Electrostatic shaping of magnetic transition regions in $La_{0.7}Sr_{0.3}MnO_3$

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We report a magnetic transition region in $La_{0.7}Sr_{0.3}MnO_3$ with gradually changing magnitude of magnetization, but no rotation, stable at all temperatures below T_C. Spatially-resolved magnetization, composition and Mn valence data reveal that the magnetic transition region is induced by a subtle Mn composition change, leading to a charge transfer at the interface due to carrier diffusion and drift. The electrostatic shaping of the magnetic transition region is mediated by the Mn valence which affects both, magnetization by Mn^{3+}-Mn^{4+} double exchange interaction and free carrier concentration.[1]

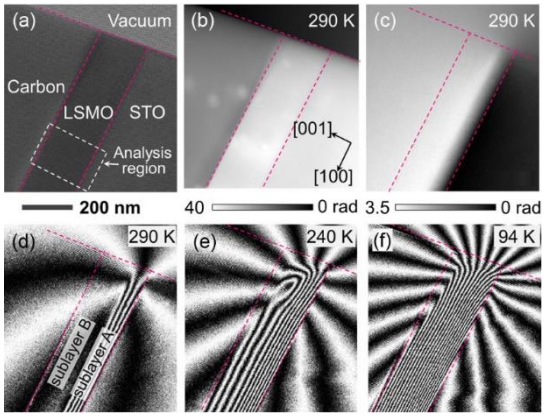

Figure 2 (a) Off-axis electron hologram of a LSMO film on Nb-doped STO. (b) Mean inner and electrostatic potential contribution to the phase. (c) Reconstructed magnetic phase shift with the mean inner and electrostatic potential contribution removed. (d)–(f) Magnetic induction maps with a phase contour spacing of π radians at 290, 240, and 94 K, respectively. The denser are the phase contours in the specimen, the stronger is the magnetization. A magnetic transition region between sublayers A and B with a gradually changing magnitude of magnetization is present at all temperatures below T_C.

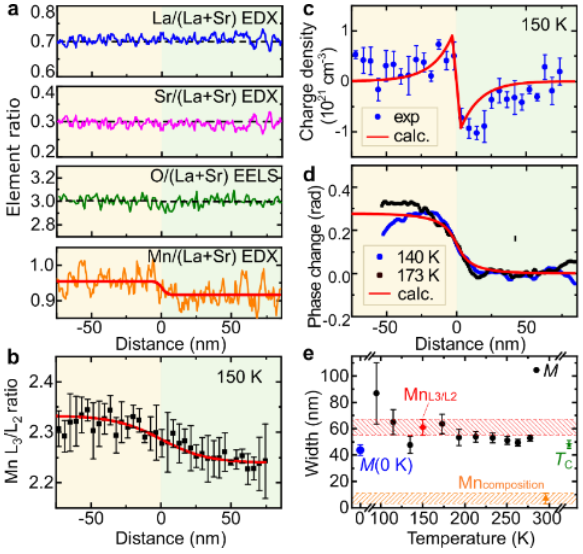

Figure 1 (a) Composition profiles measured by EDX (La, Sr, Mn) and EELS (O). (b) Ratio of integrated Mn-L_3 and L_2 edges measured by EELS. (c) Charge density derived from Mn valence and composition. (d) Phase shift measured by off-axis electron holography. (e) Temperature dependence of the transition region widths of the magnetization (black), the Mn valence (red), Mn composition (orange), and T_C (green).

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