Novel Surface Phases of Correlated Electron Materials

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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 film is a way to disturb the delicate balance and create new phases and new functionality. The physical properties of these surfaces can be investigated with the powerful arsenal of modern surface tools, such as scanning tunneling microscopy and spectroscopy, inelastic electron scattering, angle-resolved photoemission, elastic electron diffraction, and surface magneto-optical Kerr rotation. This presentation will focus on the surfaces phases of the layered (2D) TMO $Sr_xCa_{1-x}RuO_4$. The bulk is an unconventional superconductor for x=2, a Mott insulator for small x, and exhibits a quantum critical point at x=0.5. 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 in 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. Observations on the surface of this series will be related to observations on other TMO surfaces.

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