

Stability of Heterostructure Field Effect Transistors

From “Performance Stability of Gallium Nitride Based Field Effect Transistors” by A. Tarakji, X. Hu, R. Gaska, and M. S. Shur, G. Simin, H. Fatima, J. W. Yang, and A. Khan, presented at GaN Workshop-2002

Key factors affecting stability

Improved materials quality

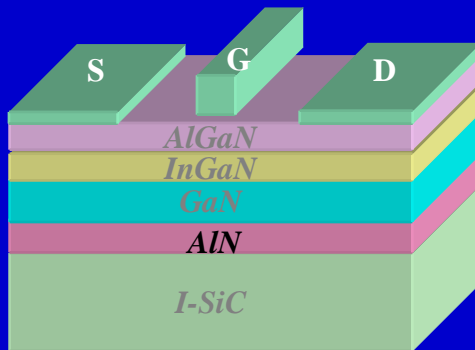
Avoiding carrier injection into defect material (GaN buffer, wide band gap barrier layer)

Hence, using highly localized or highly doped layers

Avoiding gate leakage current

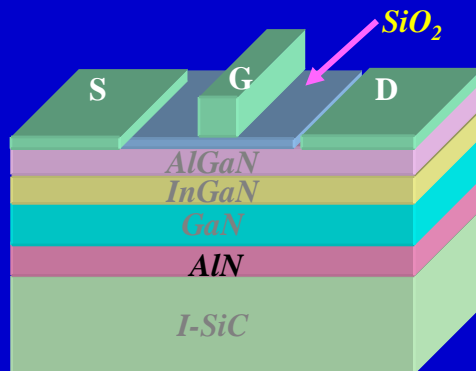
Optimizing growth for better materials quality

Novel AlGaN/InGaN/GaN Structures should improve Performance Stability



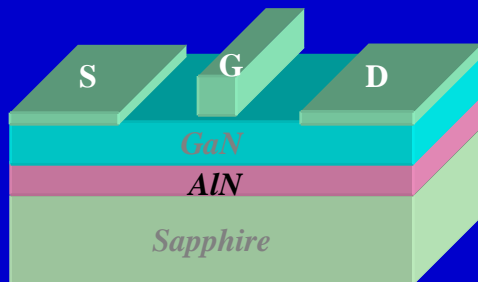
AlGaN/InGaN/GaN DHFET

Suppresses current collapse, provides better carriers confinement in 2DEG channel



MOSDHFET

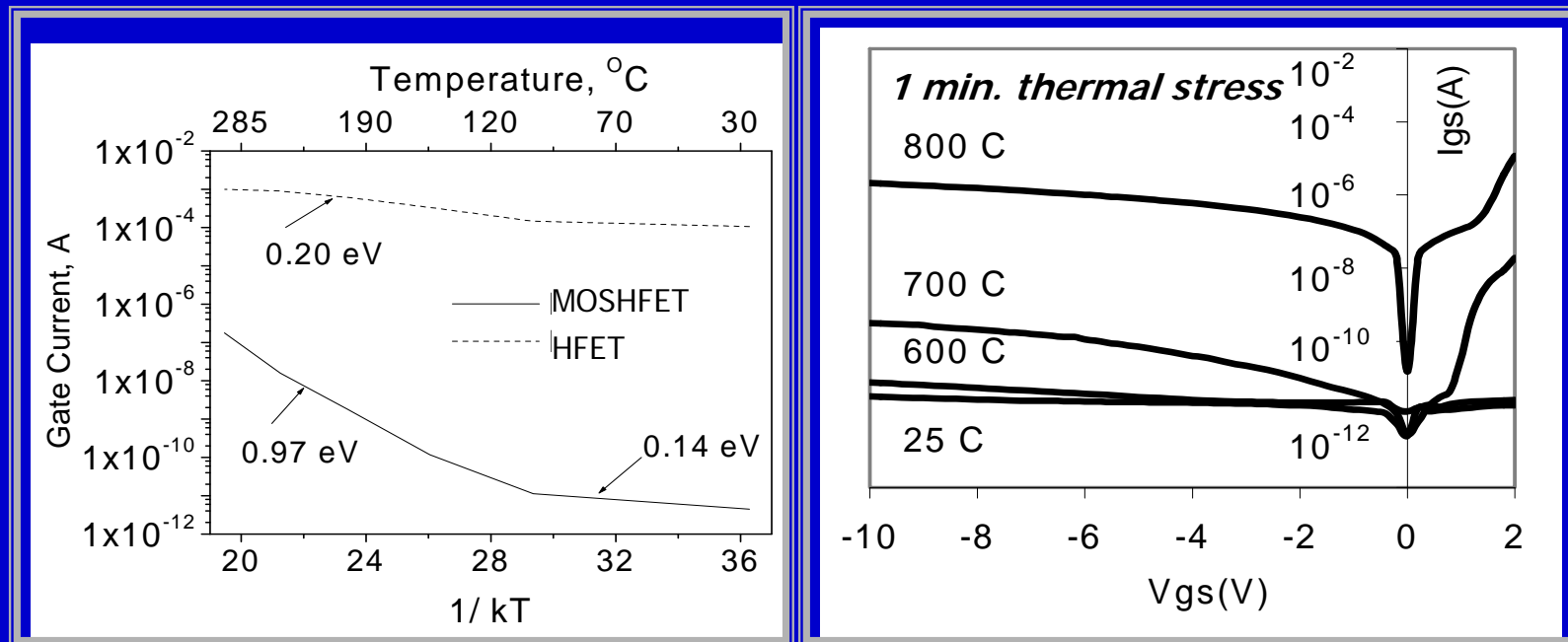
Low Gate leakage current, no current collapse



