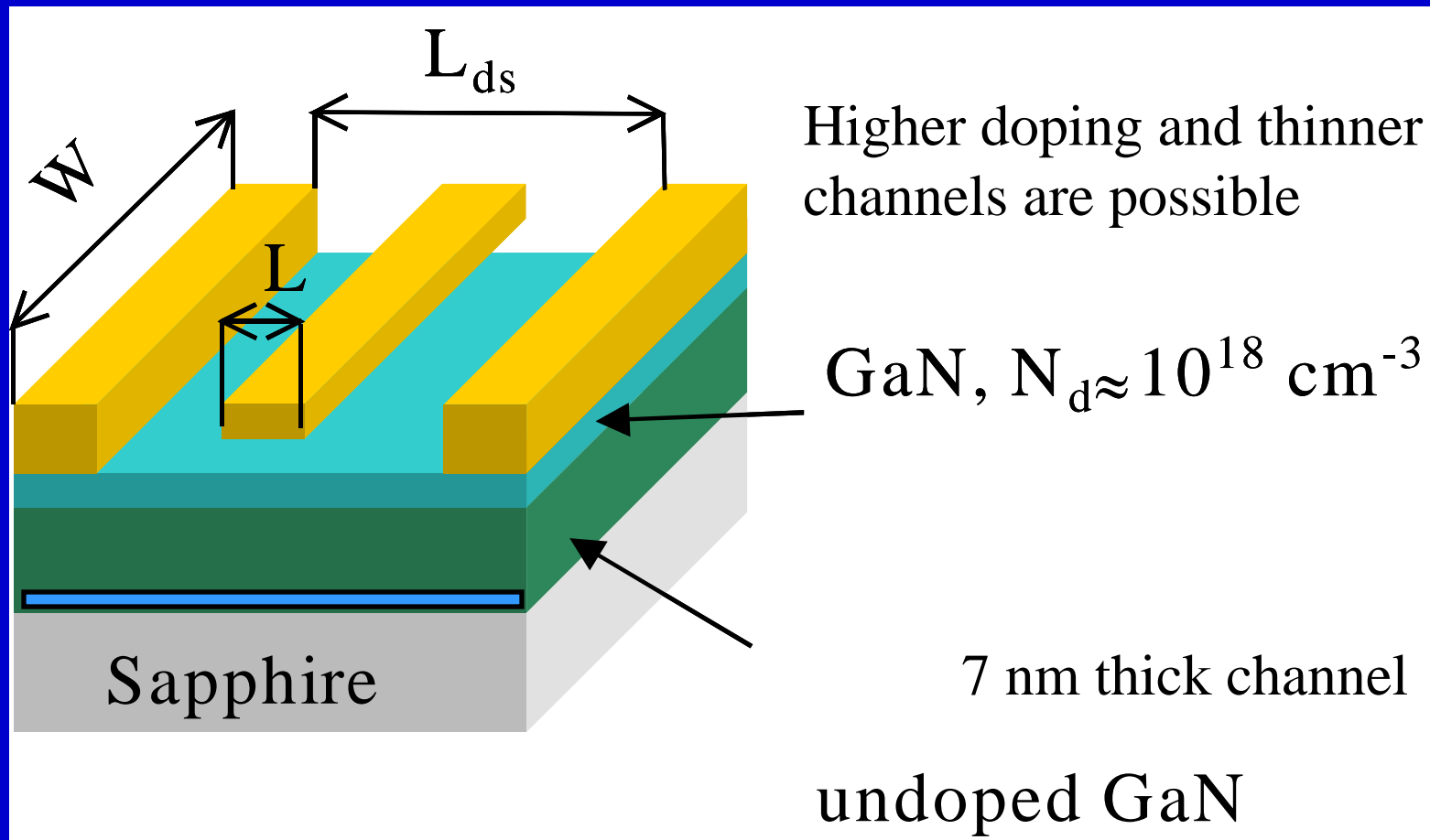


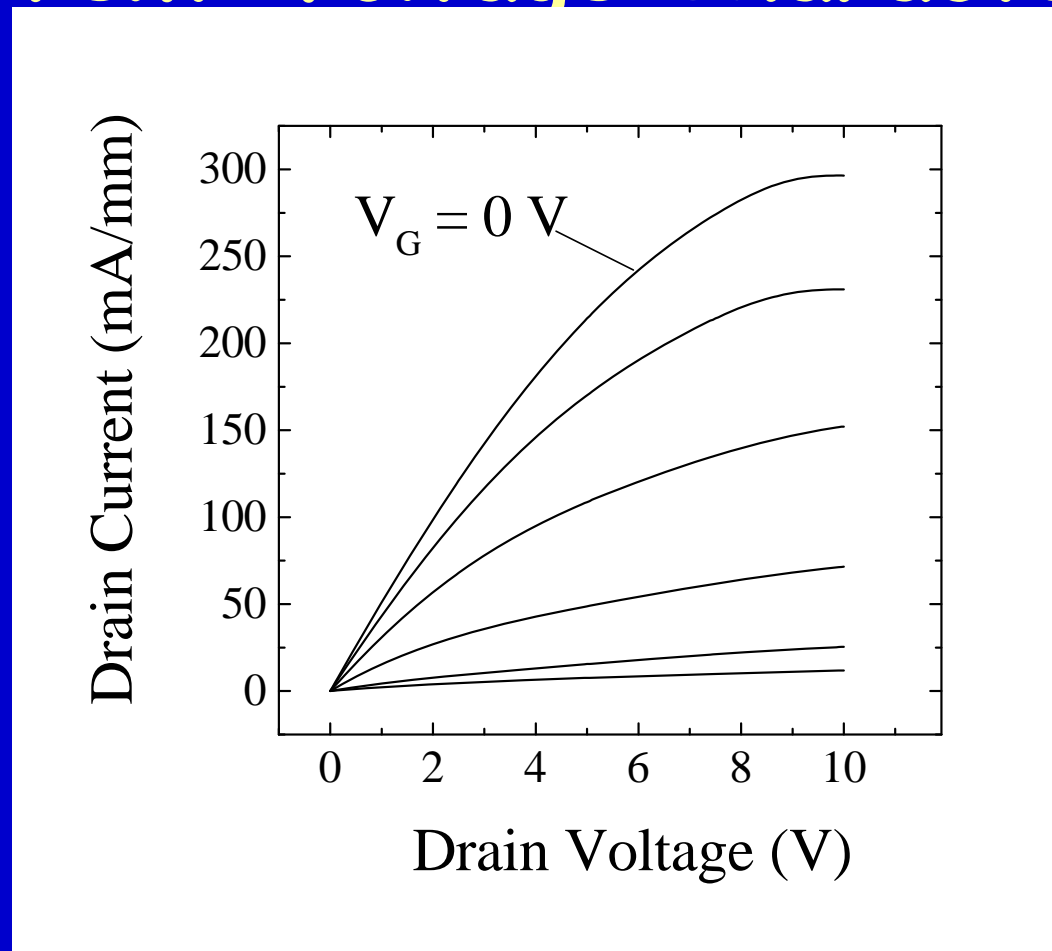
GaN MESFETs

GaN Highly Doped MESFETs



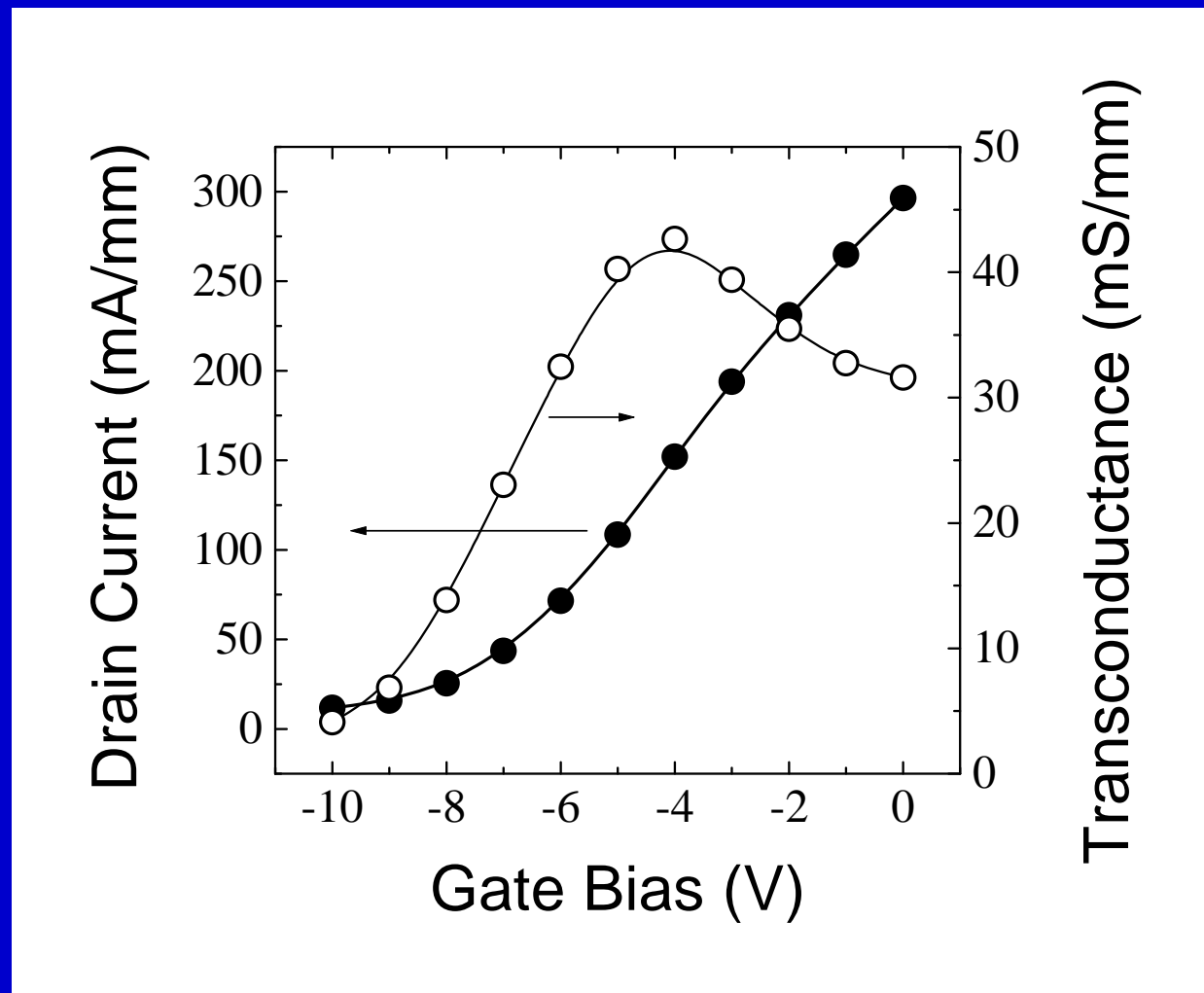
From R. Gaska, M. S. Shur, X. Hu, A. Khan, J. W. Yang, A. Taraki, G. Simin, J. Deng, T. Werner, S. Rumyantsev, and N. Pala, Highly doped thin-channel GaN-metal-semiconductor field-effect transistors, Appl. Phys. Lett. 78, No. 6, pp. 769-771 Feb. 5 (2001)

Current-Voltage Characteristics



From R. Gaska, M. S. Shur, X. Hu, A. Khan, J. W. Yang, A. Taraki, G. Simin, J. Deng, T. Werner, S. Rumyantsev, and N. Pala, Highly doped thin-channel GaN-metal-semiconductor field-effect transistors, *Appl. Phys. Lett.* 78, No. 6, pp. 769-771 Feb. 5 (2001)

Transfer characteristics



From R. Gaska, M. S. Shur, X. Hu, A. Khan, J. W. Yang, A. Taraki, G. Simin, J. Deng, T. Werner, S. Rumyantsev, and N. Pala, Highly doped thin-channel GaN-metal-semiconductor field-effect transistors, *Appl. Phys. Lett.* 78, No. 6, pp. 769-771 Feb. 5 (2001)

