Distinguishement of Contribution Ratio in NBTI and HC Test of PMOSFET under Deep-Submicron Process

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ABSTRACT

CMOS (Complementary Metal Oxide Semiconductor) devices applied to System on Chip (SOC) is becoming a trend in the future, and the most key technologies are how to grow up in the different oxide thicknesses and how to accept the variable bias voltages in IC operation. In order to enable the general logic circuits to reach a better operation state, the reliability issues and the circuit structures need to be integrated and evaluated .The Life-Time of a device is a good index to verify the device quality .However one of the variable factors in life-time adjustment is the applied voltage with the high integration and the increase of the power consumption, the life-time influence is not only at room temperature, but at high temperature. In hot carrier lifetime extraction, the high temperature operation of a device is more interesting. After comparison, the life-time effect derivate from high temperature obviously impacts the device performance. The hot carrier effect (HCE) at PMOSFET (positive) is generally weaker than that at NMOSFET. Below 0.25?m process, the negative bias temperature instability (NBTI) effect is a contributed factor in Hot carrier life-time calculation. The higher temperature and the higher electrical field in devices, the worse NBTI effect. Thus, the threshold voltage (VTH), the drain current (IDS) and the transconductance will shift obviously. In the other hand, there is some relationship between NBTI and HCE to be valuably investigated. In this thesis, the stressed device simultaneously exist the NBTI and the HCE. The enhanced damage is more concerned. To figure out it, the ratio of damage degrees in temperature variation and bias tuning will deeply analyzed. Finally, according to the experimental data, we observe that the relationship between both is not fully independent. Due to the increment of high-energy holes and the damage of the NBTI, the hot carrier lifetime at PMOSFET reliability test is necessary to include the NBTI contribution. As a result, the real hot carrier lifetime will really be calculated below the quarter micron process.

Keywords : NBTI ; HC

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