Experimental Report

26/05/2015

Proposal:	**5-31-2331**	**Council:**	4/2014	
Title:	Magnetic structure of Mn3O4 and Fe3O4 bi-magnetic Core-shell nanoparticles			
This proposal is a new proposal				
Researh Area:	Materials			
Main proposer:	**LOPEZ-ORTEGA Alberto**			
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Local Contact:	PUENTE ORENCH INES			
Samples:	FeMn MnFe			

Instrument	Req. Days	All. Days	From	To
D1B	0	2	17/11/2014	19/11/2014

Abstract:

The magnetic structure of hard-soft (conventional) and soft-hard (inverse) bi-magnetic core-shell nanoparticles based on ferrimagnetic (FiM) soft Fe3O4 and hard FiM Mn3O4 will be investigated by neutron diffraction.
XRD, TEM and EELS analyses have revealed the formation of a well established core-shell structure based on cubic spinel soft-FiM Fe3O4 and tetragonal spinel hard-FiM Mn3O4. The magnetic properties confirm the presence of both phases and evidence a strong exchange coupling between both phases. In this study we pretend to compare the influence of the morphology and structure of both magnetic phases (core vs. shell) on their magnetic structure from low to room temperature.

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Magnetic structure of Mn_3O_4 and Fe_3O_4 bi-magnetic Core-shell Nanoparticles

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In this experiment we collected the neutron diffraction patterns of two samples (labelled FeMn39 and FeMn40) with core/shell morphology (being magnetite (Fe_3O_4) the core and manganese oxide (Mn_3O_4) the shell) at diverse temperatures. The difference between both samples lies in the Mn_3O_4 shell thickness (being 1 nm for FeMn39 and 0.5 nm for FeMn40, as measured by TEM) while the Fe_3O_4 counterpart is the same (12 nm measured by TEM). The magnetometry experiments confirm the presence of both phases and evidence a strong exchange coupling between them. The goal of this proposal was to study the magnetic and crystallographic structures and correlate them with the magnetic properties of the individual layers for Fe_3O_4-Mn_3O_4 core-shell systems.

The neutron powder diffraction patterns show evidence of both Mn_3O_4 and Fe_3O_4 structural and magnetic peaks (see Fig.1). From the evolution of the magnetic Mn_3O_4 peak intensity with temperature can be inferred that the Curie temperature of FeMn39 is above the bulk temperature of Mn_3O_4 (T_C=(Mn_3O_4) ~43 K).

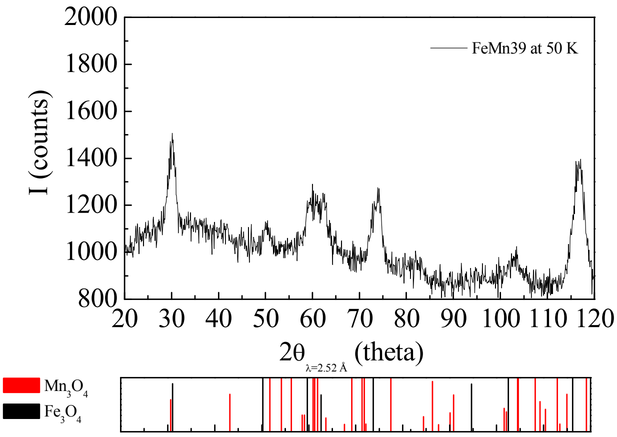

Figure 1. Neutron diffraction pattern of sample FeMn39 collected at 50 K

We are currently working on the analysis of the patterns collected at different temperatures for both samples. However, the Rietveld analysis has proven to be rather complex due to the shape asymmetry of the peaks, which probably arises from the non-spherical shape of the Mn_3O_4 and Fe_3O_4 phases (platelet-like and cubic, respectively). Moreover, the small amount of sample has resulted in somewhat noise patterns despite the long counting, which also complicates the fits.