EFFECTS OF HIGH-K ON FINFET PERFORMANCE

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ABSTRACT

Scaling down transistor to 45nm node and below might require new processing steps such as new gate stack or new device structure such as FinFET. Thus, in this work the use of high-k gate insulator - hafnium oxide (HfO_2) on FinFET performance was investigated. SPICE model was used to describe the real device operation and designing a practical analog circuit for the AC analysis. Therefore, only the gate insulator is changed in the SPICE model from silicon oxide, SiO_2 to HfO_2 and the difference of the turn on current (I_{ON}) is compared between planar and FinFET SiO_2 gate insulator with HfO_2 gate insulator FinFET transistor. The simulation results for 22nm node on inverter and chain inverter application show that better performance was obtained for FinFET compared to planar bulk CMOS.

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CHAPTER 1

INTRODUCTION

1.0 BACKGROUND OF STUDY

Moore's Law (1965), states that the density of transistor and performance of chip will be double for approximately 18 months [1]. The phenomenon known as Moore's Law is then use as benchmark or describing the pace of evolution in the semiconductor world. After 50 years of Moore's Law the technology growth of integrated circuit is still increasing. As the dimension of a transistor shrank, the transistor become smaller, lighter, faster, consumed less power and in most cases was more reliable [2]. Nowadays, Jonathan Koomey, a professor from Standford University had come out with a new law which is named after his name, the Koomey's Law. As he presented for a historical analysis, that indicates the energy efficiency of computers, as measured in compute tasks per kilowatt, has doubled every 18 months throughout history [3]. The study notes that "significant new innovation" is needed for the law to hold in the future. These elements make transistor more desirable for new generation of computing technology in any category for fastest computers to smallest hand held devices.