Local Structure and Magnetic properties of $Fe_{100-x}Mn_x$ Nanocrystalline Alloys Fabricated by Mechanical Alloying Technique

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In recent years, nanocrystalline materials have been the subject of scientific interest because of their attractive properties often superior to those of conventional polycrystalline materials and also amorphous alloys of the same composition. Their properties are quite different to those of the corresponding crystalline materials. Nanocrystalline materials are novel materials that are not only scientifically interesting but also hold great potential for a number of technological applications [1-3].

In this work, $Fe_{100-x}Mn_x$ (x=3, 10, 30, 50, and 70) metastable alloys is prepared by the mechanical alloying techniques using a SPEX 800 mixer with stainless steel ball as a function of Mn content. We are study the relationship between the magnetic and structural properties, which are used commercial Fe and Mn powders as the precursors.

The effect of variation Mn content on structural characterization is investigated by X-ray diffractometer (XRD) and extended X-ray absorption fine structure spectroscopy (EXAFS). By increasing the Mn content, the FeMn peaks became weaker, broader and shifted to small angle, which correspond to the deformation of structure and variation in the particle size. Concerning magnetic behavior, the data obtained from vibrating sample magnetic (VSM) exhibited both magnetic saturation (M_s) and coercivity (H_c) depend strongly on the Mn content. Magnetization rapidly decreased before 30 at. % Mn because there is a change in structure of mixed powder. After 30 at. % Mn the magnetization is decreased slowly until 2.8 emu/g because the structure has stable. Also, coercivity (H_c) is found to increase with Mn content, reaching a maximum value of approximately 300 Oe for 50 at. % Mn.

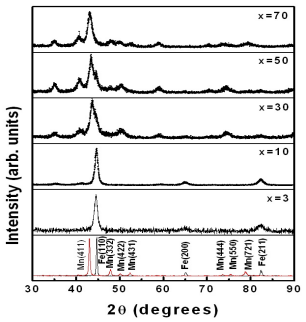

Fig. 1 XRD profiles of $Fe_{100-x}Mn_x$ mechanically alloyed.

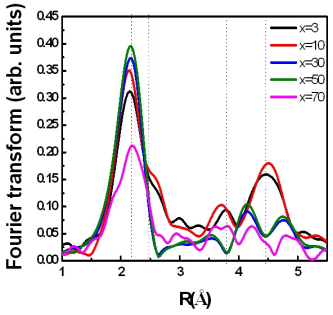

Fig. 2. Fourier transform of EXAFS spectra for $Fe_{100-x}Mn_x$ alloys measured at Fe K edge.

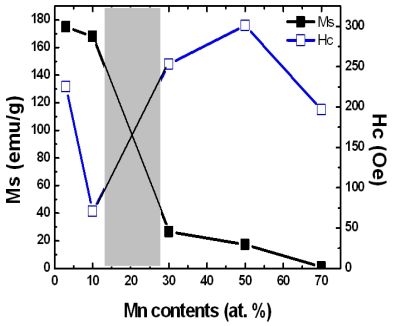

Fig. 3 Variation of magnetization and coercivity for $Fe_{100-x}Mn_x$ alloys.

References

[1] C. Suryanarayana, *Mechanical alloying and milling,* Progressin Materials Science 46 (2001) 1-184.

[2] A. Djekoun et. al., *Physics Procedia* **2** (2009) 693–700.

[3] C. Suryanarayana, C. C. Koch, *Hyperfine Interactions* **130** (2000) 5–44.