Nanocomposites and nanomaterials

Mechanisms of structure- and phase forming during heat treatment of ribbons and bulk amorphous alloys of system (Fe, Ni, Co)-(Cr, Mo, W, V, Al)-(Si, B, C, P)

M.S. Nizameyev[1], V.K. Nosenko[1], O.Yu. Rudenko[1], T.M. Mika[1], V.I. Tkach[2], Moiseeva T.N.[2]

[1] G.V. Kurdymov Institute for Metal Physics of NAS of Ukraine, 03680, Kyiv-142, Ukraine.
E-mail. serpent_87@ua.fm
[2] O.O. Galkin Donetsk Institute of Physics & Engineering of the NAS of Ukraine, 83114, Donetsk, Ukraine

Numerous bulk Fe-based metallic glass (BMG), developed in the last decade is attractive for practical applications because of their unique combination of excellent properties, including high strength, corrosion resistance and relatively low cost of materials. BMG are multicomponent alloys where important role played by the choice of chemical composition that provides the highest glass formation ability (GFA). Authors focused study on the development of alloys with high GFA. Among the different approaches to predict the GFA of alloys most widely used empirical criteria that correlate with the thermodynamic parameters [1]. In this study was carried out further verification of these criteria for the original iron-based alloys. It was found differences in nanocrystallization process for bulk amorphous alloy (BMG) and ribbons with the same chemical composition.

A series of (Fe, Ni, Co)-(Cr, Mo, W, V, Al)-(Si, B, C, P) alloys were prepared by induction melting in an argon atmosphere. The amorphous ribbons with thickness of 20-50 microns were obtained by melt-spinning. Bulk alloys (in the form of plate) with thickness up to 5 mm were obtained by casting in a sectional shape copper mold. Structure, thermal and mechanical properties of rapid quenched samples were investigated using X-ray diffraction, differential scanning calorimetry and microhardness measurement.

Experimentally established that the greatest thickness (about 2.5 mm) sample with glassy structure was obtained for plate of alloy with a total content of metalloid 22 at.%. Onset crystallization temperatures (T_{x1}) of amorphous alloys measured at heating rate of 10 K/min are 765-879 K, while the microhardness (HV) ranges from 8.85 to 11.2 GPa. The resulting linear relationship between T_{x1} and HV indicates that thermal stability and strength of the amorphous phase has a common nature.

1. *Zh. Long, H. Wei , Y. Ding, P. Zhang, G. Xie, A. Inoue, J. Alloys Comps. 475, 207 (2009).*