ICAM2009
11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25

Amorphization process by mechanical milling of the Fe_2Zr alloy

J. Medina[(1)*], Ch. Rojas Ayala[(1)], J. Quispe Marcatoma[(1)], and V.A. Peña Rodríguez[(1)]

(1) Facultad de Ciencias Fisicas, Universidad Nacional Mayor de San Marcos, Av. Venezuela Cdra 34, P.O. box 14-0149, Lima 14, Perú, e-mail: jmedinam@unmsm.edu.pe
* Corresponding author.

Abstract – In the present work we study the structure and micro-structure evolution of the Fe-Zr alloy, which is employed as a precursor for the synthesis of the Fe-Zr-B-Cu soft magnetic alloy. The structural and micro-structural characterization of the initial crystalline sample and its evolution to the amorphous state after mechanical milling has been studied employing X-ray diffraction and Mössbauer spectroscopy techniques. The results indicate that after 12 hours of milling the percentage of the amorphous phase is approximately 76%.

Soft magnetic amorphous materials, such as the Fe-Zr-B-Cu alloy (NANOPERM), has been intensively studied in the last years because of the important role they have in various technological applications. In this sense, the study of the Fe-Zr alloy is important because it is employed as a precursor for the synthesis of the Fe-Zr-B-Cu alloy -[1,2,3].

The amorphization process by mechanical milling of the Fe_2Zr alloy is studied by means of X-ray diffraction (XRD) and Mössbauer spectroscopy (MS). The initial Fe_2Zr sample was synthesized following two different routes: (1) mechanical alloying of elemental powders, or (2) melting of elemental powders in an arc furnace under argon atmosphere.

For the first case (route 1), we observed the following: (i) the obtained sample shows a crystalline structure of Laves $MgCu_2$ type; (ii) the Mössbauer spectrum can be fitted employing two Fe-sites; (iii) the structural changes during the milling process are followed by means of XRD. Thus, after 12 hours of milling the sample becomes mainly amorphous; (iv) the MS analysis for 3, 6, 9 and 12 hours milling also indicates a magnetic transition from an ordered magnetic phase to a paramagnetic amorphous phase. If we follow route 2 we observe that the Fe-sites, corresponding to the ordered structure, disappear after increasing the milling time. Thus, after 12 hours milling the percentage of the amorphous phase is approximately 76% which is less than the value obtained following the route 1 (~91%), see Figs. 1 and 2.

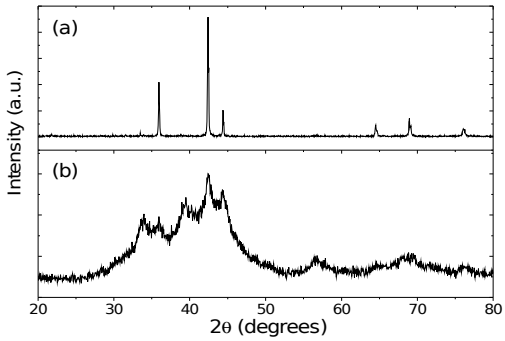

Fig1. X-ray diffraction pattern of the Fe2Zr alloy. (a) initial sample, and (b) after 12 hours milling.

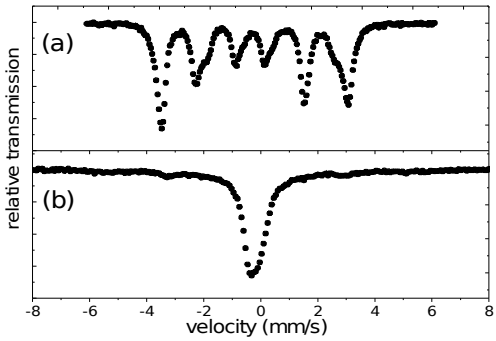

Fig2. Mössbauer spectrum of the Fe2Zr alloy. (a) initial sample, and (b) after 12 hours milling

References

[1] K. Suzuki, N. Kataoka, A. Inoue, A. Makino, T. Masumoto, *Mat. Trans. JIM* **31** (1990) 743.
[2] A. W. Weeber and Bakker, *Phys. B* **153** (1988) 93-135.
[3] G. Concas, F. Congiu, G. Spano, and M. Bionducci, *J. Magn. Magnet. Mater.* **279** (2004) 421-428.

11th International Confere
on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25