Nonparabolicity effects and the spin-split electron dwell time in symmetric III-V double-barrier structures

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References:


Abstract:

We start from the fourth-order nonparabolic and anisotropic conduction band bulk dispersion relation to obtain a one-band effective Hamiltonian, which we apply to an AlGaSb symmetric double-barrier structure with resonant energies significantly (more than 200 meV) above the well bottom. The spin-splitting is described by the $k(3)$ Dresselhaus spin-orbit coupling term modifying only the effective mass of the spin eigenstates in the investigated structure. Apart from the bulk-like resonant energy shift due to the band nonparabolicity, we obtain a substantial shift depending on the choice of boundary conditions for the envelope functions at interfaces between different materials. The shift of resonant energy levels leads to the change of spin-splitting and the magnitude of the dwell times. We attempt to explain the influence of both the nonparabolicity and boundary conditions choice by introducing various effective masses.

Keywords:

Quantum wells; Dwell time; Nonparabolicity; Spin-orbit coupling