**Minicolloque n° CPR5** ☐ **Oral** **X Poster**

# Epitaxy and interfacial coupling of FeRh nanoparticles deposited on $BaTiO_3$ or $SrTiO_3$ surfaces

F. Tournus[a*], G. Herrera-Huerta[a], D. Le Roy[a], V. Dupuis[a], C. Raton[a], A. Reyes[b], I. Cañero-Infante[c], P. Rojo-Romeo[c], B. Vilquin[c], G. Saint-Girons[c], R. Bachelet[c], A. Resta[d], P. Ohresser[d], E. Otero[d], L. Martinelli[e], X. Weng[f], G. Renaud[f]

a. Institut Lumière Matière, UMR5306, Université Lyon 1-CNRS, Université de Lyon - Villeurbanne
b. Faculty of Sciences, Universidad Autonoma del Estado de Mexico - Toluca de Lerdo (Mexico)
c. Institut des Nanotechnologies de Lyon, UMR5270 CNRS ECL INSA UCBL CPE - Villeurbanne & Ecully
d. Synchrotron SOLEIL, L'orme des merisiers - Saint-Aubin
e. Institut Néel, CNRS-UGA UPR2940 - Grenoble
f. Université Grenoble Alpes, CEA, IRIG-MEM - Grenoble

* email : florent.tournus@univ-lyon1.fr

The binary FeRh alloy displays a rich phase diagram with both crystal and magnetic order phase transitions. At the nanoscale, a strong interplay between surface configuration, morphology and magnetic state is taking place [1]. One can then envisage to control the ferromagnetic-antiferromagnetic (FM-AFM) phase transition of FeRh with external parameters (strain or electric field) which can be achieved through the use of a specific substrate. We have thus tried to extend to small nanoparticles the successful coupling observed for thin FeRh films grown on ferroelectric $BaTiO_3$ substrate [2]. A first step is to investigate the structural properties of FeRh nanoparticles on a crystalline $BaTiO_3$ thin film, or a $SrTiO_3$ surface for comparison.

In this study, we have deposited size-selected FeRh clusters (diameter lower than 10 nm), at low energy and under ultra-high vacuum conditions, on crystalline oxide surfaces. Using synchrotron radiation in grazing incidence configuration, we have observed the chemical ordering of FeRh nanoparticles into the B2 phase upon annealing. The orientation dependence of x-ray diffraction FeRh peaks indicates that particles, despite their random deposition, are finally adopting preferential orientations, reflecting an atomic coherence with the $BaTiO_3$ or $SrTiO_3$ surface. In addition to the usual epitaxy relationship met for thin films, a novel orientation is observed (corresponding to a 45° in-plane rotation), as well as other favorable coincidences for particles on $SrTiO_3$. Besides structural studies, x-ray spectroscopy experiments (XPS at the laboratory and XAS and XMCD measurements using synchrotron radiations) have revealed the impact of interfacial oxygen and potential iron oxidation on the electronic structure and consequently on the magnetic properties of FeRh nanoparticles.

These results show how cluster deposition offers an alternative approach to usual bottom-up growth methods and open the way to a possible control of FeRh nanomagnet properties taking advantage of the interfacial coupling, at the atomic level, with a ferroelectric oxide substrate.

[1] Hillion et al., Phys. Rev. Lett. **110**, 087207 (2013) ; Liu et al., Euro. Phys. Lett. **116**, 27006 (2016) ; Lewis et al., J. Phys. D: Appl. Phys. **49**, 323002 (2016)

[2] Cherifi et al., Nature Mater. **13** (2014) 345 ; Liu et al., Nature Comm. **7** (2016)