SESSION 7b: HIGH-FREQUENCY GaN DEVICES

Chairs: David Meyer, *Naval Research Lab. and* Robert Sadler, *Nitronex Corporation*

In recent years, there has been an increasing interest in developing GaN transistor technology for millimeter-wave applications such as monolithic microwave integrated circuits (MMICs). In order to achieve the high operating frequencies necessary for millimeter-wave amplification, novel device designs with laterally and vertically-scaled geometric dimensions are currently being investigated on a variety of substrates. Potentially offering the most financially viable solution, devices fabricated out of heterostructures grown on low-cost silicon substrates have begun to demonstrate performance metrics that rival transistors made on traditional substrates. This session contains reports on GaN high electron mobility transistors (HEMTs) that operate at frequencies above 30 GHz. We start with an invited talk by Prof. Colombo Bolognesi, chair of the Millimeter-Wave Electronics Group at the Swiss Federal Institute of Technology (ETH) in Zurich. Prof. Bolognesi will survey recent results for lattice-matched AlInN/GaN HEMTs that enable the very thin barrier layers required for <100-nm gate lengths. These devices have demonstrated the highest bandwidths yet attained for nitride transistors, with f_T = 205 GHz on SiC substrates and 143 GHz on high-resistivity (HR) silicon substrates. Prof. Bolognesi will compare this performance with results achieved for recessed-gate AlGaN/GaN HEMTs on HR-Si substrates. This will be immediately followed by a paper from the same group covering the RF characterization of coplanar waveguides (CPWs) on AlGaN/GaN heterostructures on HR-silicon substrates, at frequencies up to 110 GHz. The characterization shows that CPW's on GaN/Si exhibit performance comparable to those on semi-insulating GaAs or InP, clearly demonstrating the suitability of GaN/Si technology for mm-wave MMIC applications. The next paper in this session, contributed by Chabak and co-workers from the Air Force Research Laboratory and Sensor Electronic Technology, will showcase electrical results from a study investigating submicron T-gate AlInN/AlN/GaN HEMTs on SiC. By using a 6 nm-thick, strained (15% In fraction) AlInN barrier, Chabak et al. were able to demonstrate devices with high f_T-L_G product and low access resistance. This presentation will discuss the effects of post-gate passivation with PECVD Si_3N_4 and ALD-deposited Al_2O_3 on the small- and large-signal properties of this novel device. The last paper in this session will be presented by Matsushita and co-workers from Toshiba Corporation and will discuss the effects of via layout on parasitic source inductance and frequency performance of GaN HEMT devices. Matsushita will also discuss Ka-band load-pull measurements of a four via-hole configuration that has produced saturated output power of 32.6 dBm (4.5W/mm), linear gain of 7.3 dB, and PAE of 41%.