UNEXPECTED MAGNETIC PROPERTIES OF NANOSTRUCTURED NiMnFeGa FERROMAGNETIC SHAPE MEMORY HEUSLER ALLOYS

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The present revue describes recent progress in the investigation of the magnetic and structural transitions performance in the amorphous and nanostrucured ferromagnetic shape memory alloys NiMnGa. During last years much attention has been paid to study of the effect of “giant” magnetic field induced strains up to 10% in this alloys. Recently the alloy one more time has been recognized as “record-holder”. It was shown in the experimental study of the amorphous films and in the nanostructured samples of the alloy produced by severe plastic deformation that ferromagnetic order disappears in response to artificial nanostructure or amorphous state production in the alloy [1,2].

The amorphous NiMnGa films have been prepared by vacuum deposition on the cold substrate [1]. They demonstrated very low magnetic field susceptibility with plane temperature dependence which have been attributed to Pauli paramagnetism. After annealing the ferromagnetic order recovers. Further annealing leads to the recover of martensitic transition.

The nanostructered NiMnGa samples were prepared be sever plastic deformation by compression with torsion at pressure up to 7 GPa with 10π turns. [2]. The X-ray and TEM tests confirm origin of the nanostructure with mean grain size 10-30 nm. The Curie temperature of the bulky sample is found at 380 K and martensitic transition temperature at 340 K. Nor magnetic nor martensitic transition have been found in nanostructured samples. The annealing at 600 K leads to recover of the ferromagnetic ordering with approximately the same Curie point. This may be concluded that new theoretical approaches should be developed in order to treat the observed behavior.

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[1] K.W.Kim, Y.V.Kudryavtsev, et al. IEEE Trans. Magnetics, 40 (2004) 2775.
[2] R.N.Imashev, Kh.Y.Mulyukov, et al. J.Phys.:Condens.Matter 17 (2005) 2129.