World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:10, No:12, 2016

Behavior of Current in a Semiconductor Nanostructure under Influence of Embedded Quantum Dots

Authors : H. Paredes Gutiérrez, S. T. Pérez-Merchancano

Abstract : Motivated by recent experimental and theoretical developments, we investigate the influence of embedded quantum dot (EQD) of different geometries (lens, ring and pyramidal) in a double barrier heterostructure (DBH). We work with a general theory of quantum transport that accounts the tight-binding model for the spin dependent resonant tunneling in a semiconductor nanostructure, and Rashba spin orbital to study the spin orbit coupling. In this context, we use the second quantization theory for Rashba effect and the standard Green functions method. We calculate the current density as a function of the voltage without and in the presence of quantum dots. In the second case, we considered the size and shape of the quantum dot, and in the two cases, we worked considering the spin polarization affected by external electric fields. We found that the EQD generates significant changes in current when we consider different morphologies of EQD, as those described above. The first thing shown is that the current decreases significantly, such as the geometry of EQD is changed, prevailing the geometrical confinement. Likewise, we see that the current density decreases when the voltage is increased, showing that the quantum system studied here is more efficient when the morphology of the quantum dot changes.

Keywords : quantum semiconductors, nanostructures, quantum dots, spin polarization
Conference Title : ICQD 2016 : International Conference on Quantum Dots
Conference Location : Paris, France
Conference Dates : December 29-30, 2016