Anomalous Reversible Sn-Dopant Deactivation between Indium Tin Oxide and Single-Crystalline Oxide Nanowire

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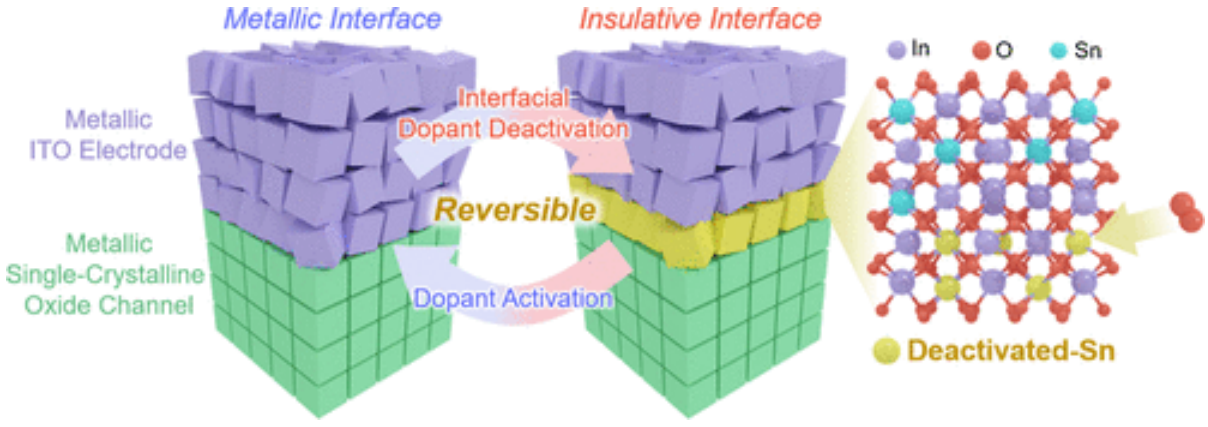
Implantation of an impurity dopant into a semiconductor is a common and irreversible technique to manipulate the electrical properties of modern electronics. Here, we present an anomalous dopant activation/deactivation behavior, which is reversible and only occurs at the interface between indium tin oxide (ITO) and single-crystalline oxide channel. We found that the conductance of the interface between ITO contact and single-crystalline oxide nanowire can be repeatedly manipulated between a metallic state and a near-insulative state via utilizing thermal annealing in air or vacuum. Interestingly, this electrical switching phenomenon cannot be observed when using the lithography-defined polycrystalline oxide nanowire instead of single-crystalline nanowire. Further atmosphere-controlled thermal treatments show that the oxygen in atmospheric air induces the reversible variation in the conductance of the interface between ITO contact and single-crystalline oxide nanowire. Systematic investigations on metal cation species and channel crystallinity indicate that the electrical switching phenomenon can be explained by an interface-specific reversible Sn-dopant activation/deactivation of ITO electrode in contact with a single-crystalline oxide channel.



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