Experimental report

24/03/2022

Proposal: 5-31-2833 **Council:** 10/2020

Title: Characterisation of the magnetic compound Mn2Co3Ge

Research area: Materials

This proposal is a new proposal

Main proposer: Simon Rosenqvist LARSEN

Experimental team: Simon Rosenqvist LARSEN
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Local contacts: Ines PUENTE ORENCH
Vivian NASSIF
Claire COLIN

Samples: Mn2Co3Ge

Instrument	Requested days	Allocated days	From	To
D20	1	0		
D1B	0	1	09/06/2021	10/06/2021

Abstract:

Mn containing compounds are studied intensely in an effort to find cheap alternatives to the powerful rare earth containing magnets. Mn containing systems in particular are investigated in order to harness the magnetic moment of the Mn atoms. The compound Mn2Co3Ge has been predicted theoretically to have good properties for an applied permanent magnetic system. The structure is previously reported with X-ray diffraction but the magnetic properties and the magnetic structure have not yet been elaborated upon. Furthermore, it is disputed whether the crystallographic structure is ordered or disordered. To gain the information to explain all these things neutron diffraction would be the perfect tool.

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03/08/2021

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Introduction

A promising rare-earth free magnet was recently discovered in the form of Mn_2Co_3Ge. This system shows potential to be tunable for permanent magnetic and magnetocaloric applications. To harness this potential for this system, and potential derivatives of it an understanding of the magnetic structure was sought. The measurements conducted at the D1B instrument at ILL provided vital information about both the crystallographic and magnetic structure.

Experimental

The sample was mounted in an 8 mm sample can placed in an orange cryofurnace which was cooled to 2 K. Diffraction patterns were collected using a wavelength of 2.52 Å for temperatures ranging from 2 K to 396 K. The temperatures of 2 K, 175 K, 200 K, 299 K and 400 K were given the majority of the measurement time. Rietveld analysis [1] was carried out on the acquired data using the software FullProf [2].

Preliminary results

All temperature scans revealed additional peaks compared to earlier X-ray diffraction measurements. In the paramagnetic regime of 396 K these peaks were able to be indexed to a unit cell corresponding to twice *a* parameter, indicating a longer-range crystallographic order than initially observed. Following X-ray diffraction measurements supported this. A small degree of intermixing was seen on all crystallographic sites except for the Mn dominated ones.

Analysis of the diffraction patterns at 200 K and 299 K indicated a ferromagnetic structure with a **k**-vector of (0 0 0), in agreement with magnetic data. The lower temperatures of 2 K and 175 K indicated an incommensurate structure, also in agreement with previous measurements.

