Title: Spin reorientation and metamagnetic transitions in $RFe_{0.5}Cr_{0.5}O_3$ (R = Tb, Dy, Ho, Er) perovskites.

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Abstract:

Magnetization vs T and vs H and powder neutron diffraction were used to characterize the spin reorientation transitions for the transition metal sublattice and rare earth cation magnetic ordering for $RFe_{0.5}Cr_{0.5}O_3$ (R = Tb, Dy, Ho, Er) perovskites. As temperature decrease, all the compounds show a fist spin reorientation (SR) transition from Γ_4 to Γ_2. The transition occurs in a wide temperature range, where both magnetic configurations co-exist.

$HoFe_{0.5}Cr_{0.5}O_3$ didn´t show any other SR transition down to 1.5 K and it shows Ho^{3+} sublattice ordering at relatively high temperature (45 K).

$DyFe_{0.5}Cr_{0.5}O_3$ and $ErFe_{0.5}Cr_{0.5}O_3$ show a second SR transition for the transition metal sublattice, from Γ_2 to Γ_1 at very low temperatures (15 K and 8 K respectively). For the Er compound the transition is an incomplete transition, since at 1.5 K both magnetic structures, Γ_2 and Γ_1 coexist. For the Dy compound the transition is complete and it is much sharper than the Γ_4 to Γ_2 transition. For these two compounds a metamagnetic transition is observed at an external magnetic field of H= 7 kOe. The fact that this is only observed for the compounds that show the transition from $\Gamma_2 \rightarrow \Gamma_1$ and around the same temperature range (5K≤T≤8) show that there is a correlation between the existence of the Γ_1 and the MM transition. We propose that the external magnetic field (H) induces a transition $\Gamma_1 \rightarrow \Gamma_2$.

$TbFe_{0.5}Cr_{0.5}O_3$ is a peculiar case, since is the only one that shows a re-entrant SR to Γ_4 at very low temperatures. This type of re-entrant SR transition, consists in the return to a state compatible with the Γ_4 representation. When both sublattices are ordered in a manner compatible with Γ_2 it is likely that there exists some degree of coupling between Fe^{3+}/Cr^{3+} and Tb^{3+}. Below a certain temperature, these sublattices become decoupled, evidenced by the return to a configuration belonging to Γ_4. A phase diagram was developed with all the SR transitions and R^{3+} ordering temperatures, for all the compounds $LnFe_{0.5}Cr_{0.5}O_3$.