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Title

Spin Polarized Current in Magnetic Nanojunctions

Source

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Abstract

Two channels of the s-d exchange interaction are considered in magnetic junctions. The first channel describes the interaction of transversal spins with the lattice magnetization. The second channel describes the interaction of longitudinal spins with the magnetization. We show that the longitudinal channel leads to a number of significant effects: 1) drastic lowering of the current instability threshold down to three (or even more) orders of magnitude; 2) creation of sufficiently large distortion of equilibrium due to the current-driven spin injection leading to inversion of populations of the energy spin subbands and laser-like instability in the THz frequency range at room temperature. External magnetic field is likely to tend to additionally lower the instability threshold due to the proximity effect of purely magnetic reorientation phase transition. This effect demonstrates new properties: the giant magnetoresistance (GMR) becomes strongly current dependent and the exchange switching becomes of very low threshold. We derived some matching condition that should be satisfied to achieve high spin injection level. Some characteristic quantities appeared in the condition, namely, the so called "spin resistances" Z_i, where i the a number of a layer in the junction. For a three-layer junction (i = 1, 2, 3), the matching condition is Z₂ << Z₁, Z₃, where the number i = 2 corresponds to the main functional layer. We investigated also the junctions having variable lateral dimensions of the layers, for example, a ferromagnetic rod contacting with a very thin ferromagnetic film. A large enhancement of the current density can appear near the contact region, leading to the spin injection luminescence. (19 References).