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# Spin reorientations and crystal field modification in $\text{Ho}_{1-y}\text{Gd}_y\text{Al}_2$ compounds

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## Abstract

We have performed an experimental and theoretical investigation on the spin reorientation transitions  $\text{Ho}_{1-y}\text{Gd}_y\text{Al}_2$  compounds. Crystallographic, magnetic and calorimetric measurements have been performed for five selected samples in the  $\text{Ho}_{1-y}\text{Gd}_y\text{Al}_2$  series ( $y = 0, 0.25, 0.5, 0.75$  and  $1.0$ ). From the results, a linear increase in the lattice parameter as a function of Gd-content ( $y$ ) is observed. Magnetization measurements show that all samples present collinear ferromagnetism. Specific heat measurements were performed in order to detail the first-order spin reorientation transition (FOSRT) that appears for  $\text{HoAl}_2$  around 20 K. Furthermore, we investigated how the increase in Gd content affects the character of such phase transition. Our results show a slightly modification in the spin reorientation transition temperature, which moves to lower temperatures as Gd is increased in  $\text{HoAl}_2$ , whereas for the selected concentrations up to  $x = 0.75$  the first-order character of the transition is maintained. The theoretical analysis by means of a model Hamiltonian that includes crystal field, exchange and Zeeman interactions reveals a modification in the crystal-field acting on Ho ions as Gd-content is increased.

*Keywords:* ferromagnetism, Spin Hamiltonians, Spin Reorientation, Crystal Field

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