

Physico-Chemical nanomaterials science

Influence of magnetization in alternating magnetic field on nanocrystallization of iron-based amorphous alloys

T. Pereverzeva¹, A. Yakymovych², K.W. Richter², O. Hertsyk¹, M. Kovbuz¹, N. Pandiak³

¹ *Department of Physical Chemistry, Ivan Franko National University of Lviv, Kyryla & Mefodiya Str. 6, Lviv-79005, Ukraine.
E-mail: djunjer1@gmail.com*

² *Department of Inorganic Chemistry - Functional materials, University of Vienna, Althanstr. 14, Vienna 1090, Austria*

³ *Ukrainian National Forestry University, Gen. Chuprynka Str. 103, Lviv-79057*

Experiments were carried out for the iron based amorphous alloys $\text{Fe}_{82}\text{Nb}_2\text{B}_{14}\text{Y}_2$, $\text{Fe}_{82}\text{Nb}_2\text{B}_{14}\text{Gd}_2$, $\text{Fe}_{82}\text{Nb}_2\text{B}_{14}\text{Tb}_2$, $\text{Fe}_{82}\text{Nb}_2\text{B}_{14}\text{Dy}_2$ obtained by melt spinning technique in the form of strips. Crystallization of the obtained alloys was examined with the use of differential thermal analysis technique. The samples were heated up to 1123/1373 K with different constant heating rate 5, 8, 15 and 25 K/min. Samples were measured in initial state and after magnetization in low-frequency (50 Hz, 0.43 T) alternating magnetic field during 0.5; 1.5; 3.5 and 10 hours. Phase and microstructure identification were carried out by X-ray diffraction (XRD) measurements. The XRD spectra were measured for samples in the as-quenched state and additionally after heating up to 1123 K with heating rate 5; 8 K/min, so after the nanocrystallization. Microstructures of the initial and after DTA experiments samples were investigated by applying scanning electron microscope (SEM).

DTA curves for all examined alloys reveal only one stage of crystallization i.e. one exothermal peak up to the temperature of 850 K. For the different heating rates of 5; 8; 15 and 25 K/min the peak positions are shifted into higher temperatures. Taking into consideration this temperature shift and using the Kissinger method the activation energy E_a was calculated for all the alloys examined (450÷1050 kJ/mol). For samples of $\text{Fe}_{82}\text{Nb}_2\text{B}_{14}\text{Gd}_2$ after magnetization in alternating magnetic field was no difference in temperatures corresponding nanocrystallization process, but it was different heat flow dependent on time kept in alternating magnetic field.

In all cases the XRD diffractograms are typical for iron-based amorphous alloys and do not show any diffraction characteristic for a crystalline structure. XRD patterns obtained for samples after DTA reveal lines corresponding to the nanocrystalline iron. Microscopic analysis on SEM confirmed presence of nanocrystalline -Fe in samples after DTA measurements.