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Magnetocaloric anisotropy in single crystals

This thesis is devoted to research on the anisotropy of magnetocaloric effect (MCA) in magnetic single crystals. The main purpose of the performed studies was to understand various mechanisms determining investigated effect. Until now the majority of studies of MCE deal with the conventional MCE, which peaks at the Curie temperature and the anisotropic contributions to MCE have not been sufficiently investigated. To achieve the objectives of this thesis a numbers of methods were used, such as: X-ray diffraction, high resolution scanning electron microscopy, magnetometry (*dc* and *ac* SQUID), specific heat, paramagnetic resonance and magnetocaloric effect direct measuring technique. Two kinds of crystals were chosen for these studies: cobaltites ($YbCoGaO_4$ and $LuCoGaO_4$) and Fe_7Se_8.

Investigated cobaltites are highly anisotropic spin glasses. In the studied compounds conventional and inverse MCE was measured and analyzed. For the first time Schottky effect contribution to MCE was observed in spin glasses. The origin of Ising anisotropy in $YbCoGaO_4$ was explained in terms of a molecular field model. The Fe_7Se_8 single crystal is ferrimagnetic metal with high Neel temperature. The reorientation spin transition from easy *c*-axis to easy *c*-plane has been observed near the temperature $T_r \approx 125$ K. It proceeds in an abrupt fashion, as a first-order phase transition. The first order metamagnetic field induced transitions have been identified above and below T_r in Fe_7Se_8 crystal. Conventional magnetocaloric effect related to the metamagnetic transitions has been found above T_r while below T_r inverse magnetocaloric effect is clearly seen. It was shown that the rotating MCE can be quite significant in this system. The phenomenological theory of rotational MCE model based on the Landau theory was developed. It was shown that rotational MCE is determined mainly by the magnitude of the magnetic anisotropy. It is in contrast to conventional MCE materials in which the contribution of the exchange energy change during