MAGNETIC NANOWIRES ARRAYS ELECTRODEPOSITED IN ALUMINA AND TITANIA MEMBRANES.

D. Navas[(1)], *V. M. Prida*[(2)], *K.R. Pirota*[(1)], *J. Torrejón*[(1)], *R. Sanz*[(1)], *M. Hernández-Vélez*[(3)], *F. Batallán*[(1)] *and M. Vázquez*[(1)].
[(1)]*Instituto de Ciencia de Materiales, CSIC, 28049 Madrid, Spain.*
[(2)] *Dpto. Física, Universidad de Oviedo, Calvo Sotelo s/n, 33007, Oviedo, Spain.*
[(3)]*Dpto. Física Aplicada, C-XII, Universidad Autonoma de Madrid 28049, Madrid, Spain.*

danavas@icmm.csic.es

During the last years our research group has been working in the fabrication and study about the properties of ferromagnetic nanowires electrodeposited into nanoporous membranes. Using an anodization process, both highly self-ordered nanoporous alumina [1] and titania (TiO_2) [2] membranes have been fabricated, characterized and used as templates to grow into nanowires employing an electrodeposition technique. In particular, in this work nanowires of $Ni_xFe_{(1-x)}$ ($0 \leq x \leq 100$) alloy, electrodeposited into nanoporous alumina and titanium dioxide membranes, have been studied.
Structural characterizations have been determined by high-resolution scanning electron microscopy (HR-SEM). The magnetic behavior has been determined by using a vibrating sample magnetometer (VSM), for nanowires of 30 nm in diameter, about 5 μm in length and 105 nm lattice parameter of the high quality hexagonal symmetry of the alumina membranes, while the electrodeposited nanowires have a diameter about 100 nm and 300 nm in length, in the case of the ones grown into the self-aligned titania nanotube membranes.
From the values of coercivity and remanence obtained from the room temperature VSM hysteresis loops, an easy magnetization direction parallel to the long nanowire axis has been assumed (see fig.1), in the Ni sample grown inside the alumina template, corresponding to a *flower* domain state [3]. Meanwhile, the hysteresis loops of the arrays of Ni nanowires into the self-aligned amorphous TiO_2 nanotubes would correspond to a *vortex-state* magnetic configuration [4], where the easy axis lies along the perpendicular direction of the nanowires length (fig. 2).
In the same way, the magnetic properties of the $Ni_xFe_{(1-x)}$ alloy have been studied as a function of the relative weight of Ni or Fe electrodeposited (fig. 3). Either coercivity or squareness (%) values have been reduced from 1535 Oe and 96% for pure Fe, to 800 Oe for Ni and 57% when an amount of Ni was added to the Fe nanowires.

References:

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[4] C.A. Ross, M. Hwang, M. Shima, J.Y. Cheng, M. Farhoud, T.A. Savas, H.I. Smith, W. Schwarzacher, F.M. Ross, M. Redjdal and F.B. Humphrey, Phys. Rev. B, 65, 144417 (2002).

Figures:

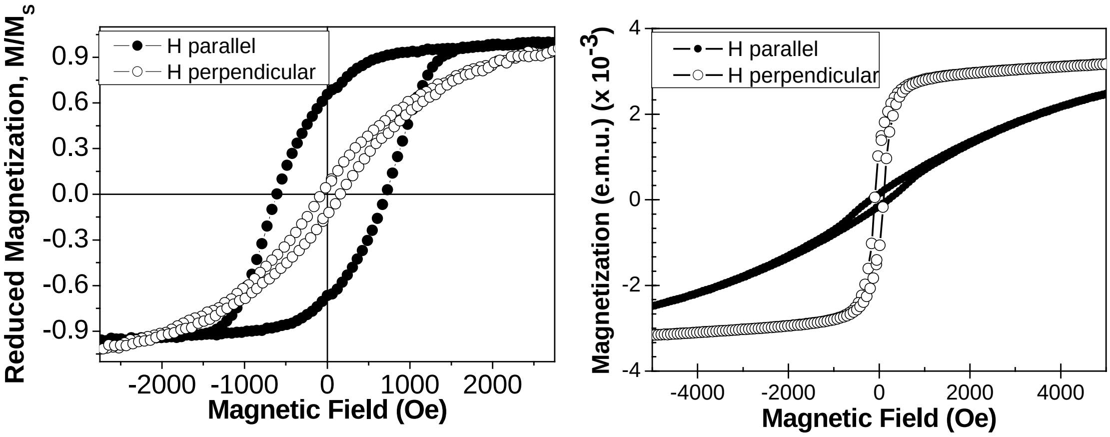

Fig. 1: Ni nanowires hysteresis loops with the magnetic field applied parallel (●) and perpendicular (○) to the longitudinal axis of the nanowires in the alumina (left) and titania (right) templates.

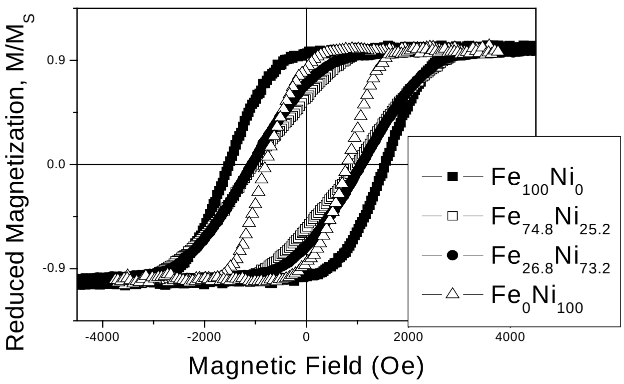

Fig. 2: Hysteresis loops of the $Ni_xFe_{(1-x)}$ nanowires arrays with the magnetic field applied parallel to the longitudinal axis.