HD MESFET

Low contact resistance, reduced piezo-effect, reduced current slump

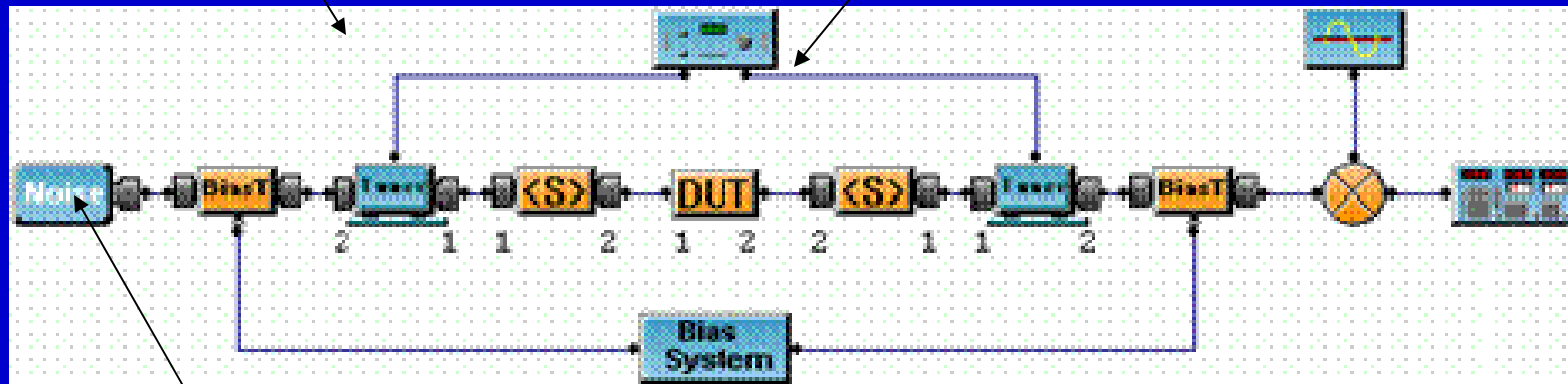
Thermal Stability and Thermal Stress



RF Stability Measurement Setup

Maury Automated Tuners

