STUDIES OF COBALT NANOCONSTRICTIONS BY SCANNING TRANSMISSION X-RAY MICROSCOPY AND MICROMAGNETIC SIMULATIONS

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High magnetoresistance values reported in literature have attracted a lot of attention to nanomagnetic contacts. However, the physical phenomena which are ruled mainly by the magnetization in the regions adjacent to the nanocostriction [1], might be masked by artifacts [2]. In order to investigate the character of magnetization reversal process the structures with asymmetric contact shape were fabricated. The samples consist of a 4 μm × 4 μm square pad and a 8 μm × 1 μm rectangular wire, which are joined together by a constriction. The minimum size of the contact areas studied is 80×10 nm^2. The structures were fabricated by focused-electron-beam-induced deposition (FEBID) — a novel single step lithography technique, which allows to obtain high purity polycrystalline cobalt deposit using the $Co_2(CO)_8$ precursor.

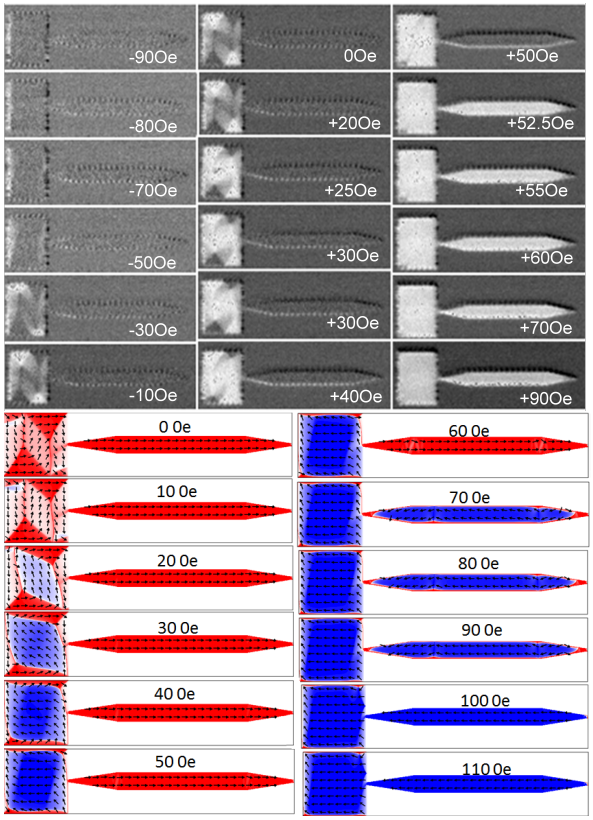

Figure 1: Room temperature STXM images of the structure as a function of the external magnetic field compared with micromagnetic simulations. Values of the x-component of the field are shown.

The magnetization reversal was investigated by Scanning Transmission X-ray Microscopy (STXM) at the Advance Light Source in Berkeley. The advanced magnetic imaging by X-Ray Circular Dichroism allows to obtain a unique insight into the process with a spatial resolution of about 40 nm. The analysis of images explains well the experimentally observed magnetoresistance (MR), basing on the theory of anisotropic (AMR) in the diffusive electrical transport regime, i.e. derived from the y-component of the magnetization. The micromagnetic simulations, complementary to MR and STXM measurements, correspond very well to the STMX images.

STXM images show a different magnetization structure during reversal as a function of the electrode thickness and constriction size, which is also confirmed by micromagnetic simulations.

The measured MR values are compared with those obtained from simulations.

References

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