Anisotropic Magnetoresistance in ordered Nanowire Arrays

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Ordered arrays of magnetic CoNi and Ni nanowire have been prepared by electroplating filling of self-assembled pores in two-step anodized alumina membranes [1]. High-purity Al disks were cleaned by degreasing and electropolishing and then submitted to anodization processes in oxalic acid bath resulting in self-assembled pores around 60 nm diameter arranged in a hexagonal network with 105 nm lattice constant. Subsequently, the non-oxidized Al bottom is chemically etched to open the porous alumina membrane typically 20 μm thick. Afterwards, Au layer about 2 μm thick is fixed at the bottom, and grown inside the pores to serve as an electrode for subsequent electroplating of either Ni or CoNi wires, several micron long. A Au layer is finally plated on top of the magnetic layer up to the upper surface of the membrane to allow an improved electrical contact at both sides of the array for electrical resistance measurements. Local compositional analysis of each layer in the nanowires has been performed by scanning electron microscopy measurements (see left figure).

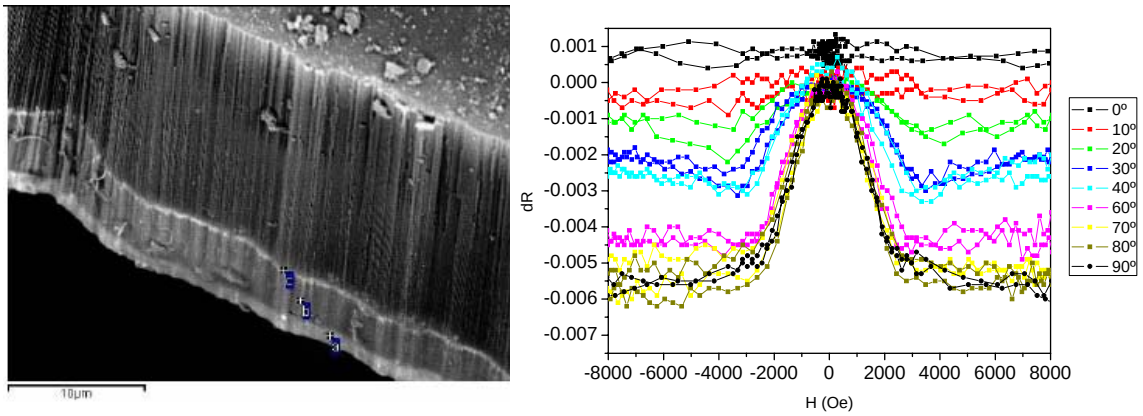

Figure.- SEM image of lateral section of a CoNi array of nanowires showing the presence of Au, CoNi and Au (not filling the pores) layers from the bottom (left). Angular dependence of the normalized magnetoresistance in a CoNi nanowire array (right).

Magnetic characterisation has been performed in SQUID magnetometer confirming the existence of a magnetic anisotropy with easy axis parallel to nanowires. Anisotropic magnetoresistance, AMR, has been measured by the four-point technique for a range of selected angles between parallel (0º) and perpendicular (90º) orientation of the applied field with regards to the nanowires axes (see right figure). AMR evolution is nearly quadratic with field amplitude suggesting a whole magnetisation reversal of the nanowires occuring by nearly reversible magnetization rotation mechanism.

[1] M. Vázquez et al., J. Appl. Phys. **95**, (2004) 6642-6648

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