Effect of pH on crystallographic orientation and magnetic behavior of arrays of continuous electrodeposited Co nanowires

A Kazadi Mukenga Bantu*[a], J. Rivas*[b], G. Zaragoza, M.A. López-Quintela**, and M.C. Blanco****

*Applied Physics, and **Physical Chemistry Department
University of Santiago de Compostela
E-15782 Santiago de Compostela / Spain.

Abstract

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We investigate the dependence of the magnetic properties of continuous Co wires arrays on the electrolyte pH. The microstructure of magnetic electrodeposited Co nanowires has been characterized by X-ray diffraction. A texture of HCP Co wires has been observed to be present when electrodeposition was performed under our synthesis conditions. Data is presented which contrasts the crystallographic orientation and magnetic properties of wires electrodeposited at low and at high electrolyte pH values. When using electrodeposition of low pH values at a low deposition rate, the crystal structure of Co wires is mainly HCP. Plating from a simple $CoSO_4$ bath, a transition in preferred orientation is observed to occur within the region of pH ≈ 4, from orientation of the hexagonal c-axis predominantly perpendicular to the axis of wires below a pH of 4 changing to c-axis orientation predominantly parallel to the axis of wires in the range of pH = 3 – 5, together with the corresponding changes in magnetic properties. Torque measurements of arrays of Co wires confirm that when the pHs of the solutions are increased a change takes place from a parallel easy direction of magnetization towards a perpendicular easy direction to the axis of the wire. This change in the easy direction of magnetization is analyzed considering the X-rays diffraction, magnetic and torque measurements.

Keywords: Arrays of continuous Co nanowires, magnetocrystalline anisotropy, crystallographic orientation.

[a] Physics Department, Faculty of Sciences, University of Kinshasa / P. O. Box 190 Kinshasa 11
Democratic Republic of Congo (Zaïre)
E-mail address: fakazadi@gmx.net

[b] . Corresponding author:
·Phone number: +34 981 563100 ext. 14021
·Fax: +34 981 520676
·E-mail address: farivas@uscmail.usc.es