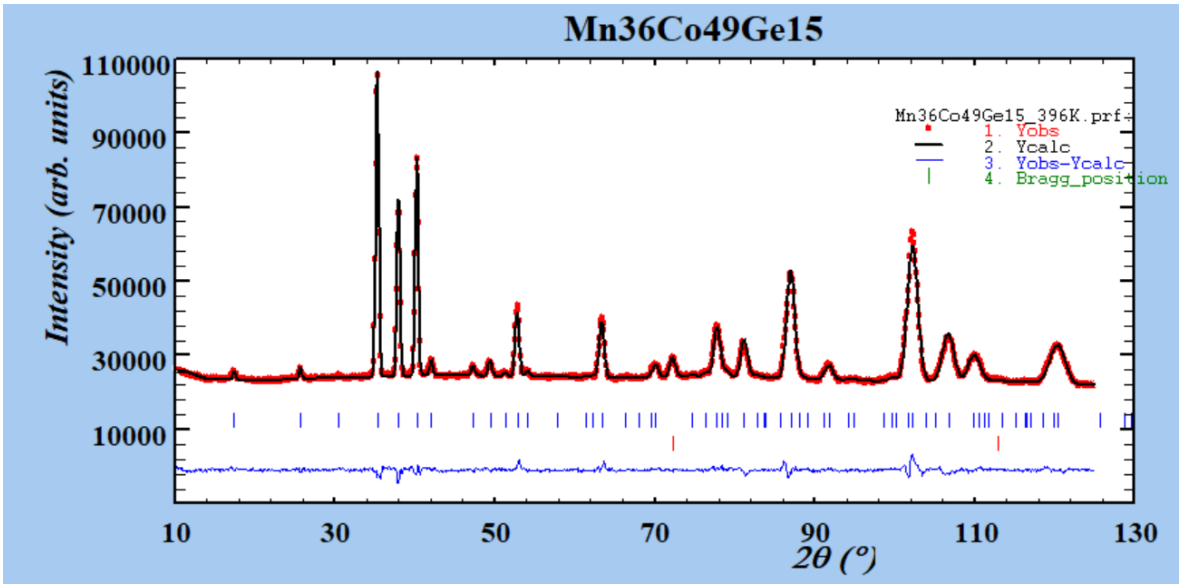

Figure 1: Neutron diffraction pattern for the sample measured at 396 K, which is the paramagnetic regime. The second phase relate to the vanadium can used for mounting.

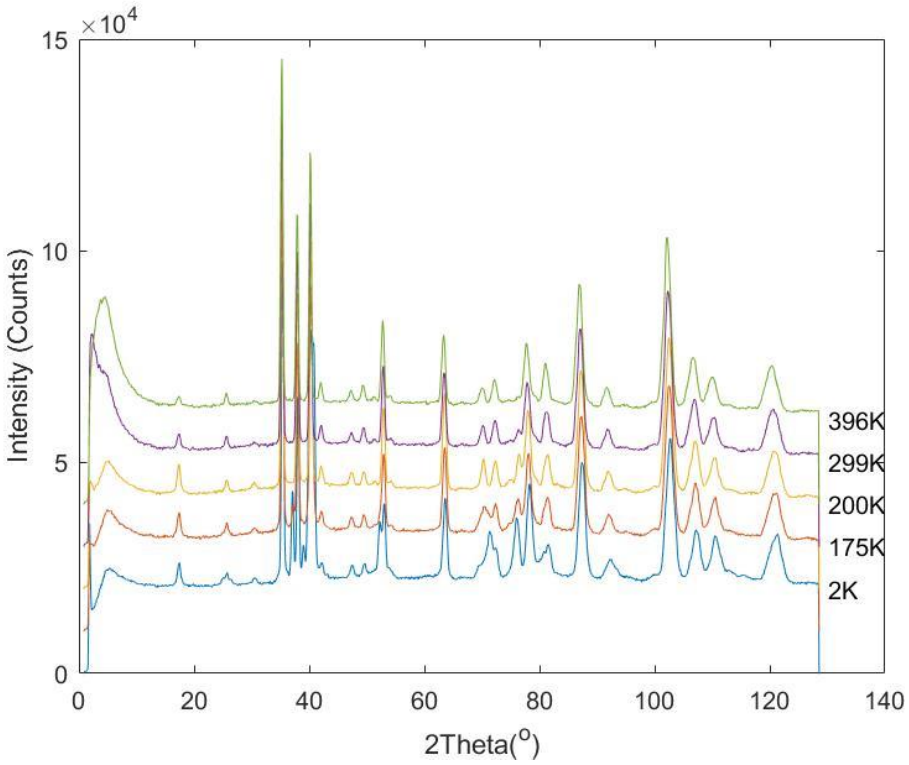

Figure 2: Comparison of the diffraction patterns of the sample at the most significant temperatures. The patterns have been displaced so as to more easily compare.

References

[1] Rietveld, H.M., A Profile Refinement Method for Nuclear and Magnetic Structures. Journal of Applied Crystallography, 1969. 2: p. 65-71.

[2] Rodríguez-Carvajal, J., Recent advances in magnetic structure determination by neutron powder diffraction. Physica B: Condensed Matter 192(1), 1993: p. 55-69.