Preparation and magnetic properties of arrays of Ni nanowires in Alumina membranes

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Most important characteristics regarding arrays of Ni nanowires embedded in porous Alumina are reviewed. The different steps for the controlled production of highly-ordered nanowires is first described. Nanopores are formed by self-assembling process during anodization of pure Al, and subsequent steps include further anodization, etching and thinning the barrier for the final electrodeposition process by which pores are filled.

Emphasis is made on the parameters of production leading to different ordering degree of hexagonal symmetry arrangement, and to control the diameter and inter-wire distance that determine the magnetic behavior.

Control of the filling of pores and the of geometrical characteristics of arrays has been done by SEM, HRSEM, RBS and AFM techniques.

The magnetic behavior of the arrays has been performed by SQUID and VSM magnetometers that allows us to gain information of the array as a whole.

MFM permits us to obtain additional information on the magnetic state of individual nanowires. Experimental studies are presented for arrays with different degree of ordering (crystalline domains up to around 1 mm), and for ratio diameter to interwire distance (diameter ranging between 20 and 180 nm, and distance between 35 and 500 nm). Studies include also FMR experiments

that allows us to obtain complementary information of the anisotropy and magnetic characteristics. Some of more relevant results include the dependence of coercivity and remanence with the ratio diameter to inter-wire distance and on the ordering degree.

Finally, modeling of interacting nanowires are presented paying particular attention to the fact that nanowires can be no more treated as single magnetic dipoles but that multipolar approach must be considered specially taking into account that their length (few microns) is much larger than diameter and interwire distances.