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Memristive behavior of ferroelectric tunnel junctions[1]

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Employment of polarization reversal in ultrathin ferroelectric layers opens new possibilities for development of electronic devices with novel functional properties not available in conventional systems. A particularly promising aspect is realization of resistive switching in the ferroelectric tunnel junctions (FTJ), which can be used as non-charge based logical switches in nonvolatile memory devices. Functionality of FTJs is intrinsically linked to a relationship between polarization orientation and tunneling resistance, which brings about a problem of ferroelectric switching and polarization retention in ultrathin ferroelectric barriers. Here, we demonstrate a giant resistive switching effect of more than 105% at room temperature in the FTJ device structure composed of an epitaxial $BaTiO_3$ ferroelectric barrier sandwiched between bottom and top electrodes. We provide experimental evidence of the memristive behavior of these FTJs where both the low- and high-resistance states can be tuned by the external voltage by several orders of magnitude. The mechanism of the memristive behavior in our junctions is discussed in terms of the modifications of the tunneling potential profile driven by the charge accumulation in the $BaTiO_3$ layer.

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