High Temperature Pulsed and DC Performance of AlInN/GaN HEMTs

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The AlGaN/GaN high-electron mobility transistors (HEMTs) have been considered as promising candidates for the next generation of high temperature, high frequency, high-power devices. The potential of GaN-based HEMTs may be improved using an AlInN barrier because of its better lattice match to GaN, resulting in higher sheet carrier densities without piezoelectric polarization [1]. This work has been focused on the study of AlInN HEMTs pulse and DC mode characterization at high temperature.

The devices were fabricated in III-V Labs [2]. Drain current (ID) and transconductance (gm) were measured from room temperature up to 500 K on devices with different geometry (Lg=250 nm; Wg=2x75 µm, 2x100 µm, or 8x75 µm). Pulsed VGS measurements (gate lag) were done to evaluate the presence of trapping effects [3]. In addition, pulsed VDS characterization was also carried out.

As with AlGaN-barrier HEMTs, the drain current of AlInN/GaN devices decreased at high temperature, due to reduction of the electron mobility and drift velocity [4]. However, unlike AlGaN barrier devices, these thermal effects on ID and gm values were not reversible (Fig. 1). This behaviour could be related to the increase of the gate leakage current. Gate lag measurements in Fig. 2 (ΔVGS=6 V, 1 µs period up to DC) have shown the presence of traps, specially located either at the surface or in the barrier near the 2DEG [3]. On the other hand, pulsed VDS measurements have shown an almost constant ID independent of pulse width. In contrast, AlGaN/GaN HEMTs typically showed an increase in ID as the duty cycle decreased. That increase in drain lag in AlInN/GaN HEMTs could correlate to the buffer trap density in our devices [3].


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