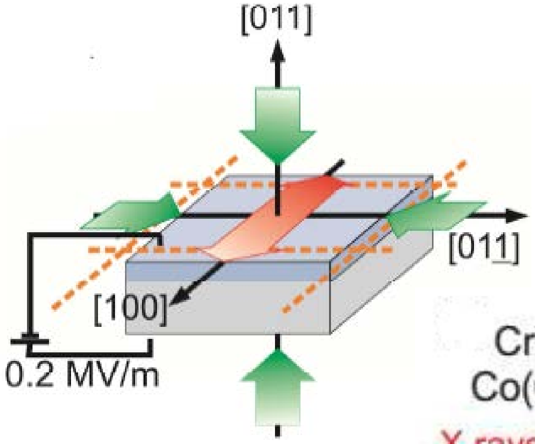

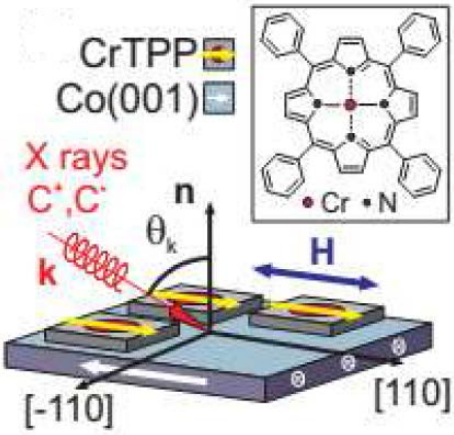

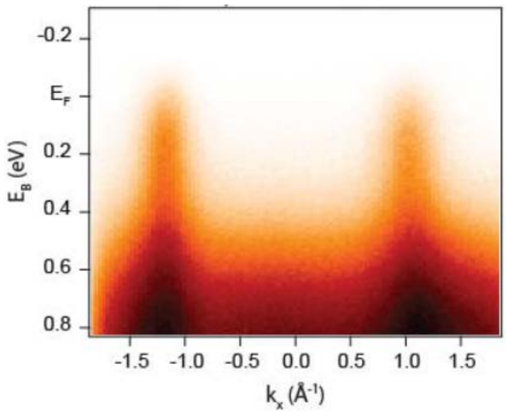

SLS Symposium on

Surfaces and Interfaces

Tuesday, October 7, 2014

10:00 to 12:15, WBGB/019

10:00 Controlling magnetism in $La_{0.7}Sr_{0.3}MnO_3$ via piezostrain
Jakoba Heidler, C. Piamonteze, R. Chopdekar, M.A. Uribe-Laverde, A. Alberca, M. Buzzi,A. Uldry, B. Delley, S. Rusponi, H. Brune, C. Bernhard and F. Nolting

10:30 Magnetic exchange coupling of metallo-porphyrins at the magnetic surfaces
Jan Girovsky, K. Tarafder, C. Waeckerlin, J. Nowakowski, D. Siewert, T. Haehlen, A. Shchyrba, M. Baljozovic, A. Kleibert, N. Ballav, P. M. Oppeneer and T. A. Jung

11:00 Coffee

11:15 Two dimensional electron gas at the surface of $BaTiO_3$ films
Stefan Muff, G. Landolt, M. Fanciulli, Z. Ristic, N. Plumb. M. Radovic and H. Dil

