

Vacancy-Driven Magnetism of GdMnO₃

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Abstract : GdMnO₃ belongs to orthorhombically distorted, GdFeO₃-type family of perovskite compounds. These compounds are naturally vacant and the amount of vacancies depend on the sample preparation conditions. Our GdMnO₃ samples were prepared by float zone method and the vacancies were controlled using an air, Ar and O₂ preparation atmosphere. The highest amount of vacancies was found for sample prepared in Ar atmosphere, while the sample prepared in O₂ was observed to be almost vacancy-free. The magnetic measurements indicate that the preparation atmosphere has no impact on Néel temperature (T_N ~ 42 K), however, it has strong impact on the incommensurate antiferromagnetic (IC) to canted A-type weak ferromagnetic (AWF) phase transition at T₁: T₁ = 23.4 K; 18 K and 6.7 K for samples prepared in Ar; air and O₂ atmosphere; respectively. The hysteresis loop measured at 2 K has a butterfly-type shape with the remnant magnetization (M_r) of 0.6 μB/f.u. for Ar and air sample, while M_r = 0.3 μB/f.u. for O₂ sample. The shape of the hysteresis loop depends on the preparation atmosphere in magnetic fields up to 1.5 T, but is independent for higher magnetic fields. The coercive field of less than 0.06 T and the maximum magnetic moment of 6 μB/f.u. at magnetic field μ₀H = 7 T do not depend on the preparation atmosphere. All these findings indicate that only AWF phase of GdMnO₃ compound is directly affected by the vacancies in the system, while IC phase and the field induced ferroelectric phase are not affected.

Keywords : magnetism, perovskites, sample preparation, magnetic phase transition

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