TT-P002

Reset-first Resistance Switching Mechanism of HfO2 Films Based on Redox Reaction with Oxygen Drift-Diffusion

Jonggi Kim[1], Sunghoon Lee[1,2], Kyumin Lee[1], Heedo Na[1], Youngjae Kim[1], Dae-Hong Ko[1], Hyunchul Sohn[1]

[1]Department of Materials Science and Engineering, Yonsei University, Seoul 120-749, Republic of Korea,
[2]Research & Development Division, Hynix Semiconductor Inc., San 136-1 Ami-ri, Bubal-eub, Icheon-si, Gyeng-Gi-do 467-701, Republic of Korea

Reset-first resistive switching mechanism based on reduction reaction in HfO2-x with oxygen drift-diffusion was studied. we first report that the indirect evidence of local filamentary conductive path formation in bulk HfO2 film with local TiOx region at Ti top electrode formed during forming process and presence of anion-migration at interface between electrode and HfO2 during resistive switching through high resolution transmission electron microscopy (HRTEM), electron disperse x-ray (EDX), and electron energy loss spectroscopy (EELS) mapping. Based on forming process mechanism, we expected that redox reaction from Ti/HfO2 to TiOx/HfO2-x was responsible for an increase of initial current with increasing the post-annealing process. First-reset resistive switching in above 350°C annealed Ti/HfO2 film was exhibited and the redox phenomenon from Ti/HfO2 to TiOx/HfO2-x was observed with high angle annular dark field (HAADF) - scanning transmission electron microscopy (STEM), EDX and x-ray photoelectron spectroscopy. Therefore, we demonstrated that the migration of oxygen ions at interface region under external electrical bias contributed to bipolar resistive switching behavior.

Keywords: ReRAM, HfO2, Redox

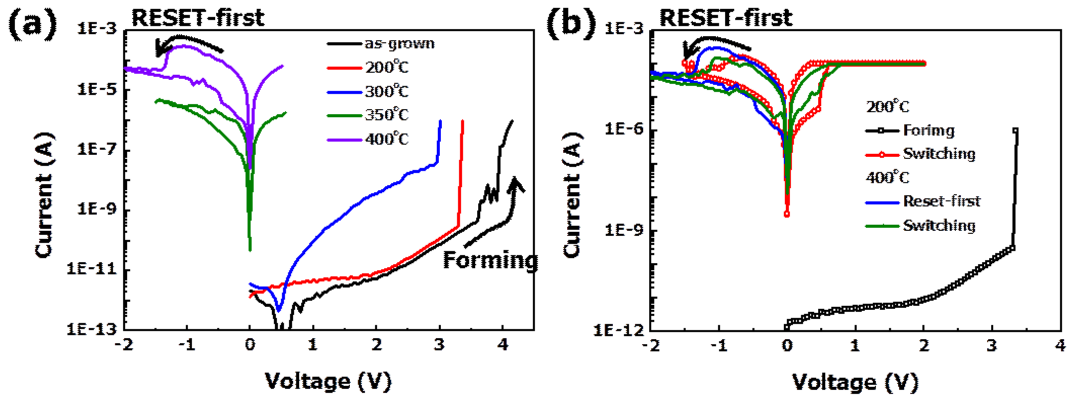

Fig. 1.

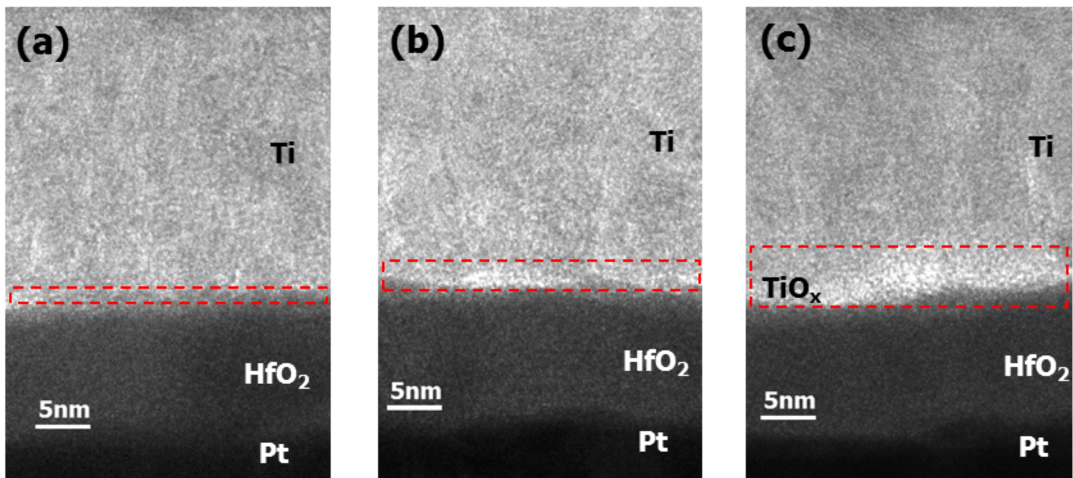

Fig. 2.

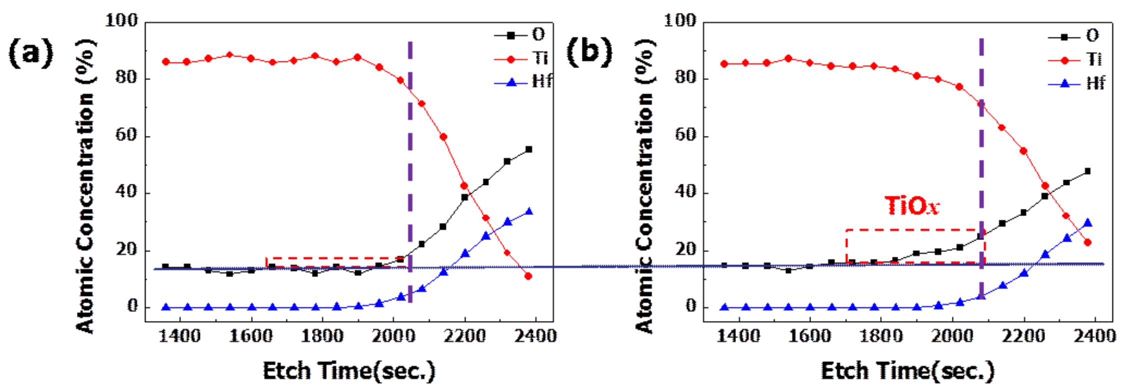

Fig. 3.