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**Anatomy of a Nanoscale Conduction Channel Reveals the Mechanism of a High-Performance Memristor** FENG MIAO, JOHN PAUL STRACHAN, J. JOSHUA YANG, WEI YI, ILAN GOLDFARB, M.-X. ZHANG, ANTONIO C. TORREZAN, Hewlett-Packard Laboratories, Palo Alto, CA, PETER ESCHBACH, RONALD D. KELLEY, Hewlett-Packard, Corvallis, OR, GILBERTO MEDEIROS-RIBEIRO, R. STANLEY WILLIAMS, Hewlett-Packard Laboratories, Palo Alto, CA — Two major challenges for resistance memory devices (memristors) based on conductivity changes in oxide materials are better performance and understanding of the microscopic picture of the switching. After researchers' relentless pursuit for years, tantalum oxide-based memristors have rapidly risen to be the top candidate, showing fast speed, high endurance and excellent scalability. While the microscopic picture of these devices remains obscure, by employing a precise method for locating and directly visualizing the conduction channel, here we observed a nanoscale channel consisting of an amorphous Ta(O) solid solution surrounded by crystalline $Ta_2O_5$. Structural and chemical analyses of the channel combined with temperature dependent transport measurements revealed a unique resistance switching mechanism: the modulation of the channel elemental composition, and thus the conductivity, by the cooperative influence of drift, diffusion and thermophoresis, which seem to enable the high switching performance observed. (Miao*, Strachan*, Yang* *et al.*, Advanced Materials. DOI: 10.1002/adma201103379 (2011))

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