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Numerical simulation of linear and nonlinear optical properties in heterostructure based on triple Gaussian quantum wells: effects of applied external fields and structural parameters

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Abstract In this work, we present a theoretical simulation of the impact of applied external fields and structural parameters on the total (linear plus nonlinear) optical absorption coefficient (TOAC) and total refractive relative index change coefficient (TRICs) in a heterostructure based on symmetric and nonsymmetric triple Gaussian quantum wells. The asymmetricity of the heterostructure was introduced by adjusting the depths of central and left potential wells. At first, we have calculated the wavefunctions and the subband energy levels for the lowest bounded states confined within the structure by solving the Schrödinger equation within the framework of the effective mass approximation under the impact of electric and magnetic fields. Throughout our study, the matrix elements and occupation ratio factor, which control the evolution of TOACs and TRICs, were evaluated and commented. The obtained results show that an increase of the intensity of electric and magnetic field produces a red shift in the TOACs and TRICs. Furthermore, we find that by increasing the depth of the left-hand quantum well (V_{LW}), the modification of the confining potential profile, which becomes asymmetric, leads to a blue-shift behavior of the TOACs and TRICs at first and then a red-shift. We believe that the present study opens the way to the design of new optoelectronic devices operating in large spectral emission.

1 Introduction

Thanks to the rapid development of the modern growth techniques [1, 2], it becomes feasible to fabricate a large variety of low-dimensional semiconductor materials. This leads in turn to raising the possibility of producing new optoelectronic devices. For instance, we can cite

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