Torque due to spin-polarized current in ferromagnetic single-electron transistors

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Theoretical analysis of the current-induced torque acting on the central part (island) of a ferromagnetic single-electron transistor has been carried out in the regime of sequential tunneling [1]. The island is assumed to be ferromagnetic and attached in a general case to two ferromagnetic leads (electrodes), whose magnetic moments may be oriented quite arbitrarily. The torque is calculated from the net spin current absorbed by the island [2]. In turn, the spin currents are calculated within the master equation approach. The torque acting on the ferromagnetic island is calculated as a function of gate voltage, spin polarization of the leads, charging energy, and other parameters describing the system. It is also calculated as a function of the angle between magnetic moments of the leads. Two different situations are compared in detail - namely single-electron transistor with one electrode being ferromagnetic and one nonmagnetic, and single-electron transistor with both electrodes ferromagnetic. In both situations the central island is ferromagnetic. All calculations are carried out in the limit of fast spin relaxation processes, when spin accumulation on the island can be neglected.

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[1] Single Charge Tunneling, Vol. 294 of NATO Advanced Study Institute, Series B, edited by H. Grabert and M. H. Devoret (Plenum Press, New York, 1992).
[2] J. Barnaś, A. Fert, M. Gmitra, I. Weymann, and V. Dugaev, cond-mat/0501570.

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