Experimental report

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Proposal: 5-31-2475 **Council:** 4/2016

Title: PrMn2O5 under pressure, a good candidate for multiferroism

Research area: Physics

This proposal is a new proposal

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Samples: PrMn2O5

Instrument	Requested days	Allocated days	From	To
D1B	6	8	06/06/2016	14/06/2016

Abstract:

RMn2O5 are multiferroic compounds which are promising for applications in data storage. In TbMn2O5, 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 qM=1/2 0 1/4. The influence of the rare earth on the multiferroic properties is obvious. The role of the R3+ size has been emphasized. Compounds of the series with large R3+ size such as PrMn2O5 are not ferroelectric and present only commensurate magnetic transition of propagation wave vector (0.5 0 0), (0 0 0.5) or (0.5 0 0.5). In order to investigate a possible chemical pressure effect, we would like to study the magnetic ordering of PrMn2O5 under pressure and compare the results with compounds of the series with smaller R3+ size such as TbMn2O5.

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Multiferroics RMn_2O_5 series is extensively studied for its quasi-collinear spin arrangement, which results in an electrical polarization according to the exchange-striction model. Variations of the interatomic distances modified by the external pressure can strongly influence the multiferroic properties. Understanding this influence is of great importance, especially for the future realization of multiferroic devices. As PrMn2O5 is paraelectric at ambient pressure, it is the best candidate for a pressure induced multiferroicity.

With the powder neutron diffraction under pressure experiments in D1B, ILL, we are able to refine the new pressure induced magnetic phase in $PrMn_2O_5$ (the figures below). This new magnetic phase presents at relatively low pressure becomes completely exclusive at 8 GPa. The determination of its magnetic structure has thus been possible for the first time. More importantly, we give hints that this magnetic structure stabilized under pressure should present strong a electric polarization due to the nearly perfect collinearity of the Mn^{3+} and Mn^{4+} spins.

This new phase is likely to be common to the RMn_2O_5 series, as it is similar to the one reported in R=Y, Dy, Tb. Further studies on other members are required to definitely confirm this universal character.