

# Low Temperature Silicon Oxynitridation Grown by Hyperthermal Neutral Beam

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This study is to characterize silicon oxynitride (SiON) films grown for gate dielectric materials by Hyperthermal Neutral Beams (HNB) at a processing temperature lower than 400 °C. The HNB is drawing attention for manufacturing future nanoscale integrated circuits owing to reducing the plasma-induced damage and thermal budget. The HNB is generated through the surface neutralization of plasma ions produced by inductively coupled plasmas (ICP) with an rf input power of 1500 W and an operating pressure less than 1 mTorr. The HNB energy is controlled by a surface neutralization plate bias voltage of 0 to -40 V. A neutralization plate materials used in the tungsten(W) and aluminum oxide (Al<sub>2</sub>O<sub>3</sub>).

The electrical and physical properties are measured with metal oxide silicon (MOS) structure: Capacitance-Voltage (C-V), Current-Voltage (I-V) characteristics analysis. As a result, the HNB SiON film leakage current is 1.0E-8 A/cm<sup>2</sup> at 6.5 MV/cm. The dielectric constant of the HNB SiON films are 4.1 ~ 4.7. The nitrogen chemical bonding state is measured by a XPS and the nitrogen depth profile is measured by a SIMS. These results support that the HNB is a method suitable to growing SiON films without the plasma-induced damage and heavy thermal budget.