

Optimization of AlGaN/GaN EdgeFETs for terahertz detection by optimization of ohmic contacts.

M. Dub¹, M. Sakowicz¹, P. Sai^{2,3,4}, D. B. But^{2,3,4}, P. Prystawko¹, G. Cywiński^{2,3}, S. Romyantsev^{2,3}, W. Knap^{2,3,5}

¹ Institute of High Pressure Physics PAS, ul. Sokołowska 29/37, 01-142, Warsaw, Poland

² Center for Terahertz Research and Applications (CENTERA), Institute of High Pressure Physics PAS, ul. Sokołowska 29/37, 01-142, Warsaw, Poland

³ CEZAMAT, Warsaw University of Technology, 02-822, Warsaw, Poland

⁴ V. Ye. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, ISP NASU Kyiv, Ukraine

⁵ Laboratoire Charles Coulomb, University of Montpellier and CNRS UMR 5221, 34950 Montpellier, France

Email: mdub@unipress.waw.pl

Field-effect transistors (FETs) can act as terahertz (THz) detectors or emitters [1]. Signal and cut-off frequency of THz FET detection depend on the RC product (C is the gate capacitance and R represent the Ohmic losses).

In order to reduce the capacitance we fabricated AlGaN/GaN FET with two gates that are located along the edges of the channel and that are contacted directly to the two-dimensional electron gas (2DEG) [2], thus forming Schottky contact between the gate metal and the 2DEG. The area of each Schottky gate in this kind of the transistor (EdgeFETs) is extremely small and is within the range of $(1-4) \times 10^{-13} \text{cm}^2$ depending on the gate width. With help of two lateral gates we are able to narrow the channel and allow propagation of plasma waves only in one direction. This should lead to resonant THz detection [2]. In order to reduce the Ohmic losses we used regrown ohmic drain and source contacts (Fig.1b).

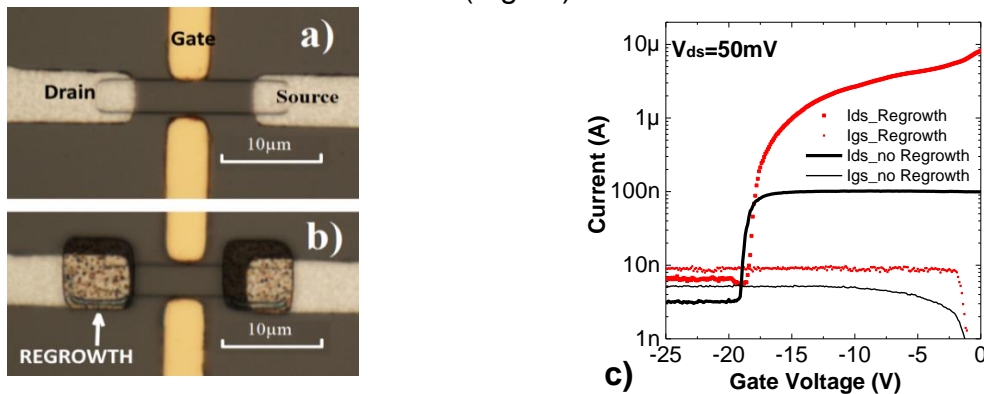


Fig. 1. EdgeFETs without regrowth a) and with regrowth b). c) Transport characteristics of EdgeFETs and gate leakage current.

The EdgeFETs contact resistance was significantly improved by regrowth as shown in Fig. 1c. At the same time both samples show similar threshold slope. Accordingly to Ref. [3] this will result in much higher detection signal registered in the case of sample with regrown contacts. As a result we show great improvement in the EdgeFETs quality, which approach us towards resonant THz detection.

[1] M. Dyakonov and M. Shur, *IEEE Trans. Electron Devices* 43, 380 (1996)

[2] P. Sai, et al., *Semicond. Sci. Technol.* 34 (2019) 024002

[3] M. Sakowicz, et al., *JOURNAL OF APPLIED PHYSICS* 110, 054512 (2011)