Tuning the properties of Hafnium oxide-based resistive memory devices via aluminum doping

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Resistive Random-Access memory (ReRAM) devices offer a promising alternative to the current non-volatile memory technology due to their low power consumption, high switching speeds, and high endurance. A prototypical ReRAM device consists of a metal-insulator-metal (MIM) stack in which the metal layers constitute the device electrodes. The dielectric in the middle of the MIM exhibits resistive switching (RS) properties so that the resistance switches between a high resistance state (HRS) and a low resistance state (LRS) by applying, for example, an external voltage through the electrodes.

Among the RS materials, Hafnium oxide is a favorable choice due to its remarkable electrical properties, impressive scalability, and compatibility with complementary metal oxide semiconductor (CMOS) technology. Furthermore, doping HfOx with metals enhances the oxide switching stability and tunes the RS parameters. In this work, we evaluate the influence of Al doping on a HfOx-based MIM device. We measure the device IV curves to determine the set/reset switching voltages and the HRS and LRS resistance ratios (RHRS/RLHRS) for different Al-doped concentrations and compare the results with an undoped HfOx-based MIM device.