Theoretical analysis of transport in ferromagnetic single-electron transistors in the sequential tunneling regime

J. Wiśniewska and I. Weymann

Institute of Physics, Adam Mickiewicz University, Umultowska 85, 61-614 Poznań, Poland

We analyze spin-dependent transport properties of a single-electron transistor, whose two external electrodes and the central part (island) are ferromagnetic. Based on the real-time diagrammatic technique [1-3], we calculate all transport contributions up to the first order in the coupling strength between the island and the leads – this comprises the sequential tunneling. The relevant occupation probabilities of different charge states are determined from the generalized master equation in the Liouville space. Assuming that spin relaxation processes on the island are sufficiently fast to neglect spin accumulation, we analyze electric current flowing through the system in the parallel and anti-parallel magnetic configurations, as well as the resulting tunnel magnetoresistance. We show that transport characteristics of ferromagnetic single-electron transistors exhibit a strong dependence on the magnetic configuration of the system. Furthermore, we also demonstrate that the bias dependence of both the differential conductance and tunnel magnetoresistance displays an oscillatory-like behavior resulting from single-electron charging effect.

[1] H. Schoeller, G. Schön, Phys. Rev. B **50** (1994) 18436
[2] J. König, H. Schoeller, G. Schön, Phys. Rev. B **58** (1998) 7882
[3] B. Kubala, G. Johansson, J. König, Phys. Rev. B **73** (2006) 165316

Name of the presenting author (poster session II): Justyna Wiśniewska
e-mail address: justyw@amu.edu.pl
http://www.amu.edu.pl