HIGH Ge-DOPING FOR LOWER OHMIC CONTACT RESISTANCE IN GaN BASED HIGH ELECTRON MOBILITY TRANSISTORS.

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Background: GaN-based high electron mobility transistors (HEMTs) are expected to play a major role in mobile communication technologies beyond 5G. However, achieving higher frequency operation and higher efficiency in GaN HEMTs require ultra-low resistance ohmic contacts. Regrown ohmic contacts achieved through Si-doped GaN by plasma-assisted molecular beam epitaxy (PAMBE) have been shown to have consistently low resistance. To reduce the contact resistance to even lower values, in this work, Ge doped GaN contacts are presented.

Methods: Contact resistance between metal and semiconductor follows Eq. 1 (Please check Eq.1 in the images file).

However, Si doping in our study showed segregation, defect states, and higher roughness for doping beyond 1×1020 cm-3.[1] The ionic radius of Ge is similar to Ga, thus allows more Ge incorporation when compared to Ga.

Results: Ge doping densities as high as 5.2×1020 cm-3 have been achieved by PAMBE growth with a sheet resistance of 7.2 ohm/sq·. Higher Ge-doped GaN layers resulted in a streaky RHEED pattern (Fig. 1 (a)) and smooth morphology (Fig 1(b)) with root-mean-square roughness of ~1nm. In this study, the effects of higher Ge doping on the structural, surface, and electrical characteristics of GaN will be presented. Moreover, the trend of contact resistance with doping concentration, as shown in Fig. 1(c), will be investigated for both Si and Ge-doped GaN.

Conclusion: Through this study, the effects of higher Ge doping and also the advantages of using Ge as a dopant for ohmic contacts for GaN HEMTs will be presented.