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Chen, Yunzhong

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

Yunzhong Chen

Department of Energy Conversion and Storage, Technical University of Denmark, Risø DTU Campus, Denmark

Email:yunc@dtu.dk

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 $cm^2V^{-1}s^{-1}$ (at low temperatures) [2]. Here, we create a new type of 2DEG at the heterointerface between $SrTiO_3$ and a spinel γ-Al_2O_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 1.4×10^5 $cm^2V^{-1}s^{-1}$ and n_s as high as 3.7×10^{14} 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.

Reference:

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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.