Quantum Hall Effect and Superconductivity at Oxide Interfaces under Electric Field

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We present quantum Hall effect (QHE) in ZnO and superconductivity in $SrTiO_3$, both of which could be modulated by an electric field effect using organic gate structures. ZnO is a promising material for ultraviolet light emitting diodes [1]. We found that two dimensional electron gas (2DEG) emerges at the interfaces of ZnO and (MgZn)O due to the discontinuity in spontaneous polarizations [2]. With spin-coating of poly (3,4-ethylenedioxythiophene) poly (styrenesulfonate) (PEDOT:PSS) on ZnO, nearly ideal Schottky junctions could be formed [3]. From capacitance-voltage (*C*-*V*) relations, we identified the presence of 2DEG as designed [4]. Transistors with a Hall-bar geometry clearly showed exhibited Shubnikov-de Haas (SdH) oscillation and QHE. Another example is inducing superconductivity in a pristine $SrTiO_3$ crystal with accumulating electrons at the surface by an electric double layer (EDL) gating with polymer electrolyte. Polyethylene-oxide electrolyte with $KClO_4$ as a supporting salt was applied on an atomically flat $SrTiO_3$ surface [5]. By applying 2.5-3.5V at the Pt electrode in the electrolyte, electrons were accumulated to show superconducting state with a T_C of about 0.4K [6]. In the presentation, further progress on these topics will be included.

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