Experimental report

23/04/2019

Proposal: 5-31-2550 **Council:** 4/2017

Title: Negative Magnetisation in Ca2PrCr2NbO9

Research area: Chemistry

This proposal is a new proposal

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Samples: Ca2PrCr2NbO9
Sr1.5La1.5Cr1.5Sn1.5O9
Ca2CeCr2TiO9

Instrument	Requested days	Allocated days	From	To
D1B	2	1	29/05/2018	30/05/2018
D2B	1	1	30/05/2018	31/05/2018

Abstract:

Ca2PrCr2NbO9 is a rare example of a material that shows magnetisation reversal, which is a cross-over from positive to negative magnetisation as a function of temperature. When Ca2PrCr2NbO9 is cooled in an applied field of 0.1 kOe the magnetisation is negative below 50 K but when cooled in fields of 1 kOe or more the magnetisation is positive. To explain this effect we propose that a small net moment in the Cr/Nb sublattice couples either antiferromagnetically or ferromagnetically with the Pr3+ cations depending on the magnitude of the applied field. To test this we need to collect powder neutron diffraction data on D2b at 2 K, 85 K and 300 K to accurately refine the crystal structure and further data on D1b collected in fields ranging between 0 and 10 kOe. This will allow us to study the field dependence of the magnetic structure of Ca2PrCr2NbO9. We therefore request one day of beamtime on instrument D2b followed by two days of beamtime on instrument D1b.

This allocation of beamtime generated some of the data reported in the paper

Magnetisation reversal in $Ca_2PrCr_2NbO_9$ and $Ca_2PrCr_2TaO_9$

E. C. Hunter, S. Mousdale, P. D. Battle and M. Avdeev

J. Solid State Chem. **269**, 80 (2019)

The abstract of that paper follows.

Polycrystalline samples of the perovskites $Ca_2PrCr_2BO_9$ (*B*=Nb, Ta) have been synthesised using the standard ceramic method and characterized by x-ray diffraction, neutron diffraction and magnetometry. Both crystallise in the orthorhombic space group *Pnma* and exhibit magnetisation reversal when field-cooled in an applied field of 100 Oe. The absolute value of the negative magnetisation at 2 K in an applied field of 100 Oe is an order of magnitude greater in $Ca_2PrCr_2TaO_9$ than it is for $Ca_2PrCr_2NbO_9$. Magnetometry and powder neutron diffraction showed that the Cr^{3+} cations in $Ca_2PrCr_2NbO_9$ and $Ca_2PrCr_2TaO_9$ order in a G_yF_z magnetic structure below 110 and 130 K, respectively. The Pr^{3+} cations remain paramagnetic down to ~10 K and show no-long range order at 2 K. Both compounds show a large degree of hysteresis in *M*(*H*), with coercive fields of 3.79 kOe and 3.03 kOe at 2 K.