Experimental report

23/06/2025

Proposal: CRG-3251 **Council:** 4/2025

Title: Magnetic Structures ofRFeSi Intermetallic Alloys(R= Y, Pr-Lu)

Research area:

This proposal is a new proposal

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Samples: RFeSi (R= Y, Pr-Lu)

Instrument	Requested days	Allocated days	From	To
D1B	3	3	03/06/2025	06/06/2025

Abstract:

Experimental report on CRG-3251: Magnetic structures of RFeSi intermetallic alloys (R= Y, Pr-Lu)

The magnetocaloric effect at cryogenic temperatures has intensified interest in rare-earth-based intermetallic compounds. Among them, the RFeSi silicides (where R = rare earth) represent a promising family of alloys, exhibiting magnetic ordering temperatures ranging from 25 to 140 K. These compounds crystallize in a tetragonal structure with a P4/nmm space group, and their magnetic ordering is primarily associated with the rare-earth (R) sublattice, the magnetic moments being aligned along the c-axis.

In this study, we investigate the evolution of the magnetic moment as a function of temperature for four different compositions (R=Pr, Tb, Dy, and Ho), over a temperature range of 2-300 K. Remarkably, at very low temperatures, new low-angle Bragg diffraction peaks emerge in the neutron diffraction patterns, indicating the presence of a incommensurate magnetic structure, likely related to the Fe sublattice. Figure 1.a) shows the neutron powder diffractogram at 2 K for the different alloys investigated. A noticeable shift in the fundamental peak suggests that the secondary magnetic structure changes between compositions, moving toward higher angles. Figure 2b shows diffractograms corresponding to three distinct magnetic states: the high-temperature paramagnetic phase; a ferromagnetic phase at 16 K, where magnetism is dominated by the rare-earth sublattice; and at 2 K a phase characterized by an additional magnetic component, presumably linked to ordering within the Fe sublattice.

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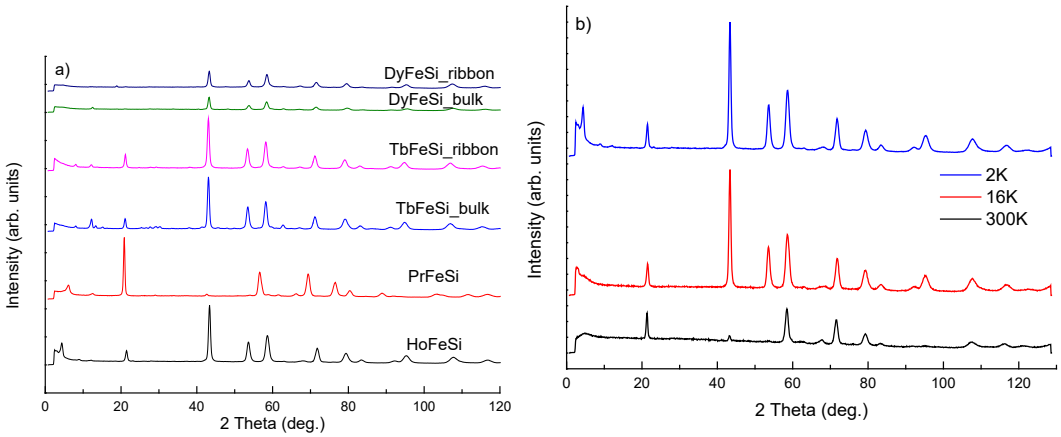

Fig. 1. a) Neutron diffractograms a 2 K for the RFeSi compounds and b) evolution of the neutron diffractograms of HoFeSi.

Building on these preliminary results, we plan to submit additional proposals for upcoming beamtime calls at the D1B instrument. Our goal is to complete the study of the RFeSi alloy family by including samples with non-magnetic rare-earth

elements such as Y, Lu, and La as well as R= Nd or Er. These compositions will help us better understand the nature of the secondary magnetic structure observed in the RFeSi intermetallics.