Features

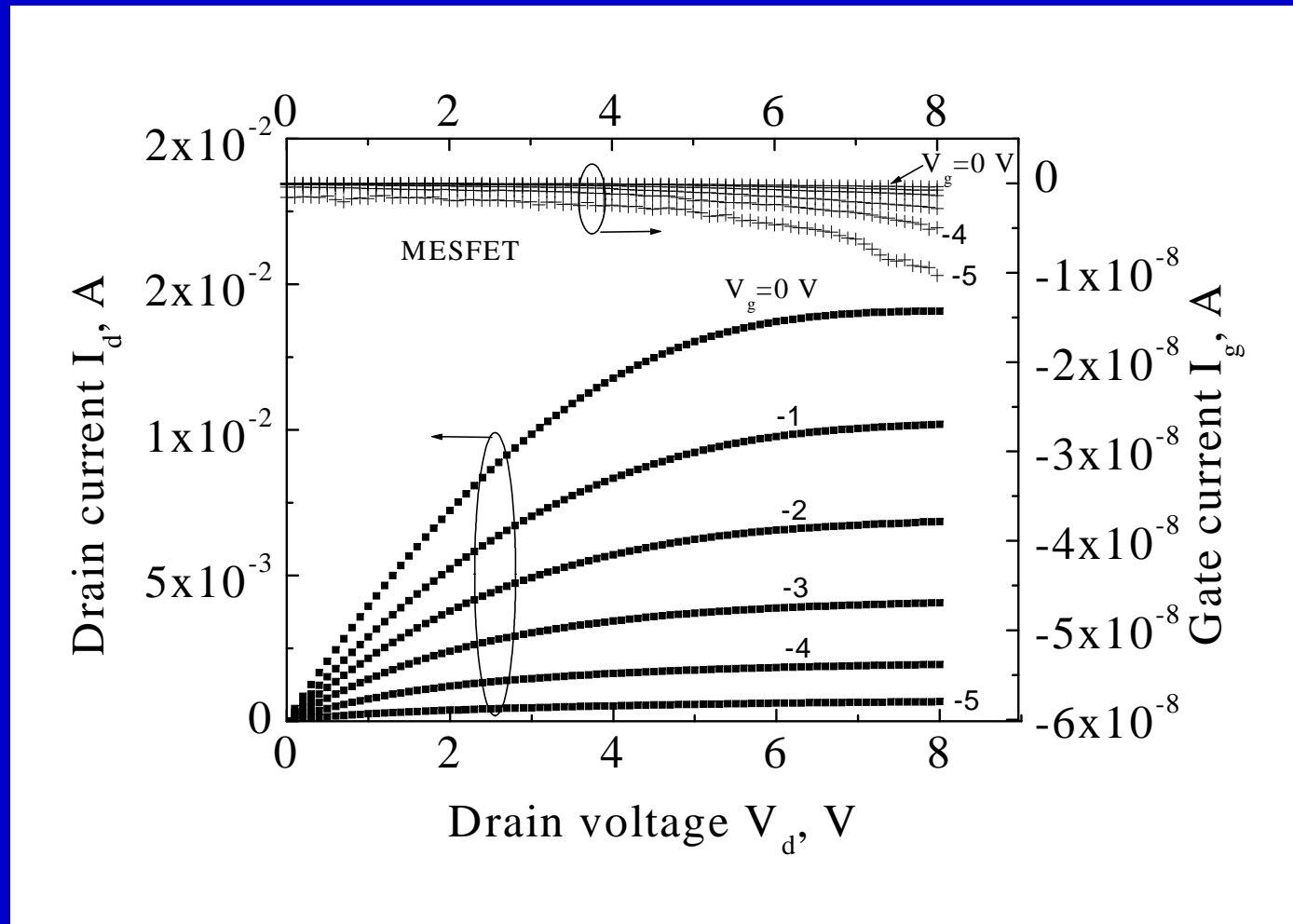
**Reasonable drain current and transconductance
(300 mA/mm and 40 to 70 mS/mm)**

Good pinch-off

Reasonable knee voltage

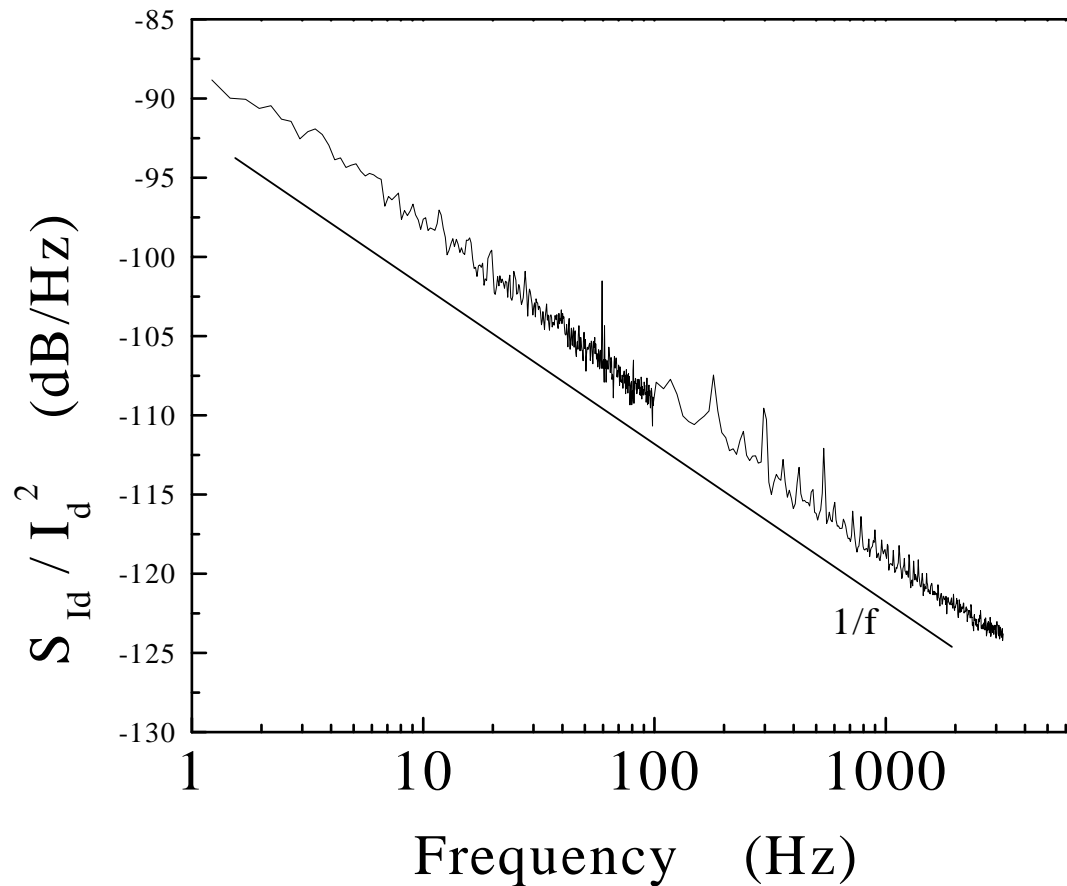
From R. Gaska, M. S. Shur, X. Hu, A. Khan, J. W. Yang, A. Taraki, G. Simin, J. Deng, T. Werner, S. Romyantsev, and N. Pala,
Highly doped thin-channel GaN-metal-semiconductor field-effect transistors, Appl. Phys. Lett. 78, No. 6, pp. 769-771 Feb. 5 (2001)

