Advanced GaAs HEMT Technologies for Ultra Low-Noise and Millimeter Wave Power Applications

Ming-Yih Kao, Matthew S. Heins, Shuoqi Chen,
Qinghui Wang, Joseph Delaney, S. Nayak,
and Paul Saunier

TriQuint Semiconductor
500 West Renner Road, Richardson, Texas 75080, USA
Phone: (972) 994-3678, e-mail: mkao@tqtx.com

A single-recess 0.15-μm gate length metamorphic HEMT (mHEMT) process on 100-mm GaAs substrates has been developed for ultra low-noise applications. These 0.15-μm Ti-Pt-Au gate mHEMTs exhibited typical g_m of 850 mS/mm, pinch-off voltages of – 0.4 volts, and extrapolated peak f_T of over 150 GHz. Wide-band low-noise amplifier (LNA) ICs have been designed and fabricated using this 0.15-μm mHEMT technology. Ultra low noise figure of 0.5 dB and high gain of greater than 31 dB from 7-11 GHz were measured on these X-band mHEMT Monolithic Microwave Integrated Circuits (MMICs) that consumed only 42 mW DC power.

We have also developed a dual-recess (DR) 0.15-μm T-shaped gate pseudomorphic HEMT (pHEMT) process for power amplification applications at frequency range of 30 to 50 GHz. 0.15-μm x 600-μm pHEMT unit cells produced output power density of greater than 740 mW/mm and power-added efficiency of 40% at 35 GHz. Furthermore, we have successfully advanced the state-of-the-art of Ka- and Q-band power MMIC performance using this DR 0.15-micron pHEMT technology. Under CW operation, 2.5 W output power from 32 to 38 GHz were measured on a compact pHEMT MMIC of 7.44 mm^2 in chip size when the circuit was biased at 6 volts. GaAs Q-band (41-46 GHz) power MMICs with record output power will be presented in the conference as well.