World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:07, 2018

Magneto-Transport of Single Molecular Transistor Using Anderson-Holstein-Caldeira-Leggett Model

Authors : Manasa Kalla, Narasimha Raju Chebrolu, Ashok Chatterjee

Abstract : We have studied the quantum transport properties of a single molecular transistor in the presence of an external magnetic field using the Keldysh Green function technique. We also used the Anderson-Holstein-Caldeira-Leggett Model to describe the single molecular transistor that consists of a molecular quantum dot (QD) coupled to two metallic leads and placed on a substrate that acts as a heat bath. The phonons are eliminated by the Lang-Firsov transformation and the effective Hamiltonian is used to study the effect of an external magnetic field on the spectral density function, Tunneling Current, Differential Conductance and Spin polarization. A peak in the spectral function corresponds to a possible excitation. In the presence of a magnetic field, the spin-up and spin-down states are degenerate and this degeneracy is lifted by the magnetic field leading to the splitting of the central peak of the spectral function. The tunneling current decreases with increasing magnetic field. We have observed that even the differential conductance peak in the zero magnetic field curve is split in the presence electron-phonon interaction. As the magnetic field is increased, each peak splits into two peaks. And each peak indicates the existence of an energy level. Thus the number of energy levels for transport in the bias window increases with the magnetic field. In the presence of the electron-phonon interaction, Differential Conductance in general gets reduced and decreases faster with the magnetic field. As magnetic field strength increases, the spin polarization of the current is increasing. Our results show that a strongly interacting QD coupled to metallic leads in the presence of external magnetic field parallel to the plane of QD acts as a spin filter at zero temperature.

Keywords : Anderson-Holstein model, Caldeira-Leggett model, spin-polarization, quantum dots
Conference Title : ICMSCMP 2018 : International Conference on Material Science and Condensed Matter Physics
Conference Location : Zurich, Switzerland
Conference Dates : July 30-31, 2018