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Strained Induced Local Distortions of $Nd_{0.5}Sr_{0.5}MnO_3$ films

M. DeLeon, T. Tyson (NJIT), W. Prellier (U. Maryland) and A. Frenkel (NSLS)

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Introduction: Magnetotransport properties of thin films are augmented by thickness dependent strain due to substrate-film mismatch [1, 2, 3]. Prellier et al has found a thickness induced metallic state of $Nd_{0.5}Sr_{0.5}MnO_3$ films at ~150K, while thinner films are found to be insulating as in bulk [4]. The local structural details as studied by polarized Mn-K edge absorption spectra of $Nd_{0.5}Sr_{0.5}MnO_3$ films of 500Å, 1000Å, and 2000Å thickness reveal a preferential orientation of the e_g orbitals out of plane for the thinnest film. The thicker films show lesser anisotropy of orientation [5]. The local structure about the Sr atoms would be of crucial importance in understanding the order of the lattice as depending on thickness.

Methods and Materials: Epitaxial $Nd_{0.5}Sr_{0.5}MnO_3$ films (202) of 500Å, 1000Å, and 2000Å thickness were deposited on $LaAlO_3$ (100) substrates via the pulsed laser deposition technique. An extended x-ray absorption fine-structure study was conducted at the Sr K-edge.

Results: Figure 1 depicts the fourier transforms of $\chi(k)*k^3$ of these films and that of bulk. There is an increased local distortion in the Sr-O shell for the 500Å film, whereas the 1000Å and 2000Å films track the bulk data. However, previous measurements have found that in-plane strain persists in the 1000Å and 2000Å thick films, which prevents the transition from metallic to insulating phase as seen in bulk [5].

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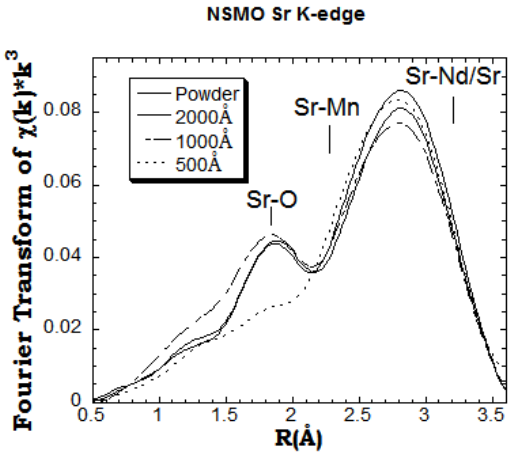

Figure 1. The local distortions manifested, as the small Sr-O peak, is consistent with the high resistivity [insulating phase] observed in the 500 Å film compared to the 1000Å and 2000 Å films.