Very Low Leakage Current



From R. Gaska, M. S. Shur, X. Hu, A. Khan, J. W. Yang, A. Taraki, G. Simin, J. Deng, T. Werner, S. Rumyantsev, and N. Pala, Highly doped thin-channel GaN-metal-semiconductor field-effect transistors, *Appl. Phys. Lett.* 78, No. 6, pp. 769-771 Feb. 5 (2001)

Low 1/f noise

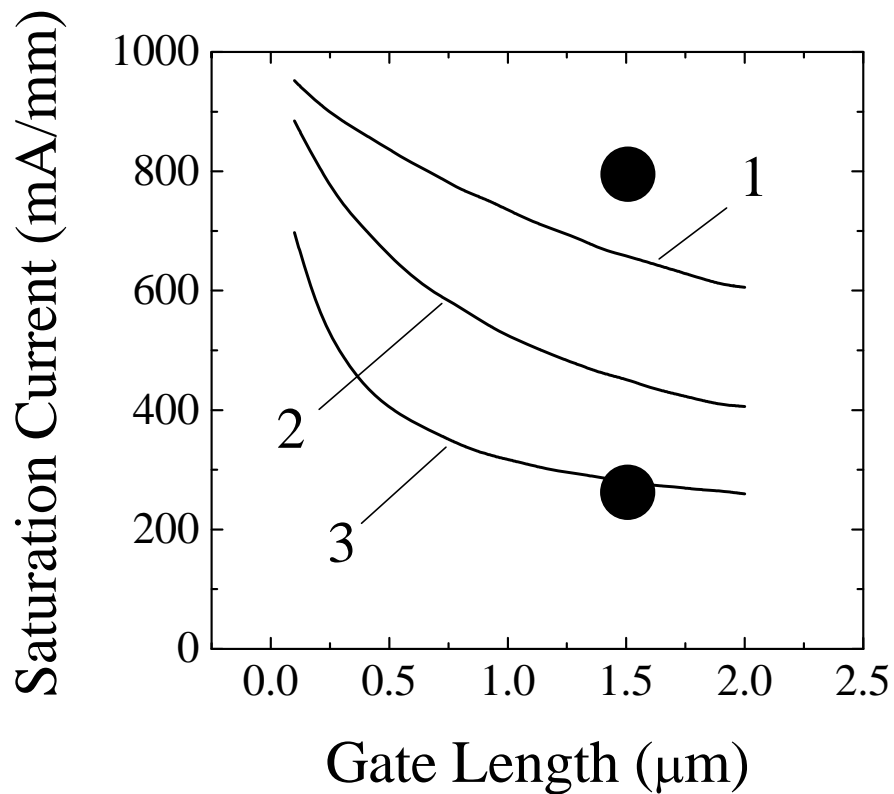


$$\alpha = \frac{S_I}{I_d^2} \times N \times f$$

$$\alpha = (2-3) \times 10^{-3}$$

From R. Gaska, M. S. Shur, X. Hu, A. Khan, J. W. Yang, A. Taraki, G. Simin, J. Deng, T. Werner, S. Romyantsev, and N. Pala, Highly doped thin-channel GaN-metal-semiconductor field-effect transistors, Appl. Phys. Lett. 78, No. 6, pp. 769-771 Feb. 5 (2001)

Maximum drain current in GaN HD MESFETs versus gate length



Electron mobility

1- 1,200 cm²/Vs

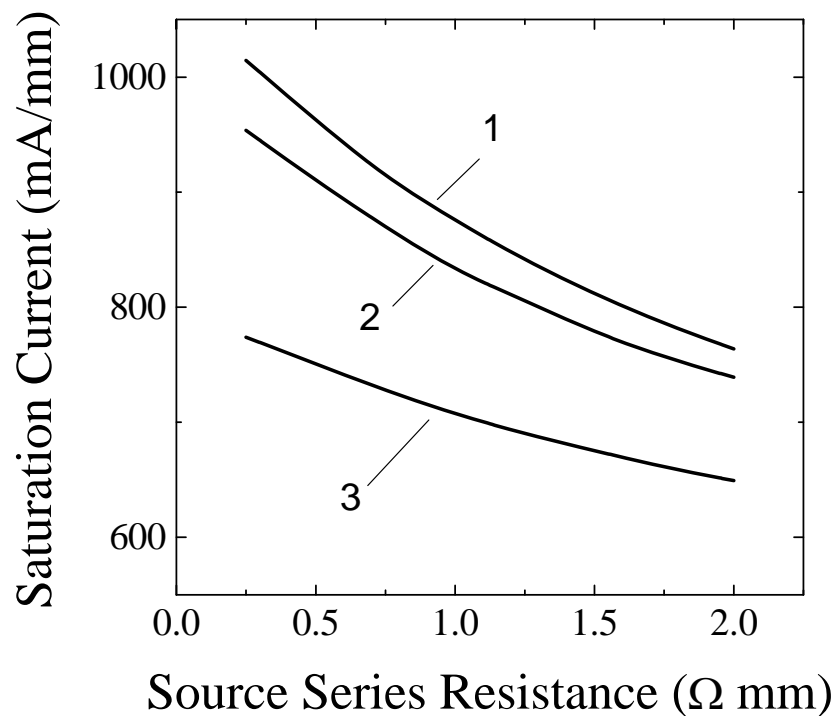
2 - 400 cm²/Vs

3 - 100 cm²/Vs.

