Experimental Report

Proposal: **5-31-2204** **Council:** 4/2012

Title: Structural and magnetic investigations of the LaFe12-xCoxB6 series ofitinerant electron magnetic compounds

This proposal is a new proposal

Researh Area: Physics

Main proposer: **ISNARD Olivier**

Experimental Team: DIOP Leopold Vincent Birane
ISNARD Olivier
TENCE Sophie

Local Contact: SUARD Emmanuelle

Samples: LaFe12-xC0xB6 x=0,2,4,6,8,10,12 (made with isotopic boron)

Instrument	Req. Days	All. Days	From	To
D1B	4	4	02/11/2012	04/11/2012
			09/11/2012	11/11/2012

Abstract:

We propose to determine the magnetic structure of the LaFe12-xCoxB6 compounds which are exhibiting interesting and unusual itinerant electron metamagnetic behavior. Indeed, the magnetic ordering is ferro against antiferromagnetic for the Co and Fe containing compounds respectively, we are also interested in the determination of the composition dependence of the magnetic structure. The possible preferential location of the Fe atoms on some crystal sites will also be investigated at high T (paramagnetic state). A further aim is to determine the effect of the local environment on the magnitude of the magnetic moments of the Fe or Co atoms.

Structural and magnetic investigations of the $LaCo_{12}B_6$ itinerant electron magnetic compound

Introduction

Intermetallic compounds based on rare-earth and transition metal form an important class of materials exhibiting numerous applications such as: permanent magnets, magnetostrictive devices or magneto-optical recording. The outstanding magnetic properties of these materials result from the combination of the different magnetic features of the localised 4*f* electronic states of the rare earth and the itinerant 3d states of the transition metal. Naturally, a key role in these combined systems is played by the 3*d*-4*f* exchange interaction, which mediates the interplay of the two magnetic subsystems. In addition to these potential applications, it is also of major interest to study these types of compounds from the fundamental point of view and to quantitatively determine their magnetic structure.

Experiments

We have performed on each $LaCo_{12}B_6$ sample a long acquisition at 1.5 K and 200 K. These two temperatures correspond to the ordered (ferromagnetic) state on the one hand and the disordered (paramagnetic) state on the other hand. In addition, a scan in temperature from 1.5 K up to 300 K was done to follow the thermal evolution of the lattice parameter and the possible presence of magnetoelastic phenomena at the magnetic transition. The experiments were carried out on the D1B diffractometer with a neutron wave length of 2.52 Å using a vanadium sample holder.

Results

A Rietveld refinement of the 200 K neutron diffraction patterns of $LaCo_{12}B_6$ has been carried out and is shown in Figure 1(a). The $LaCo_{12}B_6$ retains the expected $SrNi_{12}B_6$ type crystal structure. The analysis of the diffraction pattern recorded at 1.5 K –Figure 1(b) – reveals that the $SrNi_{12}B_6$ type crystal structure is kept at low temperature. Extra Bragg peak of magnetic origin appeared when cooling below the ordering temperature. It is shown that $LaCo_{12}B_6$ compound exhibits an incommensurate conical type magnetic structure. Significantly different magnetic moments have been observed on the two Co crystal sites.

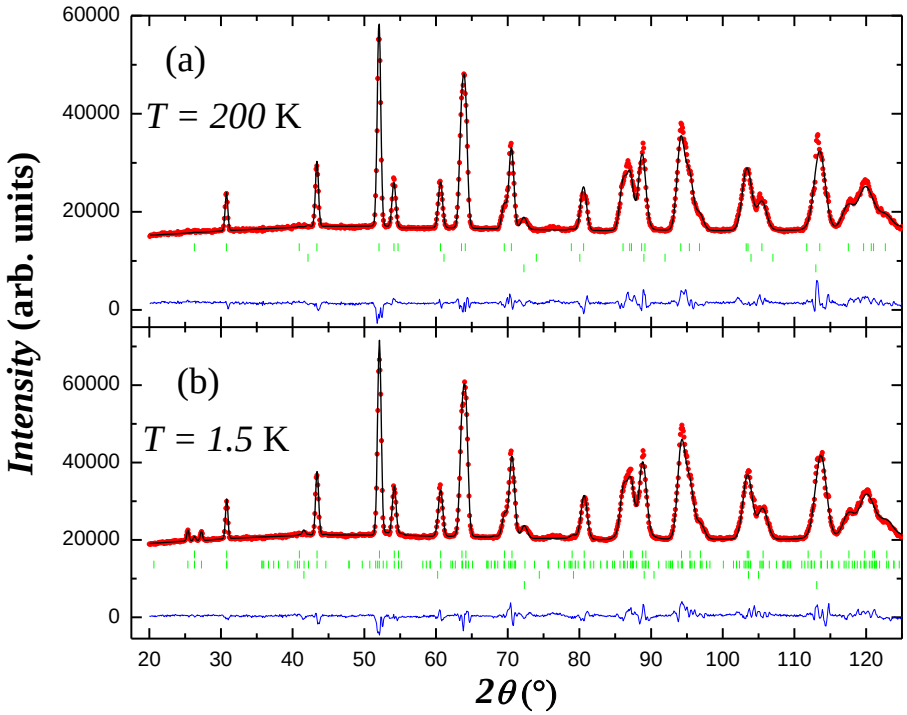

Figure 1: Refinements of the neutron diffraction patterns for $LaCo_{12}B_6$ taken at 200 K (a) and 2 K (b).

Publications

These results have been published:

L.V.B. Diop, Z. Arnold O. Isnard and J. Kamarad, Journal of Alloys and Compounds **593** (2014) 163–168.