

## Reentrant Surface Anisotropy in the Antiferromagnetic/Ferromagnetic Bilayer Mn/Co/Cu(001)

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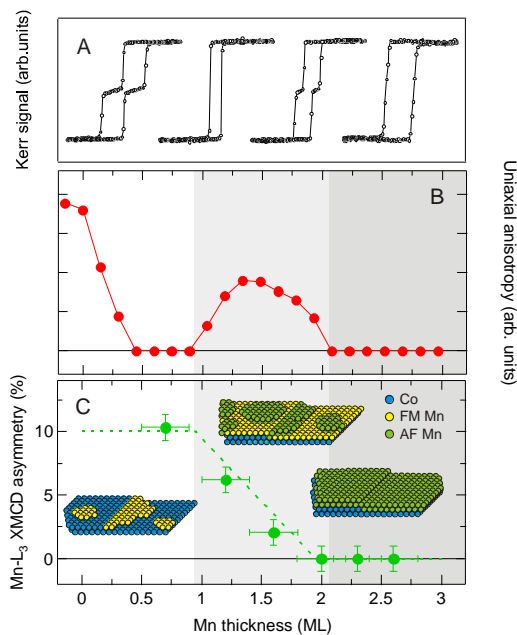
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The magnetic anisotropy of ferromagnetic (FM) nanostructures is strongly influenced by the presence of symmetry-breaking elements. This is for instance the case of low-coordinated sites at the surface of ultrathin magnetic films, whose contribution to the magnetic anisotropy may over-



Uniaxial anisotropy (arb. units)

whelm that of the constituent material in the bulk form [1-3]. In antiferromagnetic (AF) nanostructures, the difficulty in assessing the magnetic anisotropy has hampered the identification of the role played by the same symmetry-breaking elements. In this respect, we have investigated the magnetic anisotropy energy of monatomic surface-step atoms in AF/FM epitaxial Mn/Co bilayers grown on stepped Cu(001) surfaces. As shown in Fig. 1B, a re-entrant uniaxial surface anisotropy was observed for Mn thickness ( $t_{\text{Mn}}$ ) between 1 and 2 monolayers (ML). X-ray magnetic circular dichroism (XMCD) experiments (Fig 1C) show that the Mn films undergo a  $t_{\text{Mn}}$ -dependent transition from FM to AF in the 1–2 ML range, which entails the coexistence of FM and AF Mn phases in the film. The observation of a sizeable uniaxial anisotropy exclusively in the Mn-thickness range of coexistence of the FM and AF phases points out the crucial role of the boundaries between FM and AF regions, thus showing that the magnetic anisotropy of low-coordinated atoms may not be the sole consequence of a geometric symmetry breaking, but rather arise at the boundary between two different magnetic phases.

Figure 1 (A) Hysteresis loops measured with external magnetic field perpendicular to the steps of Co/Cu(001) for increasing Mn coverage: 0, 0.7, 1.6, and 2 ML (from left to right); (B) Uniaxial anisotropy as a function of  $t_{\text{Mn}}$  in Mn/Co/Cu(001); (C) XMCD asymmetry at the Mn- $L_3$  edge as a function of  $t_{\text{Mn}}$ . The insets schematically show the growth model.

[1] R. Moroni *et al.*, Phys. Rev. Lett. 91, 167207 (2003)

[2] F. Bisio *et al.*, Phys. Rev. Lett. 96, 057204 (2006)

[3] R. Moroni *et al.*, Phys. Rev. B 76, 214423 (2007)



## Highlights 2014

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