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STM probe of charge ordering and 2D carrier confinement in mixed valence manganites[1]

CHRISTOPH RENNER, University College London

One property common to most layered transition metal perovskite oxides is their highly anisotropic transport properties. The in-plane resistivity is metallic, whereas electron transport perpendicular to the layers is more characteristic of a semiconductor. We present vacuum tunneling spectroscopy on cleaved $La_{1.4}Sr_{1.6}Mn_2O_7$ single crystals using a scanning tunneling microscope (STM) in ultrahigh vacuum. We find a gap E_g that is associated with the room temperature c-axis conductivity. Surprisingly, E_g remains finite when the temperature is lowered through the metal-insulator transition at 90 Kelvin. This remarkable result suggests that the intrinsic electron transport between adjacent perovskite bilayers is thermally activated at all temperatures, with a characteristic activation energy E_g. We further find no evidence of electronic phase separation, as E_g is spatially homogeneous at all temperatures. We shall discuss these spectroscopy data and atomically resolved STM micrographs in the context of colossal magnetoresistance (CMR), and their contribution to our understanding of CMR manganites.

[1]Work done in collaboration with H.M.Roennow and G.Aeppli