New Materials: Electronic Phase Separation and Non-Equilibrium Structures

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Several new developments in materials have opened up exciting new research directions for condensed matter physics but also severe challenges for photoemission measurements. Our group has been exploring different avenues toward synthesizing new materials. The main focus here is on electrochemical intercalation of excess oxygen into oxide compounds. We find an entirely electronically driven phase separation in the high temperature superconductor $La_{2-x}Sr_xCuO_{4+y}$ in the vicinity of optimal doping. Irrespective of *Sr* amount, adding adequate amounts of excess oxygen produces a superconducting phase with T_C near *40 K* and a separate magnetic phase characterized by a spin density wave that also orders near *40 K*. These represent two line phases in hole content, a superconducting phase with *0.16* holes per Cu site and a magnetic phase at *1/8* doping.

Separately, we have been investigating epitaxial films of complex oxides. Such films can be considerably different from corresponding bulk compounds. The primary differences are due to the possibility of large strains and the structural constraint imposed by epitaxy with the substrate. A short description will be given of how these effects lead to the formation of new phases and phase transitions in $SrTiO_3$ and cause the destruction of charge stripes in $La_{1.67}Sr_{0.33}NiO_4$.