

Tuning the electrical properties of oxides: the role of interface effects

Giuliano Gregori

Max Planck Institute for Solid State Research, Stuttgart, Germany

It is well known that grain boundaries in polycrystalline ceramics and interfaces in thin films (interfaces between neighboring layers in heterostructures as well as film/substrate interfaces) can lead to the occurrence of phenomena that do not belong to the bulk (single crystal) properties of the constituting materials: A famous example in this context is the formation of a 2D electron gas at the $\text{LaAlO}_3/\text{SrTiO}_3$ interface.

In many cases, the local redistribution of ionic defects (i.e. vacancies, interstitials and dopants) plays a crucial role in defining the concentrations of the mobile charge carriers (both electronic and ionic) at the interfaces and hence the functional properties that rely on them. Obviously, such effects are particularly exciting in nanostructured systems, in which the boundaries become predominant over the bulk and can even fully dominate the properties of the whole material.

In this presentation, I intend to illustrate a selection of examples dealing with electrically conducting oxides (e.g. pulsed laser deposited CeO_2 and $\text{Y}_2\text{Zr}_2\text{O}_7$ thin films) as well as superconducting heterostructures, based on molecular beam epitaxy grown La_2CuO_4 .

In all these cases, thanks to a combination of complementary experimental techniques (e.g. electrical transport measurements and high-resolution transmission electron microscopy) a considerable deviation from the bulk properties is detected locally, which is due to strain and/or space charge effects.