Comparison of AlGaN/GaN and InAlN/GaN HEMT structures

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The AlGaN/GaN HEMT structures are broadly studied as terahertz (THz) range emitters and detectors due to their relatively high carrier density and mobility in 2DEG channel [1]. In this work InAlN/GaN HEMT structures were developed and their performance were compared with AlGaN/GaN HEMT devices. The InAlN/GaN HEMT devices showed potential to have at least two times larger carrier densities in a shallower 2DEG channel with similar room temperature mobility values in comparison to the AlGaN/GaN HEMT structures [2-3].

Both type HEMT structures were grown on sapphire substrate employing metalorganic chemical vapor deposition (MOCVD) method. The sheet resistances of 2DEG layer determined by contactless resonant RF cavity measurements was of about 430 Ω/sq and 350 Ω/sq for the AlGaN/GaN and InAlN/GaN samples, respectively. The test devices were developed using a standard UV photolithography procedures. At first, mesas of approx. 420 nm in depth were etched with Cl-based plasma in ICP RIE chamber. The Ohmic and Schottky contacts were developed one after another using a Ti/Al/Ni/Au and a Ni/Au metal stacks, respectively. The I/V and C-V characteristics of typical Schottky diodes (SDs) are shown in Fig. 1. SDs demonstrated the leakage currents and forward currents at applied 3 V bias voltage down to 0.08 A/mm and up to 0.9 kA/mm for AlGaN/GaN, 0.03 A/mm and 0.9 kA/mm for InAlN/GaN structures, respectively. In addition, the 2DEG carrier density and the threshold voltage obtained from C-V data were of about 7.5×10^{12} cm^{-2} and 3 V for AlGaN/GaN, and 5.1×10^{12} cm^{-2} and 1.35 V for InAlN/GaN, respectively.

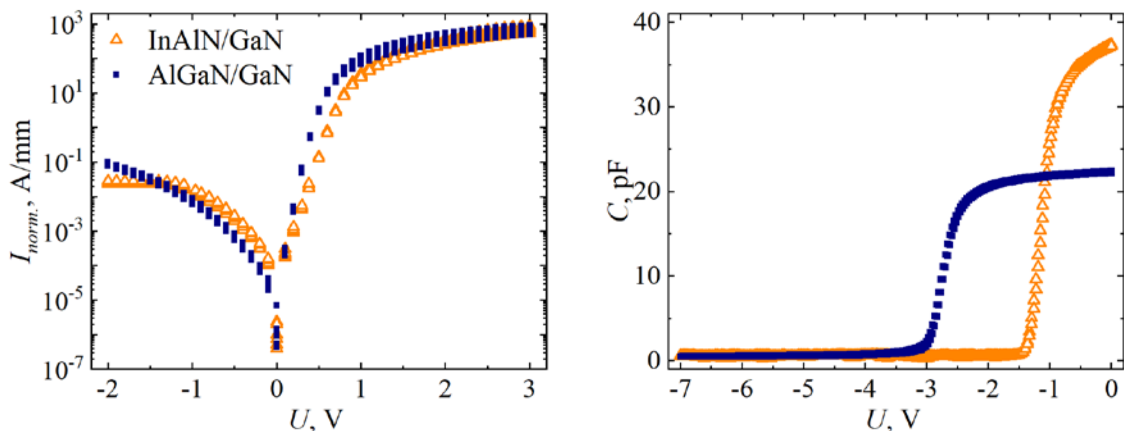

Fig.. 1. Current-Voltage I-V (left hand side) and Capacitance-Voltage C-V (rigth hand side) characteristics of the Ni/Au Schottky diodes developed of AlGaN/GaN and InAlN/GaN HEMT strucutres.

References

[1] W. Knap, et al., *J. Infrared,Millimeter, Terahertz Waves* **32**, 618 (2011).
[2] Y. Yue, et al., *IEEE Electron Device Lett.* **33**, 988 (2012).
[3] F. Medjdoub, et al., in *2006 Int. Electron Devices Meet.* (IEEE, 2006), pp. 1–4.