The Spin Polarized Electronic Structure of Metal Overlayers on Magneto-Electric Cr_2O_3

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Perpendicular exchange-bias structures, based on the antiferromagnetic and magneto-electric Cr_2O_3(0001), have drawn considerable attention, in part because of potential applications in voltage controlled spintronics. The boundary spin polarization at the surface of the magnetoelectric Cr_2O_3(0001), can be isothermally voltage-controlled to provide perpendicular voltage-controlled exchange-bias in an adjacent ferromagnet [1,2]. This means that the adjacent ferromagnet is typically chosen with perpendicular magnetic anisotropy, e.g. Co-Pd or Co-Pt multilayers. Recently, scalable magneto-electric magnetic random access memory, based on the anomalous Hall effect that occurs in Pt overlayers on Cr_2O_3 has been proposed [3,4]. But this latter memory device concept depends on an induced polarization in the Pd or Pt overlayer on Cr_2O_3(0001).

In this presentation, we illustrate the induced polarization in several different overlayers, such as Pt, Pb, and Co, on the top of Cr_2O_3(0001). The interaction between the Cr_2O_3(0001) surface and an overlayer can be quite complex [5,6]. For example, we were recently able to show that the antiferromagnetic exchange coupling between the surface Cr ions of magneto-electric Cr_2O_3(0001) and Co atoms in an overlayer, shows significant canting, as seen in Figure 1, and demonstrated by spin polarized photoemission in Figure 2.

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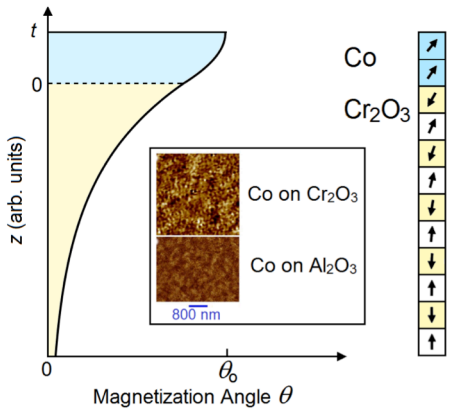

Figure 1: The micromagnetism of the spin canting in the Co/Cr_2O_3 system [5]. The inset compares magnetic force microscopy images of Co on Cr_2O_3 and Co on Al_2O_3: the more pronounced contrast in Co/Cr_2O_3 is caused by the exchange interaction to the antiferromagnetic substrate. In the complete absence of a normal component of magnetism, the magnetic force microscopy images would be featureless [5].

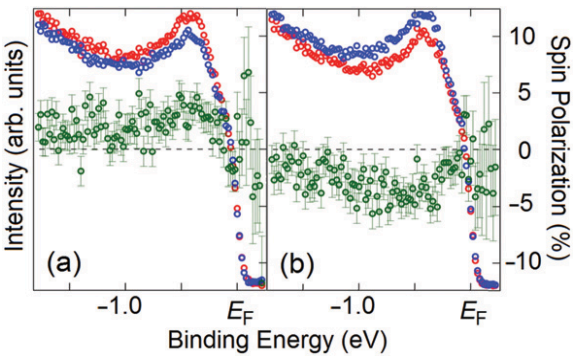

Figure 2: The spin-polarized photoemission spectra for 10 nm Co on top of Cr_2O_3: (a) measured in-plane spin polarization and (b) perpendicular (out-of-plane) spin polarization, acquired at HiSOR [5].