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Magnetic phase transitions in rare-earth intermetallic compounds

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Intermetallic compounds of rare-earth and 3*d*-transition metals attract an attention due to both technical and fundamental interest. These RT compounds are of interest of engineering as a basis for ultra strong permanent magnets. From the fundamental point of view the RT compounds attract an attention as subjects of inquiry, which show various kinds of magnetic phase transitions. A number of dramatic and pronounced effects, originated from exchange interactions and a magneto crystalline anisotropy, can be observed at those transitions. For example, a dependence of the magnetization magnitude from its orientation relatively the crystallographic axesis revealed at the spontaneous spin-reorientation transitions. The itinerant metamagnetism of the 3d-electron subsystem is accompanied by first-order phase transition from paramagnetic to ferromagnetic state. Modulated magnetic structures are transformed to the induced ferromagnetic state by a commensurate-incommensurate phase transition.

We review the results of our investigations of the magnetic phase transitions in Tm_2Fe_{17}, $Tb_{1-x}Er_xNi_5$, $TbMn_6Sn_6$, $Er_xY_{1-x}Co_2$, $Tb_xTm_{1-x}Co_2$, $LaFe_xGa_{1-x}C$ and $La_{0.75}Sm_{0.25}Mn_2Si_2$compounds. Neutron diffraction experiments were carried out on diffractometers: D-3 (Zarechny, Russia), E-4 (Berlin, Germany), HRPD (Taejon, Korea), C-2 (Chalk River, Canada) DMC, FOCUS and HRPT (Willigen, Switzerland).

In the Tm_2Fe_{17} the spontaneous spin-reorientation transition is accompanied by large magnetization anisotropy of Tm- and Fe-sublattices. Using temperature dependence of the Tm-sublattice magnetization we have determined the parameter of Tm-Fe exchange interaction and anisotropy constants of the Tm- and Fe-ions. The spin-reorientation transition, governed by concentration, is observed in $Tb_{1-x}Er_xNi_5$ as a rotation of the spontaneous magnetization from the basal plane to the *c*-axis at 2 K. The spin rotation in $TbMn_6Sn_6$ can be induced at room temperature by an application of a relatively low external magnetic field. The commensurate-incommensurate phase transition in $TbNi_5$ can be droved by the external field 3.5 kOe. A coexistence of long and short-range magnetic orders is revealed in concentration range near the critical concentration in $R_{1-x}Y_xCo_2$ compounds, in which the itinerant metamagnetic transitions takes place.