ESRF	**Experiment title:** Strain in patterned epitaxial nickel films	**Experiment number**: **25-02- 655**
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Names and affiliations of applicants (* indicates experimentalists):

José Luis DIEZ FERRER (Instituto de Nanociencia de Aragón, Universidad de Zaragoza)
Edna Corredor (Instituto de Nanociencia de Aragón, Universidad de Zaragoza) Dr. Miguel CIRIA (Instituto de Ciencia de Materiales de Aragón-Consejo Superior de Investigaciones Científicas)

Report:

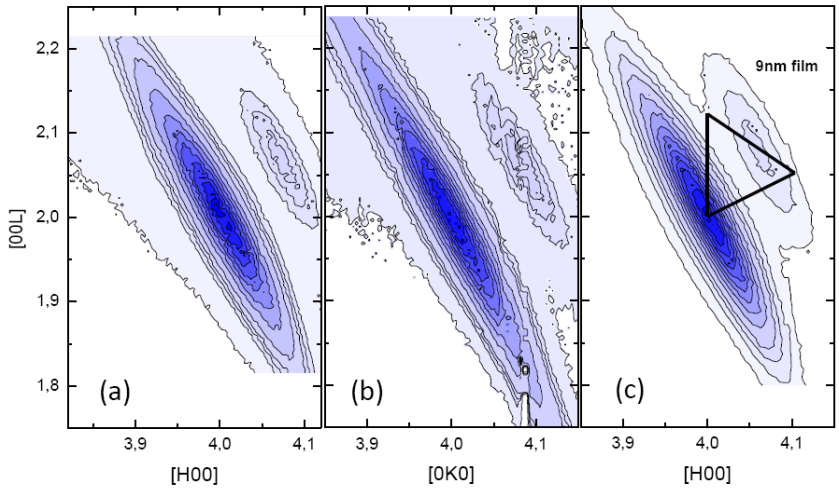

Figure 1 Reciprocal space maps taken for the 10NW array along the [402] (a) and the [042](b) directions and (c) for a 9 nm thick Ni film along the [402] direction. The relaxation triangle is also shown.

We have carried out experiments in an array of planar nanowires (NW) fabricated on epitaxial Cu(5)/Ni(10)/Cu(100) thin film (thickness in nm). The purpose was to determine the anisotropic strain in the plane due to the patterning process. We do so by measuring the lattice parameters longitudinal and transverse to the NW axis using reciprocal space maps in the vicinity of the (402) and (420) asymmetric Bragg reflection, see Fig. 1. These scans are sensitive to the lattice parameter parallel a_x [Fig. 1(a)] and transverse a_y [Fig. 1(b)] to the NW axis, as well as the out of the plane lattice parameter a_z [1]. From the experimental positions of these maximum peaks of the scattered intensity the lattice constants were determined as a_x = 3.553 Å, a_y = 3.541 Å and a_z= 3.504 Å that leads to ε_{xx}= 0.83%, ε_{yy} = 0.49 % and ε_{zz}= -0.57%. A similar

scan was done in a 9 nm thick nickel film [Fig. 1(c)]. The characterization of these films was completed with reciprocal space maps, with l=2 done at the (402) and (042) peaks.

We have obtained the in-plane strain ε by measuring the in-plane lattice parameter by means of grazing incidence X-ray diffraction in the (400) plane in several Cu(5)/Ni(t_{Ni})/Cu(100) and Cu(5)/Ni(3)/Cu(t_{Cu})/Ni(3)/Cu(100) structures. Thus, we have completed the thickness dependence of ε with t_{Ni} [Fig. 2(a)] and t_{Cu} [Fig. 2(b)]. For Cu/Ni/Cu films, ε decreases as t_{Ni} increases [Fig. 2(a)], while in the case of Cu/Ni/Cu/Ni/Cu, for t_{Cu}>1.5nm, ε is almost independent of the copper thickness being that value quite similar to the value measured for the 3 nm thick nickel film.

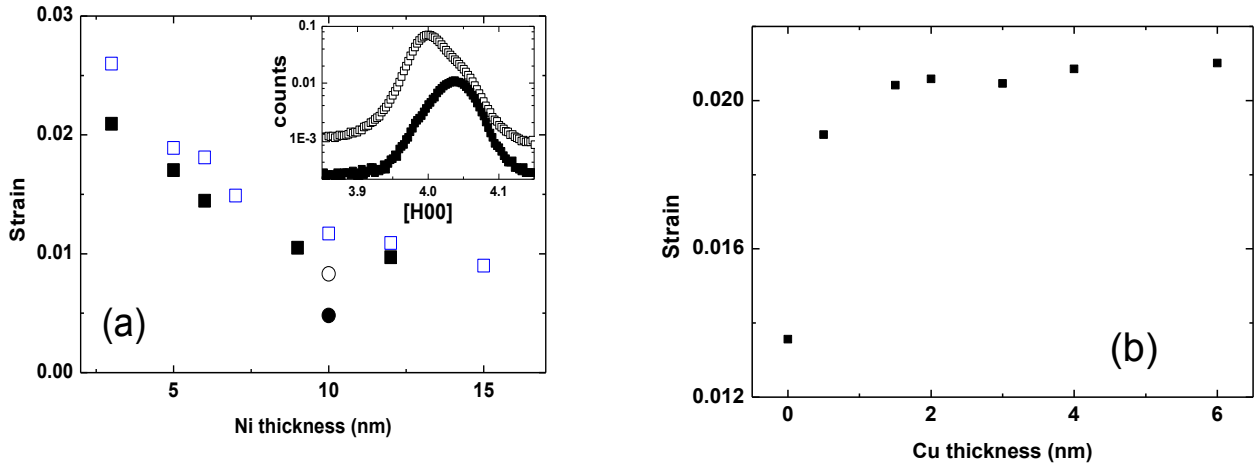

Figure 2 (a)In-plane strain for the 10NW array longitudinal (empty circle) and transverse to the NW axis (full circle) and for the nickel films(full squares), and data extracted from reference [2] (empty squares). The inset shows two scans taken at 0.2 and 0.5. (b) In-plane strain for Ni/Cu/Ni double films as a function of the copper thickness.

The measurement of the strain in the NW array is used to determine directly the magnetoelastic ME contribution to the magnetic anisotropy and demonstrate that the ME contribution explains the transverse magnetization observed in this NW array [3]

[1] H. Heinke, S. Einfeldt, B. Kuhn-Heinrich, G. Plahl, M. O. Möller and G. Landwehr, J. Phys. D: Appl. Phys. **28**, A104 (1995).
[2] K. Ha, M. Ciria, R. C. O'Handley, P. W. Stephens, and S. Pagola, Phys. Rev. B, **60**, 13780 (1999).
[3]M.Ciria et al, submitted to Phys Rev. B