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Report:

The Mössbauer spectra of the binary alloy and ternary quasiordered $Fe_{65}Al_{35-x}M_x$ and $Fe_{65-y}Al_{35}M_y$ alloys (x, y = 5, 10 at.%) were measured at variable temperature (3.3 – 80 K) and magnetic field (0 – 7 T). The form of the spectra is typical for systems with some degree of chemical disorder inherent in superstructure of non-stoichiometric composition. The average hyperfine magnetic field (HMF) at various temperature calculated from the ^{57}Fe HMF distributions p($\boldsymbol{B}_{hf}$) is given in Fig.1. $\boldsymbol{B}_{hf}$(T) dependences of three systems: $Fe_{65}Al_{35}$, $Fe_{65}Al_{30}Ga_5$ and $Fe_{60}Al_{35}Mn_5$ are similar. One can see a sharp collapse of the high-field magnetic components of spectrum starting with 30-40 K and followed by relatively slow decrease of a low-field magnetic splitting above 80K. These dependencies can be described by two functions Brillouin type, belonging to different magnetic phases with different values of magnetic ordering temperature and $\boldsymbol{B}_{hf(0)}$. The $\boldsymbol{B}_{hf}$(T) dependence for the $Fe_{65}Al_{30}B_5$ alloy is closest in their behavior to the systems with a ferromagnetic ordering, but there is the segment in the curve near 40K, indicating that not a single magnetic phase is presented in the alloy.

Mössbauer spectra of the $Fe_{65}Al_{35}$ alloy at T = 5K in external magnetic field were measured according to the scheme 0.1 T → 2.5 T → 0.1T. A comparison of the spectra did not reveal any significant differences neither in their shape nor in the average HMF.

Analysis of a series of in-field Mössbauer spectra clearly showed that the spectra contain components with an effective HMF, which decreases with the increase of external magnetic field (Fig 2.). That is, these components correspond to the probe atoms whose magnetic moments are ordered ferromagnetically. The values of the ^{57}Fe effective HMF of these components are arranged in the interval [15.0÷33.0 T] and are close to the field values for some local configurations of probe atom in the ordered Fe–Al alloys [1]. Comparison of HMF distributions (calculated using SpectrRelax [2]) for spectra, measured without an external magnetic field and in the magnetic field, proves that there are components in the spectra, demonstrating the behavior in the field, not typical for ferromagnetic ordering of magnetic moments (Fig. 2). The values of the effective HMF of these components are arranged in the interval [0÷15.0-17.5 T]. From these considerations the model of magnetic microstructure was developed. The Mössbauer spectrum is represented as a superposition of a set of discrete components (related to a probe atom in a certain local environment) and of the contribution from the resonance of atoms whose magnetic moments form an incommensurate spin density wave. Correct processing of the Mössbauer spectra in context of this model is a nontrivial problem and requires detailed validation.

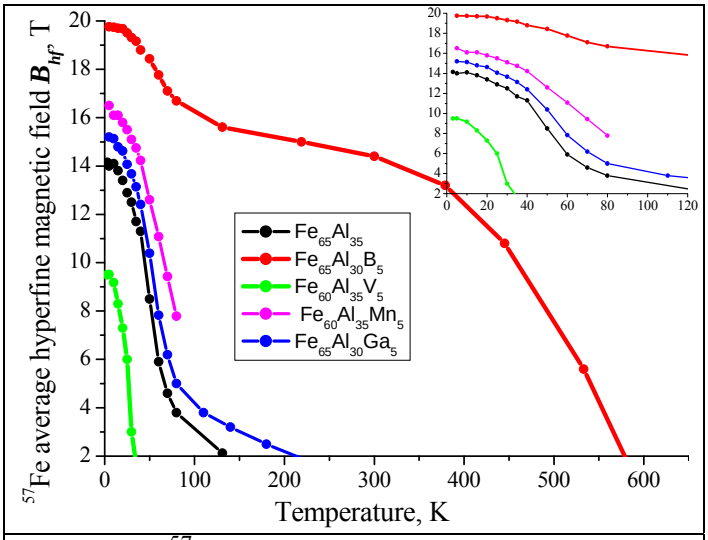

Fig.1. The ^{57}Fe average hyperfine magnetic field at various temperature

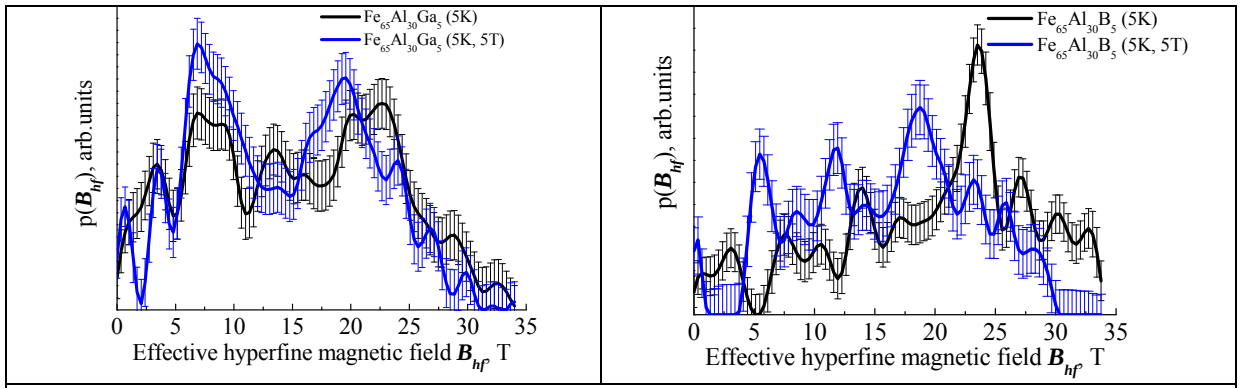

Fig 2. p($\boldsymbol{B}_{\rm hf}$) distributions for the spectra of the $Fe_{65}Al_{30}Ga_5$ and $Fe_{65}Al_{30}B_5$ alloys measured at T=5K and at T=5K, under magnetic field H=5T.

Mössbauer spectroscopy analysis of the alloys showed that the influence of *sp*-admixtures on is essentially different: adding Ga to the initial binary alloy results in a slight increase in the average ^{57}Fe HMF, whereas addition of 5 at % of boron to the initial alloy $Fe_{65}Al_{35}$ makes grow the average HMF of ^{57}Fe considerably, from 14.0 to 20.0 T. The same is observed for 3*d*-admixtures: replacing Fe with V in ternary alloy $Fe_{65-x}V_xAl_{35}$ leads to collapse of weak hyperfine magnetic splitting. Insertion of Mn atoms into the initial alloy results in an increase of hyperfine magnetic splitting and disappearance of the nonmagnetic component.

1. Elsukov E.P., Voronina E.V., Korolev A.V., Elsukova A.E., and Godovikov S.K. **Fiz. Met. Metalloved**., **104**, 38-42, (2007).
2. Matsnev M.E., Rusakov V.S. **AIP Conf. Proc. 1489**, 178-185 (2012).