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Magnetic mapping of phase separated manganite films[1] CASEY ISRAEL, DIANA SANCHEZ, TAKESHI KASAMA, RAFAL DUNIN-BORKOWSKI, NEIL MATHUR, Department of Materials Science and Metallurgy, University of Cambridge, TIEN-MING CHUANG, ALEX DE LOZANNE, Physics Department, University of Texas at Austin — We summarize the recent results of efforts to image the different phases in phase-separated epitaxial thin manganite films. We present images acquired by three techniques, electron holography in a transmission electron microscope, magnetic force microscopy (MFM), and conducting atomic force microscopy (CAFM), all of which are applied to $La_{1-x}Ca_xMnO_3$ (LCMO) films grown on $NdGaO_3$ (001) substrates. Electron holography images of a focused ion beam milled LCMO ($x = 0.3$) film (uniformly ferromagnetic at low temperatures) demonstrate the feasibility of using this method to distinguish local phases with different magnetic properties and illustrate the dangers of ion implantation during focused ion beam processing. MFM and CAFM scans of an as-deposited LCMO ($x = 0.40$) film (phase-separated at low temperatures) indicate the coexistence of ferromagnetic (metallic) and nonferromagnetic (insulating) regions characterized by length scales below roughly 100 nm. It appears that the ferromagnetic regions preferentially form conducting pathways aligned with the film's easy-axis for magnetization. This seems intrinsic, in that there are no topographical features linked with this phase anisotropy.

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