MAGNETOSTATIC INTERACTION IN Fe-Co NANOWIRE ARRAYS

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Recently, nanowire arrays of Fe-Co were being studied as potential materials for high-density magnetic recording due to its high coercivity and squareness resulting from shape anisotropy [1]. Besides this applied aspect, the nanowire arrays constitute one of the most important systems for studying the effect of magnetic interactions on the magnetization process in ordered systems. In this work, we have performed a study of the magnetic properties of Fe-Co nanowires with different lengths by analyzing the hysteresis loops and two different remanence curves, the isothermal remanent magnetization and the dc demagnetization remanence [2].

The arrays of Fe-Co nanowires have been prepared by coelectrodepositing Fe and Co into anodic aluminium oxide (AAO) membranes. The ordered porous alumina membranes with pore diameter about 35 nm and 105 nm interpore distance were prepared by anodic oxidation of 99.999% Al sheet at 40 Vcc in a 0.3M $C_2H_2O_4$ aqueous solution at 1-3 ºC via two–step.

The Fe-Co nanowires were obtained by pulsed electrodeposition. The Fe and Co atoms were coelectrodeposited into the AAO membranes from an aqueous bath containing $CoSO_4 \cdot 7H_2O$ 0.045M, $FeSO_4 \cdot 7H_2O$ 0.18 M, boric acid 0.54 M, ascorbic acid 0.006M and NaOH to obtain a pH about 4.

Morphology of nanowire arrays of $Fe_{70}Co_{30}$ was characterized by SEM and TEM. Fig.1 shows a SEM image corresponding to Fe-Co nanowires of 8 μm length after dissolving the alumina using a 5 M NaOH solution for 30 min. The nanowires are clearly uniform in size. The average diameter of the nanowires has been measured from the TEM images and is ≈ 35 nm.

The hysteresis loops and remanence curves were measured using a VSM magnetometer at 300 K and at a maximum applied magnetic field of 20 kOe. Fig. 2 shows the magnetic hysteresis loops of Fe-Co nanowires array of 8 μm length with applied magnetic field parallel and perpendicular to nanowire axes. The experimental data can be explained using a quantitative description of interaction field obtained by treating the wire as a linear chain of several thousand point dipoles [3].

References:

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Figure 1

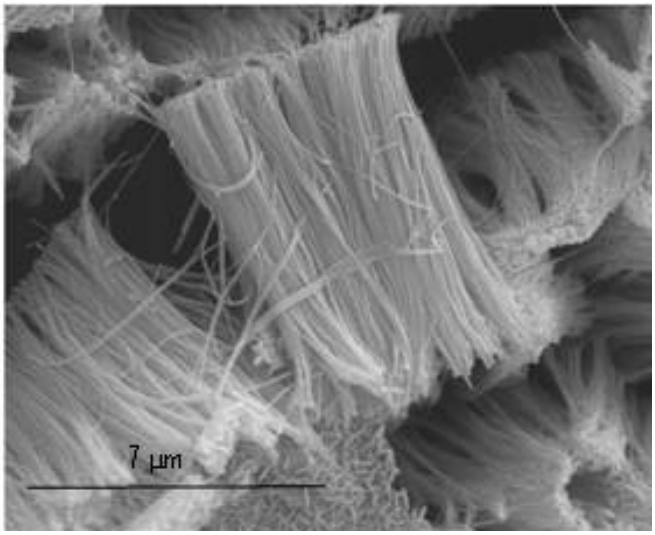

Figure 2