Experimental report

13/12/2022

Proposal: **5-31-2558**

Council: 4/2017

Title: 160GdMn2O5 under pressure, a good candidate for multiferroics

Research area: Physics

This proposal is a new proposal

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Samples: GdMn2O5

Instrument	Requested days	Allocated days	From	To
D20	5	5	29/03/2018	03/04/2018

Abstract:

RMn2O5 are multiferroic compounds which are promising for applications in data storage. In TbMn2O5, a strong magneto-electric effect has been evidenced. In particular, a spin-induced ferroelectric transition occurs in a CM magnetic phase with the propagation wave vector qCM =(½+, 0, ¼+). The role of the R3+ size has been emphasized because of the influence of the rare earth element. GdMn2O5 with intermediate R3+ size is at the boundary between ferroelectric and non-ferroelectric compounds. This compound is particularly interesting due to its strong electric polarization and giant tenability (ΔP = 5000 μC/m2) with magnetic field. In addition, the electric polarization increased under pressure. With the help of isotope 160Gd enriched compound, our team already determined its magnetic structure at ambient pressure by neutron diffraction experiment. Combined with the results of PrMn2O5 under pressure we obtained recently, it will be very promising to investigate the magnetic ordering of 160GdMn2O5 and the possible phase transition associated with the large magnetoelectric effect under pressure.

Experimental report of Proposal: 5-31-2558

RMn_2O_5 are multiferroic compounds which are promising for applications in data storage. In $TbMn_2O_5$, a strong magneto-electric effect has been evidenced. In this compound, a succession of phase transitions and in particular a spin-induced ferroelectric transition which occurs in a CM magnetic phase with always the same propagation wave vector q_{CM}=1/2 0 1/4. The influence of the rare earth on the multiferroic properties is obvious. The role of the R^{3+} size has been emphasized. $GdMn_2O_5$ with intermediate R^{3+} size is at the boundary between ferroelectric and nonferroelectric compounds. This compound is particularly interesting due to its strong electric polarization and its giant tunability (ΔP = 5000 µC/m2) with magnetic field. In addition, the electric polarization is also increased under pressure. In order to investigate a possible phase transition associated with the large magnetoelectric effect under pressure, we would like to study the magnetic ordering of $^{155}GdMn_2O_5$ under pressure and compare the results with other RMn_2O_5 compounds such as $TbMn_2O_5$ and YMn_2O_5.

The PND experiment was conducted with a wavelength of λ = 2.42 Å on a sample ^{160}GdMn2O5. We used a Paris-Edinburgh pressure cell with a sample volume of about 50 mm3, with ethanol-methanol as the pressure-transmitting medium to obtain hydrostatic compression up to 10 GPa. Lead (Pb) was placed inside the anvil cell enabling pressure estimation using a Pb diffraction pattern combined with its equation of state. We obtained a very good result showed in figure 1. The magnetic structure at the propagation wave vector q_{CM} is thus replaced under pressure by a PCM (1/2 0 ½) magnetic order. The refinement of the nuclear and magnetic structures were carried out using the FULLPROF program. A paper as been published : W. Peng, V. Balédent, C. V. Colin, T. C. Hansen, M. Greenblatt, and P. Foury-Leylekian, Phys. Rev. B 99, 245109 (2019)

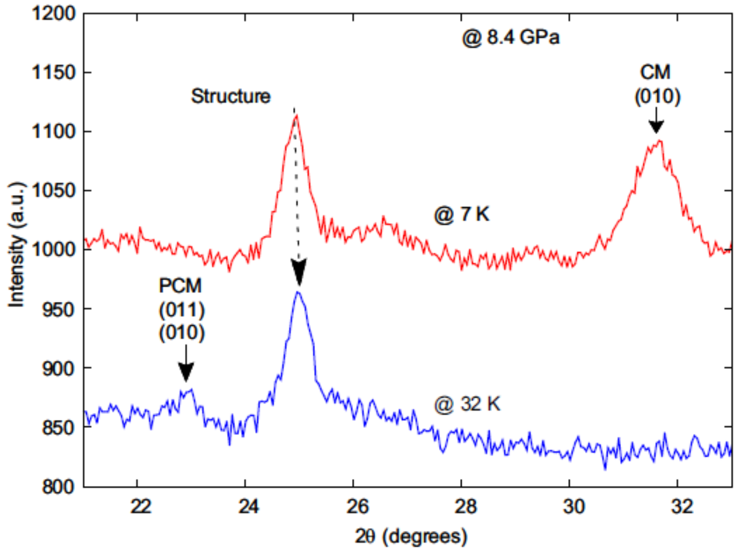

Figure 1 : Temperature evolution of the main reflections of the CM: (010) and PCM: (010) & (011) phases at 8.4 GPa.