

Control of orbital ordering in magnetic epitaxial thin film

PhD @ Institut Laue Langevin (ILL, Grenoble, France) 2020-2023

Scientific aims: The search of new materials in magnetism for spintronics is an important issue. In this frame, the role of orbital ordering to control the magnetism in epitaxial manganite thin films was demonstrated by combination of ab-initio calculations and magnetic measurements [1]. The strains induced by the substrate control the orientation of the orbitals during the film deposition (see Fig. 1 (b)) and control the orientation of the spins in the ordered phase. The control allows to fabricate artificial structures by creating antiferromagnetic ordering along the c axis (perpendicular to the substrate) of ferromagnetic monolayers with a quite high critical temperature. These new materials open new magneto-electronic applications such as nonvolatile magnetic memory working far above room temperature.

[1] A. Sadoc, B. Mercey, C. Simon, et al. Phys. Rev. Lett. 104, 046804 (2010).

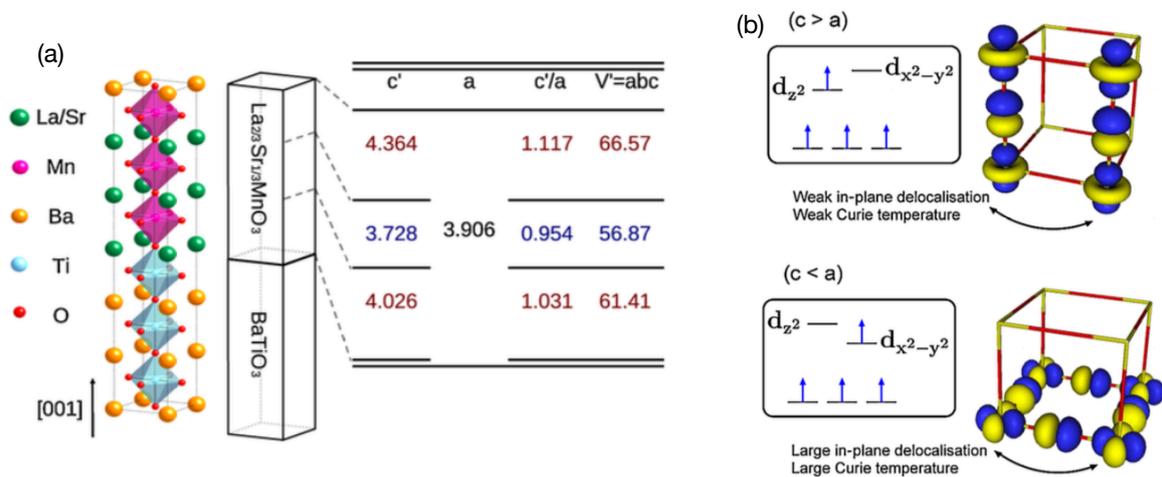


Figure 1: (a) Superlattice of a manganite thin film. (b) Orbital ordering induced by strains.

Project description: The films are superlattices $(\text{La}_{2/3}\text{Sr}_{1/3}\text{MnO}_3)_n(\text{BaTiO}_3)_m$ deposited on a lattice matched SrTiO_3 (001)-oriented substrate (see Fig. 1 (a)). We propose to determine the magnetic structure of the films by neutron diffraction, using the unique versatility of the D10 instrument at ILL and the future D10⁺. The samples will be characterized by X-rays, transmission electron microscopy and macroscopic magnetic measurements. The student will measure existing thin films and also will prepare new samples with different n , m numbers of layers in CRISMAT (Caen). An important part will be devoted to the analysis of data, including ab-initio calculations of the magnetism for optimized geometries.

Practical information: The thesis will be performed at ILL, with few visits in Caen, synchrotron Soleil and LNCMI (Grenoble) for additional characterizations. The successful candidate will be employed for three years (starting from October 2020), with a gross salary of around 2400 €/month (see [the web page about the PhD work at the ILL](#)). Applicants should have a degree in a Physics discipline. Academic knowledge of condensed matter physics will be an advantage. A cover letter, a detailed CV, and the names and contacts of two referees should be sent to the three supervisors with the subject “PhD project 201_14”.

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