Cascade Probe station

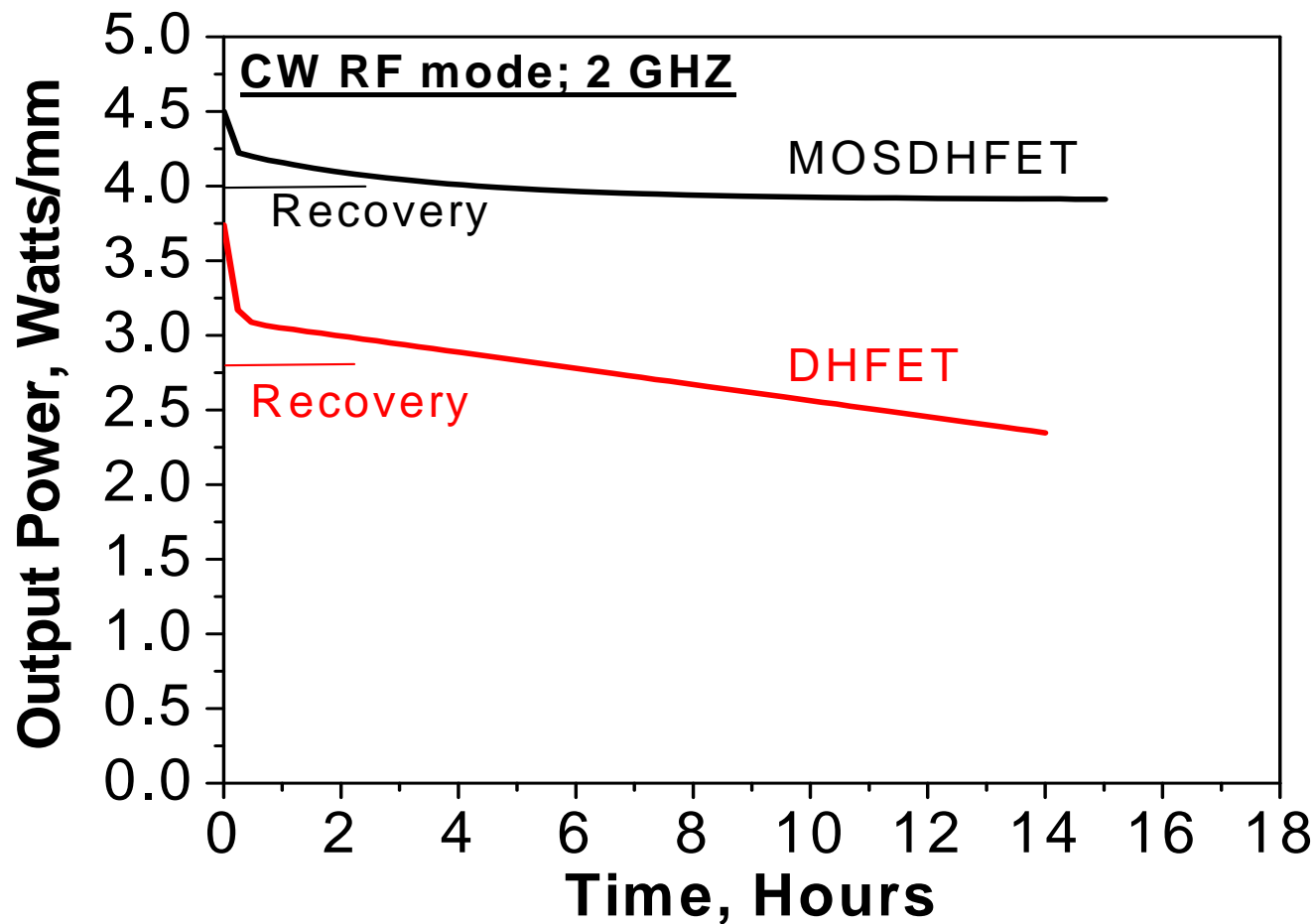


RF signal: CW @ 2 GHz, up to 30 dBm

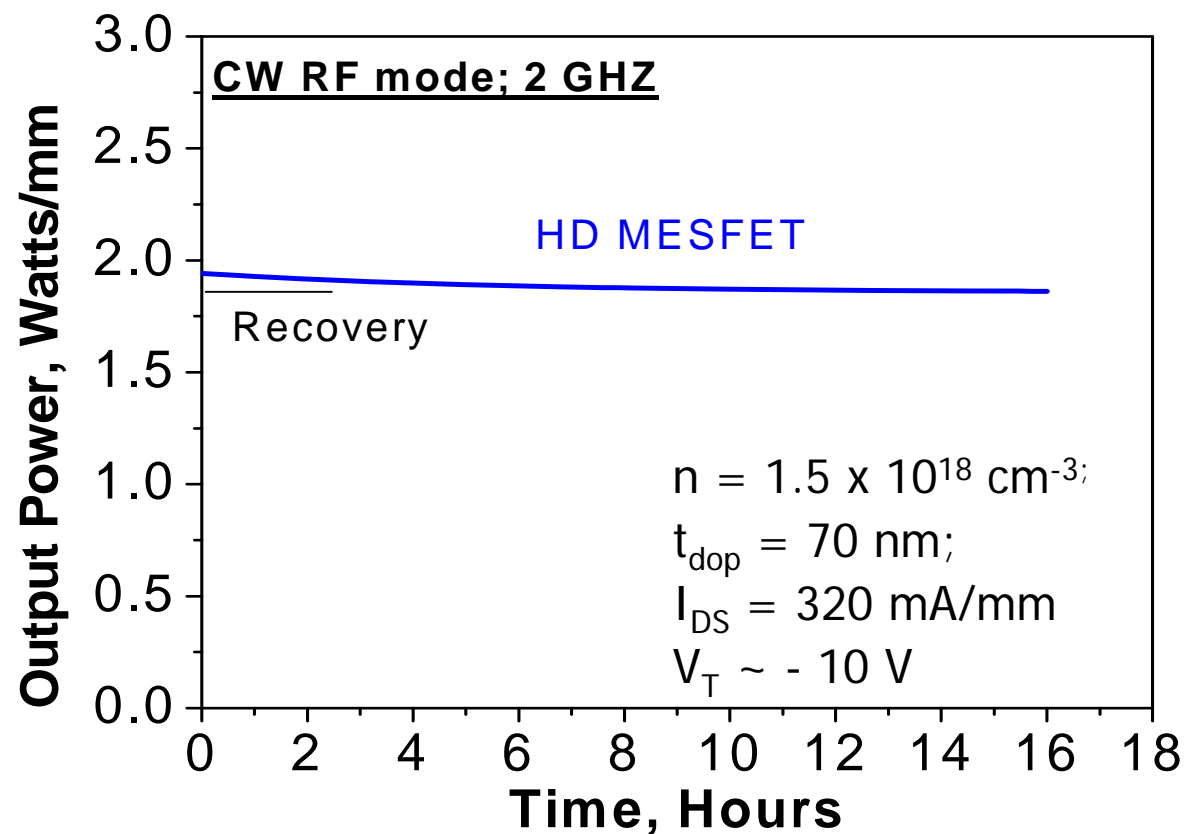
Bias: $V_D = 35\text{ V}$; $I_D \sim I_{D\text{max}}/2$;

