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A high-mobility two-dimensional electron gas at the spinel/perovskite interface of $\gamma\text{-Al}_2\text{O}_3/\text{SrTiO}_3$

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Abstract:

The discovery of two-dimensional electron gases (2DEGs) at the heterointerface between two insulating perovskite-type oxides, such as LaAlO_3 and SrTiO_3 [1], provides opportunities for a new generation of all-oxide electronic devices. Key challenges remain for achieving interfacial electron mobilities much beyond the current value of approximately $1000 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ (at low temperatures) [2]. Here, we create a new type of 2DEG at the heterointerface between SrTiO_3 and a spinel $\gamma\text{-Al}_2\text{O}_3$ epitaxial film with compatible oxygen ions sublattices. Electron mobilities more than one order of magnitude higher than those of hitherto investigated perovskite-type interfaces are obtained. Particularly, electron Hall mobilities as large as $1.4 \times 10^5 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ and n_s as high as $3.7 \times 10^{14} \text{ cm}^{-2}$ at 2 K is obtained at this spinel/perovskite complex oxide interface [2]. The spinel/perovskite 2DEG, where the two-dimensional conduction character is revealed by quantum magnetoresistance oscillations, is found to result from interface-stabilized oxygen vacancies confined within a layer of 0.9 nm in proximity to the interface. Our findings pave the way for studies of mesoscopic physics with complex oxides and design of high-mobility all-oxide electronic devices.

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Yunzhong Chen: He received his Ph.D. in Condensed Matter Physics in 2009 from Institute of Physics, Chinese Academy of Sciences, China. He is currently a researcher in Technical University of Denmark. His research focuses on the creation and understanding of the interface phenomena in atomically engineered complex oxide heterostructures, in particular the high-mobility 2DEG at the interface between insulating oxides.