

# Scanning Probe Studies of Manganite and Multiferroic Materials

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Over the past decade we have developed scanning force microscopes capable of operating down to 4K. The latest of these instruments has the capability of finding a particular place in the sample and following it from room temperature to the lowest temperatures in applied magnetic fields up to 8 Tesla. This unique capability has made it possible for us to study the formation and coexistence of paramagnetic, charge-ordered and ferromagnetic phases in a single crystal of  $La_{.25}Pr_{.375}Ca_{.375}MnO_3$  over a wide range of temperature and field. The power of real-space techniques is demonstrated in the observation of the interaction of these phases with twin boundaries and defects, as well as the determination of characteristic length scales and shapes. Our most important conclusion is that after zero-field cooling the macroscopic magnetization is a measure of the volume fraction of the ferromagnetic phase, which seems to rule out the classic spin-glass model for this material.

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