NOTICE

Oral Defense of Doctoral Dissertation School of Information Technology and Engineering

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Bachelor of Engineering, 2001
Master of Science (Engineering), 2004

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Study of Reliability Mechanisms and their Interaction in Nano-scale CMOSETs

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A copy of the doctoral dissertation is on reserve in The Johnson Center Library.

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ABSTRACT

STUDY OF RELIABILITY MECHANISMS AND THEIR INTERACTION IN NANO-SCALE CMOSFETS

Rahul Mishra, formal defense, George Mason University, 2008

This dissertation is a study of device reliability issues and their interactions in nano-scale bulk and silicon-on-insulator (SOI) complementary metal oxide field-effect-transistors (CMOSFETs). This work focuses on understanding the major reliability concerns electrostatic discharge (ESD), negative bias temperature instability (NBTI) and hot carrier injection (HCI), and their interactions in both bulk and SOI MOSFETs.

In this dissertation, by investigating various aspects of ESD behavior involved in advanced 65nm bulk CMOS technology, it is identified that the power dissipation volume, location of parasitic bipolar transistor (pBJT) formation, and the gain of pBJT plays a competitive role in determining the ESD robustness with technology scaling. Similarly, the issues specific to SOI MOSFETs such as floating body and self-heating are studied to assess the ESD robustness of the devices under investigation.

The interaction between ESD and NBTI in bulk pMOSFETs shows that the pre-stressing by one mechanism worsens the other subsequent mechanism. The HCI and NBTI studies on bulk pMOSFETs reveal the increase influence of NBTI like degradation under hot carrier stress condition at high temperature. The NBTI and HCI behavior of SOI pMOSFETs is addressed next. The analysis of grounded body device show higher NBTI degradation than the corresponding floating body device due to the lowering of the oxide field in the floating body devices caused by the gate tunnel current.