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Upper limit to magnetism in $LaAlO_3/SrTiO_3$ heterostructures

MICHAEL FITZSIMMONS, Los Alamos National Laboratory

In 2004 Ohtomo and Hwang reported unusually high conductivity in $LaAlO_3$ and $SrTiO_3$ bilayer samples. Since then, metallic conduction, superconductivity, magnetism, and coexistence of superconductivity and ferromagnetism have been attributed to $LaAlO_3/SrTiO_3$ interfaces. Very recently, two studies have reported large magnetic moments attributed to interfaces from measurement techniques that are unable to distinguish between interfacial and bulk magnetism. Consequently, it is imperative to perform magnetic measurements that by being intrinsically sensitive to interface magnetism are impervious to experimental artifacts suffered by bulk measurements. Using polarized neutron reflectometry, we measured the neutron spin dependent reflectivity from four $LaAlO_3/SrTiO_3$ superlattices. Our results indicate the upper limit for the magnetization averaged over the lateral dimensions of the sample induced by an 11 T magnetic field at 1.7 K is less than 2 G. SQUID magnetometry of the neutron superlattice samples sporadically finds an enhanced moment (consistent with past reports), possibly due to experimental artifacts. These observations set important restrictions on theories which imply a strongly enhanced magnetism at the interface between $LaAlO_3$ and $SrTiO_3$. Work performed in collaboration with N.W. Hengartner, S. Singh, M. Zhernenkov (LANL), F.Y. Bruno, J. Santamaria (Universidad Complutense de Madrid), A. Brinkman, M.J.A. Huijben, H. Molegraaf (MESA+ Institute for Nanotechnology), J. de la Venta and Ivan K. Schuller (UCSD).

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