Experimental report

14/01/2016

Proposal: 5-31-2271 **Council:** 10/2012

Title: Investigations of Crystal and Magnetic Structure of "Star" Antiferromagnet C42D83Fe9O55

Research area: Physics

This proposal is a new proposal

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Experimental team: Zhendong FU

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Samples: C42D83Fe9O55

Instrument	Requested days	Allocated days	From	To
D2B	3	3	10/05/2013	13/05/2013

Abstract:

The interplay of lattice geometry and magnetic interactions may lead to interesting magnetic phenomena, such as magnetic frustration. As an analog of the kagome lattice, the so-called star lattice has also shown strong spin frustration when it hosts antiferromagnetically coupled spins. A star lattice, formulated as C42D83Fe9O55, has been synthesized by connecting cationic iron(III) carboxylates with acetate bridges. The Fe3+ ions in the anionic layers form a star lattice. The DC susceptibility yields a Curie-Weiss temperature of -581 K, indicating a strong antiferromagnetic exchange. The significant increase of DC susceptibility below 4.5 K in a field of 0.005 T indicates the presence of both canted antiferromagnetism and long-range magnetic order below 4.5 K. The occurrence of magnetic order below 4.5 K is further confirmed by the sharp peaks observed in both the real and the imaginary components of the AC susceptibility.
In order to determine the detailed crystal structure and explore the nature of the long-range magnetic order at 4.5 K, it is proposed to perform neutron powder diffraction measurements on D2B at ILL.

Experimental report

The star lattice, formulated as $C_{42}D_{83}Fe_9O_{55}$ (also called $[Fe_3(\mu_3\text{-}O)(\mu\text{-}OAc)_6(H_2O)_3][Fe_3(\mu_3\text{-}O)(\mu\text{-}OAc)_{7.5}]_2\cdot 7H_2O$) (**1**), has been measured on D2B with an incoming wavelength of 1.6 Å. According to the magnetic susceptibility measurements on the non-deuterated sample, there is a magnetic phase transition at 4.5 K. The main purpose of the proposed measurement is to identify the nature of this magnetic phase transition.

The neutron powder diffraction (NPD) patterns were collected at 1.7 K and 10 K. Unfortunately we didn't observe any change as seen in Fig. 1. The NPD pattern obtained at 300 K cannot be refined with the crystal structure determined from the non-deuterated sample. We think the crystal structure and the magnetic property of the sample have been changed during deuteration.

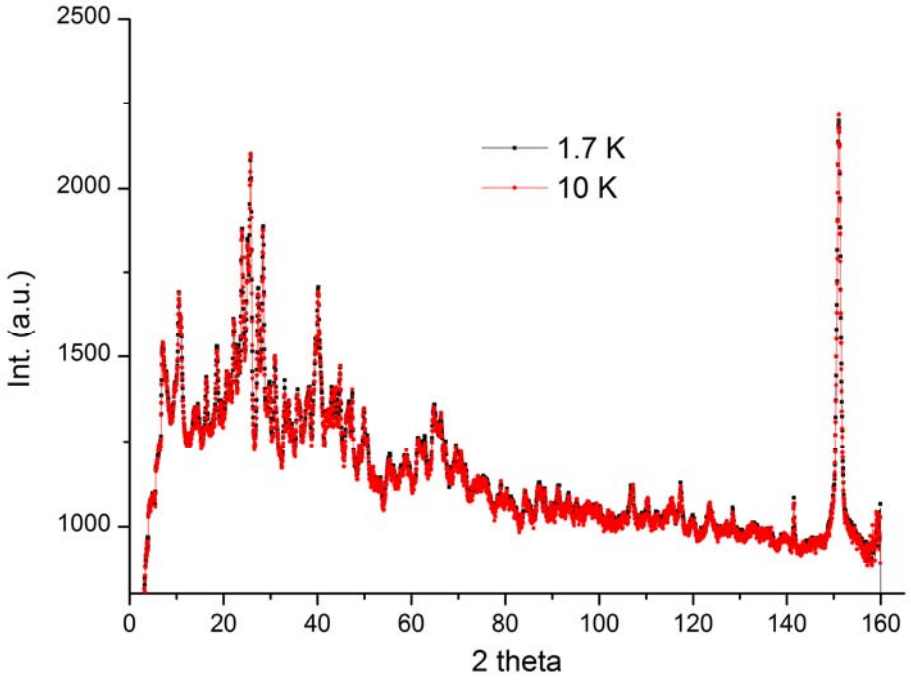

Fig. 1 neutron powder diffraction patterns measured at 1.7 and 10 K.