(IP08)
12nd International Conference on LEEM/PEEM (2020 online version)

Manipulation of magnetic domains in thin magnetite films

Anna Mandziak[1,2,3], Miguel A. Aristu[2], Jose E. Prieto[2], M. Foerster[1], Juan de la Figuera[2], Lucia Aballe[1]

[1] *Alba Synchrotron Light Facility, CELLS, Barcelona E-08290, Spain*
[2] *Instituto de Química Física "Rocasolano", Madrid, 28006, Spain*
[3] *SOLARIS National Synchrotron Radiation Center, Czerwone Maki 98, 30-392 Cracow, Poland*

Email: anna.mandziak@uj.edu.pl

The study of static and dynamic properties of magnetic domains in ferromagnetic nanostructures has recently received a lot of attention not only because of the fundamental interest, but also due to the emergence of technological applications based for example on domain walls (DWs) and their dynamics in memory and logic devices. Consequently, their behavior under applied magnetic field or spin-polarized electric currents as a driving force has been studied extensively over the past years. For most spintronic applications, thin films or nanostructures are required, while many materials show unwanted modification of their properties when their dimensionality is reduced to the nanoscale. For example, thin films of transition metal spinel oxides such as magnetite typically suffer from so-called anti-phase boundaries and exhibit disappointing properties with respect to the expectations. Thus, there is a strong motivation to understand and control the growth of functional ferromagnetic films and nanostructures and to study their magnetic properties and their manipulation. During the past few years we have shown that transition metal oxide films grown by high temperature oxygen-assisted MBE on metallic substrates present an extremely high structural quality and thus strongly improved magnetic properties [1,2,3].

In an effort to probe functional properties of such microstructures, we have developed a exchangeable sample holder system [cite manuscript in preparation] which permits in situ surface preparation and growth at high temperature (up to more than 1500 K) and in situ applications of small magnetic fields either in-plane or out-of-plane, all within the ultra-high vacuum system.
In this talk we present first experiments with the new sample holder system. In particular we study microstructures of ferrimagnetic F_3O_4 grown on a Ru(0001) substrate by high temperature oxygen-assisted MBE. The chemical and magnetic characterization is performed by x-ray absorption spectroscopy (XAS) and x-ray magnetic circular dichroism (XMCD) spectromicroscopy. Further the switching characteristics of individual magnetite microstructures under applied field are subsequently imaged by means of XMCD-PEEM at tens of nm resolution. The experimental magnetization distribution will be compared with micromagnetic simulations.

References

[1] Martin-Garcia L., et al., Atomically Flat Ultrathin Cobalt Ferrite Islands, Adv. Mat. **27**, 5955-5960 (2015)
[2] Ruiz-Gomez S., et al., Geometrically defined spin structures in ultrathin Fe_3O_4 with bulk like magnetic properties, Nanoscale **10**, 5566-5573 (2018)
[3] Mandziak A., et al., Tuning the Neel temperature in an antiferromagnet: the case of $Ni_xCo_{1-x}O$ microstructures, Sci. Rep. **9**, 13584 (2019)