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Oxygen controlled bipolar switching in NiO memristor ZHONG SUN, YONGGANG ZHAO, DIYANG ZHAO, Tsinghua Univ, DEPARTMENT OF PHYSICS, TSINGHUA UNIVERSITY, BEIJING 100084, CHINA TEAM — As Leon Chua demonstrated, both unipolar and bipolar resistance switching devices are memristors. Over the past decade, metal/oxide/metal structure with NiO as a ReRAM functional layer has been investigated widely and in depth, due to its intrinsic unipolar resistance switching, which is attributed to the connection and rupture of nickel filament in NiO. Recently, several papers studying NiO nanowires or NiO films with C-AFM infer that bipolar switching mechanism may govern the NiO memristors on the nanoscale. However, a systematic research on the mechanism of bipolar switching in NiO memristor on the nanoscale is still lacking. Especially, the role of oxygen in a NiO memristor has never been explored. Here we carry out a comprehensive study of the mechanism of bipolar switching in NiO memristor, and uncover the dominant role of oxygen. NiO/Pt structures were measured by C-AFM equipped with 20 nm conductive tips. By controlling the inherent oxygen concentration of NiO film, film thickness, and chamber oxygen pressure, we demonstrate that it is the inner oxygen distribution, related to electric field-induced ion drift and oxygen exchange between NiO film and ambient, that acts as the state variable, whose response to applied bias results in the bipolar switching in NiO memristor.

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