SET VOLTAGE DISTRIBUTION STABILIZED BY CONSTRUCTING AN OXYGEN RESERVOIR IN RESISTIVE RANDOM ACCESS MEMORY

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In this letter, the instability mechanism of RRAM was investigated, and a technique was developed to stabilize the distribution of high resistance state (HRS) and better concentrate the SET voltage. In previous research, we found that an interface-type switching characteristic was observed on the I-V curve beneath the filament-type switching behavior, owing to the oxygen accumulation effect. In this letter, this interface-type switching characteristic is used to fit the natural distribution of HRS for an analysis of the instability mechanism. According to the results, the reason for the HRS distribution is the accumulation of extra oxygen ions which are left over from a lower degree of oxygen and oxygen vacancy recombination during the reset process. We propose a solution which creates an extra oxygen reservoir by changing the surface topography of the electrode to store the surplus oxygen ions from the reset process, eliminating the accumulation effect, and indeed improving stability.

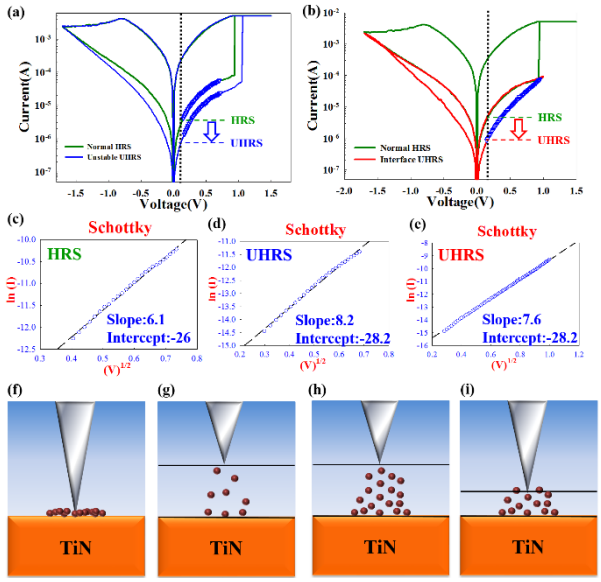

Figure 1 – (a) The HRS and the UHRS sweep cycle in normal RRAM. (b) UHRS achieved by interface-type switching. Fitting result of (c) HRS, (d) unstable UHRS, and (e) interface UHRS. The conduction model of (f) LRS, (g) HRS, (h) interface UHRS, and (i) unstable UHRS.

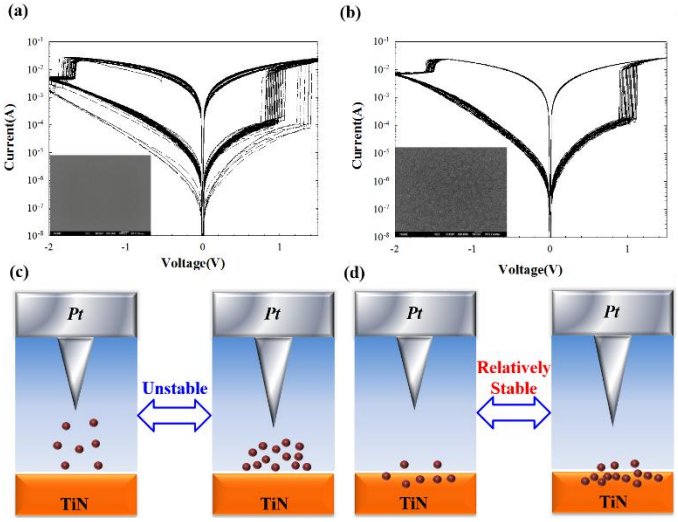

Figure 2 – The distribution of the I-V characteristic (a) before and (b) after CF4 plasma treatment and the SEM image on bottom left. The conduction model (c) before and (d) after CF4 plasma treatment.