

# High Breakdown Field and Low Trapping Effects up to 1400 V in Normally Off GaN-on-Silicon Heterostructures

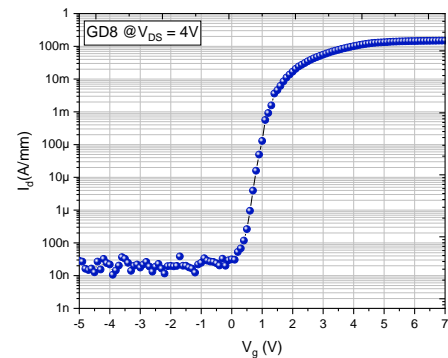
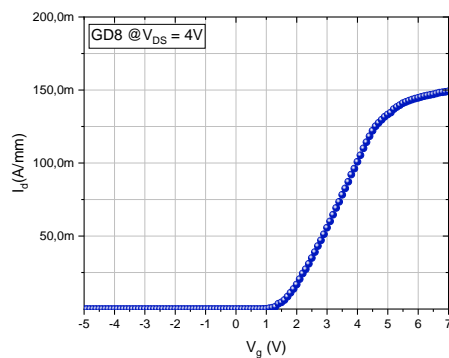
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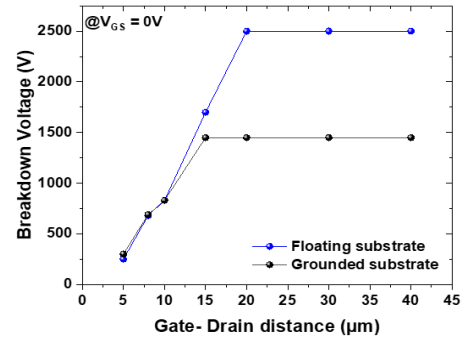
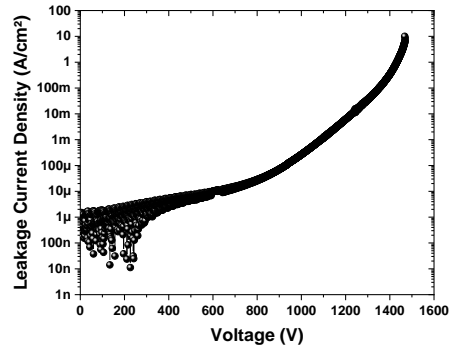
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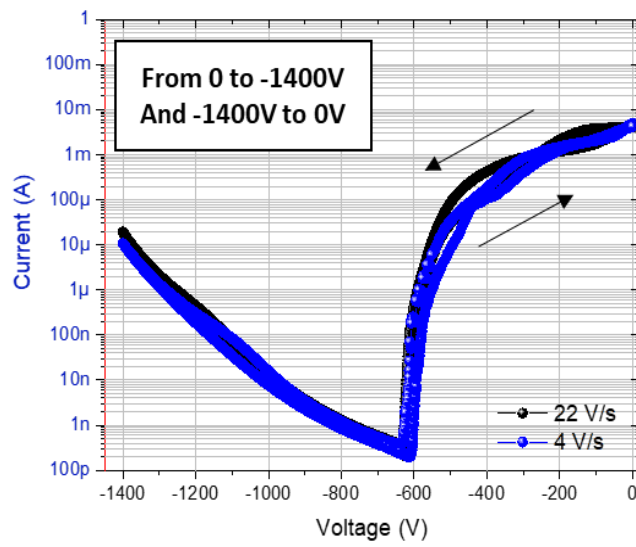
**Abstract:** In this study, we report on the development of a fully normally-off high electron mobility transistor (HEMT) gallium nitride on silicon (GaN-on-Si) heterostructures designed for high voltage operation. The normally-off configuration was achieved by means of a p-gallium nitride (p-GaN) cap layer enabling a positive threshold voltage higher than +1 V. The high voltage operation was ensured with a buffer based on AlN/GaN superlattice (SL) delivering a vertical breakdown voltage about 1.1 kV for a leakage current density of 1 mA/cm<sup>2</sup>. With the substrate grounded, hard breakdown voltage transistors at  $V_{GS} = 0V$  is about 1.45 kV, corresponding to an outstanding breakdown field higher than 2.4 MV/cm. High voltage characterizations revealed a state of the art combination of breakdown voltage at  $V_{GS} = 0V$  together with low electron trapping effects up to 1.4 kV as assessed by means of substrate ramp measurements.



Transfer characteristics in linear and logarithmic scales at  $V_{DS} = 4V$  of a GD8



Vertical breakdown and Three-terminal hard breakdown voltage at  $V_{GS} = 0V$  for a GD20



Substrate ramp measurements at 1.4 kV

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**Keywords:** GaN-on-Si, Normally off, High power, Trapping

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