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High Frequency Characteristics of Recessed gate GaN MESFETs

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Interest in field effect transistors (FETs) for high power and high temperature application has attracted attention to GaN-based semiconductors because of their properties such as wide band gap, high electron velocity, and high electric field at breakdown voltage. The operation of recessed gate GaN MESFETs was investigated using a large-signal RF frequency model simulator. The simulator accepts as input data. semiconductor material parameters, device structure, bias conditions, and d.c. and RF circuit impedance information and delivers as output dc and RF performance data such as d.c. bias currents, RF output power, gain, power-added efficiency, input and output impedances, and spectrum. The maximum frequency was calculated from the power gains at different operating frequenciesIn this paper, we report on the DC and large-signal RF performance of recessed gate GaN MESFETs fabricated using the photoelectrochemical etching process. The fabricated GaN MESFET exhibits a current saturation at V_{DS} = 4 V and a pinch-off at V_{GS} = -3 V. The peak drain current of the device is about 230 mA/mm at 300 K and the value is remained almost same for 500 K operation. The f_T and f_{max} from the device are 6.35 GHz and 10.25 GHz, respectively. The experimental device characteristics compared with the results obtained by the large-signal RF model utilizing the harmonic balance techniques. Typical large-signal RF (4 GHz) performance of the simulated device showing about 40 % of PAE and of output power. Further investigation using the simulator suggested that the maximum frequency could be enhanced by the optimization of the impedence matching during the device characterization.