

DC, RF, and microwave noise performances of AlGaN/GaN HEMTs on sapphire substrates

W. Lu, V. Kumar, R. Schwindt, E. Piner and I. Adesida. "DC, RF, and microwave noise performances of AlGaN/GaN HEMTs on sapphire substrates." *2002 Transactions on Microwave Theory and Techniques* 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2499-2504.

High-performance AlGaN/GaN high electron-mobility transistors with 0.18- μm gate length have been fabricated on a sapphire substrate. The devices exhibited an extrinsic transconductance of 212 mS/mm, a unity current gain cutoff frequency (f_{T}) of 101 GHz, and a maximum oscillation frequency (f_{MAX}) of 140 GHz. At $V_{\text{ds}}=4$ V and $I_{\text{ds}}=39.4$ mA/mm, the devices exhibited a minimum noise figure (NF_{min}) of 0.48 dB and an associated gain (G_{a}) of 11.16 dB at 12 GHz. Also, at a fixed drain bias of 4 V with the drain current swept, the lowest NF_{min} of 0.48 dB at 12 GHz was obtained at $I_{\text{ds}}=40$ mA/mm, and a peak G_{a} of 11.71 dB at 12 GHz was obtained at $I_{\text{ds}}=60$ mA/mm. With the drain current held at 40 mA/mm and drain bias swept, the NF_{min} , increased almost linearly with the increase of drain bias. Meanwhile, the G_{a} values decreased linearly with the increase of drain bias. At a fixed bias condition ($V_{\text{ds}}=4$ V and $I_{\text{ds}}=40$ mA/mm), the NF_{min} values at 12 GHz increased from 0.32 dB at -55/spl deg/C to 2.78 dB at 200/spl deg/C. To our knowledge, these data represent the highest f_{T} and f_{MAX} , and the best microwave noise performance of any GaN-based FETs on sapphire substrates ever reported.

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