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COMSOL modeling of filamentary switching in a RRAM device.[1]
DIPESH NIRAULA, VICTOR KARPOV, Univ of Toledo — Resistive switching (RS) in resistive random access memory (RRAM) devices operate by the processes of growth and dissolution of the conducting filament (CF) in an insulating matrix. Several proposed microscopic models relate these processes to the migration of ions and defects. A more general phenomenological approach by our group is based on the thermodynamics of phase transformations. It involves the transitions between 3 phases representing one insulating and two conductive states of the material. That approach yields a number of analytical solutions describing RRAM operations including the current voltage (I-V) characteristics. Here, we present the corresponding numerical modeling reproducing the unique features of the I-V. Our computational technique emulates the free energy of the system and finds a stable phase configuration of the RS structure. The corresponding electric current and voltage are then computed. We use the COMSOL Multiphysics package to calculate the electric field and temperature distributions, which are used then to find the system free energy; the MATLAB package is used to find the stable phase configurations and to communicate with COMSOL. Using the known material parameters, our modeling results so far appear rather approximate compared to the measured

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