

Electrical and structural properties of HfO₂ deposited by r.f magnetron sputter

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The need for high-k gate dielectrics has been primarily emphasized in abundant reports. High-k dielectrics are being considered as a possible replacement for SiO₂ as gate oxide of complementary metal-oxide-semiconductor (CMOS) device because the conventional oxide thickness is reduced to a regime in which direct tunneling current dominates the gate leakage current. High-k oxides such as Ta₂O₃, Al₂O₃, TiO₂, HfO₂ and ZrO₂ have received considerable attention. Among the many candidate materials, HfO₂ are one of most promising candidate gate material for metal oxide semiconductor(MOS) device.

HfO₂ was formed by r.f magnetron sputter on p-type silicon (100). HfO₂ film thicknesses were approximately 4 nm which measured by ellipsometry. To evaluate the thermal stability of the HfO₂ film, post annealing of the samples was performed by rapid thermal annealing (RTA) at temperatures ranging from 650 °C to 850 °C for 5 min. Increasing annealing temperature, electrical properties of HfO₂ film was improved also flat band voltage was fixed. HfO₂ film was crystallized at 650°C which investigated by X-ray diffraction. To analyze the electrical characterization, metal-insulator-semiconductor(MIS) capacitors were fabricated by depositing pd top electrodes using an evaporation method. High frequency capacitance was performed by using a boonton 7200 at 1 Mhz. The equivalent oxide thickness (EOT) and dielectric constant was calculated by capacitance value. current-voltage (I-V) curves were measured by stepping the voltage and measuring the current with a HP 4140B. HfO₂ film was shown that high dielectric constant and good leakage current. Also HfO₂film shows that low flat band voltage, narrow hysteresis band width.

Result indicated that HfO₂ film were one of the most promising materials for MOS device