GaN HEMT using partial high-k films at G-D spacing to improve breakdown voltage

Yasuyuki Miyamoto[1], Yoshikaze Ito[1], Itsuki Yoshida[1]
[1] Tokyo Tech

I. INTRODUCTION

In GaN HEMTs, shorter gate-drain (G-D) lengths are desirable for high-speed operation, but shorter G-D lengths generally result in lower breakdown voltage. To make it work both ways, it is necessary to mitigate the concentration of electric fields in the G-D depletion region. Recently, we proposed the increase the breakdown voltage by high-k protecting film with thickness distribution by the simulation. In this report, we fabricated the partial high-k film on G-D of GaN HEMT.

II. DEVICE STRUCTURE

As the structure of GaN HEMT, the distance of G-D of 100 nm and the gate length of 2 μm were used for suppression of gate leakage current to observe breakdown due to gate-drain voltage. The S/D electrode has a Ti/Au/Al/Ti/Au structure to make the electrode edge sharp. After the gate (Ni/Au) formation, Ta_2O_5 was deposited on gate-drain channel by sputtering. Four different structures were fabricated: uniform, partial deposition at half of gate side, partial deposition at half of the drain side, and no deposition.

III. RESULTS

The three-terminal breakdown voltage was measured by applying VG- VTH = -3V (VTH = -3.5V). As shown in Fig.1, I-V characteristics showed that the breakdown voltage was in the order of Partial(Gate)>Uniform>Partial(Drain)>None, and the subthreshold leakage was in general agreement with the simulation results.

IV. CONCLUSION

The GaN HEMTs with high-k protective films with thickness distribution were fabricated and observed results suggest that the electric field at the gate edge may have been mitigated by the high-k film with thickness distribution.