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Using Noise to Study Switching Dynamics of Oxide Memristors A.M. BRATKOVSKY, WEI YI, G. MEDEIROS-RIBEIRO, R.S. WILLIAMS, Hewlett-Packard Laboratories, Palo Alto, CA 94304, S. SAVEL'EV, Loughborough U, United Kingdom — Oxide memristors present attractive opportunities in the areas of nonvolatile memory, random access storage, novel electronic circuits, and new cognitive computing paradigms. The progress in those areas requires detailed understanding of the origin of memristive (resistance switching) behavior, state evolution, and noise. We have found that in TaOx memristors, there is a boundary between semiconducting and metallic conductivity that is characterized by quantized conductance states, demonstrating the formation of an atomic-scale point contact within the oxide. We have measured the noise spectra of a wide range of conductance states, and observed a variety of conductance-dependent behaviors including a transition from $1/f^2$ (semiconducting regime) to 1/f (flicker noise in the "metallic" regime) frequency (f) dependence and a peak in the noise amplitude at the conductance quantum $G_Q = 2e^2/h$. We have modeled the point contact using stochastic molecular dynamics and can understand the observed behavior in terms of thermally-activated atomic-scale fluctuations that make and break the contact in the non-conducting matrix. The data provides important input for circuit designs and other applications of memristors.

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