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Average Lattice Symmetry and Nanoscale Structural Correlations in Magnetoresistive Manganites

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Results: We report x-ray scattering studies of nanoscale structural correlations in the paramagnetic phases of perovskite manganites $La_{0.85}(Ca_{0.45}Sr_{0.55})_{0.25}MnO_3$, $La_{0.625}Sr_{0.375}MnO_3$, and $Nd_{0.45}Sr_{0.55}MnO_3$. We find that the nanoscale correlations are present in the orthorhombic *O* phase in $La_{0.85}(Ca_{0.45}Sr_{0.55})_{0.25}MnO_3$. These correlations, however, abruptly disappear at the orthorhombic-to-rhombohedral transition in this compound. The rhombohedral phase exhibits reduced electrical resistivity and increased ferromagnetic coupling, in agreement with the association of the nanoscale correlations with insulating regions. The structural correlations are also not detected in the rhombohedral and tetragonal phases in the other compounds. Based on these results, as well as on previously published work, we propose that the local structure of the paramagnetic phase and, consequently, its physical properties, correlate strongly with the average lattice symmetry.