

“Oxide interfaces in the light of electrons”

Oxide interfaces offer an amazingly interesting playground where we can test the effects of low dimensionality, interplay between different phenomena or even unexpected behaviors. In order to study such effects probes capable of analyzing the structure, chemistry and physical properties with atomic resolution in real space are a must, since they can provide information not always available through standard (average) diffraction methods. Aberration corrected scanning transmission electron microscopy (STEM) combined with electron energy loss spectroscopy (EELS) and density-functional calculations provides a unique combination of tools to look into this exciting world, in real space and with spatial resolutions around or below 0.1 nm. This level of sensitivity allows us to analyze in great detail the crystal and electronic structures of complex oxides. Images now show greatly improved contrast and signal to noise ratio, sufficient to allow sensitivity to light atoms (such as oxygen) and even to single atoms in both imaging and spectroscopy. This talk will review the state-of-the-art of the technique, and show several examples of how these tools unveil the origin of macroscopic properties of oxide interfaces with unexpected effects related to epitaxial strain. One example is the colossal ionic conductivity found near room temperature in Y₂O₃ stabilized ZrO₂ (YSZ) / SrTiO₃ (STO) interfaces. When the YSZ is thin enough that is epitaxially strained to match the STO there is a mismatch in the oxygen sublattices at the interface that results in a extreme degree of disorder and O mobility in the YSZ O sublattice near the interface. Another example is that of LaMnO₃ (LMO) / STO interfaces. The LMO/STO relative layer thickness ratio changes the degree of epitaxial strain within the layers and dramatically affects the physical properties of the system, which can be tuned from insulating, mild ferromagnetic, to metallic ferromagnets.