Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Physical Insight into III-Nitride Material Quality for RF Transistors Based on Delay Time Analysis PANKAJ SHAH, TONY IVANOV, FRANK CROWNE, TERRANCE O'REGAN, ANTHONY BIRDWELL, EDWARD VIVEIROS, US Army Research Laboratory — A delay time analysis provides valuable guidance on optimizing III-nitride high electron mobility transistors (HEMTs). The procedure involves extracting an RF lumped element compact model with parasitics. We will present trends observed for different III-nitride HEMTs. One case indicated an AlGaN/GaN structure with a thin GaN channel layer on a thicker low aluminum AlGaN buffer exhibited lower total carrier delays (2.48 ps) in the saturation region of operation (Vds between 4V and 9V) compared to a structure with a single thick GaN buffer (3.14 ps). This is related to the former structure's lower total transit time (1.88 ps vs. 2.21 ps). This result may be due to fewer defects in the thin GaN channel region grown on a thicker AlGaN buffer compare to using a single somewhat thicker GaN buffer on a thin AlGaN buffer, and a different electrostatic potential distribution due to the AlGaN acting as a back barrier. The former had a maximum intrinsic current cutoff frequency of 67 GHz vs 56 GHz for the latter. The influence of temperature which can affect carrier transport (intrinsic delay) and series resistances (charging delay) will be discussed. In-house pulsed current-voltage analysis and impedance analyzer based conductance measurements provide related information to confirm our results.

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Date submitted: 08 Nov 2012 Electronic form version 1.4