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Effect of Non-lattice Oxygen Concentration on Non-linear Interfacial Resistive Switching Characteristic in Ultra-thin HfO2 Films

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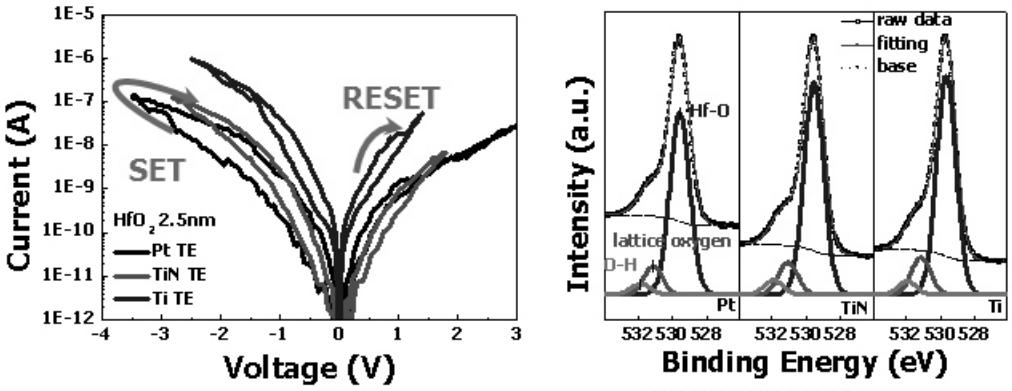
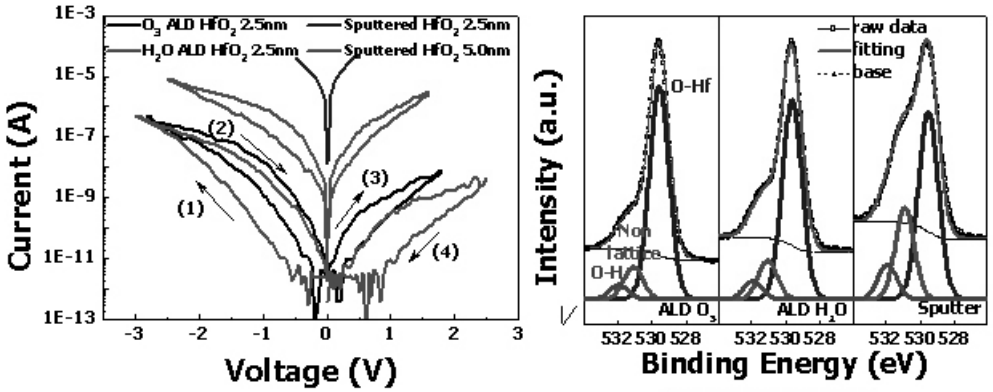
The effect of electrode and deposition methods on non-linear interfacial resistive switching in HfO2 based 250×250 nm2 cross-point device was studied. HfO2 based device has the interfacial resistive switching properties of non-linearity and self-compliance current switching. The operating current in HfO2 based device was increased with negatively increasing the heat of formation energy in top electrode. Also, it was investigated that the operating current in HfO2 based device was changed with deposition methods of O3 reactant ALD, H2O reactant ALD and dc reactive sputtering, resulting the magnitude of the operating current and on/off ratio in order of HfO2 films deposited by dc reactive sputtering, H2O reactant ALD, and O3 reactant ALD. To investigate the effect of electrode and deposition methods on operating current of non-linear interfacial resistive switching in the cross-point device, X-ray photoelectron spectroscopy was measured. Through the analysis of O 1s spectra, non-lattice oxygen concentration, which is closely related to oxygen vacancies, was increased in order of Pt, TiN, and Ti top electrodes and in order of O3 reactant ALD, H2O reactant ALD, and O3 reactant ALD, and dc reactive sputtering deposition method. From all results, non-lattice oxygen concentration in ultra-thin HfO2 films play a crucial role in the operating current and memory states (LRS & HRS) in the non-linear interfacial resistive switching.

Keywords: ReRAM, Interfacial resistive switching, Non-lattice oxygen ions, Electrode



	O-H	Hf-O	Non-lattice
Pt	5.05%	83.84%	11.11%
TiN	5.35%	82.53%	12.12%
Ti	4.74%	81.48%	13.78%

Fig. 1.



	O-H	Hf-O	Non-lattice
ALD O_3 HfO_2	5.35%	82.53%	12.12%
ALD H_2O HfO_2	6.77%	78.71%	14.52%
Sputter HfO_2	10.67%	61.21%	28.12%

Fig. 2.