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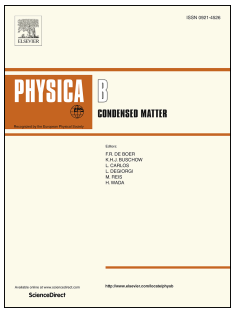

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Effects of the temperature and pressure on the electronic and optical properties of an exciton in $GaAs/Ga_{1-x}Al_xAs$ quantum ring

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ABSTRACT

Using a variational approach, we have calculated the binding energies ($E^b_{1s,2s}$) and interband emission energy (E_{ph}) of an exciton confined in $GaAs/Ga_{1-x}Al_xAs$ quantum rings (QRs) structures under effects of the temperature and pressure, in the effective mass approximation. We have taken into consideration the difference in the effective masses of the charge carriers in two materials, well and barrier. The results that we have obtained show clearly that $E^b_{1s,2s}$ and E_{ph} are influenced by the structure geometries of QR (height H, radial thickness ΔR and potential barrier), the temperature and pressure. Indeed, with a smaller geometric parameter, $E^b_{1s,2s}$ and E_{ph} become higher due to the improvement in confinement of the charge carriers. We have also observed that for a given value of the temperature, the pressure leads to an increasing of the $E^b_{1s,2s}$ and E_{ph}, and the latter quantities are decreasing with temperature. In addition, these variations of the $E^b_{1s,2s}$ and E_{ph} under the external perturbations are more remarkable in small H for fixed ΔR, and for larger ΔR for a given value of the H, because for the choice of a finite height of the barrier in the z direction and an infinite confinement in ρ direction.

Keywords: Exciton, Quantum ring, Temperature, Pressure, Binding energy, Interband emission energy

1. Introduction

In nanostructures, the charge carriers are possibly to confine in one directions (quantum wells), two directions (quantum wires) and tree directions (quantum dots). Recently the researches have rendered possible the realization of nanostructures in the geometry of a ring named quantum rings (QRs) [1], due of their significance properties (optical and electronic) the researchers have increased the attention to study this kind of quantum dots, which are of interest for potential device applications [2,3]. Experimentally, different techniques of growth have been utilized to manufacture the QR such as droplet epitaxy or the Koguchi method and