Charge transfer phenomena at ferromagnetic/superconducting oxide interfaces

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YBa₂Cu₃O₇₋ₓ/La₀.₆₇Ca₀.₃₃MnO₃ (YBCO/LCMO) ferromagnetic/superconducting interfaces have been analyzed by scanning transmission electron microscopy (STEM) and electron energy loss spectroscopy (EELS) with monolayer resolution. Extensive charge transfer occurs between the manganite and the superconductor (fig1a), in a manner similar to modulation-doped semiconductors, which explains the reduced critical temperatures of heterostructures. Since CMR and HTCS oxides are extremely sensitive to doping these charge transfer processes at the interfaces will directly affecting the superconducting and/or magnetic properties of the individual layers. This behavior has not been observed with insulating PrBa₂Cu₃O₇ layers in YBa₂Cu₃O₇₋ₓ/PrBa₂Cu₃O₇ (YBCO/PBCO) superlattices. EELS in these samples provides direct confirmation that holes in the YBa₂Cu₃O₇₋ₓ are located on the CuO₂ planes (fig 1b).

FIG.1: (a) Normalized pre-peak intensity for the O K edge acquired at the YBCO side of a YBCO/LCMO interface, as a function to the distance to the interface. The horizontal dotted line marks the pre-peak intensity in bulk YBCO. (b) Normalized pre-peak intensity within the YBCO in a YBCO/PBCO interface, as a function of the distance to the interface. The background Z-contrast images are on the same scale than the EELS profiles.

References
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