NEUTRONS FOR SOCIETY

Universidad de Oviedo
Universidá d'Uviéu
University of Oviedo

MAGNETIC AFTEREFFECT OF FIRST-ORDER PHASE TRANSITION MATERIALS

Position offered (description)

We offer a position for a PhD researcher to investigate the magnetic aftereffect of first-order phase transition materials to be developed at the Laboratory of Magnetic Materials within Department of Physics (Oviedo, Spain) and the Institute Laue Langevin (Grenoble, France). Fe-Rh and magnetic shape memory alloys (MSMAs) present interesting effects, such as caloric, owing to their first-order magnetostructural transition. However, their applicability is affected by the characteristic thermal irreversibility associated with first-order phase transitions. In this sense, the analysis of the phase transition kinetics is essential to characterize their repeatable behavior. Although earlier studies have solved some of the questions about the underlaying mechanisms, the conditions that lead to an athermal transition in MSMAs or the existence of a magnetically arrested FM phase in Fe-Rh alloys remain unclear.

Goals, Main Tasks, and Requirements

This PhD project aims to take control on the repeatability of the magnetocaloric properties of Ni-Mn-(Ga, In, Sn)-Fe and $Fe_{100-x}Rh_x$ (x ~ 50 at. %) alloys by understanding the effect of the microstructure on the mechanisms of their magnetostructural transition kinetics. We propose a study of the phase transition characteristics of these materials obtained as arc-melted bulks and melt-spun ribbons. The candidate will analyze both the changes in the crystal and magnetic structures resulting from the phase transition through magnetization and X-ray and neutron diffraction experiments and the dynamics of the transition through a combination of out-of-equilibrium magnetic relaxation and time-resolved neutron scattering experiments. In addition, this strategy will be complemented by ab initio calculations.

GOALS

1. Preparation of bulk and ribbons of Ni-Mn-X-Fe MSMAs and Fe-Rh alloys with magnetostructural phase transition close to room temperature.
2. Determination of the fabrication parameters that affect the structural and magnetic changes.

3. Clarification of the underlying mechanisms that lead to a reproducible magnetostructural transition of both systems.

Main Tasks

1. Fabricate Ni-Mn-(Ga,In,Sn)-Fe and Fe-Rh alloys in bulk and ribbon shape exhibiting a structural phase transformation close to room temperature.
2. Fundamental structural, microstructural, and magnetic characterization:
   a. Calorimetry, electron microscopy, electric transport, and X-ray powder diffraction.
   b. Magnetometry and neutron powder diffraction.
3. Analysis of magnetic aftereffects:
   a. Out-of-equilibrium magnetization.
   b. Diffraction experiments during magnetic relaxation.
   c. Inelastic neutron scattering.
   d. Ab initio calculations.

Requirements

- A degree in Physics.
- A good knowledge of English is required.
- Documented skills of communicating science.

Institutions

Institute Laue Langevin (Grenoble, France, https://www.ill.eu/about-the-ill).

Facilities:

- Powder Neutron thermodiffraction under pressure.
- Inelastic Neutron scattering.

Universidad de Oviedo (Oviedo, Spain, https://nanobioap.org/uniovi_magnes/).

Facilities:

- Differential scanning calorimetry.
- X-ray powder thermodiffraction.
- Scanning and Transmission Electron Microscopies.
- Electric transport.
- Magnetometry.

Contract conditions

- Application deadline: 31st of December.
- Duration of the contract: 1+2 years.
  - A follow–up of the evaluation is carried out during the PhD-student's annual interview and the procedure published in the Position Paper.
- Gross salary: about 2500 €/month.
- Support for travel to conferences and other activities associated with the research.
- Facilities to teach at University of Oviedo.

Contact

If you are interested, contact us:

- Universidad de Oviedo supervisor 1: Prof. Pedro Gorria (pgorria@uniovi.es)
- Universidad de Oviedo supervisor 2: Dr. Pablo Álvarez (alvarezapablo@uniovi.es)
- ILL supervisor: Dr. Gabriel Cuello (cuello@ill.eu)