Optical and Quantum Electronics (2021) 53:676
https://doi.org/10.1007/s11082-021-03340-w

Effect of magnetic field, size and donor position on the absorption coefficients related a donor within the core/shell/shell quantum dot

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Received: 24 August 2021 / Accepted: 19 October 2021

Abstract
In this study, linear, nonlinear and total optical absorption coefficients related a single shallow donor atom confined in semiconductor core/shell/shell quantum dot heterostructure are researched in detail within the compact density matrix formalism approximation. For this purpose, firstly, the energies and the wavefunctions are computed by the diagonalization method in the effective mass approach. Moreover, the effects of size modulation, donor position and magnetic field are analyzed. The numerical results indicate that the linear and nonlinear parts of the absorption coefficients related with intersubband $1s \rightarrow 1p$ and $1p \rightarrow 1d$ donor transitions undergo significant changes.

Keywords Donor impurity · Spherical quantum dot · Optical absorption coefficient · Magnetic field

1 Introduction

It is generally accepted that the progress of electronic and opto-electronic devices depends on understanding the basic chemical and physical properties of low-dimensional structures (LDSs). In these LDSs, the geometric confinement limits the movement of charge carriers in space and it displays large changes in electrical and optical properties due to the occurrence of discrete energy distribution. Therefore, in recent years, intensive research activities have been conducted around the world on the behavior of matter at nanoscale. Although various devices related nanoscale particles have been developed, the properties of controlled nanoscale materials such as light emitting diodes, photo detectors and quantum dot (QD) single photon source are still the biggest problem of scientists.

Due to the last developments of semiconductor nanoelectronics, it has become possible to reduce dimensionality from bulk semiconductors to zero-dimensional semiconductor nanostructures (QDs). These nanostructures are very significant because their charge carrier motion is confined in all three directions, and therefore efficient control of the physical

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Published online: 02 November 2021