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Memristive switching of ZnO nanorod mesh[1] PUZYREV YEVGENIY, Vanderbilt University, XIAO SHEN, University of Memphis, KAI NI, XUAN ZHANG, JORDAN HACHTEL, Vanderbilt University, BO CHOI, Vanderbilt Institute of Nanoscience, MATTHEW CHISHOLM, Oak Ridge National Laboratory, DANIEL FLEETWOOD, RONALD SCHRIMPF, SOKRATES PANTELIDES, Vanderbilt University — We present a combined experimental and theoretical study of memristive switching in a self-assembled mesh of ZnO nanorods. A ZnO nanorod mesh spans the area between Ag contacts in a device that exhibits hysteresis with large ON/OFF ratio, reaching ION/IOFF values of 104. We show that switching behavior depends critically on the geometry of the nanorod mesh. We employ density functional theory (DFT) calculations to deduce the mechanism for resistive switching for the nanorod mesh. Redistribution of Ag atoms, driven by an electrical field, leads to the formation and evolution of a conducting path through nanorods. Field-induced migration of Ag atoms changes the doping level of nanorods and modulates their conductivity. Using static DFT and nudged-elastic-band calculations, we investigate the energy of interaction between Ag clusters and a ZnO surface, including migration barriers of Ag atoms. Current-voltage (I-V) characteristics are modeled using percolation theory in a nanorod mesh. To describe the dynamics of SET/RESET phenomena, model parameters include the experimentally observed nanorod geometry and the energetics of Ag on ZnO surfaces, obtained from DFT calculations.

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Puzyrev Yevgeniy
Vanderbilt University

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