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Electronic and magnetic properties of $Fe/SrTiO_3(001)$ interfaces

P. Catrou[a], J. Gosteau[b], J. Mordret[a], G. Delhaye[a], J.-C. Le Breton[a], P. Turban[a], B. Lépine[a], S. Tricot[a], R. Arras[b], and P. Schieffer[a*]

a. Université de Rennes 1, CNRS, IPR (Institut de Physique de Rennes) - UMR 6251, F-35000 Rennes, France
b. CEMES, Université de Toulouse, CNRS, UPS, 29 rue Jeanne Marvig, F-31055, Toulouse, France

* email : philippe.schieffer@univ-rennes1.fr

There is currently a fast-growing interest in being able to control magnetism through an applied voltage. Exciting potential applications in spintronics offer many reasons for this enthusiasm of the research community. For example the magnetic anisotropy of a nanoscale-thick ferromagnetic layer can be substantially altered by the application of an electric field in oxide-based magnetic tunnel junctions [1]. This effect is called VCMA for *Voltage Control Magnetic Anisotropy*. This coupling mechanism can be related to magneto-elastic effects, but also to the variation of the electrical polarization or even to the electromigration mechanisms at the interface. Actually, the VCMA effect is related to various contributions that interplay and its precise origin is not fully understood to date.

In this presentation, we will focus on the intimate electronic and magnetic properties of $Fe/SrTiO_3(001)$ interfaces in order to obtain a better understanding of the VCMA effect in ferromagnetic-oxide systems. We will present an experimental x-ray photoemission study of the $Fe/SrTiO_3$ interface along with results obtained from first-principles calculations [2, 3]. Two main characteristics of the $Fe/SrTiO_3$ structures will be highlighted. First, the Fe deposition on $SrTiO_3$ surfaces leads to the creation of oxygen vacancies within the $SrTiO_3$ lattice in the first planes beneath the $Fe/SrTiO_3$ interface. Second, iron grows in three-dimensional islands for the thinnest films (< 1.5 nm). The impact of such oxygen vacancies as well as the $SrTiO_3$ surface termination change on the electronic properties at the $Fe/SrTiO_3$ interface will be discussed. Finally, a detailed analysis of the ferromagnetic properties owing to the morphology of the ultrathin ferromagnetic films will be given in the light of micromagnetic and atomistic simulations.

[1] W.-G. Wang *et al.*, Nat. Mater. **11**, 64 (2012).
[2] P. Catrou, *et al.*, Phys. Rev. B **98**, 115402 (2018).
[3] R. Arras, *et al.*, Phys. Rev. B **102**, 205307 (2020).