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Nanoscale analysis of high-mobility electron gases at $SrTiO_3$ interfaces and surfaces

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Electronic reconstructions or defects localized next to an interface between two oxides may lead to dramatic modifications of their physical properties. One intriguing example of such phenomena is the formation of high-mobility two-dimensional electron gases (2DEG) at the interface between $LaAlO_3$ and $SrTiO_3$ (STO), two insulating dielectric perovskite oxides. To characterize crucial aspects of these 2DEG such as the spatial extension as well as carrier density profiles, sophisticated techniques are required. Here I explain how we used the synergetic combination of different advanced characterization tools including depth-resolved positron annihilation spectroscopy, conductive-tip atomic force microscopy [1], electron energy loss spectroscopy [2] or low-temperature high-magnetic field measurements [3, 4], to characterize with nanometric space resolution high-mobility electron gases at STO interfaces and surfaces. Our results emphasize the relevance of using interface/surface characterization tools that resolve spatially the physical properties and also detect spatial tiny changes of stoichiometry at the interface/surface of complex oxide structures.

[1] M. Basletic et al., Nature Materials, 7, 621 - 625 (2008)
[2] J.-L. Maurice et al., Europhys. Lett. 82, 17003 (2008)
[3] G. Herranz et al., Phys. Rev. Lett. 98, 216803 (2007)
[4] G. Herranz et al., Phys. Rev. B 73, 064403 (2006)