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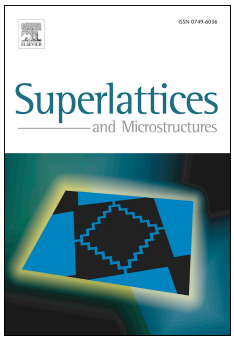

Evidence of molecular states in single quantum dots with structural anisotropy under magnetic fields

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Evidence of molecular states in single quantum dots with structural anisotropy under magnetic fields

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Abstract

The present work reports on the analysis of the effect of the structural anisotropy of a self-assembled quantum dot of InAs/GaAs, on the energy spectrum of an electron and in the presence of an external magnetic field applied along growth direction. The anisotropy is modelled by periodic variations in the dot height with respect to the azimuthal angle. First, we considered a problem of an axially symmetric lens-shaped quantum dot that could be resolved completely by the application of adiabatic approximation. Secondly, we resolved the problem of the anisotropic quantum dot by using the Galerkin method based on the solution of the axially symmetric lenticular dot. We found that for structures with symmetries C2 and C4, the degeneration of the levels observed in the isotropic case was destroyed, and anti-crosses appear between the levels due to the rupture of the rotational symmetry. The dependency of energy levels corresponding to low-lying states of the quantum dot, as a function of the strength of a magnetic field and of the dot size, for different anisotropy configurations is analysed. Our results reveal that the presence of some degree of structural anisotropy in a single QD has the potential to generate molecular states such as those arising in systems of coupled quantum dots.

Keywords: one-electron quantum dot, energy spectrum, molecular states, effect of the structural anisotropy, Galerkin method

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