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Magnetization reversal behavior in electrodeposited ferromagnetic Co-Pt-based nanotubes and nanowires

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For a single-domain particle the two most common magnetization-reversal modes can be modeled either by coherent rotation or curling. These two mechanisms lead to different values of coercivity (H_C), depending on the direction/angle (Θ) of the applied field with respect to the axis tube/wire axis. This study based on *fcc* Co-Pt-based nanotubes and nanowires combines magnetic force microscopy (MFM) measurements with an applied external magnetic field [1] and angular-dependence measurements using a vibrating-sample magnetometer (VSM) to clearly distinguish between the two different magnetization reversal mechanisms. The Co-Pt based nanotubes were synthesized with electrodeposition having length~ 2000 nm and diameter~200 nm inside polycarbonate membrane. While Co-Pt based nanowires with different aspect ratios were deposited via direct electroplating into anodic alumina oxide (AAO). Due to the increased amount of surface charges in nanotubes, magnetization circumferentially curls around the nanotube since this is energetically the most preferable state [2]. In the case of the nanowires the magnetization direction can be tuned from the parallel to perpendicular direction, just by changing the aspect ratio. Coercivity (H_c) and remanent squareness (SQ) as a function of the nanowire length support the crossover of easy axis. In-situ magnetization reversal studies were performed on the nanotubes and nanowires under MFM which revealed a vortex-type magnetization configuration for nanotubes and dipole contrasts in the nanowires in dependence of the easy axis orientation. The angular variation of coercivity for the nanotubes showed that curling reversal behavior dominates at angles smaller than 40° with transition to coherent rotation at $\Theta > 40^{\circ}$. Angular variation of coercivity for nanowires reveals that the curling is the dominant magnetization reversal process.

References:

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