

Fig. 1. (a) Schematic and (b) photo of the double-side packaged Ga₂O₃ SBD encapsulated in silicone gel. (c) Ga₂O₃ SBD's fabrication process. (d) Schematic of the fabricated bare-die Ga₂O₃ SBDs. Photos of the Ag layer (e) before and (f) after 250°C sintering. If Ag is directly deposited on Au, during the 250°C sintering process, Ag was found to diffuse into the Au layer due to the absence of the Ti barrier layer. The Ag layer after sintering is porous, and the bonding quality of the sintered silver joint is bad (<10 MPa).

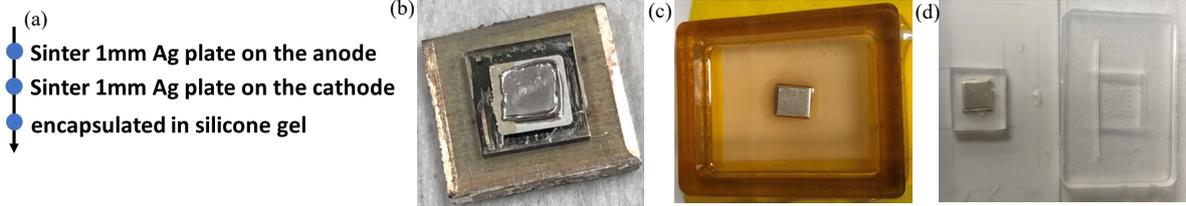


Fig. 2. (a) Process of double-side-cooling packaging. (b) Silver paste was stencil-printed (c) silicone encapsulant was poured into a mold to seal the Ga₂O₃ SBD, and cured in an oven. (d) The excess encapsulant was cut out with a sharp knife to liberate the packaged Ga₂O₃ SBD.

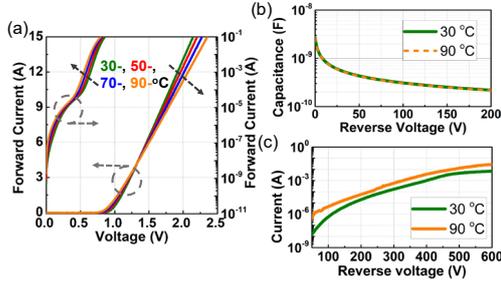


Fig. 3. Temperature-dependent (a) forward I-V, (b) reverse C-V and (c) reverse I-V characteristics of the packaged device.

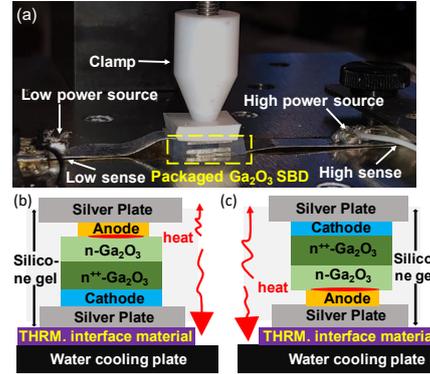


Fig. 5. (a) Photo of the R_{thJC} measurement test setup. Schematic of R_{thJC} measurements under (b) bottom-side cooling and (c) junction-side cooling.

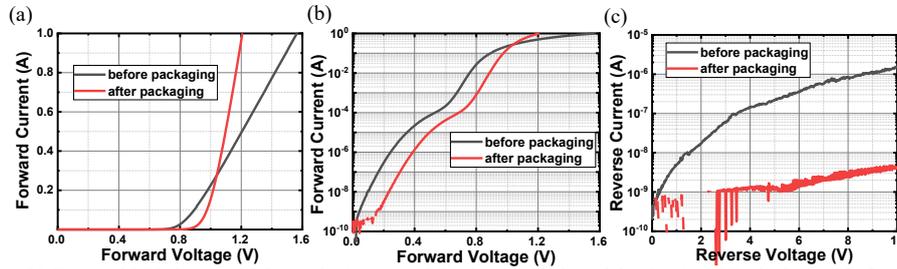


Fig. 4. (a), (b) Forward I-V characteristics and (c) reverse I-V characteristics of the Ga₂O₃ SBDs before and after packaging.

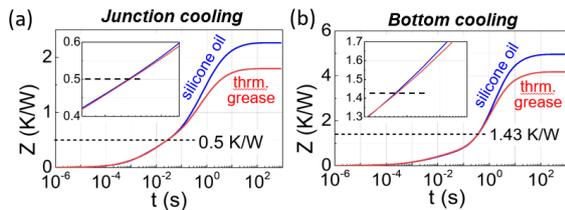


Fig. 6. Transient thermal impedance curves of the Ga₂O₃ SBD measured with two thermal interface materials (silicon oil and thermal grease) under (a) junction- and (b) bottom-side cooling. The insets show the zoom-in plot of the separation point.

TABLE I. Thermal resistance comparison between Ga₂O₃ SBDs and commercial SiC SBDs with similar current ratings and package sizes.

Device	Package	Package Size* (mm ²)	V _{ON} (V)	I _F (A) ** @ 2 V	Cooling	R _{thJC} (K/W)
Ga ₂ O ₃ SBD (this work)	Double-side	7.3×7.3	0.9	13	Junction Bottom	0.5 1.43
SiC SBD (C3D10060G)	TO-263-2	6.5×7.9	0.85	18	Bottom	1.2
SiC SBD (E3D08065G)	TO-263-2	6.5×7.9	0.85	14.5	Bottom	1.47
SiC SBD (C6D04065E)	TO-252-2	5.2×4.3	0.85	12	Bottom	2.89

*Size of the die-attached thermal. **Forward current at 2 V forward voltage.