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Microstructural and magnetic characterization of metastable solid solutions in the Cu-Co-Ni system obtained by mechanical alloying

***M.López*[1]*(*), M.E.Gómez*[2]*, R.Koduri*[1]*, D.Reyes*[2]*, R.Mangalaraja*[1]*, J.Jiménez*[3]*, P.Prieto*[4]

[1]Departamento Ingeniería de Materiales, Universidad de Concepcion-Chile
[2]Grupo de Películas Delgadas, Departamento de Física, Universidad del Valle, Cali-Colombia
[3]Departamento de Metalurgia Física, CENIM-CSIC, Madrid-España
[4]Centro de Excelelencia de Nuevos Materials CENM, Cali-Colombia

* E-mail: marlope@udec.cl

ABSTRACT

The recent development of magnetic nanocrystalline copper alloys shows their emerging candidacy in multi-functional and structural applications. One of these type materials is the Cu-Co-Ni alloy, which has excellent magnetic properties of a fine particle system, and strongly dependant on the interactions among the particles distribution and the nanometric size Cobalt particles. The further consolidation through sintering process has to improve the necessary ductility to make pieces with complex shapes for structural uses. In this work, we report on the microstructure and magnetic properties of the Cu_{1-x}-Co_xNi_5 alloys produced by mechanical alloying containing 5, 7 and 10 at.% Co and 5 at% Ni in each alloy by varying milling time (20,30,45,60 and 80 h) to obtain little magnetic Co-clusters, far from percolation threshold, into the Cu matrix, as evidenced from magnetization measurements. The results of magnetic characterization are consistent with the structural changes occurred during milling and the growth of small Co-fcc nano-particles, and correlated to the evolution in the superparamagnetic behavior as observed by magnetization, X-ray diffraction measurements and TEM microanalysis. These measurements revealed that magnetic properties show that there are differences in the magnetic behavior, coercive fields and saturation magnetization with milling time and for each Cobalt concentration. The Ni content inhibited the two-solid (Cu-Co) phases segregation of the sintered alloys, leading to a grained structure with precipitated Co particles in homogeneous Cu-Ni strengthened solid solution matrix.

Keywords: *Cu-Co-Ni nanoAlloys, Mechanical Alloying, Transport Properties, superparamagnetism*

SIMPOSIA:

- STRUCTURES AND PROPERTIES OF METASTABLE MATERIALS
- DEVOPMENT IN THE PROCESSING AND APPLICATIONS OF Cu BASED ALLOYS