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Current-induced Domain Wall Dynamics

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The details of the spin structure of domain walls and vortex cores have recently become the focus of intense research. This is not only due to improved measurement techniques that now allow one to image the magnetization configuration on the nanoscale but also due to the fundamental physical questions associated with domain walls, such as the wall type and width dependence on the geometry [1,2], the intrinsic domain wall magnetoresistance and domain wall propagation induced by spin-polarized currents [3].

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 [3]. We have comprehensively investigated this effect and observed that this interaction is strongly dependent on the temperature [4] and the wall spin structure [3]. In addition to wall motion we observe periodic domain wall transformations in line with theoretical predictions [5].

Dynamic measurements show that AC currents can excite domain wall and vortex core oscillations and current densities below what is necessary for displacement. We determine the oscillatory eigenmodes and find a strong dependence on the wall type [6]. Using variable power, we can determine the resonance frequency as a function of power, and we find a strongly non-linear behaviour. From this we can directly determine the shape of the potential well in which the vortex core oscillates.

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