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Nature of the magnetoelectric coupling in PZT/LSMO multiferroic structures CARLOS A.F. VAZ, JASON HOFFMAN, YARON SEGAL, JAMES REINER, CHARLES AHN, FRED WALKER, Yale University, ZHAN ZHANG, Argonne National Laboratory — By using a combination of electric, transport, magnetic and spectroscopic techniques, we shed light on the origin of the magnetoelectric coupling recently observed in $La_{0.8}Sr_{0.2}MnO_3/Pb(Zr_{0.2}Ti_{0.8})O_3$ (LSMO/PZT) multiferroic heterostructures [1]. Hall-bar device structures are grown by molecular beam epitaxy (LSMO) and off-axis rf magnetron sputtering (PZT). From x-ray absorption near edge spectroscopy measurements as a function of the PZT polarization, we find a modification in the Mn valence state, in good agreement with the expected charge modulation, demonstrating the electronic origin of the large magnetoelectric coupling effect found in these multiferroic heterostructures. We also show that the large change in magnetic moment observed in this system cannot be fully accounted for by the measured change in the Mn valency. This result indicates the occurrence of a change in the spin configuration of the interfacial LSMO layer, from a ferromagnetic spin configuration to an antiferromagnetic spin arrangement with respect to the underlying LSMO layers. This effect is attributed to the balance between charge and competing super-exchange, along with double exchange interactions that are a hallmark of these strongly correlated oxides. [1] Molegraaf et al, , Advanced Materials 21 (2009) 3470.

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