A high-mobility two-dimensional electron gas at the spinel/perovskite interface of -Al2O3/SrTiO3

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A high-mobility two-dimensional electron gas at the spinel/perovskite interface of γ-Al_2O_3/$SrTiO_3$

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❑ Background and motivation

The realization of high-mobility 2DEGs in epitaxially grown heterostructures made of traditional semiconductors is at the heart of present electronics, which has led to a wealth of new physical phenomena as well as new electronic and photonic devices over the past few decades. 2DEGs at the interface between insulating complex oxides not only provide a wealth of opportunities to study mesoscopic physics with strongly correlated electrons confined in nanostructures, but also show promise for multifunctional all-oxide devices with probably even richer behavior than those we experienced in semiconductor devices.

❑ Metallic interface between insulating oxides of Al_2O_3 and $SrTiO_3$

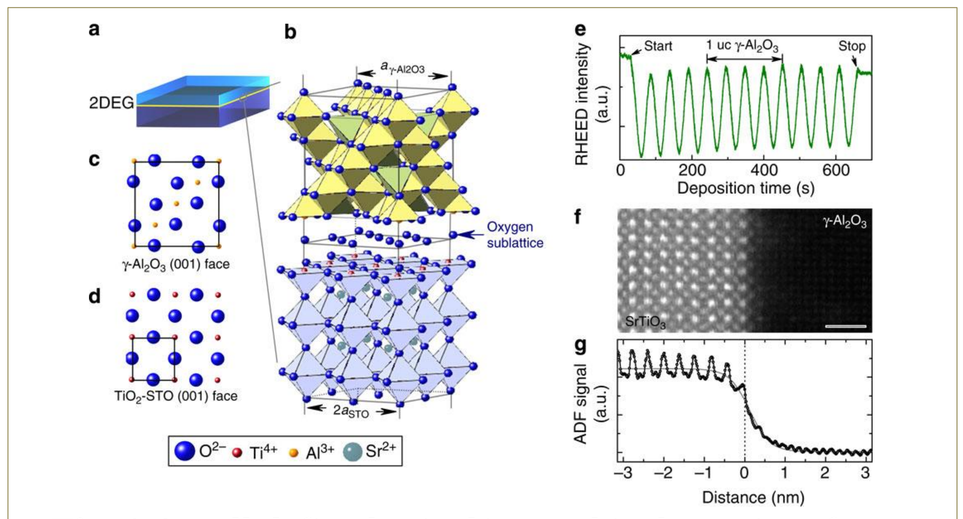


Fig. 1 A well defined spinel/perovskite heterointerface determined by STEM-EELS, grown by PLD-RHEED.

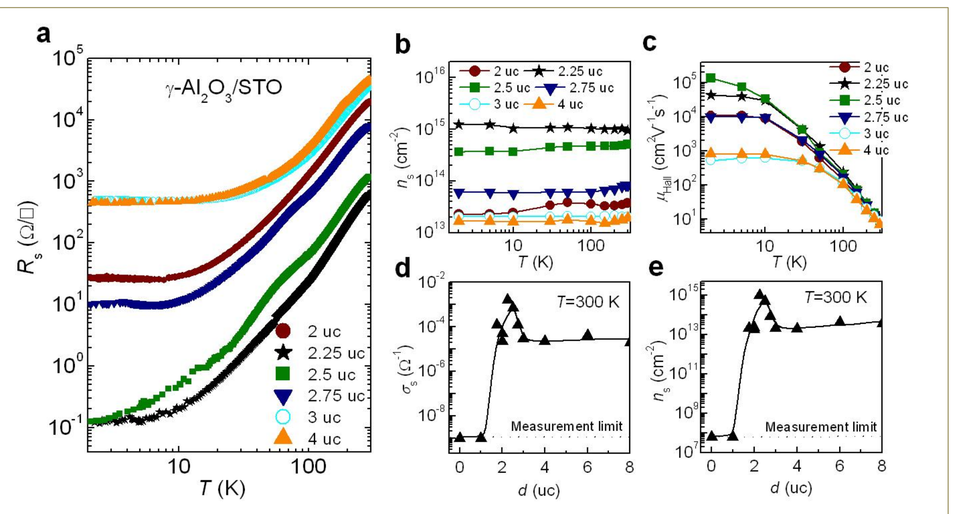


Fig. 2 High mobility metallic conduction with critical thickness depencence.

