Surface Effects on the Orbital Order in $La_{0.5}Sr_{1.5}MnO_4$

Beamline: X21

Category of Researcher: GU

Technique: x-ray scattering

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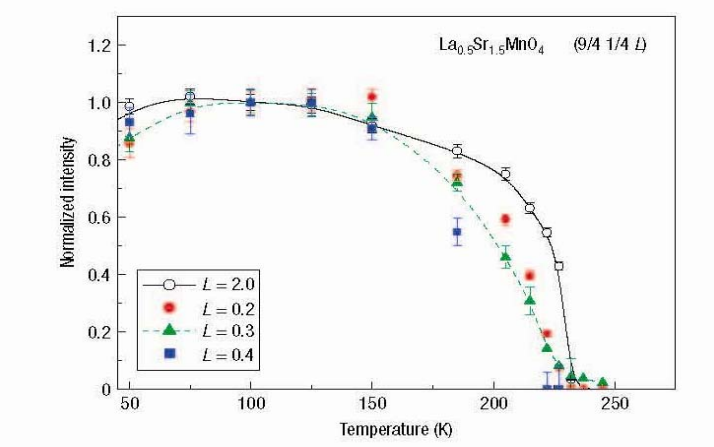
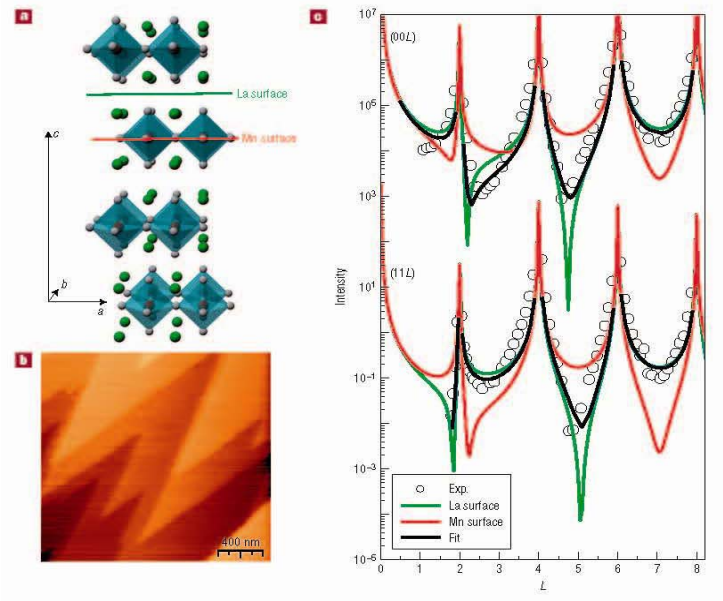
Publication: Nature Materials 6, 972 (2007)

Motivation: The surface termination of bulk electronic order is intriguing and has possible practical implications for nanoscale devices. Surface x-ray scattering was used to study the orbital order in the single-layered manganite $La_{0.5}Sr_{1.5}MnO_4$.



Temperature dependence of the bulk- and surface-orbital order.



The crystal structure of $La_{0.5}Sr_{1.5}MnO_4$ (a), with an AFM image of a cleaved sample used in the study (b), and crystal truncation rod scattering with calculated intensities for La- and Mn-terminated surfaces (c).

Results: Orbital truncation rods due to the abrupt termination of orbital order by a surface were observed. While the crystallographic surface is atomically smooth (see AFM image, above), the orbital surface that is observed through the atomic displacements caused by the orbital order is much rougher, with a typical scale of the surface roughness of ~7 Å. The temperature dependence of the scattering due to the surface orbital order shows evidence of a surface-induced second-order transition.