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Exchange coupling in (111)-oriented $La_{0.7}Sr_{0.3}MnO_3/La_{0.7}Sr_{0.3}FeO_3$ superlattices

YUE JIA, RAJESH CHOPDEKAR, Department of Chemical Engineering and Materials Science, Univ. of California, Davis, ELKE ARENHOLZ, ANTHONY YOUNG, MATTHEW MARCUS, ANDREAS SCHOLL, Advanced Light Source, Lawrence Berkeley National Laboratory, YAYOI TAKAMURA, Department of Chemical Engineering and Materials Science, Univ. of California, Davis — Epitaxial $La_{0.7}Sr_{0.3}MnO_3$(LSMO)/$La_{0.7}Sr_{0.3}FeO_3$(LSFO) superlattices serve as ideal systems to explore the magnetic structure and exchange coupling in (111)-oriented perovskite oxides. The (111) orientation offers a buckled honeycomb structure resembling that of graphene with the stacking of highly polar layers. Furthermore, the bulk LSFO magnetic structure predicts that the (111) interface should have fully uncompensated antiferromagnetic (AF) moments leading to exchange bias interactions. Detailed soft x-ray magnetic spectroscopy and microscopy reveal that interfacial effects and the ultrathin nature of the sublayers of the superlattices can stabilize orientations of the LSFO AF spin axis which differ from that of LSFO films and LSMO/LSFO bilayers. A portion of the interfacial AF moments can be reoriented to an arbitrary direction by a moderate external magnetic field through spin-flop coupling with the ferromagnetic LSMO sublayers with low magnetocrystalline anisotropy in the (111) plane. The remaining decoupled moments are pinned by the crystalline anisotropy, displaying 3-fold symmetry consistent with the crystal symmetry of the (111) plane.

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