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# Effects of Temperature Stress on VFB Shifts of HfO2-SiO2 Double Gate Dielectrics Devices

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In this work, we investigated the effects of temperature stress on flatband voltage (VFB) shifts of HfO2-SiO2 double gate dielectrics devices. Fig. 1 shows a high frequency C-V of the device when a positive bias for 10 min and a subsequent negative bias for 10 min were applied at room temperature (300 K). Fig. 2 shows the corresponding plot when the same positive and negative biases were applied at a higher temperature (473.15 K). These measurements are based on the BTS (bias temperature stress) about mobile charge in the gate oxides. These results indicate that the positive bias stress makes no difference, whereas the negative bias stress produces a significant difference; that is, the VFB value increased from △0.51 V (300 K, Fig. 1) to △14.45 V (473.15 K, Fig. 2).

To explain these differences, we propose a mechanism on the basis of oxygen vacancy in HfO2. It is well-known that the oxygen vacancy in the p-type MOS-Cap is located within 1 eV below the bottom of the HfO2 conduction band (Fig. 3). In addition, this oxygen vacancy can easily trap the electron. When heated at 473.15 K, the electron is excited to a higher energy level from the original level (Fig. 4). As a result, the electron has sufficient energy to readily cross over the oxide barrier. The probability of trap about oxygen vacancy becomes very higher at 473.15 K, and therefore the VFB shift value becomes considerably larger.

**Keywords:** HfO2, Oxygen vacancy, MOS-cap, Double-layer, Temperature stress

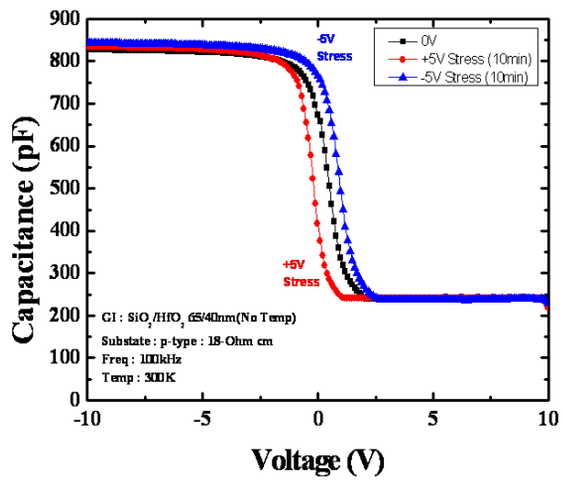


**Fig. 1.** ±5V bias Stress & no temperature high-Frequency C-V.

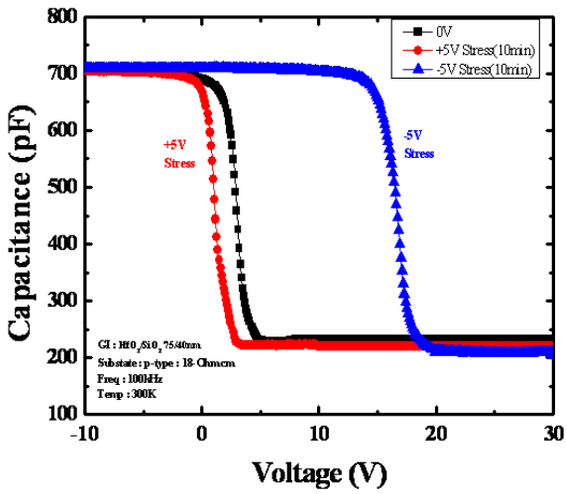


**Fig. 2.** ±5V bias Stress & 200°C temperature high-Frequency C-V.

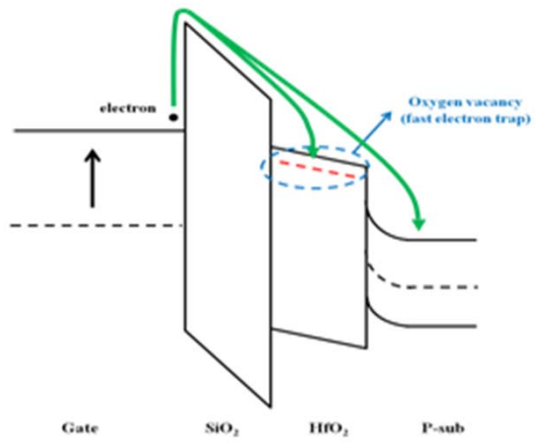


**Fig. 3.** Energy band diagram of MOS in -5V bias Stress & no temperature.

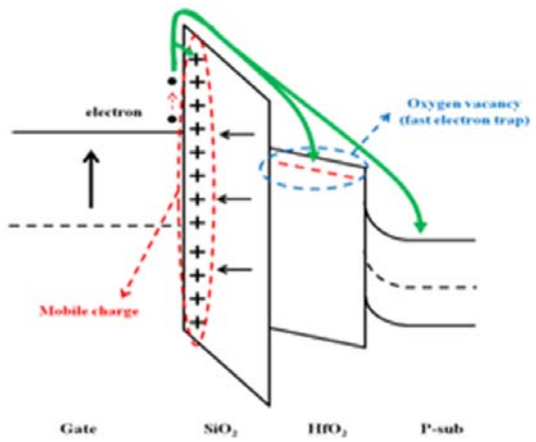


**Fig. 4.** Energy band diagram of MOS in -5V bias Stress & 200°C temperature.