Dots: saturation currents in
HD-MESFETs (lower dot)

HFETs (upper dot)

Maximum drain current in GaN HD MESFETs versus source series resistance



Electron mobility

1- 1,200 cm²/Vs

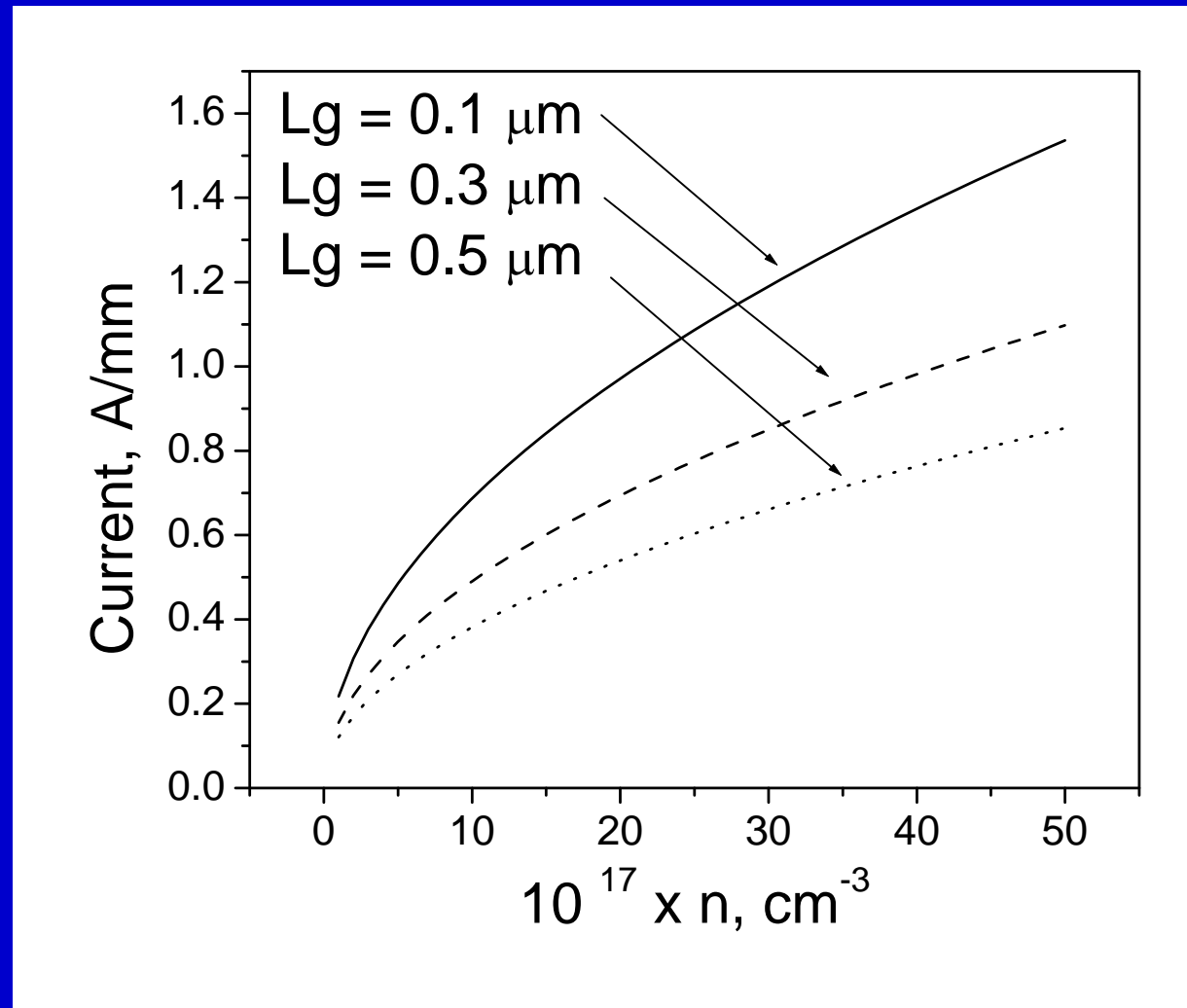
2 - 400 cm²/Vs

3 - 100 cm²/Vs.

