Simulation of CBRAM devices with the level set method

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CBRAM is a promising technology for future nonvolatile memories, due to its low operating voltages, low power consumption and ease of integration in the back end of a logic process. A CBRAM cell is composed of a resistive switching layer encapsulated between an electrochemically active electrode, and an electrochemically inert counter electrode. The storage of the information is based on the contrast between a high resistance state and a low resistance state. Resistance switching is induced by electro-chemical driven growth and rupture of a metallic filament in the electrolyte. A new simulation tool based on the finite element discretization of a system of partial differential equations is presented in this presentation. Our model relies on assumptions used in [1][2]. During write operation (SET), cations obtained from the oxidation of the top electrode migrate through the electrolyte, reduce on the filament and contribute to filament?s growth until it connects the two electrodes. The erase operation (RESET) is achieved by the electro-chemical driven dissolution of the filament. The Level Set Method (LSM), introduced by Osher and Sethian [3], is used to simulate the filament growth and dissolution. The level set method classically needs a stabilization term to prevent instabilities in the numerical simulation. We used a stabilization method which was applied by Olsson [4] in two-phase flow simulation.

Références

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