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Electrodeposition and magnetic properties of Ni and Co nanotubes in nanoporous alumina templates

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Magnetic nanowires (NWs) and nanotubes (NTs) are attracting considerable attention due to their unique properties and potential applications, ranging from magnetic storage and recording devices to sensors and biomedical chips. The use of a template assisted method has arouse great interest and shown many potentialities, as it allows the low-cost and high-yield growth of highly ordered nanomagnet arrays.

In this work we describe the synthesis and characterization of ordered arrays of magnetic NWs and NTs by potentiostatic electrodeposition in nanoporous alumina templates (NpATs). First, we present a detail study on the optimized conditions for the potentiostatic electrodeposition of Ni NWs inside NpATs by tuning the applied potential [1]. We then present a systematic comparative study on the fabrication of Ni NW and NT arrays with small diameters (~50 nm), by monitoring the deposition current density transients during potentiostatic electrodeposition in NpATs [2].

The magnetic properties of highly ordered hexagonal arrays of Ni and Co NWs and NTs are also presented. In particular, we describe a systematic comparative study on the magnetization reversal processes in ordered NW and NT arrays with different diameters (30 – 65 nm). For this study we performed analytical calculations and experimental measurements of the angular dependence of the coercivity, allowing us to determine the reversal modes in NW and NT arrays [3,4]. The magnetic interactions between the NWs and NTs grown in the NpAT were also measured using first-order reversal curves. In this work we also present, for the first time, experimental evidence of exchange-bias (EB) coupling in core-shell Co/CoO nanotubular structures, along both the parallel and perpendicular directions of applied magnetic field.

References:

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