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MOSCAP's and MOSFET's on III-V Channel Materials with Si, Ge and SiGe Interface Passivation Layer

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HfO₂ and other high-k dielectrics have been considered as alternative to SiO₂ in Si-based CMOS technology. The alternative dielectrics provide excellent opportunity for considering alternative channel materials such as GaAs. Our results showed that in order to achieve unpinning Fermi level, a thin Si or Ge interface passivation layer (IPL) in between GaAs and HfO₂ is effective [1-2]. Si IPL MOSCAPs have been shown to exhibit less C-V hysteresis, while Ge IPL devices can provide very thin EOT [2]. In this talk, we will present the electrical and materials characteristics of TaN/HfO₂/GaAs MOS capacitors and MOSFETs with Si or Ge IPL. In addition, SiGe IPL under various deposition time and post deposition anneal (PDA) conditions has also been investigated. Using different Si and Ge deposition rate, we adjust the Si:Ge ratio in the SiGe IPL. Thin EOT (~1nm) in Ge-rich IPL, low frequency dispersion (<5%), low hysteresis and low leakage current density in Si-rich IPL have been obtained. We will also discuss other alternative channel materials such as InGaAs.

[1] I. Ok et al, Conf. Digest, DRC, p. 45, 2006

[2] H.S. Kim et al, Appl. Phys. Lett., 88, p.252906, 2006

Jack C. Lee, Ph.D. is a Professor of the Electrical and Computer Engineering Department and holds the Cullen Trust For Higher Education Endowed Professorship in Engineering at The University of Texas at Austin. His current research interests include thin dielectric breakdown and reliability, high-K gate dielectrics and gate electrode, high-K thin films for semiconductor memory applications, and semiconductor device fabrication processes, characterization and modeling. From 1981 to 1984, he was a Member of Technical Staff at the TRW Microelectronics Center, CA, in the High-Speed Bipolar Device Program. He worked on bipolar circuit design, fabrication and testing. In 1988, he joined the faculty of The University of Texas at Austin. He has published over 300 journal publications and conference proceedings. Dr. Lee has been awarded two Best Paper Awards, numerous Teaching/Research Awards and several patents. Dr. Lee is a Fellow of IEEE; and a Distinguished Lecturer for IEEE DS Society.

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