Experimental report

13/02/2018

Proposal: 5-31-2508 **Council:** 10/2016

Title: Structure and magnetism of ALa2FeNiSbO9 (A=Ca, Sr, Ba) and CaLa2FeCoSbO9

Research area: Chemistry

This proposal is a new proposal

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Samples: SrLa2FeNiSbO9
BaLa2FeNiSbO9
CaLa2FeCoSbO9
CaLa2FeNiSbO9

Instrument	Requested days	Allocated days	From	To
D1B	1	1	27/02/2017	28/02/2017
D2B	2	2	28/02/2017	02/03/2017

Abstract:

Due to the presence of only very weak magnetic Bragg peaks in powder neutron diffraction data, despite SQUID magnetometry revealing La3Ni2SbO9 to be ferrimagnetic below 105 K, we described La3Ni2SbO9 as the first example of a relaxor ferromagnet. By introducing iron onto the B sites to form ALa2FeNiSbO9 (A=Ca, Sr, Ba) we have substantially raised the ferrimagnetic transition temperature to around 250 K in all cases. The same magnetic behaviour is observable for the related perovskite CaLa2FeCoSbO9. To search for differences in the nuclear and magnetic structure between these novel compositions and La3Ni2SbO9 we propose to collect powder neutron diffraction data on instrument D2b at room temperature and at 5K using a wavelength of 1.59 Å plus one data set on D1b for each of the four samples. We therefore request two days of beamtime on instrument D2b and one day of beamtime on instrument D1b.

Previous neutron diffraction studies had shown that $SrLa_2FeCoSbO_9$ is a ferrimagnet with a saturation magnetisation of ~1.5 μ_B below a transition temperature of ~250 K. This experiment aimed to study analogous compositions in an attempt to understand what factors affect the behaviour so that we could subsequently optimise the magnetic properties. The new compositions are also being studied by electron microscopy and Mössbauer spectroscopy in collaboration with groups in Antwerp and Canberra. For each sample listed below we collected data on D2b at room temperature and 5 K in order to define the crystal structure and on D1b at 5 K in order to determine the magnetic structure and the magnitude of the ordered moment on each cation site.

We had prepared the trio of compositions $ALa_2FeNiSbO_9$ where A = Ca, Sr, Ba in order to follow systematically the variation in properties as the unit-cell volume increases and the degree of octahedral rotation decreases. We also prepared $CaLa_2FeCoSbO_9$ to complement our study of $SrLa_2FeCoSbO_9$ and to provide an additional data point in a comparison of Fe/Ni and Fe/Co compounds.

The experiment went smoothly and analysis of the neutron diffraction data is complete, see Figure 1 for an example.

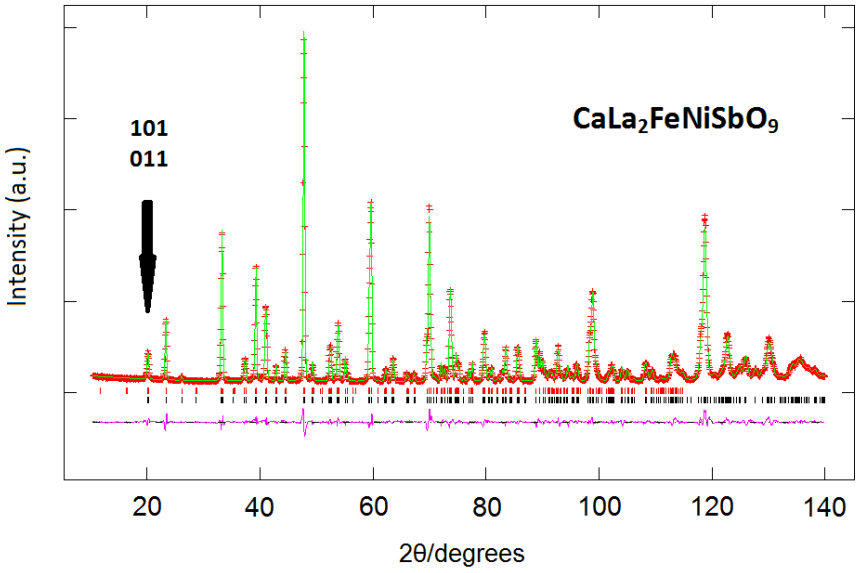

Figure 1

The remaining challenge is to provide a self-consistent description of these materials over the different length scales sampled in neutron diffraction and electron diffraction experiments.