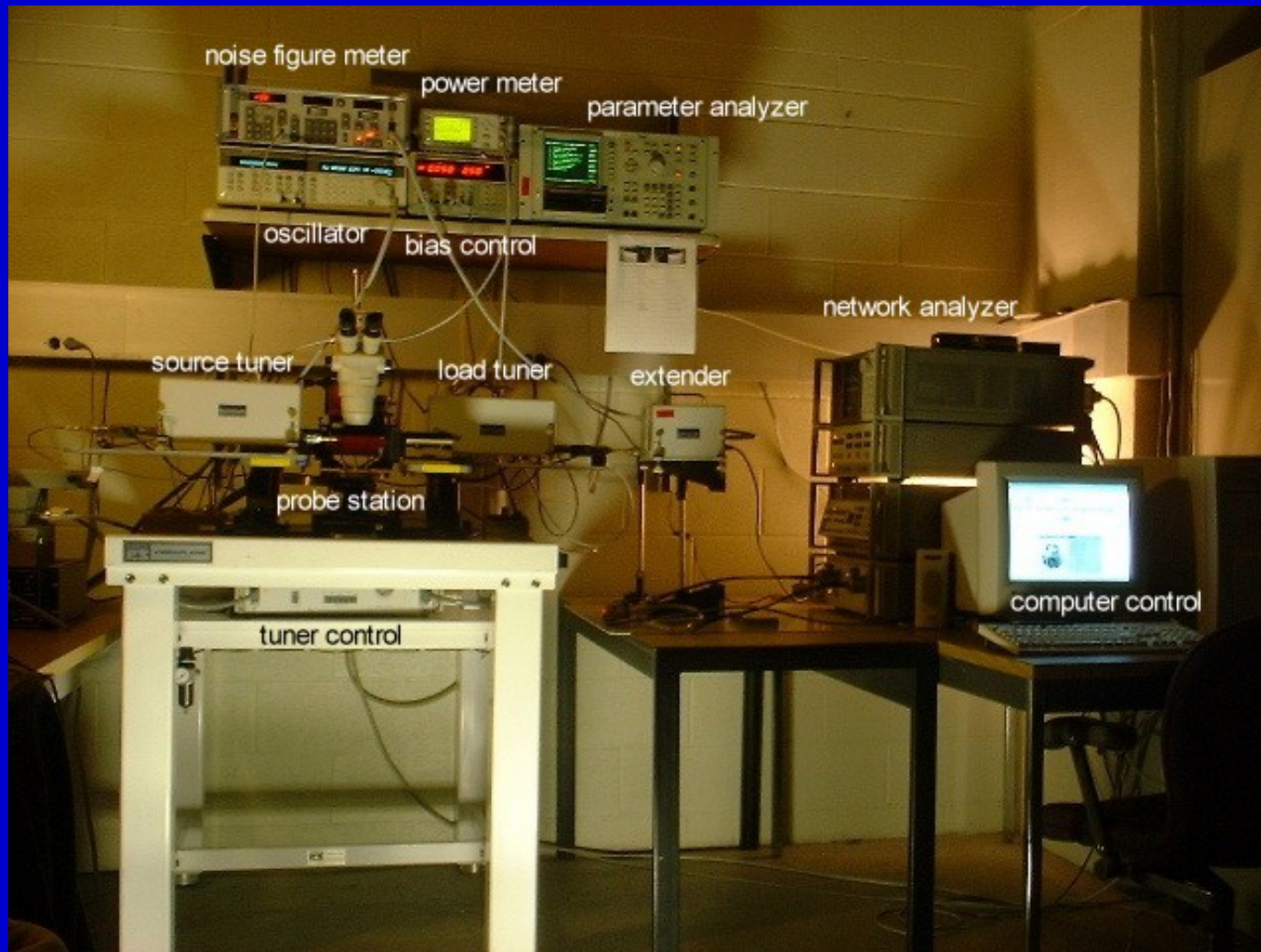
$V_T = -6V$

Gate length 0.1 micron

Maximum drain current versus channel doping



Microwave Setup at RPI

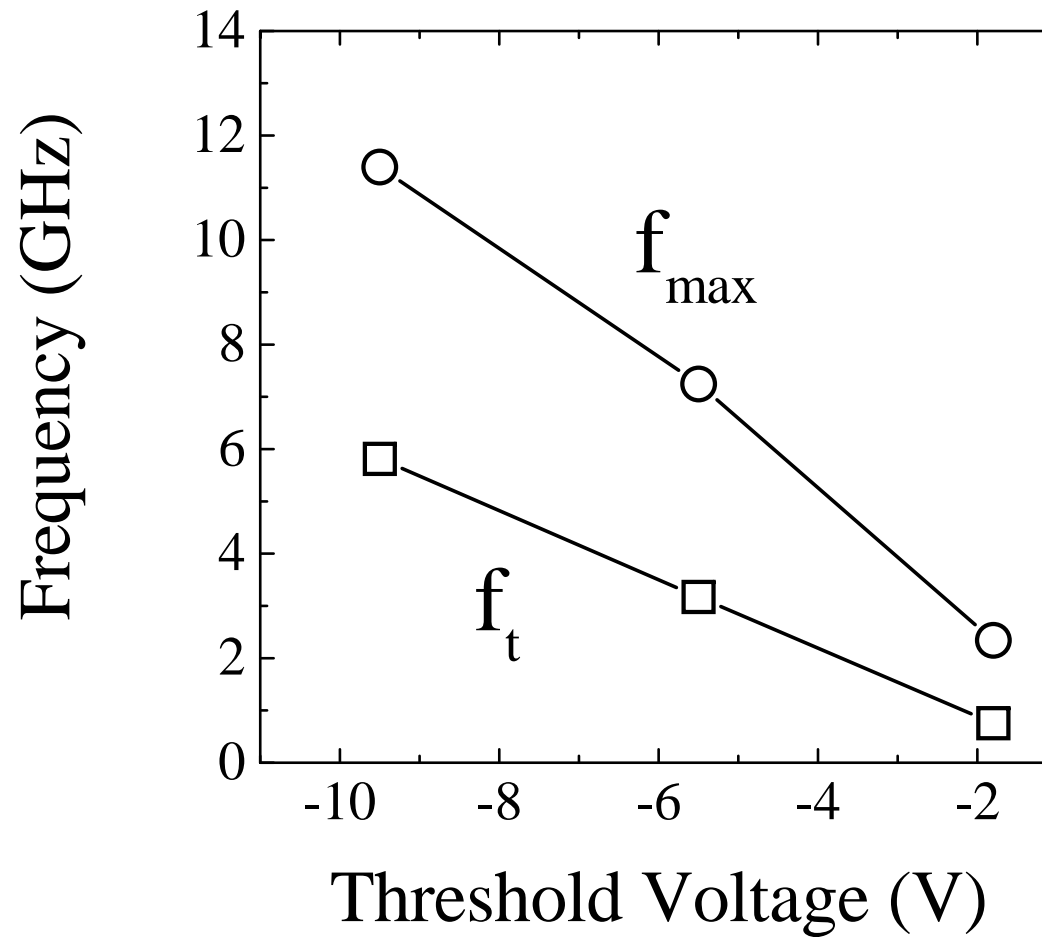


Microwave Performance

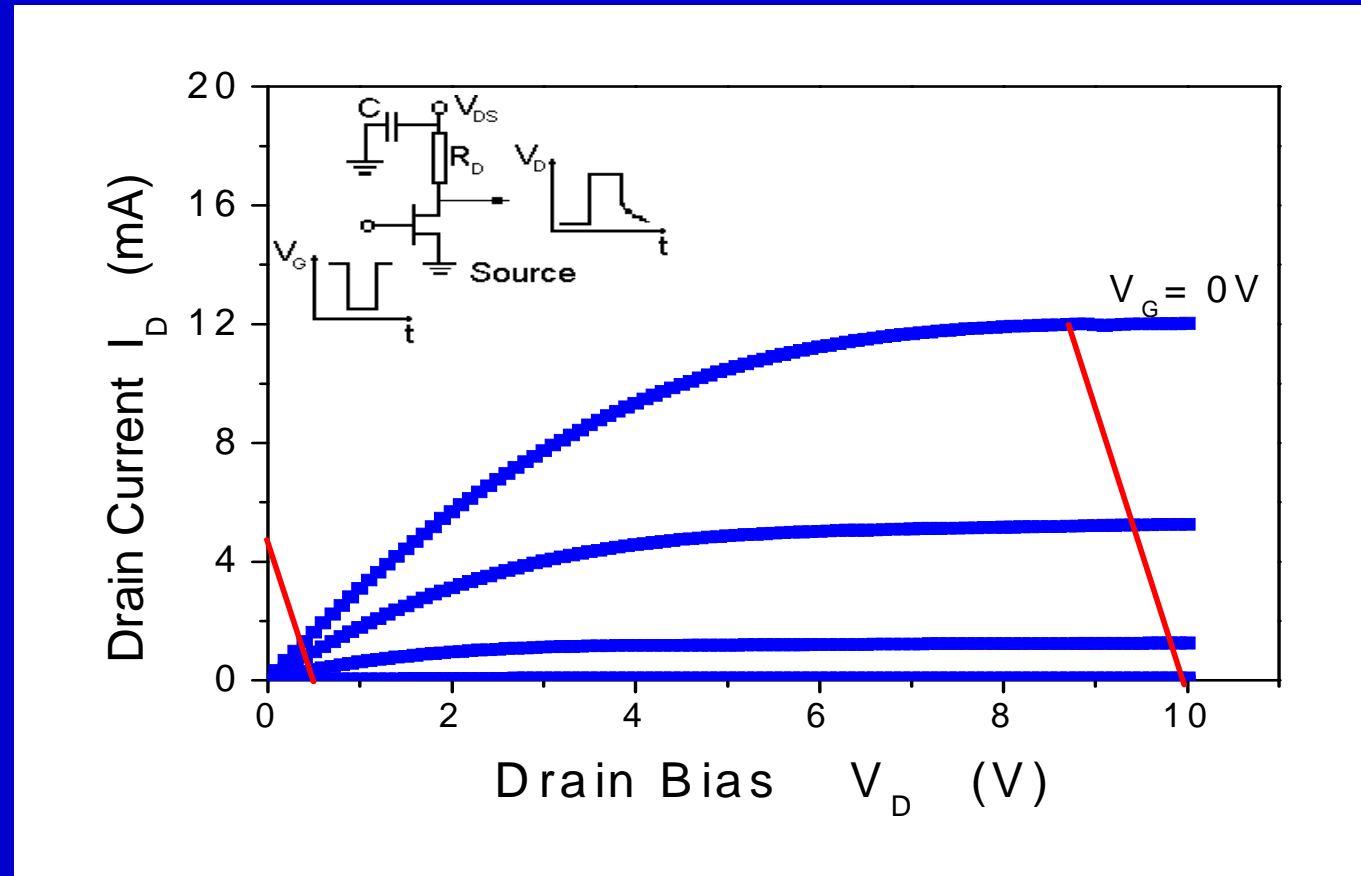
200 μm wide GaN HD-MESFETs with channel doping of $1.5 \times 10^{18} \text{ cm}^{-3}$ at 2 GHz

Pulsed RF was measured using 20 μm drain voltage pulses
Time duration between pulses 7.8 ns