Controlling magnetism in $La_{0.7}Sr_{0}.3MnO_{3}$ via piezostrain

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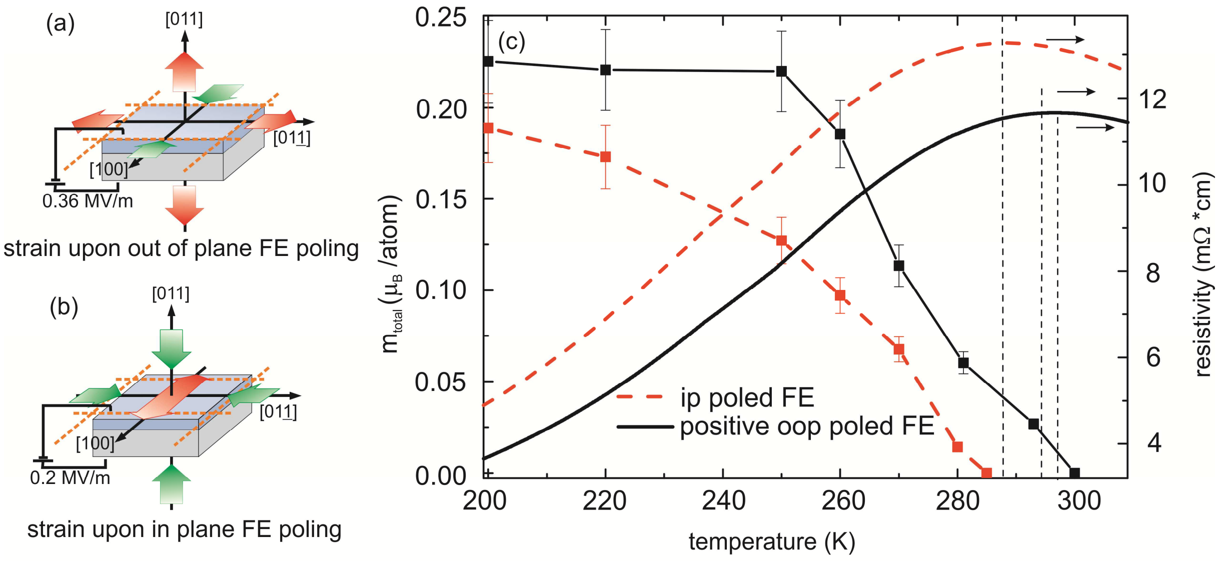
Multiferroic composites consisting of cross-coupled ferromagnetic and ferroelectric layers are promising candidates amongst the strategies to achieve electric field control of magnetism. In this talk I will show results on magnetoelectric coupling in a Perovskite oxide heterostructure consisting of a thin film of ferromagnetic $La_{0.7}Sr_{0}.3MnO_{3}$ (LSMO) grown on the relaxor ferroelectric (FE) crystal $[Pb(Mg_{1/3}Nb_{2/3})O_3]_{(1-x)}$-$[PbTiO_3]_x$ (011) (x=0.32), where reversible electrical switching induces a 10 K shift of the ferromagnetic Curie temperature. The substrate imposes a biaxial strain on the manganite thin film. Reciprocal space maps highlight the two distinct strain states that can be set in the ferroelectric and are stable at remanence. The magnetic response to the strain changes is probed by temperature dependent Mn $L_{3,2}$ XMCD and resistance measurements. X-ray natural linear dichroism spectra for both strain states probe changes in crystal field. Multiplet and DFT calculations support the emerging picture that the structural modifications lead redistribution of the e_g orbital occupation. Reducing the e_g electron itineracy, that leads to ferromagnetism due to double exchange coupling, results ultimately in lower T_C.



(a) and (b): Schematic of the two distinct strain states in LSMO/PMN-PT that can be set by an electric field. (a) Strain state for oop poled FE polarization. (b) At the coercive electric field the majority of the domains exhibits a FE polarization lying in-plane. The polarization rotation is accompanied by a large change of both in plane and out of plane strain imposed on the LSMO thin film. (c) Magnetic moment measured by XMCD along the (01$\bar{1}$) axis at remanence and resistivity as a function of temperature. Red dashed lines correspond to ip poled FE, black lines correspond to positively oop poled FE. Electrical switching between both FE PMN-PT poling states induces a 10K T_c shift in the LSMO thin film.

Magnetic exchange coupling of metallo-porphyrins at the magnetic surfaces

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Magnetism at the nanoscale has recently attracted considerable attention. One of the possibilities to investigate molecular magnetism on the nanometer scale is by bringing organic molecules comprising magnetic atoms. Here we present a study of metallo-porphyrins containing different center metal atoms (M = Cr, Mn, Fe, Co, Ni) as they are adsorbed on ferromagnetic substrates. By XMCD and XAS we study their chemical bonding to and their exchange coupling with the substrate. The electronic configuration of the 3d-shell of the magnetic atoms predominates the nature of the exchange coupling of the molecules to the substrate. Our work contributes to the in-depth understanding of the interaction of magnetic molecules to their environment. It is thereby relevant to the physics of spintronic devices and potentially also useful to assess principles for future magnetic storage and quantum computers on the level of spin states.

