Experimental Report

20/02/2014

Proposal: **DIR-108** **Council:** 10/2012

Title: Huge field induced metamagnetic transmission in La1-xCexFe12B6 itinerant electron system: study of crystal and magnetic structure changes

This proposal is a new proposal

Researh Area: Physics

Main proposer: **ISNARD Olivier**

Experimental Team: ISNARD Olivier
DIOP Leopold Vincent Birane

Local Contact: SUARD Emmanuelle

Samples: La1-xCexFe12B6

Instrument	Req. Days	All. Days	From	To
D2B	2	2	18/03/2013	20/03/2013

Abstract:

Study of crystal and magnetic structure changes during the field induced metamagnetic transition in $La_{1-x}Ce_xFe_{12}B_6$ itinerant electron system:

Introduction

The rare-earth iron intermetallic compounds are facinating magnetic materials from both fundamental and applied point of views. Indeed they exhibit unique feature resulting from the combination of both localized magnetism of 4*f* electrons of the rare-earth and itinerant magnetism of the 3*d* electrons of an iron group metal. This has led to the discovery of high performance applications such as magnetostrictive effect, the best permanent magnets as well as more recently new materials for giant magnetocaloric applications have all been discovered among the binary and ternary R-Fe system.

In the frame of the PhD thesis of Léopold DIOP we discovered that the $La_{1-x}Ce_xFe_{12}B_6$ series compounds exhibit an unusual metamagnetic transition from an antiferromagnetic (AFM) to ferromagnetic (FM) state by applying external magnetic field. These are a model compounds to study the transition metal magnetism. The proposed experiment was aimed to determine the magnetic structure and its evolution under the application of an external magnetic field.

Experiments

In order to follow the AFM→FM metamagnetic transition at 2 K we recorded neutron powder diffraction patterns on $La_{0.825}Ce_{0.175}Fe_{12}B_6$ at the different magnetic field of 0, 2, 4.5 and 6 T. In addition, a diffraction pattern was recorded at 75 K in the paramagnetic state at zero external magnetic field. The experiments were carried out on the D2B diffractometer with a neutron wave length of 1.594 Å using a vanadium sample holder.

Preliminary results

The neutron diffraction profiles of $La_{0.825}Ce_{0.175}Fe_{12}B_6$ compound at 2 K in 0 and 6 T are presented in figure 1. The AFM state is stable in 0 T and the field-induced FM state is realized in the magnetic field of 6 T because the critical magnetic transition field $\mu_0 H_{cr}$ is 3 T at this temperature. The experiments have been successful and we have obtained good experimental diffraction patterns as can be seen from the following figure. Upon increasing magnetic field a significant modifications of the diffraction pattern are observed on both the intensity and the position of the diffraction peaks. The detailed Rietveld refinement of the obtained diffraction patterns are in progress for investigation of the magnetic part. The results will be presented in the Ph D Thesis of L. Diop University of Grenoble 2014.

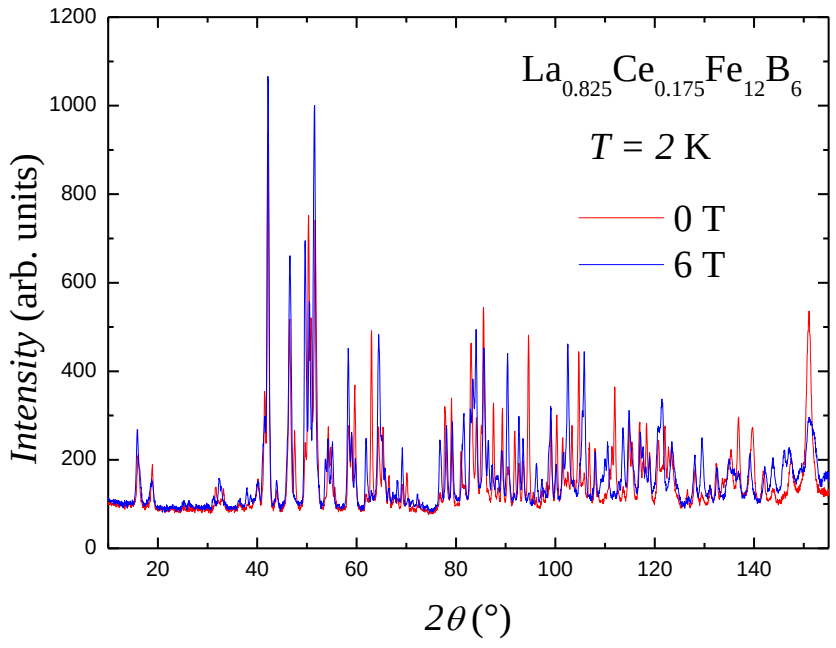

Figure1: Neutron diffraction pattern of $La_{0.825}Ce_{0.175}Fe_{12}B_6$ compound recorded at 0 and 6 T on D2B (λ = 1.594 Å).