Model Parameterization for Coherent Manipulation in Spin Current through FM-QD1-QD2-FM

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Abstract. In this work, model parameterization for coherent manipulation, for serially coupled double quantum dots embedded between ferromagnetic leads (FM-QD1-QD2-FM), is presented. Theoretical model based to the non-equilibrium Green's function approach is considered. Since the spin current and its spin channels are formulated incorporating the spin polarization and the type of spin configuration on the leads. Our model incorporates the inter-dot hopping, the intra-dot Coulomb correlation, the spin exchange energy and the coupling interactions between the quantum dots and leads. The results concerned to the parallel configuration at strong inter-dot coupling regime shows the preferable coherent state for spin down electrons only at relatively high polarization. While, for weak coupling regime and antiparallel configuration, the decoherent state is dominating. Interesting results have been concluded by calculating the molecular energy levels of the quantum dots. In all our calculations the same spin polarization on the leads is considered. The case of different spin polarization on the lead is also investigated but no unprecedented features are concluded as active region is symmetric.

1. Introduction

Nanotechnology has stimulated much interest in the study of quantum transport in mesoscopic structure. Devices based on quantum dot (QD) have particular attention, in semiconductor quantum dot a two-dimensional electron gas is wasted by an arrangement of gate barriers such that a zero-dimensional region is produced. Transport through this quantum dot takes place through spin-conserving tunnel events.

The advantage of these systems is that their parameters can be continuously changed by modifying the applied external potentials so that different coupling regimes can be studied. For such devices to be useful, an understanding of the processes which couple the microscopic device to the macroscopic environment is paramount, that is to say, the decoherent processes of such systems must