Theoretical investigation of oxygen concentration dependence on the magnetic properties of GdN\(_{(1-x)}O_x\)

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The magnetocaloric effect (MCE) is usually investigated by two processes: isothermal and adiabatic ones leading to two important characteristic thermodynamic quantities: the isothermal entropy change (\(\Delta S_T\)) and the adiabatic temperature change (\(\Delta T_{ad}\)). Its applicability on the so called magnetic refrigeration is well known, since it may come as environmental friendly and high efficiency substitution for the gas compression refrigeration. More specifically, the rare-earth nitrides (RN) are good candidates in order to be used as magnetic refrigerants for the liquefaction of hydrogen, since the RN does not react with hydrogen, as per example, the RAl\(_2\) family of compounds [1]. The use of hydrogen as fuel for energy systems is also an environmental friendly solution for energy systems. In this work, we have studied theoretically the MCE properties and the oxygen concentration dependence on the magnetic properties of the antiferromagnetic GdN\(_{1-x}\)O\(_x\). The experimental data shows a decrease in the transition temperature, T\(_N\), for a low increase on the oxygen content and a metastable transition from the antiferro to ferromagnetic state with increasing the magnetic field [2]. Our model Hamiltonian includes contributions of the Zeeman effect, and the exchange interactions among the Gd sublattices.


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