The behavior of secondary phase in FeCo-based alloys subjected to high-pressure torsion.

In this work we investigating the influence of high-pressure torsion (HPT) on phase transformations, microstructure, magnetic properties and ordering of the FeCo-Ni, FeCo-Mo, and FeCo-Nb ternary alloys. The behavior of the different secondary phase precipitates under the HPT is of particular interest.

Severe plastic deformation techniques such as HPT can cause different phase transformations. Recently we investigated the effect of HPT-induced γ-phase suppression in FeCo-V ternary alloys [1]. Generally speaking, HPT process caused martensitic transformation of γ-phase along with non-equilibrium supersaturation of a bcc-type solid solution (α-phase) in the FeCo-V alloy. HPT-induced supersaturation of the α-phase in FeCo-based alloys can be used for tailoring functional properties, such as coercivity and microhardness.

The goal of this research is to study the influence of HPT on microstructure, phase composition, atomic ordering and functional properties of the equiatomic FeCo-based intermetallic alloys.

Three alloys were selected for this research: $FeCo_{(1-x)}$-$Ni_{(x)}$, $FeCo_{(1-x)}$-$Mo_{(x)}$, and $FeCo_{(1-x)}$-$Nb_{(x)}$. The concentrations of the ternary elements are selected with regard to a ternary phase diagram (in case of Ni) and previous studies [2] on solubility of ternary elements in FeCo. The alloys in form of cylindrical bars with a diameter of 10 mm were prepared by arc melting and tilt casting in Kato lab, IMR. Two series of the samples were prepared. In the first series the content of the third element was within or close to the solvability limit, in the second series the content exceeded the solvability limit. The samples were homogenised at 1000 ^{0}C for 1 hour under an argon atmosphere, to obtain nearly equilibrium state. x-ray diffraction was used to identify the phase composition after annealing (Cu Kα radiation). High-temperature solid solution type gamma-phase is clearly seen on the diffraction pattern of the FeCo-Ni20 alloy (Fig. 1) Due to high background noise from Fe-rich samples, it is hard to see the second phase in other diffraction patterns. However, second phase can be seen with an optical microscope. Fig 2 shows microhardness values, averaged over 10 measurements of each sample. Microhardness of FeCo-20at%Ni is the lowest, owing to the substantional amount of γ-phase. Other samples have elevetated values of HV, due to solid-state hardening and precipitation

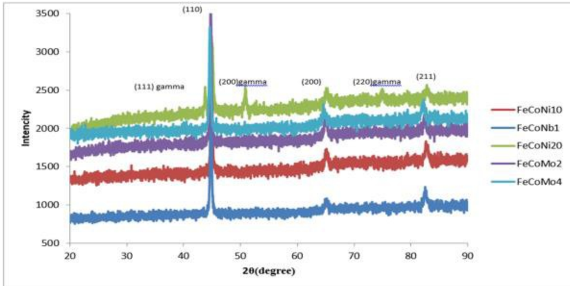

Fig. 1 X-ray diffraction pattern of FeCo-X alloys after annealing.

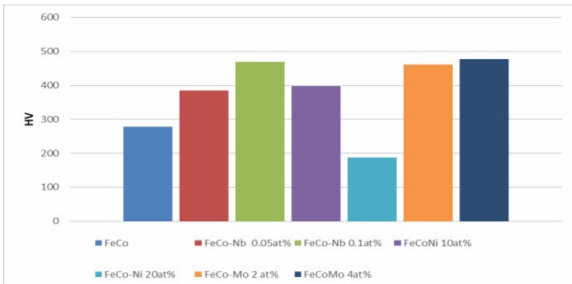

Fig. 2 Microhardness of FeCo-X alloys.

HPT experiments in the Bridgman chamber followed by TEM, magnetic hysteresis measurements will be conducted in I. P. Bardin Central Research Institute of Iron and Steel Industry (Russia) and in National University of Science and Technology MISiS (Russia) shortly. We also planning to measure an atomic order degree by means of neutron diffraction.

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