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Magnetic Correlation in Complex Oxide Nanostructures

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Perovskite-structured oxides possess a wide range of technologically relevant functional properties including ferromagnetism, ferroelectricity, and superconductivity. Furthermore, the interfaces of perovskite oxides have been shown to exhibit unexpected functional properties not found in the constituent materials. These functional properties arise due to various structural and chemical changes as well as electronic and/or magnetic interactions occurring over nanometer length scales at the interfaces. Exchange interactions which occur at the interface between ferromagnetic (FM) and antiferromagnetic (AFM) layers play a key role in devices such as magnetic hard drives and magnetic random access memory, however, a fundamental understanding of the phenomena remains elusive. In this work, we investigate the FM/AFM system consisting of FM half metal, $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) and the G-type AFM insulator $LaFeO_3$ (LFO). Previously, the LSMO/$La_{1-x}Sr_xFeO_3$ system was shown to display a unique spin-flop coupling where the FM moments and the AFM spin axis maintain a perpendicular orientation relative to one another.[1, 2] Through this coupling mechanism, the direction of the AFM spin axis can be reoriented with an applied magnetic field. In this talk, I will discuss our recent results using x-ray photoemission electron microscopy to directly image the FM and AFM spin in embedded nanostructures patterned in LSMO/LFO bilayers.[3] A transition from perpendicular to parallel spin alignment is observed, depending on the size and crystallographic orientation of the nanostructures, as well as the measurement temperature. These results demonstrate that shape-induced anisotropy in the AFM layer can override the interface exchange coupling in spin-flop coupled nanostructures.

[1] E. Arenholz, G. van der Laan, F. Yang, N. Kemik, M. D. Biegalski, H. M. Christen, and Y. Takamura, "Magnetic Structure of $La_{0.7}Sr_{0.3}MnO_3$ / $La_{0.7}Sr_{0.3}FeO_3$ superlattices," *Appl. Phys. Lett.,* vol. 94, p. 072503, 2009.

[2] F. Yang, N. Kemik, A. Scholl, A. Doran, A. T. Young, M. D. Biegalski, H. M. Christen, and Y. Takamura, "Correlated domain structure in perovskite oxide superlattices exhibiting spin-flop coupling," *Phys. Rev. B,* vol. 83, 2011.

[3] E. Folven, A. Scholl, A. T. Young, S. T. Retterer, J. E. Boschker, T. Tybell, Y. Takamura, and J. K. Grepstad, "Crossover from Spin-Flop Coupling to Collinear Spin Alignment in Antiferromagnetic/ Ferromagnetic Nanostructures," *Nano Letters,* vol. 12, pp. 2386-2390, 2012.