



Highly Reliable SiC MOS Transistors Operated at High Temperatures

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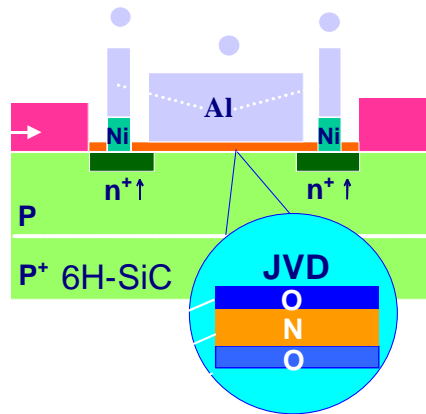


A Major Problem of State-of-the-art SiC MOSFETs at High Temperatures: Very Short Operating Lifetimes.

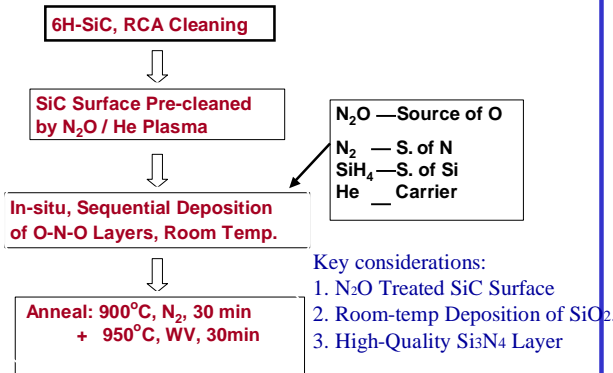
Dielectric	Lifetime (@ 350°C)	Breakdown Field (MV/cm)	
		RT	350°C
SOA SiO ₂	< 1.2 min	4.5-5	3.2-3.6
Dry-Wet SiO ₂	< 4.8 min	7	5
LPCVD SiO ₂	45 min	9	7
Conventional ONO	75 hour	11.4	6.4

Source: Lipkin, IEEE Trans. on ED, Vol. 46, 1999

Fabrication of SiC MOSFET

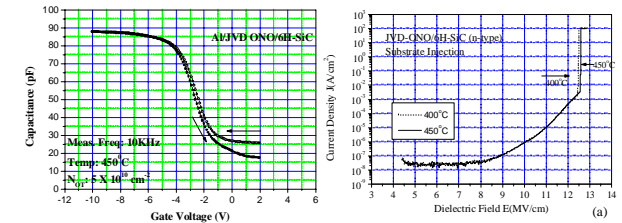


Formation of O-N-O Stack Gate Dielectric



Research done in collaboration with Jesse Tucker and Mulpuri Rao of George Mason University
Research supported by ONR

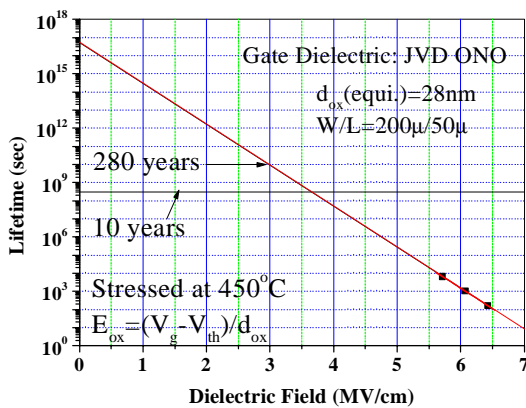
C-V and I_g – V_g



C-V characteristics indicate excellent Gate dielectric and interface properties.

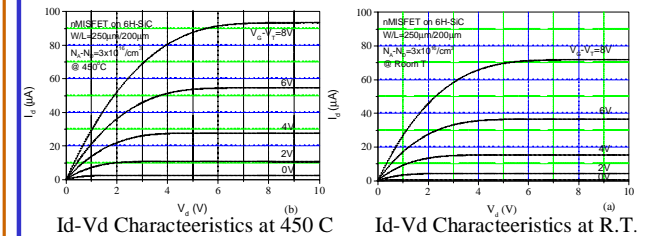
Low gate current and high breakdown field contribute to the excellent reliability.

Our Approach Has Resulted in Extrapolated Lifetime of 280 Years



Key to success: Dielectric and Interface Engineering

SiC MOSFET I_d – V_d Curves



Id-Vd Characteristics at 450°C (a) and Id-Vd Characteristics at R.T. (b)

Conclusion:

By use of a novel gate dielectric, we have demonstrated highly reliable & highly durable SiC nMOSFETs operating at 450°C with over 4 orders of magnitude longer operating lifetimes than the state-of-the-art.