric, magnetic, and non-resonant intense laser field on the coefficients of intersubband linear, third-order nonlinear, and total optical absorption and of relative refractive index change in GaAs/GaAlAs quantum wells with exponentially confining potential. It also includes the study of the impact of adjustable potential parameters. The energy states of conduction band electrons in the structure are calculated by using the effective mass and envelope function approximations. With regard to the optical response, it is found that with the strengthening of magnetic field, the resonant peak positions shift to lower energies and their magnitudes decrease. Increasing in the values of adjustable potential parameters as well as of the static electric and laser intensities causes the peak positions to shift toward higher energies and their magnitudes to augment. These results show that the optical properties of the system can be adjusted according to the purpose, by changing the magnitude of applied external fields and structure parameters.

1 Introduction

Development of epitaxial growth technologies has resulted in the fabrication of many novel electronic and optoelectronic devices based on semiconductor nanoscale structures. This has enabled quantum mechanical studies about the features of discrete energy spectra occurring in low-dimensional systems [1]. Owing to the quantum confinement effect, extraordinary properties—compared to those in bulk materials—have been revealed. This kind of heterosystems has become the subject of intense research over four decades [2,3]. In particular,

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Published online: 23 November 2021