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Understanding the resistive switching in thin-film Ta-O memristors by their d.c. switching characteristics WEI YI, GILBERTO MEDEIROS-RIBEIRO, FENG MIAO, ILAN GOLDFARB, MAX ZHANG, J. JOSHUA YANG, MATTHEW D. PICKETT, JOHN PAUL STRACHAN, R. STANLEY WILLIAMS, Hewlett-Packard Laboratories, 1501 Page Mill Road, MS1123, Palo Alto, CA 94304, USA, HEWLETT-PACKARD LABORATORIES TEAM — Tantalum oxide (Ta-O) memristor is a promising candidate for resistive switching memory (RRAM) technology as they have demonstrated outstanding features such as high endurance, high speed, and low power. However, the responsible mechanisms remain vague partly due to difficulties in characterizing the amorphous film structure, nanoscale active regions, coupled ionic and electronic transport, and intertwined electrochemical and thermochemical processes. Rich information about Ta-O memristors has been revealed by microscopic structural and chemical characterizations of Ta-O conduction channels combined with temperature-dependent transport measurements. As an alternative approach, we took perspectives from a statistical study of the switching behavior under d.c. excitation. We identified distinctive behaviors in device switching characteristics depending on the chemical compositions of conductance channel, and found close correlations with previous temperature-dependent transport measurements and X-ray photoemission (XPS) characterizations. We were able to gather further insight into the microscopic switching mechanisms based on these observations, revealing the granularity of the switching phenomena.

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