❑ High-mobility 2DEGs dominated by interface-stabilized oxygen vacancies

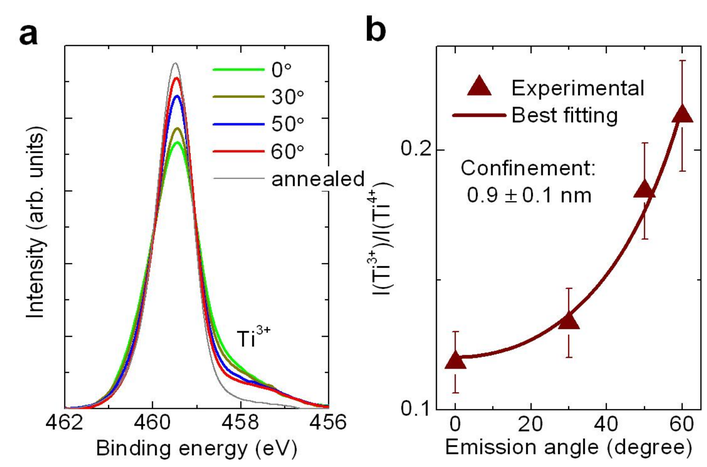


Fig. 3 Oxygen deficient thin layer of 0.9 nm in proximity to the heterointerface determined by angle-resolved X-ray photoelectron spectroscopy.

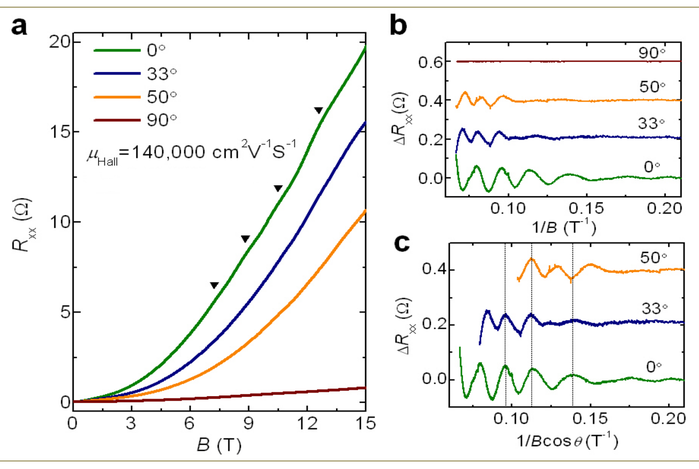
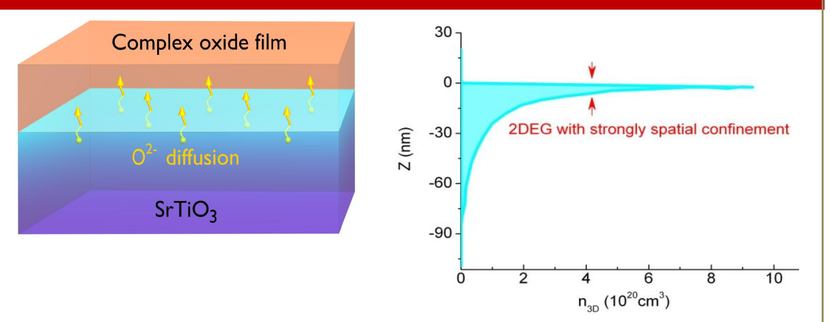


Fig. 4 Unambiguous two-dimensional conduction revealed by the angle-dependent Shubnikov-de Hass (SdH) quantum oscillations.

Exploring 2DEGs at oxide interfaces



1) **Oxygen ions redistribution across interface can result in metallic conduction in STO-based heterostructures involving complex oxides with Al, Ti, Zr, and Hf as component elements.**
2) **Defect engineering of oxygen vacancies, especially interfacial redox reactions with strongly spatial confinement will be a crucial issue for the conductive interface between insulating complex oxides.**

❑ Conclusion

Confined redox reactions in STO-based heterointerfaces: an alternative way to create high-mobility 2D conductivity at oxide nterfaces.

1)Y. Z. Chen *et al.* Nat. Commun. 4:1371 doi: 10.1038/ncomms2394 (2013). 2) News story: Electron gas conducts at insulating interface (nanotechweb.org);