Thin channel GaN HEMT with 10 kV capability

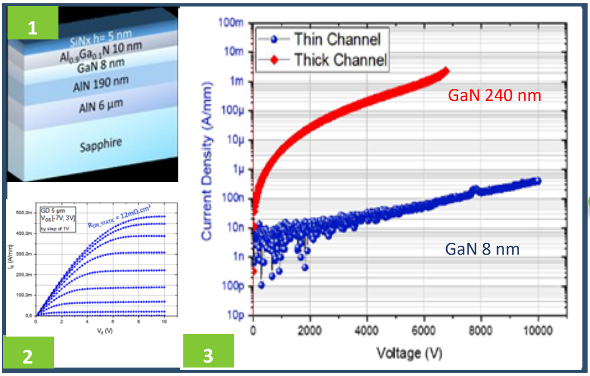

Fig 1: Cross section view of the Aluminum-rich HEMT structure with thin channel on AlN .

Fig 2: Output characteristics of a transistor with 8 nm thin channel.

Fig 3: Lateral leakage current recorded between two isolated ohmic contact pads for HEMTs

For power, the thinner channel is the better

AlN is investigated as the basement of new high-electron-mobility transistors (HEMTs) for high-power and high-voltage electronic applications. Thanks to a very large band gap energy beyond 6 eV and high thermal conductivity, such semiconductor is very promising to overcome the limitations encountered with GaN based electron devices. Recently, Aluminum-rich AlGaN/GaN HEMTs have been grown on AlN-on-Sapphire templates to study the influence of various parameters such as the channel thickness on the electrical properties. It appeared that reducing the GaN channel thickness was a key for reaching high breakdown voltages. For a HEMT with thin (8 nm) channel, the buffer assessment revealed a remarkable lateral breakdown field of 5 MV/cm for short contact distances, which is far beyond the theoretical limit of GaN-based material system. 1 kV breakdown voltage was achieved with a contact distance of 2 µm, whereas 10 kV were reached for 96 µm. The static on-resistance R_{on} of the transistor scaled as expected with the gate-drain distance to reach 12 mΩ.cm² for 5 µm.

Breakthroughs

1kV (10kV) breakdown voltage between contacts separated by 2µm (96µm) on a thin channel device structure.

Perspectives

Evaluations on other substrates (bulk AlN, SiC).

Collaborations : IEMN, Institut Néel (ANR-17-CE05-00131 BREAKUP)
More information : Micromachines 2019, 10 (10), 690, https://doi.org/10.3390/mi10100690
Contact : Yvon Cordier | yc@crhea.cnrs.fr