MAR11-2010-005176

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Electronic Reconstruction at oxide interfaces: from an electron-hole bilayer to a spin-polarized 2DEG

ROSSITZA PENTCHEVA, University of Munich

The origin of conductivity at the interface between the band insulators $LaAlO_3$ and $SrTiO_3$ has been subject of continued interest and debate. Density functional theory calculations can provide not only insight into the underlying mechanisms but also allow one to identify further parameters to tune the electronic reconstruction in this system in view of device applications. In particular, the potential build up induced by the polarity of the $LaAlO_3$ film is found to be counteracted by a strong lattice polarization in the $LaAlO_3$ film. The latter allows the system to remain insulating for the first several $LaAlO_3$ layers before a crossover to an electronic reconstruction takes place at around 4-5 monolayers (ML). We demonstrate that, owing to a dispersive surface state, an additional $SrTiO_3$ capping layer can trigger the insulator-to-metal transition already at two ML of $LaAlO_3$. As a result, two spatially separated sheets of carriers emerge: electrons at the interface and holes at the surface that are only 1 nm apart and can be used to study excitonic phenomena. Furthermore, we explore the effect of a metallic contact layer on top of the $LaAlO_3$ film which not only eliminates the potential build up but turns out to be a promising way to enhance the carrier concentration and possibly to realize a spin-polarized electron gas at the interface. Work in collaboration with W.E. Pickett, K. Otte, V. Ruiz López.