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RESONANCE TUNNELLING IN 3D/1D NANOSCALE INAS/GAAS COMPLEX

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Weakly coupled binary semiconductor nanoscale systems demonstrate perspectives for laser and nano-sensor applications, due to high sensitivity of the resonance tunnelling between the objects of the system on the symmetry violation. The single electron tunnelling properties of 1D, 2D and 3D structures as well as double quantum wells (DQWs) (1D), double quantum dots (DQDs), and quantum rings (3D) are well known. The electron spectra of such quantum objects in 2D and 3D were studied in our previous works with relation to the electron localizations and tunnelling between the objects. The wave function of electron may be localized in one of the QDs or be delocalized when it is spread over the whole system, tunnelling occurs in the last case. Under the condition of weak coupling objects, electron wave function can be localized in the both objects but with different probabilities. In this work we focus on the resonance tunnelling in 3D/1D nanoscale InAs/GaAs complex. Modelling carrier transfer from the barrier in InAs/GaAs dot-well, tunnel-injection structure is performed by using the band gap model based on the effective potential. This complex has a hybrid spectral structure: discrete spectrum for QD and continue spectrum for QW when QW is considered in three-dimensional space. We describe the tunnelling in the terms of localized/delocalized states and their spectral distribution. It was shown that the resonance tunnelling is going through the lowest spectral levels of 1D object. The QD-QW distance and geometry of the complex are varied. The relation to the PL experiments will be presented. **This work is supported by the NSF (HRD-0833184) and DMR-1523617 awards, and ARO grant W911NF-13-0165.**

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