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Solid-gate control of insulator to 2D metal transition at SrTiO3 surface. ALEJANDRO SCHULMAN, PABLO STOLIAR[1], AI KITOH, AIST, Japan, MARCELO ROZENBERG, Universite Paris Sud, CNRS, ISAO H. INOUE, AIST, Japan — As miniaturization of the semiconductor transistor approaches its limit, semiconductor industries are facing a major challenge to extend information processing beyond what can be attainable by conventional Si-based transistors. Innovative combinations of new materials and new processing platforms are desired. Recent discovery of the 2D electron gas (2DEG) at the surface of SrTiO3 (STO) and its electrostatic control, have carried it to the top of promising materials to be utilized in innovative devices. We report an electrostatic control of the carrier density of the 2DEG formed at the channel of bilayer-gated STO field-effect devices. By applying a gate electric field at room temperature, its highly insulating channel exhibits a transition to metallic one. This transition is accompanied by non-monotonic voltage-gain transfer characteristic with both negative and positive slope regions and unexpected enhancement of the sheet carrier density. We will introduce a numerical model to rationalize the observed features in terms of the established physics of field-effect transistors and the physics of percolation. Furthermore, we have found a clear signature of a Kondo effect that arises due to the interaction between the dilute 2DEG and localized Ti 3d orbitals originated by oxygen vacancies near the channel.

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