KOLLOQUIUM

Institut für Elektrotechnik, Elektronik und Informationstechnik

Large-Signal Operation of Microwave SiC and AlGaN/GaN Field-Effect Transistors

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Recent developments in wide bandgap semiconductor devices provide the opportunity to design and fabricate microwave transistors that demonstrate performance previously available only from microwave tubes. The most promising electronic devices for RF power applications are SiC MESFET's and an HFET fabricated using the AlGaN/GaN heterojunction. These devices can sustain bias voltages significantly in excess of what can be applied to standard semiconductor devices, and SiC MESFET's and AlGaN/GaN HFET's have demonstrated RF output power density on the order of 4-6 W/mm and 10-12 W/mm of gate periphery when biased at Vds=40v, respectively. The nitride devices have demonstrated RF power density over 30 W/mm when biased at Vds=120v. The AlGaN/GaN HFET's should produce useful performance well into the mm-wave region, and potentially as high as 100 GHz. However, the high voltage operation of these devices introduces a variety of physical effects that currently limit RF performance, linearity, and device reliability. Also, an IMPATT-mode operation of these devices has been discovered under high voltage operation, and this mode has implications for practical utilization of these devices.

This presentation will focus upon the RF large-signal operation of these devices, with an emphasis upon the physical effects associated with various charge trapping, surface, and space-charge phenomena that affect the RF performance of these devices. Engineering approaches to controlling these performance limiting effects will be discussed.