Output powers were 0.6 W/mm and 3.4 W/mm for CW and pulsed operation, respectively

f_t , and f_{\max} 

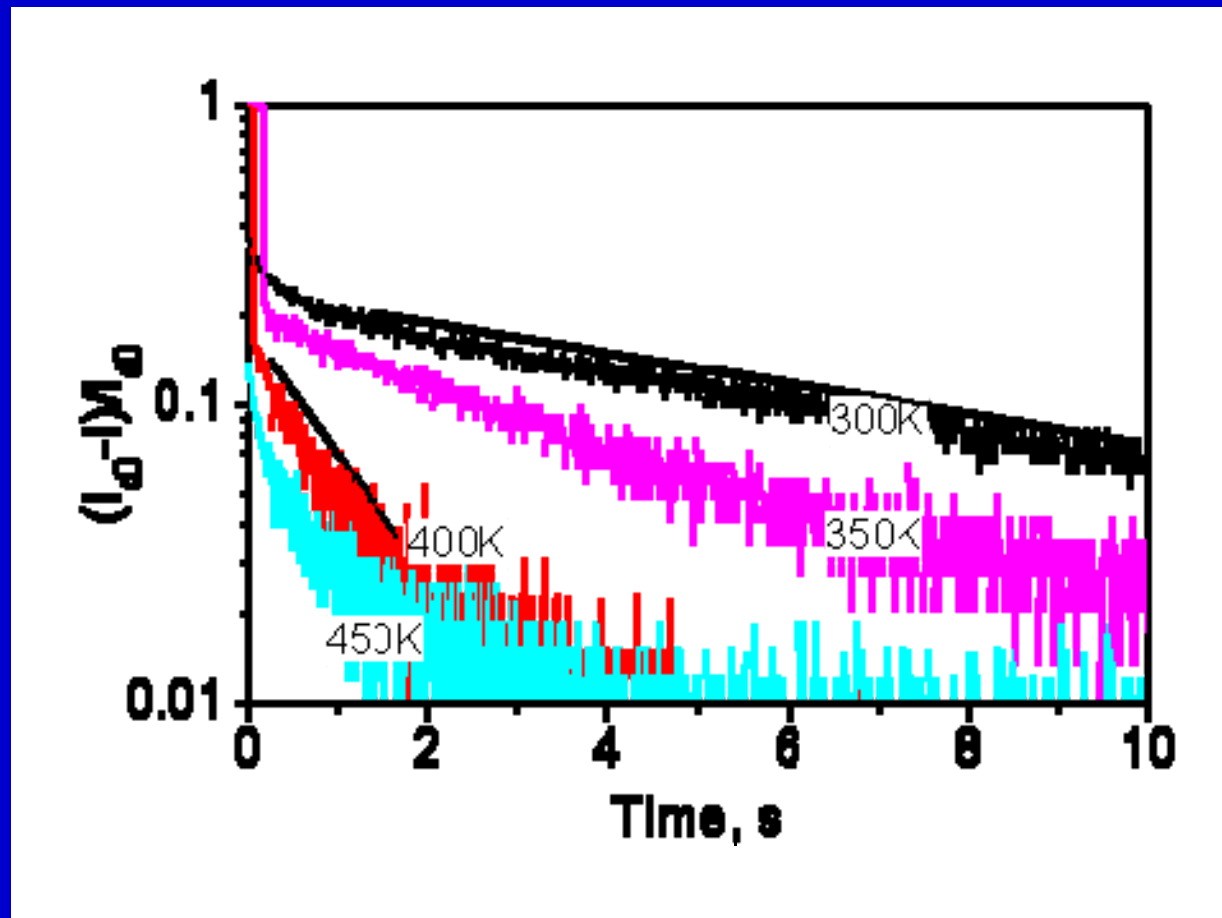
Transient effects



N. Pala, S. L. Romyantsev, M. S. Shur, X. Hu, A. Tarakji, R. Gaska, M. Asif Khan, G. Simin, and J. Yang, Transient response of Highly Doped Thin Channel GaN Metal-Semiconductor and Metal-Oxide-Semiconductor Field Effect Transistors, Solid State Electronics, vol. 46,

pp. 711–714, (2002)

