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Metal oxide resistive switching: evolution of the density of states across the metal insulator transition ALIREZA MOTTAGHIZADEH, QIAN YU, ALEXANDRE ZIMMERS, HERVE AUBIN, Laboratoire de Physique et d'Etude des Materiaux (LPEM)- UMR 8213- CNRS- UPMC- ESPCI-ParisTech — Memristive devices have attracted considerable attention since the recognition that two-terminal resistive switching elements represents an example of a memristive element. In oxide materials such as $SrTiO_3$ (STO), oxygen vacancies are doping sites that can be displaced by an electric field. This allows for electric-field manipulation of doping as exploited in memristive devices. In this work, we present the study of metal-semiconductor-metal junctions formed on STO, where we demonstrate that the junction characteristics can be fine-tuned through electric field migration of oxygen vacancies at very low temperature ($T \sim 260$ mK). At very low dopant concentration, the junction displays characteristic signatures of discrete dopants levels. As the dopant concentration increases, the semiconductor band gap fills in but a soft Coulomb gap remains, at even higher doping, a transition to a metallic state occurs where the density of states at the Fermi level becomes finite and Altschuler-Aharonov correction to the density of states is observed. This work demonstrates that electric field induced migration of dopants can be used to tackle open questions on the physics of correlated electron systems. This work was supported by the French ANR grants 10-BLAN-0409-01 and 09-BLAN-0388-01.

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