CURRENT INDUCED DOMAIN WALL DYNAMICS

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When combining transport with magnetic materials on the nanoscale, a range of exciting and novel phenomena emerge. It was found that the magnetization configuration influences strongly the transport due to spin-dependent scattering in ferromagnets. Such domain wall magnetoresistance is due to scattering of electrons as they pass abruptly from a domain with the magnetization pointing in one direction into a domain with an opposite magnetization. If the spin of the electron cannot follow the change in magnetization adiabatically, it will be scattered resulting in an additional resistance contribution.

Conversely the reciprocal effect of the spin polarized currents on the magnetization also exists. This spin transfer torque effect leads to current-induced domain wall motion, which has become the focus of intense research in the last few years due to a strong interest in the fundamental interaction between spin polarized currents and the magnetization in ferromagnets.

Furthermore for applications, it has recently become possible to replace the conventional field-induced reversal by current-induced switching, which exhibits are more favourable scaling behaviour with decreasing lateral dimensions. It has become possible to engineer the domain wall spin structure in device, which then allows controlled switching by wall displacement opening up a novel avenue towards storage, logic and sensing devices.

We study in detail current-induced domain wall motion (CIDM), where due to a spin torque effect, electrons transfer angular momentum and thereby push a domain wall [1]. We have comprehensively investigated this effect and observed that this interaction is strongly dependent on the temperature [2] and the wall spin structure [1]. In addition to wall motion we observe periodic domain wall transformations in line with theoretical predictions [3].Dynamic measurements show that AC currents can excite domain wall oscillations and current densities below what is necessary for displacement. We determine the oscillatory eigenmodes and find a strong dependence on the wall type [4].

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[4] D. Bedau, M. Kläui et al., Phys. Rev. Lett. 99, 146601 (2007).