IN-SITU LORENTZ MICROSCOPY STUDIES OF VORTEX DOMAIN WALLS IN NANOWIRES CONTAINING PINNING POTENTIALS

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We present a Lorentz microscopy study of the controlled pinning and de-pinning of magnetic domain walls (DWs) in ferromagnetic nanowires with precisely defined geometric features. Our present investigations have focused on the reproducible control of DWs behaviour in permalloy nanowires with anti-notch structures which act as pinning potentials. It is expected that the pinning strength and characteristics of these potentials can be tailored by adjusting the anti-notch geometry. Using e-beam lithography and lift-off techniques we have fabricated 300 nm wide and 20 nm thick permalloy wires to contain three anti-notches (either rectangular or triangular) of variable dimensions. Vortex DWs are nucleated at the corner of a diamond-shaped pad connected to the nanowire [1] and driven along the wire under an applied magnetic field. Lorentz microscopy allows *in-situ* observation of vortex DW formation, propagation, and interaction with the tailored pinning potentials. We observed that as the strength of the magnetic field is increased, the magnetic structure of the DWs was modestly modified prior to de-pinning from the anti-notch. The geometrical pinning features behave either as potential well or barrier depending on the direction of the incoming DW, its type either symmetric or asymmetric and the position of the anti-notch in the nanowires. The experimental results are compared with micromagnetic simulations and show good agreement. Further work is being carried out to fabricate nanowires with exactly same geometry using focused ion beam to elucidate and compare the influence of the two fabrication techniques (e-beam and ion beam) on magnetic behaviour of DWs.

[1] C. Brownlie, S. McVitie, J.N. Chapman and C.D.W. Wilkinson, J App. Phys. **100** (2006) 033902.