DEPOSITION AND CHARACTERIZATION OF HIGH PERMITTIVITY THIN-FILM DIELECTRICS

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ABSTRACT

As integrated circuit (IC) devices scale to ever smaller nodes, replacing the front end dielectric has become a primary challenge. To enable greater device densities, control power consumption, and enhance performance, a new class of insulators with large dielectric constants (high-κ) will need to be employed as a replacement for oxides and oxynitrides of silicon. A variety of semiconductor devices ranging from metal oxide semiconductor field effect transistors to flash and dynamic random access memories stand to benefit from new high-κ dielectric thin-films. In addition, compact capacitors using high-κ dielectrics can enable high density on-chip energy storage. Compounds of HfO_2 and Al_2O_3 are among the leading high-κ candidates. There is also potential in incorporating nanoparticles into an insulating medium to enhance its dielectric constant. Previously, the use of nanoparticles for this purpose has typically been performed using techniques and materials that cannot be readily incorporated into modern IC fabrication. This thesis presents the results of work on reactive electron beam evaporated Al_2O_3 and HfO_2 thin-films, the incorporation of nanoparticles, and the characterization of these films on silicon substrates.