Novel surface phases of correlated electron materials–E.W. Plummer, *Condensed Matter Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831* and *Department of Physics and Astronomy, The University of Tennessee, Knoxville, TN 37996*. The physics of correlated electron materials such as the transition-metal oxides (TMO) involves a delicate balance between competing interactions and competing length scales. This balance renders the materials exquisitely sensitive to external stimuli and therefore attractive for applications ranging from advanced sensors to active electronic materials. Creating a surface, either by cleaving a layered TMO or growing in-situ thin films using laser MBE is a way to disturb the delicate balance and create new phases and new functionality. The surfaces phases of the layered (2D) TMO $Sr_xCa_{1-x}RuO_4$ will be discussed for $0<x<2$. For $x=2$, the surface reconstructs to stabilize a bulk soft phonon, by an in-plane rotation of the octahedral, stabilizing magnetic ordering. At the other extreme ($x=0.1$), the surface has a lower Mott insulator-metal transition than is the bulk, which is totally unexpected. LEED *I-V* structural analysis shows a distortion of the surface octahedral, which we believe is the origin of many of the surface properties. The electronic and magnetic properties at the surface of 3D TMOs has been investigated by in-situ scanning tunneling microscopy/spectroscopy and ex-situ SQUID magnetometer characterization of laser MBE grown films. In particular, we have observed both large-scale (larger than a few tens nanometers) and nanoscale electronic phase separation (PS) in epitaxially grown thin films of $(La_{5/8-0.3}Pr_{0.3})Ca_{3/8}MnO_3$. While the large PS domains are present only below the Curie temperature (T_c), the nanoscale PS clusters, imaged with atomic resolution, exist at temperatures both below and above T_c, which reflects the doping-related polaron formation.

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