Structure and Properties of Amorphous-nanocrystalline Alloy $Fe_{77,5}Ni_{3,5}Mo_1Si_2B_{16}$, obtained by controlled Annealing from the Amorphous State

T. Tsaregradskaya, I. Ovsiienko, T. Len, G. Saenko, O. Turkov

Physical Department, Taras Shevchenko National University of Kyiv, Ukraine, tsar_grd@ukr.net

For the amorphous alloy $Fe_{77,5}Ni_{3,5}Mo_1Si_2B_{16}$ study was performed to obtain an amorphous-nanostructured state. The temperature interval for which the growth condition of frozen-in crystallization centers is fulfilled is calculated, but the process of intensive crystallization has not yet begun. Controlled annealing in the found temperature range was carried out.

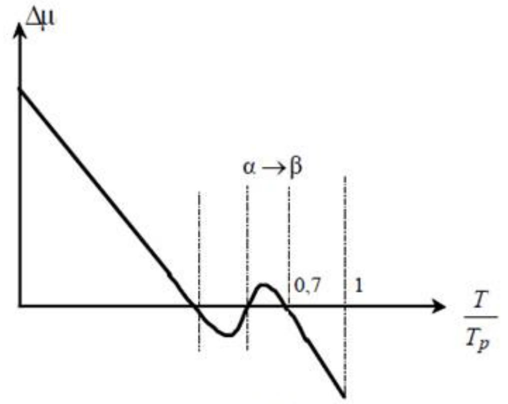

Fig.1. Temperature dependence of the difference of chemical potentials of the *i*-th component in the α- and β-phases, calculated according to the equations of the thermodynamic theory of high-temperature stability of amorphous alloys

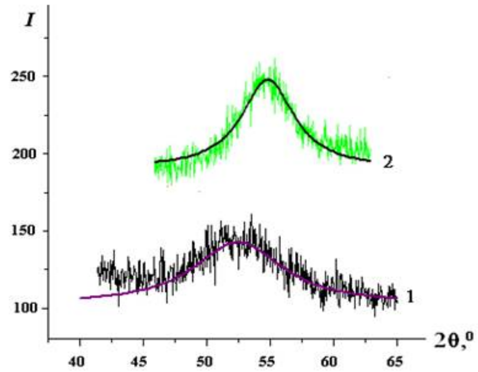

Fig. 2. X-ray diffraction picture (1st maximum) of alloy $Fe_{77,5}Ni_{3,5}Mo_1Si_2B_{16}$ in the amorphous state (1) and after isothermal annealing for 1 h at 450^{0}C (2)

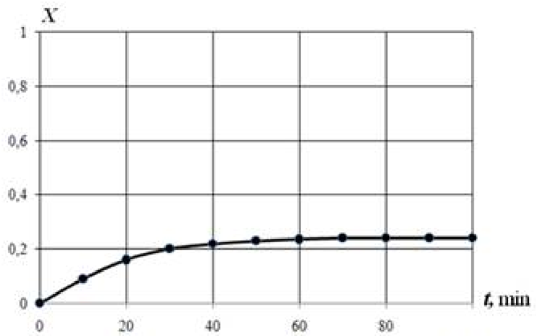

Fig.3. The time dependence of the volume part of the crystalline phase formed during 2 hours of annealing at temperature 455^{0}C in the $Fe_{77,5}Ni_{3,5}Mo_1Si_2B_{16}$ alloy.

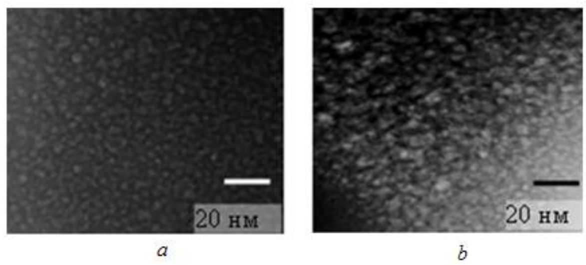

Fig. 4. Electron microscopic (dark field) images of $Fe_{77,5}Ni_{3,5}Mo_1Si_2B_{16}$ alloy in (a) its initial state and (b) after isothermal annealing for 2 h at 455^{0}C

Based on the conclusions of the thermodynamic theory of high-temperature stability of amorphous alloys, a method for obtaining an amorphous-nanocrystalline state from the initial amorphous state by isothermal annealing in the temperature range in which the controlled growth of frozen crystallization centers takes place is proposed.

Samples in the amorphous-nanocrystalline state were obtained, which was confirmed by the results of electron microscopic and *X*-ray diffraction experiments and it was found that the proportion of the crystalline phase in the obtained materials has the value $X = 0.22$.

The microhardness of the obtained alloys increases by 21% compared to the initial amorphous state, which indirectly confirms the growth of frozen crystallization centers and the formation of the amorphous-nanocrystalline state.