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ABSTRACTS

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INFLUENCE OF LOW-TEMPERATURE THERMOCYCLING ON MAGNETIC PROPERTIES OF AMORPHOUS METALLIC ALLOYS OF METAL-METALLOID TYPE

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Our intensive investigations indicate that low-temperature treatment (LTT) in liquid nitrogen or liquid helium acts as a destabilising factor for amorphous glassy metals obtained by rapidly quenching from the melt. LTT causes irreversible changes in chemical and topological short range order and main physical properties of amorphous metallic alloys (AMAs). It was established that magnetic properties of AMAs are the most sensitive to LTT influence and their changes depend primarily on the parameters of LTT (temperature and duration) and the chemical composition of alloy. Fe-based AMAs demonstrate after LTT the increase of the saturation magnetization on 20-30% and small increase in the coercive force. Co- and Ni- based alloys show the opposite tendency - significant increase (up to 30%) in the coercive force and small increase of the saturation magnetization. Moreover, we have obtained that the Curie temperature of AMAs after LTT changes to lower magnitudes (up to 5-7 K at duration LTT in liquid nitrogen 3-5 h). Obtained changes in magnetic properties of AMAs are discussed in the framework of elaborated physical model of LTT-effect.

THE INFLUENCE OF LOW-TEMPERATURE TREATMENT ON THERMOMAGNETIC BEHAVIOR OF Fe- AND Co-BASED AMORPHOUS RIBBONS

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Different external actions are known to cause the changes of operational properties of amorphous ribbons (AR) because of their structural instability. In particular, the irreversible change of the structure and properties in a result of low-temperature treatment (LTT) was found to be inherent in a certain extent to all AR and, hence, such behavior is the global property of such systems [1].
Here we preset the data of magnetometric investigation of Fe- and Co-based AR subjected to LTT in liquid nitrogen for 3 hrs. The contents of the studied AR prepared by melt-spinning technique were as follows: Fe81Si4B13C2 (a), Co58Ni10Fe5Si11B16 (b), Fe61Co20Si5B14 (c) and Fe77Ni1Si9B13 (d). Temperature dependencies of magnetization were obtained in the temperature range 300-900 K in the field 550 kA/m using automatic Faraday magnetometer (the heating rate was equal to 10 K/min).
The shape of thermomagnetic curves was found to be qualitatively similar for as-quenched and treated AR. However, some quantitative changes, which may be considered as the evidence of the nearest neighbor atomic rearrangement, were observed. Namely, the Curie temperature after LTT became some lower as compare to as-quenched AR: 637 and 634 K for sample (a), 480 and 477 K for sample (c), 676 and 763 K for sample (d). Besides, LTT was revealed to change the character of thermomagnetic curves that may reflect the reducing of spin-wave stiffness coefficient, which is directly related to the mean value of exchange energy. One more general consequence of LTT consists in the variation of crystallization temperature corresponding to the formation of metalloid-containing phases. This effect is rather small but significant and may testify the variation of the metal-metalloid nearest neighboring and of the character of quenched structural inhomogeneities. So, LTT promotes transformation of amorphous system to the new state of metastability that differs from the initial state by the atomic order and rate of homogeneity. An additional confirmation of the above statement was obtained from the analysis of magnetic moment localized on metal atoms in as-quenched and treated AR.
It should be noted that the obtained results are in agreement with the data of Mossbauer studies and small-angle neutron diffraction available in literature.

[1] A.M.Glezer, S.G.Zaichenko, N.S.Perov a.o. Izv.RAN (Phys.), 65 (2001) p.1472.