P15

Control of magnetic domain wall motion in Co microwires by tridimensional e-beam lithographied structures

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In the last few years, being capable of controlling the motion of magnetic domain walls has been a matter of increasing attention as it is a key factor in the development of modern memory devices [1]. In this work we present how wall motion can be pinned along a cobalt microwire by the presence of a cobalt 3D e-beam lithographied bridge that crosses over it.

Co microwires and bridges are both patterned over a Si substrate by electron beam lithography in a multistep method consisting in double exposition of the stripes and bridges separately. First, Si substrates are spin-coated with PMMA to pattern pairs of 50 µm length x 3 µm width wires with a needle-like shape and alignment marks, then a 40 nm Co film is grown by magnetron sputtering and Co wires are obtained after a lift-off process. Subsequently the sample is again spin-coated with a bilayer combination of PMMA and MMA in order to achieve a more suitable T-shape sidewall profile, due to the different resist sensibility to an electron flux. Bridges are then patterned over one Co wire in each pair using the previously lithographied alignment marks. Typical sizes of these Co bridges, also grown by magnetron sputtering, are 8 µm length, 3 µm width and 250 nm thickness, with 4 x 3 µm pillars, and rise over the substrate surface 240 nm on average [Figure 1(a)].

Magnetization process in these systems has been analyzed by Kerr Microscopy in longitudinal geometry. It is found that when a magnetic field is applied in the direction along the Co microwires, Co bridges act as pinning sites for the magnetic wall coming from the nucleation area [Figure 1(b)], confirming that this kind of 3D microstructures can be a useful tool to control magnetic domain wall motion.

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References
[1] S. S. P. Parkin, M. Hayashi and L. Thomas, Science **320**, 190 (2008)

Figures

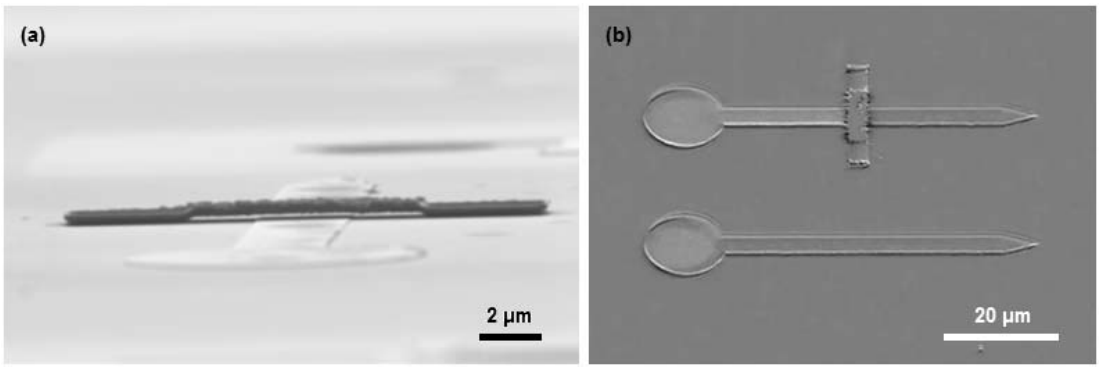

Figure 1: (a) Scanning Electron Microscopy (SEM) image showing the patterned microstructures: a Co bridge is seen clearly above the Co wire with a needle-like shape to control domain nucleation and wall propagation direction. (b) Propagation of the magnetic wall is pinned by the effect of the Co bridge.