The Evolution from Chip Performance to System Performance

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Retention performance continues to deteriorate due to scaling of DRAM and NAND devices. The decrease in thickness of the gate oxide and the increase of the channel dose cause strong e-field inside, which is caused by increased gate induced drain leakage (GIDL) and junction leakage. Recently, efforts have been made to improve the retention characteristics by adjusting the e-field to be applied to the inside of the device by applying dipole. However, the research on e-field control mechanism is still insufficient

This study investigated efield change with Vfb variation. Evaluation was made on La2O3 and Al2O3, which are typical diplo materials. MOSCAP evaluation was performed on the La2O3 / SiO2 stack. In the La2O3 study, Vfb shift increases with increasing La2O3 thickness, and Vfb shift differs with lower film condition. The amount of dipole was determined according to the top electrode,
To confirm the Vfb change mechanism, MOSCAP was evaluated in SiO2 / Al2O3 / SiO2 stack. The Vfb change is determined by the negative charge, not the dipole formed between Al2O3 and SiO2. As the lower SiO2 thickness decreases, Vfb shifts in the positive direction. Since Vfb is affected only by the charge generated at the interface between Al2O3 and SiO2, there is no Vfb change according to the upper SiO2 thickness or Al2O3 thickness variation. Depending on the subsequent thermal conditions, the Vfb shift proceeded in the other direction. In a low thermal budget that can cure negative charge, Vfb has a negative shift and a positive shift in a high thermal budget where Al atoms can migrate. The results of this study can be applied to e-field control research in DRAM and NAND device in the future.