Effect of high pressure torsion at different temperatures on the structure-phase transformations in amorphous iron-based alloys

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The effects of the temperature (293 and 77 K) of deformation by high-pressure torsion (HPT) on the atomic structure of melt-quenched amorphous Fe83-xNiB17 alloys (x = 25, 29, 33) and their crystallization thermal effect upon continuous heating have been analyzed by EXAFS in synchrotron radiation, transmission electron microscopy, and X-ray diffraction analysis. HPT at 293 K decreases the crystallization thermal effect, whereas HPT at 77 K increases it regardless of the alloy composition. The observed effect is caused by the reversibility of the structural transformations in the alloys upon variation in the deformation temperature. According to the results of the structure examination, HPT at 298 K leads to the formation of more ordered state (partially crystallized) of the initial amorphous alloys, while HPT at 77 K, on the contrary, stimulates the formation of even more disordered amorphous structure (by destruction of short-range order and an increase in the average values of the coordination numbers around the iron atoms in the first coordination sphere). This work was supported by the Russian Foundation for Basic Research (projects No. 20-32-70007) and the grant of President of the Russian Federation (No. MK-43.2020.2).