

Thermal Stability of HfO₂/AlGaIn/GaN Normally-Off Transistors with Ni/Au and Pt Gate Metals

© Y.-C. Lin¹, J.-S. Niu¹, W.-C. Liu¹, J.-H. Tsai^{2,¶}

¹ Institute of Microelectronics, Department of Electrical Engineering, National Cheng-Kung University, 1 University Road, Tainan 70101, Taiwan

² Department of Electronic Engineering, National Kaohsiung Normal University, 116, Ho-ping 1st Rd. Kaohsiung 802, Taiwan

¶ E-mail: jhtsai@nknucc.nknu.edu.tw

Received January 24, 2021

Revised January 24, 2021

Accepted for publication February 26, 2021

A hybrid gate approach, including a two-step gate recess and a sputtered HfO₂ layer, is employed to fabricate HfO₂/AlGaIn/GaN normally-Off high electron mobility transistors (HEMTs). Ni/Au and Pt are used as gate metals in the studied metal–oxide–semiconductor (MOS)-type devices. The two-step gate recess approach can effectively deplete the two-dimensional electron gas density in the channel. The studied MOS-type structure demonstrates a lower gate leakage and significantly positive gate threshold voltage. Attributed to the high work function of Pt metal, the device with Pt gate metal exhibits excellent thermal stability, including gate leakage, high saturation current, transconductance, On/Off current ratio, and threshold voltage, measured from 300 to 500 K, as compared with the device with Ni/Au gate metal. Furthermore, the studied devices show superior behaviors as compared with other devices.

Keywords: AlGaIn/GaN, normally-Off, HEMT, two-step gate recess, temperature-dependent, thermal stability.

Full text of the paper will appear in journal SEMICONDUCTORS.