GALLO

CNF Project Number: 323825
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Primary CNF Tools Used: GCA AutoStep 200 DSW i-line stepper, JEOL 6300 E-beam, SEM, PT770 etcher, O2 Asher, Oxford RIE Etcher, AJA sputter system, E-beam evaporator, Oxford PECVD, RTA AG610

Abstract:

Gallium oxide (Ga_2O_3), an ultra-wide bandgap semiconductor, offers strong potential for highpower, high-voltage power electronics due to its large bandgap and high critical electric field strength. This research focuses on the design, fabrication, and testing of Ga_2O_3)-based diodes and transistors, with iterative improvements guided by performance data. Current efforts emphasize electric field management and thermal mitigation to enhance device performance and support future commercialization.

Summary of Research:

Gallium oxide (Ga_2O_3) is an ultra-wide bandgap (~4.8 eV) semiconductor [1]. Its large bandgap and high critical electric field strength make it well suited for high-power, high-voltage power electronics applications [2].

To commercialize Ga_2O_3-based transistors and diodes, devices must be carefully designed, fabricated, and tested. Effective electric field management and thermal mitigation strategies are essential to achieving the material's full potential.

We have designed, fabricated, and tested both diodes (Fig. 1) and transistors (Fig. 2) to evaluate the device performance (Fig. 3), and we continuously iterate: fabrication, testing, and data analysis to inform subsequent design improvements.

Conclusions and Future Steps:

We are working to introduce additional electric field management strategies, and to implement efficient heat removal strategies.

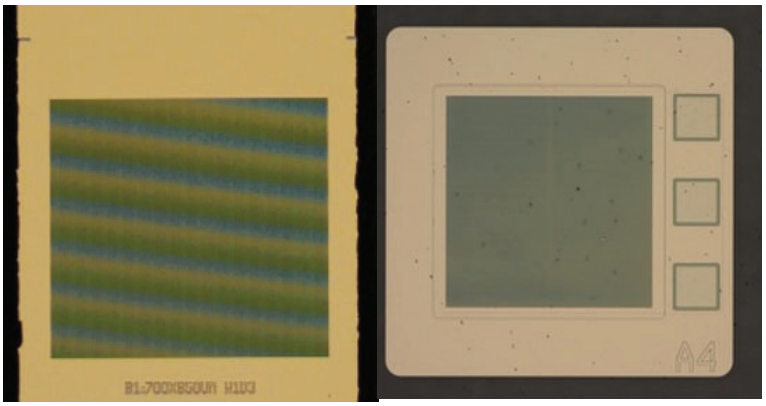

Fig. 1 (Left). A Schottky barrier diode is shown. Fig. 2 (Right). A field effect transistor is shown.

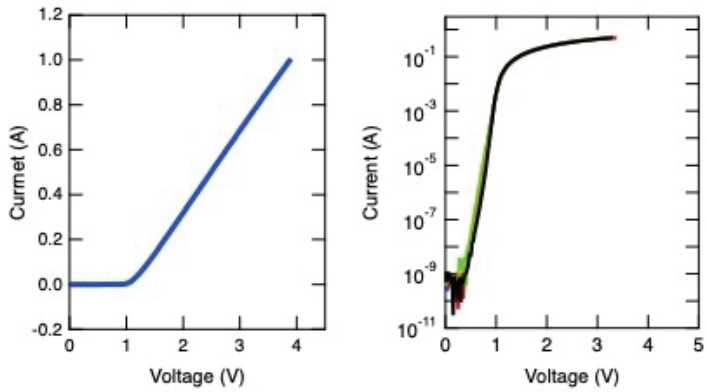

Fig. 3. Schottky barrier diode performance is characterized, and performance is assessed in order to optimize and iterate on the devices design. Current vs voltage measurements are obtained and plotted on a (left) linear scale and (right) log scale.

References:

[1] T. J. Huang, A. Ankolekar, A. Pacheco-Sanchez, and I. Puchades, "Investigating the Device Performance Variation of a Buried Locally Gated Al/Al2O3 Graphene Field-Effect Transistor Process," Applied Sciences (Switzerland), vol. 13, no. 12, Jun. 2023, do