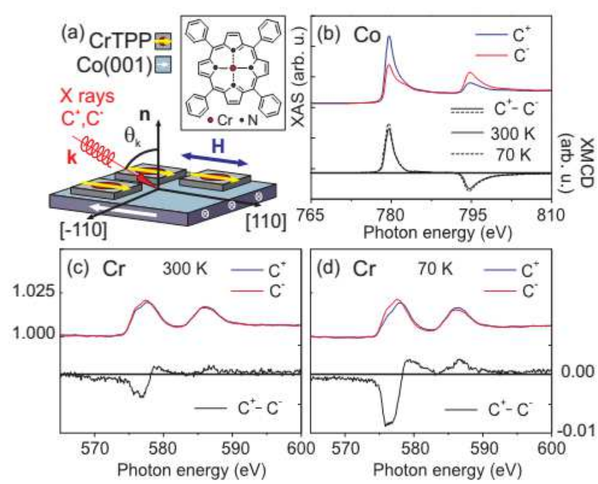

Figure 1. a) Sketch of the experimental setup. b) XMCD signal of the ferromagnetic cobalt substrate measured at Co $L_{3,2}$ edge c),d) XMCD spectra of Cr $L_{3,2}$ edge reveal and antiferromagnetic coupling of CrTPP molecules with respect to susbstrate magnetization.

Two dimensional electron gas at the surface of $BaTiO_3$ films

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Transition metals oxides with perovskite structure ABO_3 show a wide range of interesting properties. Of particular interest is the existence of a two dimensional electron gas (2DEG) at interfaces of TMO as found on the surface of clean $SrTiO_3$ both for cleaved and homogeneously prepared samples.[1,2,3] In the case of $SrTiO_3$ it was possible to identified a spin-splitting of the bands of the 2DEG with the use of spin- and angle-resolved photoelectron spectroscopy (SARPES).[4] In our recent work we were able to show the presence of a similar 2DEG at the surface of homogeneously grown films of $BaTiO_3$ with thicknesses of 10 and 20 unit cells on $SrTiO_3$ and $KTaO_3$ substrates. The surface states show a clear two dimensional dispersion with photon energy and a circular Fermi surface with intensity towards the next Γ-points. By the help of SARPES we were further able to clarify the existence of multiple spin polarized bands at the Fermi level.

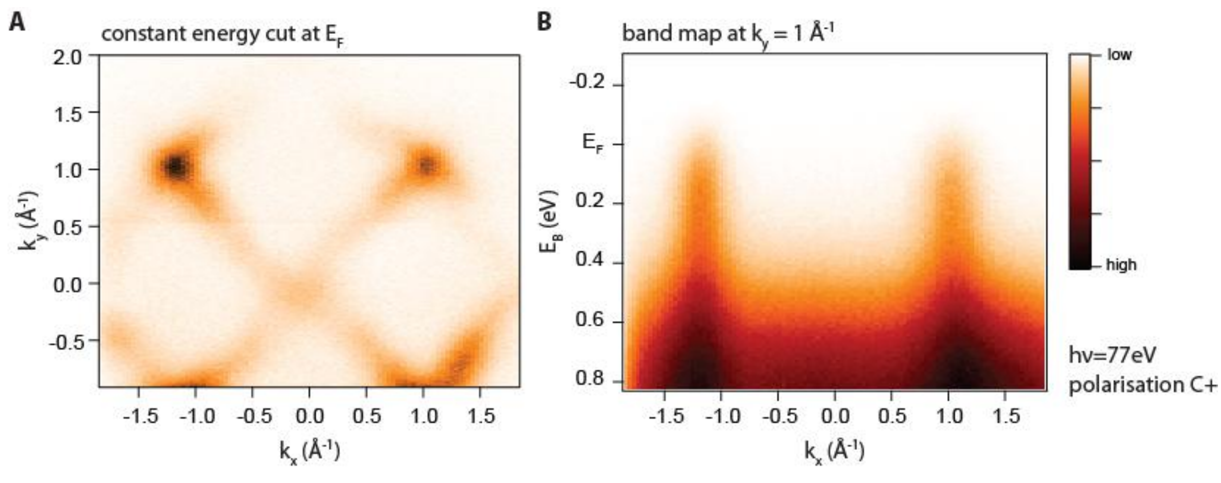

Figure 1. A) Cut at a constant binding energy (E_B=E_F) merged from two different measurements. Γ_0 is aligned at k_x=k_y=0Å^{-1}. B) Bandstructure in k_x direction measured at k_y=1Å^{-1} cutting through two Γ_1 points.

Refrences:

[1] A.F. Santander-Syro et al., Nature 469, 189 (2011).
[2] W. Meevasana et al. Nature Mater. 10, 114 (2011).
[3] N.C. Plumb et al. Phys. Rev. Lett. 113, 086801 (2014).
[4] A.F. Santander-Syro et al., Nature Mater. *in press* (2014)