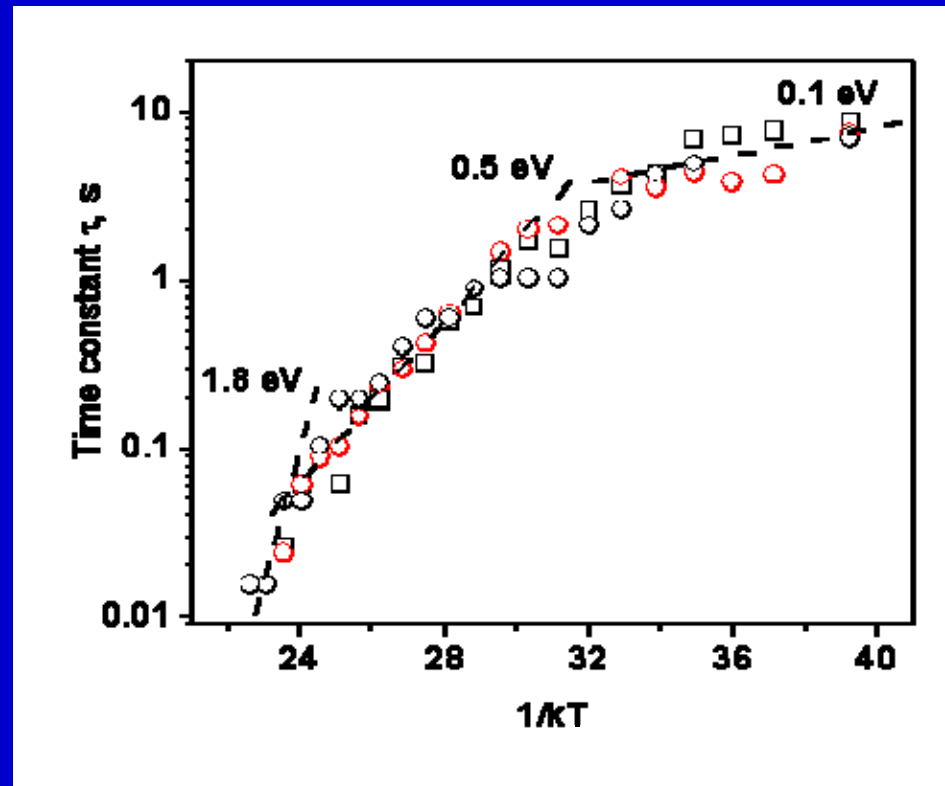
Temperature dependence



From N. Pala, S. L. Romyantsev, M. S. Shur, X. Hu, A. Tarakji, R. Gaska, M. Asif Khan, G. Simin, and J. Yang, Transient response of Highly Doped Thin Channel GaN Metal-Semiconductor and Metal-Oxide-Semiconductor Field Effect Transistors, Solid State Electronics, vol. 46,

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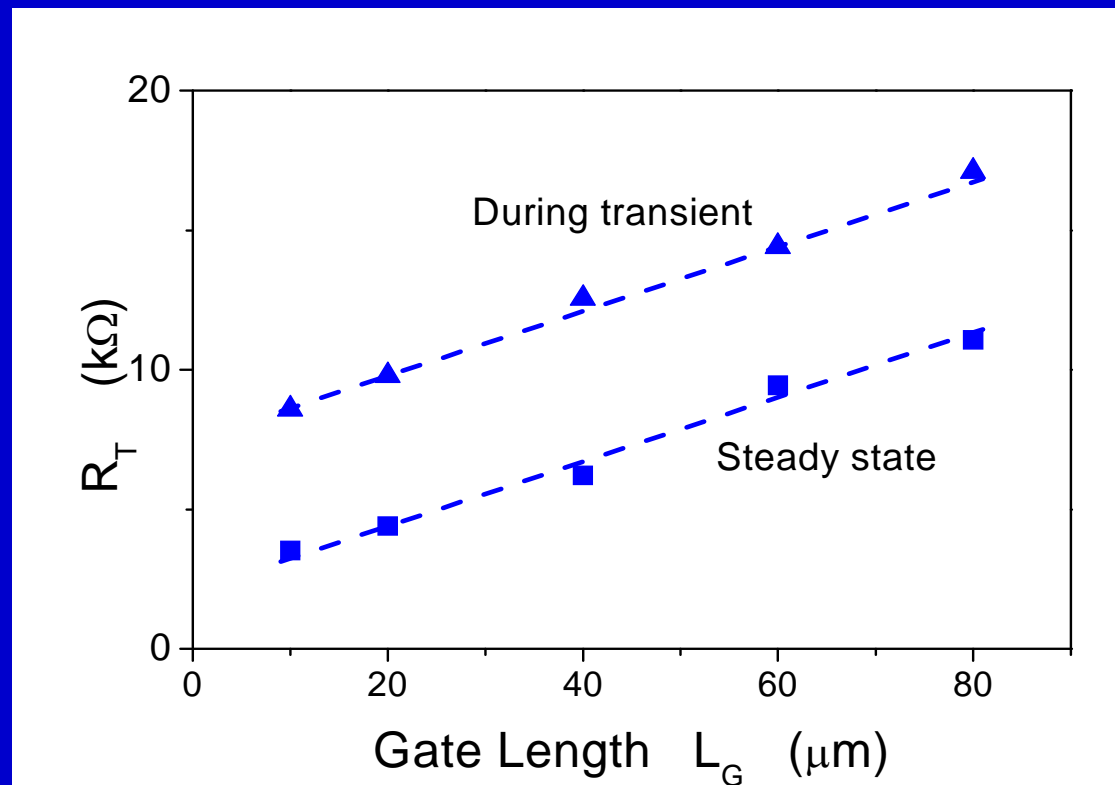
Time constant



From N. Pala, S. L. Romyantsev, M. S. Shur, X. Hu, A. Tarakji, R. Gaska, M. Asif Khan, G. Simin, and J. Yang, Transient response of Highly Doped Thin Channel GaN Metal-Semiconductor and Metal-Oxide-Semiconductor Field Effect Transistors, Solid State Electronics, vol. 46,

pp. 711–714, (2002)

Transient is affected by the regions outside the gate



Source Drain



From N. Pala, S. L. Romyantsev, M. S. Shur, X. Hu, A. Tarakji, R. Gaska, M. Asif Khan, G. Simin, and J. Yang, Transient response of Highly Doped Thin Channel GaN Metal-Semiconductor and Metal-Oxide-Semiconductor Field Effect Transistors, Solid State Electronics, vol. 46,

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