

# Trap Profile and Bias Temperature Instability of ALD-HfSiON Gate Stacks in Advanced MOSFETs

Chen-Kuo Chiang, Yu-Han Chen, Nai-Chao Su, Shui-Jinn Wang, Chin-Chuan

Huang, Hao-Yuan Huang, 吳建宏

Microelectronics Engineering

Engineering

rossiwu

## Abstract

The use of HfSiON as gate dielectric for advanced CMOS technology is attracting much attention due to good mobility of electrons/holes and significant reduction of gate leakage. However, there are critical reliability concerns as trade-offs to its good characteristics for transistors. Nitrogen incorporation in HfSiON was found effective for improving PBTI of nMOS, but unfortunately resulting in poor NBTI lifetime of pMOS and degraded electron/hole mobility. In this work, we simultaneously extract delay-free NBTI over broad range of stress-fields, stress-temperatures and [N]%, model gate leakage current ( $J_g$ ) and NBTI degradation within a theoretically consistent framework of field-dependent reaction-diffusion (R-D) model, and conclude that the reduction in  $J_g$  at NBTI-limited [N]% can be significant and would reduce power dissipation without affecting NBTI-margin. Also, the technique of combining charge pumping method and low frequency noise measurement helps us to monitor the defect distribution in dielectric layers, and support the nitridation mechanism we proposed.

Keyword : ALD MOSFET