Magnetic properties of $YbFe_4Al_8$ compound studied by Mössbauer spectroscopy

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The RFe_4Al_8 compounds with tetragonal $ThMn_{12}$ type structure (R = rare earth) show unusual magnetic properties which have been subject of intensive study. These compounds crystallize in a body centered tetragonal cell, space group *I4/mmm*. The rare earth occupies the *2a* crystallographic sites, at the origin and center of the cell. In the ordered and ideally stoichiometric compound the remaining *8f* sites are fully occupied by Fe atoms and *8i* and *8j* sites by the Al atoms only. However in the partially ordered compounds or in compounds with an excess of iron atoms, the random occupation of *8i* and *8j* sites by Fe atoms is also detected [1]. Recently in the papers [2, 3] the results of investigations on $YbFe_4Al_8$ intermetallic compound were reported. It was found that the value of magnetization is highly dependent of the value of applied magnetic field. Magnetization measurements as a function of decreasing temperature shown a characteristic flat dependence started at 150 K and reached a maximum at about 100 K [2]. Below the temperature of 35 K the field cooled (FC) magnetization becomes negative what was interpreted in [2] as a manifestation of a superconducting transition.

In this work the temperature dependence of the hyperfine parameters for ^{57}Fe nucleus in the range (80-370) K was determined. The room temperature Mössbauer spectrum exhibits an asymmetric quadrupole doublet. With decreasing temperature a magnetic component (Zeeman sextet) attributed to iron Fe-8f atoms appears in experimental spectra. In Fig. 1 the hyperfine magnetic field B_{hf} and the relative intensity A_2 of peak pairs (2,5) of the Zeeman sextet as a function of temperature are plotted. The increase in B_{hf} is connected with an abrupt decrease in value of A_2 at 150 K followed by a continuous increase up to temperature about 100 K. This result indicates that observed below 150 K ordering of the Fe atoms occurs by a spin-reorientation process, the iron moment rotates from the almost parallel to the almost perpendicular direction relatively to the incident gamma rays.

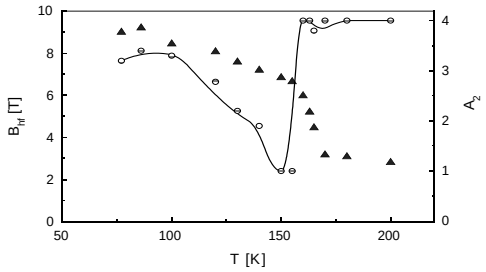

Fig.1. Hyperfine magnetic field B_{hf} (triangles) and intensity A_2 (circles) of peak pairs (2,5) of the Zeeman sextet plotted as a function of temperature

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