MÖSSBAUER, XRD AND SEM STUDY OF FE-AL-BASED POWDER ALLOYS WITH NANOINCLUSIONS.

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Iron aluminides are considered as potential candidates for high temperature structural applications due to their excellent resistance to oxidation and corrosion as well as good mechanical properties at high temperatures and low cost of raw materials. Oxide dispersion strengthening, which involves milling of FeAl powders with the addition of oxide (Al_2O_3, Y_2O_3, etc.), is an effective method to improve the high temperature creep resistance, heat resistance and hardness. Self-propagated High Temperature Synthesis with preceding Mechanical Activation (MA SHS) is one of the most prospective methods of powder metallurgy. SHS of FeAl powders is rapid and non-equilibrium process which leads to the formation of non-equilibrium and nonstoichiometric phases accommodating essential concentration of defects effectively influencing the properties of alloys [1].

$(FeAl)_{1-x}(Al_2O_3)_x$ (x=64-80 wt.%) samples has been prepared using SHSMA method from FeAl (30 Al wt.%) and Al_2O_3 powders mechanically activated in the attritor. Samples have been studied by ^{57}Fe transmission Mössbauer spectroscopy (TMS), X-ray diffraction (XRD) and scanning electron microscopy (SEM) with attached energy dispersive spectroscopy (EDS) system.

SEM results revealed that typical grain size of iron-containing phases varies from 50 to 200 nm. Diffusion of Fe atoms in Al_2O_3 has not been observed by EDS analysis. XRD studies showed the formation of iron-containing phases B2 FeAl and Fe_2Al_5 in all studied samples. TMS investigations confirmed the presence of B2 FeAl and Fe_2Al_5 phases as well as some amount of unreacted (retained) α-Fe. Moreover TMS allowed to detect the formation of magnetic phase with H_{eff} close to solid solution α-Fe(Al) phase not observed by XRD. Analysis of hyperfine parameters demonstrated the tendency to decrease of IS characterizing B2 FeAl phase with growth of Al_2O_3 fraction. According to the model suggested in our earlier papers [2] this tendency indicates Al depletion of B2 FeAl with the increase of Al_2O_3 content. Possible mechanisms of rearrangement in B2 FeAl lattice are discussed.

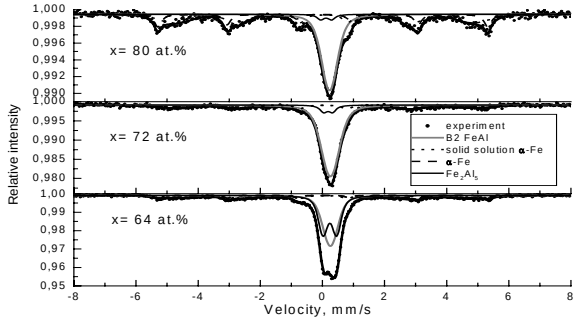

Fig. 1 Mossbauer spectra

[1] M. Kogachi, T. Haraguchi, S. M. Kim, Intermetallics **6** (1998) 499-510.
[2] J. Fedotova, et al., Proc. Int. Conf. "ISIAME", Madrid, (accepted for publication) **(**2004**).**