No chuck cooling

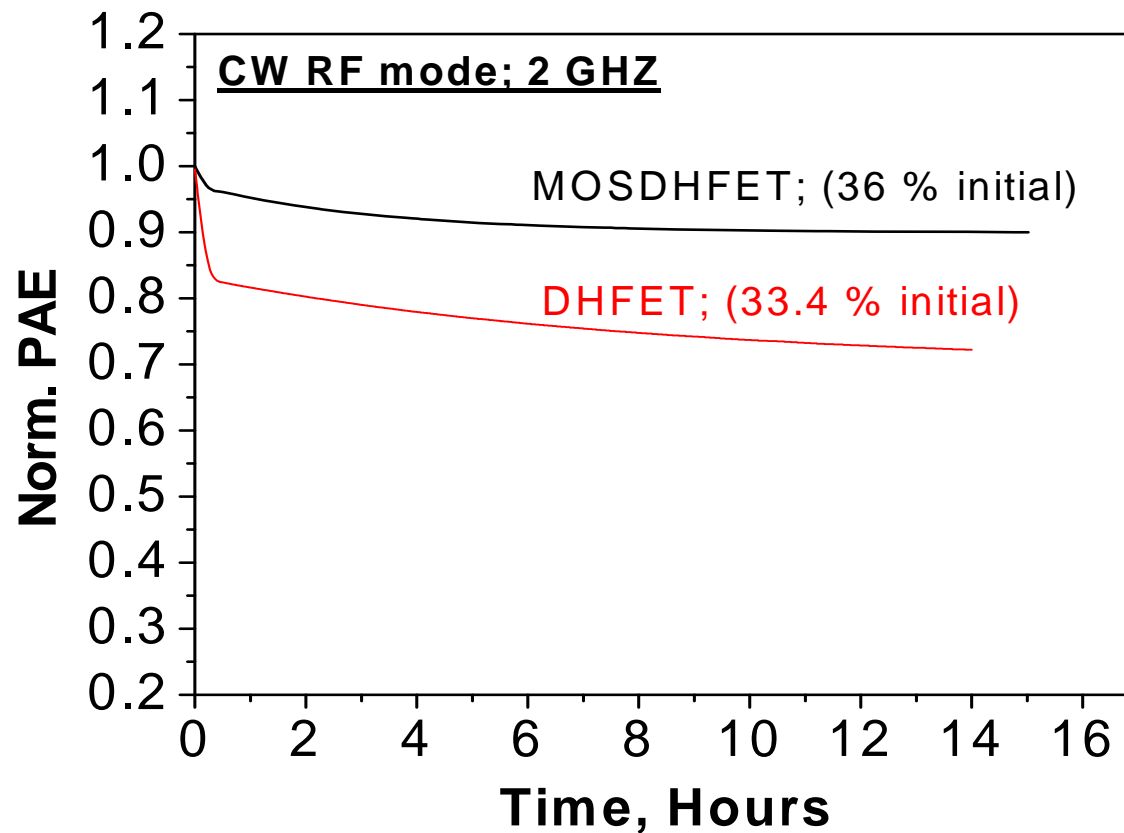
Life-time stability at optimal Load / Source Tunings MOSDHFET and DHFET



Life-time stability at optimal Load / Source Tunings HD-HFET



Life-time stability at optimal Load / Source Tunings Pout is optimized



Conclusions

In addition to current collapse free operation and 4 orders of magnitude lower gate leakage current MOSDHFET devices demonstrate :

- Improved thermal stability
- Better RF performance stability