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Enhanced Magnetization in $CuCr_2O_4$ Thin Film Barriers for Spin Filtering in Fe_3O_4-Based Magnetic Junctions.

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We have demonstrated that a ferrimagnetic $CuCr_2O_4$ (CCO) layer can be an effective barrier layer between two highly spin polarized electrodes of $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) and Fe_3O_4. These junctions exhibit distinct switching between parallel and anti-parallel states of the electrode magnetization in magnetotransport measurements with junction magnetoresistance (JMR) values of up to -4%. In most conventional magnetic junctions, the magnetoresistance decreases monotonically with applied voltage bias. Instead, in LSMO/CCO/Fe_3O_4 structures at low temperatures, we observe a bimodal behavior with a suppression of the JMR near zero bias. We may account for this suppression by the opening of a gap in the Fe_3O_4 density of states at its Verwey transition ($T_{Verwey, bulk}$~120K). Furthermore, element-specific X-ray circular magnetic dichroism (XMCD) was used to probe the interface magnetism by decoupling the magnetic response of the transition metal cations at the LSMO-CCO and the isostructural CCO-Fe_3O_4 interfaces.

In order to understand the role of the ferrimagnetic CCO barrier layer in the junction transport, we have studied the magnetism of this electrically insulating material in detail. CCO is an electrically insulating, magnetic oxide with a normal spinel cation distribution at room temperature. It has a bulk magnetic moment of $0.5\mu_B$/f.u. due to a frustrated triangular cation configuration. However, CCO thin films grown epitaxially on (110) $MgAl_2O_4$ substrates exhibit more than a 200% increase in magnetic moment when compared to its bulk moment. This enhanced magnetization is attributed to lattice distortions arising from the epitaxial strain induced by the lattice mismatch between the film and substrate. Together our complimentary studies of magnetotransport in junction structures, interfacial magnetism at oxide heterointerfaces, and manipulation of magnetic configuration in frustrated spin lattices can suggest new pathways in designing novel magnetic junctions and spin filtering devices.

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