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Engineering Spin Textures in Nanostructured Complex Oxides

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Abstract

Due to the strong interaction between the charge, spin, lattice, and orbital degrees of freedom, complex oxides possess a wide range of technologically relevant properties such as ferromagnetism, ferroelectricity, and superconductivity. Recent advances in modern thin film growth and characterization techniques have revealed that interfacial interactions with structural, chemical, electronic, and magnetic origins can provide additional sources of emergent behavior in complex oxide heterostructures. These emergent properties enable the engineering of their functional properties and spin textures which can serve as the basis for various spin-based memory and logic devices as these complex oxides are patterned down to micron and nanoscale dimensions. This nanoscale patterning is performed using a local structural modification due to an ion implantation process which result in magnetic islands embedded within a non-magnetic matrix. A complex 3D strain state develops within the magnetic islands from the combined effects of the underlying substrate as well as the surrounding amorphous matrix. As a result, distinctive and coupled ferromagnetic and antiferromagnetic spin textures have been observed in x-ray photoemission electron microscopy (X-PEEM) images of thin films and heterostructures composed of ferromagnetic $La_{0.7}Sr_{0.3}MnO_3$ and antiferromagnetic $La_{1-x}Sr_xFeO_3$ sublayers. These spin textures can be manipulated based on the details of magnetic parameters such as exchange interactions, as well as shape and magnetocrystalline anisotropy energies.[1,2] These studies demonstrate that complex oxide heterostructures provide a unique platform for engineering spin textures for future memory and spintronic device applications.

1 M. S. Lee *et al. ACS Nano* **10**, 8545-8551, (2016).
2 Y. Takamura *et al. Physical Review Letters* **111**, 107201, (2013).

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Biography

Yayoi Takamura received her B.S. from Cornell University in 1998 and her M.S. and Ph.D. degrees from Stanford University in 2000 and 2004, respectively, all in the field of Materials Science and Engineering. She was a postdoctoral researcher at UC Berkeley with Prof. Yuri Suzuki in the Dept. of Materials Science and Engineering before joining the Dept. of Materials Science and Engineering at UC Davis in July 2006. Her research focuses on the growth of complex oxide thin films, heterostructures, and nanostructures and the characterization of the novel functional properties associated with their interfaces. Prof. Takamura is a recipient of the NSF CAREER Award and the DARPA Young Faculty Award.