MÖSSBAUER AND MAGNETOMETRIC STUDIES OF SPIN REORIENTATIONS IN $ER_{2-X}TH_XFE_{14}B$

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In our long term program of spin reorientation studies in $R_2Fe_{14}B$ (R = rare earth), ^{57}Fe Mössbauer Spectroscopy and magnetometry have been used to study the polycrystalline $Er_{2-x}Th_xFe_{14}B$ (x = 0.5, 1.0, 1.5) compounds in the temperature range 4.2 - 340 K. Thorium is not a lanthanide, yet is was possible to incorporate it into Er sites of the crystal lattice, which made studies of this material quite interesting. The studied compounds crystallize in a tetragonal crystal structure of the $Nd_2Fe_{14}B$ - type with six inequivalent iron sites. The compounds exhibit spin reorientation phenomena (transitions from planar to axial spin arrangement) with increasing temperature.

The spin reorientation for each compound has been investigated by narrow step temperature scanning in the neighborhood of the spin reorientation temperature. The Mössbauer spectra of the whole series were analyzed using simultaneous fitting procedure and the exponential approximation of the transmission integral. For temperatures outside the transition region, the Mössbauer spectra were analysed using six Zeeman subspectra (Fig.1),

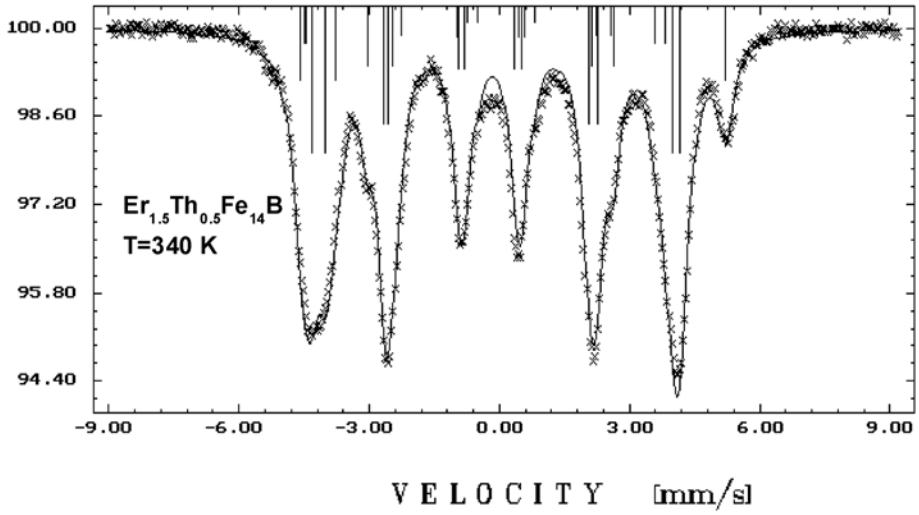

Fig. 1

associated with six inequivalent crystal sites in $Er_{2-x}Th_xFe_{14}B$ according to site occupations ($16k_1$:$16k_2$:$8j_1$:$8j_2$:4c:4e). In the region of transition - each subspectrum splits into two Zeeman sextets. Those sextets were described by different hyperfine magnetic fields and quadrupole splittings. The composition dependencies of hyperfine interaction parameters were determined from fits.

The spin reorientation temperatures for the investigated compounds were derived from magnetometric and Mössbauer studies and the spin phase diagram for the whole series was constructed.