11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Structural and Magnetic Properties of Electrodeposited Co-Ni alloys

E.M.Silva[(1,2)*], L.C.Lima[(3)], M.V.B. Pinto[(2)], D.Givord[(3)], R.A.Simão[(1)], V.M.T.S.Barthem[(2)]

(1) Engenharia Metalúrgica e de Materiais, COPPE,UFRJ, Cx. Postal 68505, 21945-970 Rio de Janeiro, RJ, Brazil; *elizams@metalmat.ufrj.br;
(2) Instituto de Física, UFRJ, CT, Bloco A, C.P. 68528, 21945-970, Rio de Janeiro, Brazil;
(3) CETEM—Centre for Mineral Technology, Av Ipê, 900, Ilha do Fundão, Rio de Janeiro, RJ, 21941-590, Brazil;
(4) Insitut Néel, CNRS-UJF, 25 avenue de Martyrs, 38042 Grenoble, France

Abstract - Ni–Co alloys having different compositions and microstructures were produced by electrodeposition. The chemical, morphological and magnetic properties were characterized by EDS, AES,XRD , AFM, MOKE and SQUID. The film morphology and the alloy grain size are mainly influenced by the Co content. The crystallographic structure changes gradually from fcc in Ni-rich alloys to hcp in Co-rich alloys (Fig.1). The observed magnetic properties are discussed in relation with film morphology and composition.

Co–Ni alloy thin films are used in various magnetic devices, especially in micro system technologies, for manufacture of sensors, actuators and other devices [1-4].

These alloys can be produced using different preparation routes, including thermal evaporation, sputtering and electrodeposition. Their magnetic properties are incompletely understood. In the present work, we concentrate more specifically on the understanding of the conditions for the formation of stripe domains [5].

Co-Ni alloys were electrodeposited by the application of different potential intensity in an aqueous electrolyte bath containing $CoSO_4$ and $NiSO_4$. Two different deposition dynamics were used: pulsed potential deposition and continuous potential deposition. As derived from EDS and Auger analysis, the alloy chemical composition varied from $Co_{88}Ni_{12}$ to $Co_{12}Ni_{88}$. The alloy microstructure, analyzed using AFM, (fig 2), was found to depend on the Co amount. Spherical grains were observed in the Co rich alloys while elliptical grains were observed in the Ni rich alloys. As revealed by XRD analysis (Fig 1) Ni-rich alloys crystallize in the fcc structure of Ni whereas Co-rich alloys crystallize in the hcp structure of Co [1-3]. Magnetic measurements were used for analyzing magnetization processes. In Co-rich alloys the magnetization lies in the film plane whereas in Ni-rich alloys the measurements reveal the occurrence of stripe domains which indicate that the magnetization is at an angle with the plane.

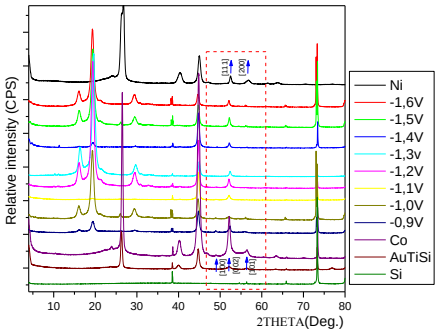

Figure 1: XRD patterns of Ni–Co electrodeposited films of various chemical compositions, the patterns equivalent to $Co_{44}Ni_{56}$ (-1,6V), $Co_{42}Ni_{58}$ (-1,4V), $Co_{50}Ni_{50}$ (-1,3V), $Co_{63}Ni_{37}$ (-1,2V), $Co_{73}Ni_{27}$ (-1,1V), $Co_{85}Ni_{15}$ (-1V), $Co_{88}Ni_{12}$ (-0,9V).

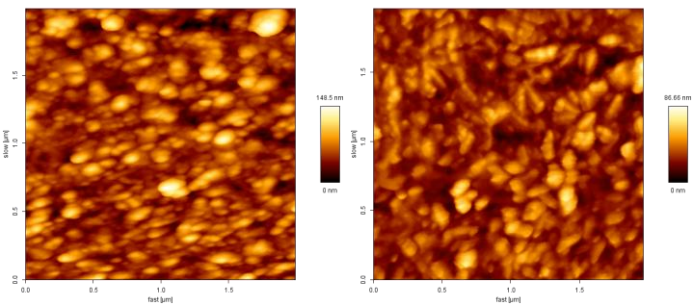

Figure 2: AFM images for (a) $Co_{88}Ni_{12}$ and (b) $Co_{34}Ni_{66}$;(film thickness 200 nm).

References

[1] Liping Wang et al, Appl. Surf. Sci.242 (2005) 326
[2] Meenu Srivastava et al, Surface & Coatings 201(2006) 3051
[3] Goméz E. et al, Electrochim. Acta 51 (2005) 146
[4] Dolati, A. et al, Materials Chemistry and Physics 102 (2007) 118
[5] Khapikov, A. and Uspenskaya, L., Phys. Rev. B 57 (1998) 14990