

# **Investigation of Surface Treatment on the Electrical Interfacial Properties of GaN MOS Capacitors with Plasma-TEOS and LTO SiO<sub>2</sub> as Gate Dielectrics**

By

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## Abstract

In this thesis, an extensive study has been performed to study the electrical interfacial properties to control the threshold voltage of GaN MOS capacitors without affect the interface quality. Two types of P-TEOS samples show more positive flatband voltage and one order lower  $D_{it}$  than those with LTO.  $N_2$  and  $CH_4$  plasma treatment to the GaN surface before oxide deposition increase  $D_{it}$  up to one order higher than the as-grown capacitors, and the  $D_{it}$  is a function of the plasma exposure time, rather than the specific plasma. These plasma treatments also make the flatband voltage more negative. Another aspect aims at recovering dry-etch damages at the GaN surface while preventing alkaline ion contamination. TMAH, NaOH wet etch and  $N_2$  plasma treatment are all effective in reducing  $D_{it}$  with wet etch methods, yielding more positive flatband voltages. TMAH method has the advantage of no alkaline ion contamination over NaOH wet etch, and we have found the longer the treatment process is, the lower the  $D_{it}$  it could achieve, resulting in a minimum  $D_{it}$  of  $5 \times 10^{10} \text{ cm}^{-2} \text{ eV}^{-1}$  over the upper half of GaN energy bandgap after 15 minutes wet etch treatment.