Evaluation of the external electric- and magnetic field-driven Mathieu quantum dot's optical observables

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Abstract:

In this study, for the first time, the total refractive index changes (TRICs) and total absorption coefficients (TACs) of the quantum dot including the Mathieu potential confinement formed by the InxGa1-xAs/GaAs heterostructure under the influence of external electric and magnetic fields are theoretically investigated. The spectra and eigenfunctions of the Mathieu quantum dot are obtained using the effective mass approximation by forming a tridiagonal matrix formalism. The iterative method and compact-density-matrix formalism are used together to examine the nonlinear optical properties of the Mathieu quantum dot. Throughout the study, the effects on the TRICs and TACs of the external electric and magnetic field, as well as the In concentration and confinement width, are probed. Considering the strong and weak regimes of the external electric and magnetic fields, their alternatives to the structural parameters in terms of optical properties are also evaluated. The increment of the In concentration causes the quantum dot encompassment to turn into the opposite character after a certain radial distance. This result may be remarkable in terms of experimental applications. Under certain conditions, the incident optical intensities photons on the structure are determined at the limit values. As well as determining the functional range of the Mathieu quantum dot in terms of the TRICs and TACs characters, using both structure parameters and external fields and as a function of the incident photon energy, the determination of the optimum for these characters is an important theoretical gain in terms of providing a prediction for experimental studies.

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Author Keywords: Nonlinear optical properties; Quantum dot; Mathieu potential; Electric field; Magnetic field

Keywords Plus: ABSORPTION; WELL; ELECTROABSORPTION; GENERATION; EFFICIENT; STATES; GAAS; BAND

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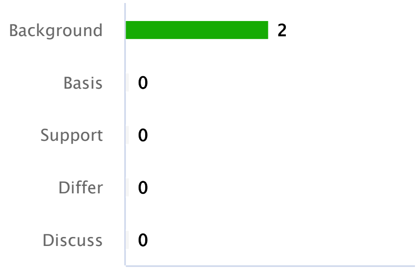

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