Enhancement-mode AlGaAs/InGaAs Pseudomorphic High-Electron-Mobility Transistor with a Liquid Phase Oxidized GaAs as Gate Oxide

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Recent progress in AlGaAs/InGaAs pseudomorphic high-electronic-mobility transistors (PHEMTs) with a low Al-content Schottky layer grown on top of an InGaAs channel has shown promising features and performance in communication systems and for commercial purposes. However, the key issues of Schottky-based devices are limited gate voltage swing and lower breakdown voltage. Moreover, the gate-recess process creates surface states that induce a gate leakage current and generate parasitic capacitances that degrade device performance. This paper presents a discussion on the dc performance of an enhancement-mode (E-mode) AlGaAs/InGaAs MOS-PHEMT with an oxidized GaAs gate without a gate recess. Without a gate recess, the gate oxide is obtained directly by oxidizing the GaAs capping layer in the liquid phase oxidation (LPO) growth solution, and fully planar surface is performed around the active region.

The device isolation was achieved by mesa wet etching down to the buffer layer. Ohmic contacts of the Au/Ge/Ni metal were deposited by evaporation, and then patterned by lift-off processes, followed by annealing. An LPO growth solution was used to generate a thin gate oxide (i.e., the oxidized GaAs) at 50 ^{o}C without a gate recess. Finally, the gate pattern was defined with Au. Fig.1 shows the transconductance (g_m) and drain current density versus the gate-to-source voltage (V_{GS}) of the proposed device. Base on the measurement results, the breakdown voltage is increased and the leakage current is improved for the E-mode AlGaAs/InGaAs MOS-PHEMT as compared to those of Schottky-gate PHEMT, which will be beneficial to the device application.

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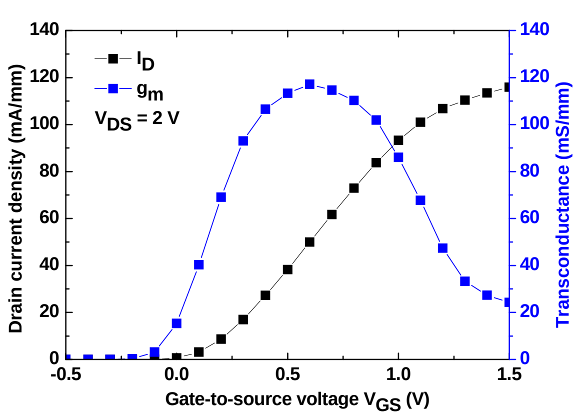

Fig. 1: Transconductance and drain current density versus V_{GS} at V_{DS} = 2 V for the E-mode AlGaAs/InGaAs MOS-PHEMT.