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SPIN-CURRENT INDUCED PERIODICAL STRUCTURES IN FERROMAGNETIC NANOWIRES

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The usage of spin-polarized current is a convenient way to handle the magnetization states of planar magnetic nanoparticles, without applying the external magnetic field of complex space-time configurations. That allows one to create high density arrays of nanodots, which provides new opportunities in construction of purely current controlled devices, e.g. Magnetic Random Access Memory (MRAM) [1,2].

Recently, we studied the influence of strong spin-polarized current on the magnetic films [3,4,5] under the CPP configuration and it was shown that stable two-dimensional vortex-antivortex superlattices appear in the pre-saturated regime. Also we developed a linear theory of instability of the saturated state for thin films under the influence of spin-polarized current and proposed a mechanism of current-induced vortex-antivortex superlattice formation.

In this work we focused on the case of thin nanowires with square cross-section and studied the possible stationary states under influence of perpendicular spin-current. Contrary to the case of films, no dynamical states appear in the nanowire, only stationary states exist for the whole range of current densities. For the current absence the wire is magnetized uniformly along its axis. With the current increasing the magnetization uniformly deflects from the wire axis. The deflection takes place within plane perpendicular to the current direction and the deflection angle increases up to the value $\pi/4$ with the current increasing [6]. For the large currents the state uniformly saturated along current appears. The wire thickness is a crucial parameter for the behaviour of wire magnetization. If the thickness is smaller than the critical one then the periodical domain structure appears in between of two uniform states. For more thick wires the domain structure was not observed but the hysteresis loop appears in the process of current induced saturation.

For the case of nanostripes we demonstrated that the dependence of the saturation current on the stripe width is nonmonotonic one. We also found a variety of stable regular structures which appear in the process of the nanostripe saturation. All theoretical results were confirmed by using micromagnetic simulations [7].

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