Investigation of Pd|HfO_2|AlGaN|GaN Enhancement-Mode High Electron Mobility Transistor with Sensitization, Activation, and Electroless-Plating Approaches

© Y.-C. Lin[1], J.-S. Niu[1], W.-C. Liu[1], 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 February 10, 2020
Revised March 10, 2020
Accepted March 10, 2020

A new Pd|HfO_2|AlGaN|GaN metal-oxide-semiconductor (MOS) enhancement-mode high electron mobility transistor (HEMT) is fabricated with low-temperature sensitization, activation, electroless-plating, and two-step gate-recess approaches. Experimentally, a high positive threshold voltage V_{th} of 1.96 V, a very low gate leakage I_G of $6.3 \cdot 10^{-8}$ mA/mm, a high maximum extrinsic transconductance gm,max of 75.3 mS/mm, a high maximum drain saturation current $I_{D,max}$ of 266.9 mA/mm, and a high ON/OFF current ratio of $7.6 \cdot 10^7$ are obtained at 300 K. Moreover, the related temperature-dependent characteristics, over temperature ranges from 300 to 500 K, are comprehensively studied. The very low temperature coefficients on gate current, drain saturation current, transconductance, and threshold voltage confirm the thermal-stable capability of the studied device. Therefore, based on these advantages, the studied Pd|HfO_2|AlGaN|GaN MOS structure is suitable for the development of high-performance HEMTs.

Keywords: HfO_2, AlGaN|GaN, metal-oxide-semiconductor, high electron mobility transistor, electroless plating, gate recess, threshold voltage.

Full text of the paper will appear in journal SEMICONDUCTORS.