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The rules of the resistive switching operation parameters based on Ta/Ta_2O_5 RRAM device[1] HAITAO LI, GMU & NIST, CURT RICHTER, OLEG KIRILLOV, NIST, HUI YUAN, HAO ZHU, DIMITRIS IOANNOU, QILIANG LI, GMU, DEPT. ECE, GEORGE MASON UNIVERSITY TEAM, SEMICONDUCTOR AND DIMENSIONAL METROLOGY DIVISION, NIST TEAM —
The resistive switching (RS) of the TaO_x based RRAM has been widely studied due to its excellent endurance and thermal stability. The RS mechanism is generally understood as the formation and dissolution of nanometer-size conductive filament (CF) formed in set and reset process, respectively. However the exact process of dielectric break down remains unknown. In this work we studied the RS of the Ta/Ta_2O_5 based RRAM devices from the dependences of operation parameters V_{set}, I_{CC}, V_{reset}, and I_{reset} on device resistance. From statistical analysis of variation in the threshold parameters, we found that the set process is mainly determined by the voltage stress on the device, instead of current. The first forming process is different from the following set process. The forming voltage exponentially depends on the pristine resistance. The forming process gives a smallest low resistance (R_{LRS}) for each device. As a result change in compliance current (I_{CC}) has no obvious effects on this low resistance state.

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