Nanocomposites and nanomaterials

The influence thermal treatment on phase-formation processes in metallic glasses

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The topical direction of researches of metallic glasses is development of methods of receipt nanostructure state by partial crystallization of amorphous alloys due to external influences. Large attention to thermal treatment of alloys with the amorphous structure of explained with an acquisition of the special properties option in the nanocrystalline state.

Using highly sensitive dilatometer techniques the influence of thermal treatment on the properties of binary and multicomponent metallic glasses ($Fe_{80}B_{20}$, $Fe_{83}B_{17}$, $Fe_{76}Ni_4Si_6B_{14}$, $Fe_{78}Mo_2Si_6B_{14}$, $Ni_{78}Si_4B_{18}$, $Co_{67}Fe_3Cr_3Si_{15}B_{12}$) was experimentally investigated. By the parameter, which determines thermal stability of amorphous alloys there is the temperature of beginning of intensive crystallization. The temperature of preliminary thermal treatment (annealing temperature) was determined empirically based on theoretical positions thermodynamic theory of high-temperature stability of amorphous alloys, according to which there is a temperature range in which the difference between the chemical potentials of the phases of the amorphous matrix – frozen crystallization centers is negative $\Delta\mu_i < 0$. This is performed thermodynamic condition for the possibility of dissolution of frozen crystallization centers due to the process of ascending diffusion. The obtained results showed that the proposed modes of thermal treatment can extend thermostability intervals of amorphous alloys to (20-60) K, due to the dissolution frozen crystallization centers in amorphous phase. As a comparison parameter properties of amorphous alloys in the initial state and after thermal treatment values microhardness were used. It is shown that the microhardness decreases after the thermal treatment by (15-20)%, indicating decrease in part of crystalline phases in samples.

Thus, based on the provisions of the thermodynamic theory of high-temperature stability of amorphous alloys practically implemented purification process of amorphous matrix frozen crystallization centers due to the process of ascending diffusion. Thus there is dissolution frozen crystallization centers present in the original sample that confirmed by results of electron microscopic researches.