Department of the Navy SBIR/STTR Transition Program

Topic # N201-071
Develop Ultra-Fast Metastable Ion Implant Activation System
Agnitron Technology Inc.

WHO

SYSCOM: ONR

Sponsoring Program: Office of Naval Research - Naval Air Warfare Center

Transition Target: High Power and High Efficiency Converters for Weapons, Radar, and Propulsion

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Other Transition Opportunities: Space Applications such as satellite for advance communications

https://www.navair.navy.mil/product/Harpoon

Notes: Traditional in-situ annealing has achieved the minimal standards for use of GaN in real world applications. Our new system will help GaN achieve maximum capability for GaN to be used to it's full potential in high power applications.

WHAT

Operational Need and Improvement: The future of defense relies on the advances of high voltage power electronics. Gallium Nitride (GaN) is a suitable material to make those advancements happen with a Baliga Figure of Merit that is 5 times higher than Silicon Carbide (SiC) and 850 times higher than Silicon (Si). Because GaN is thermodynamically unstable at high temperatures, conventional annealing methods cause sturctural damage to GaN devices. These are significant hurdles that need to be cleared to manufacture high-voltage/high-frequency devices using GaN.

Specifications Required: Annealing to adequately remove implant-induced damage would usually require temperatures ~2/3 of the crystal's melting point, which is ~1400-1500 °C for GaN. But GaN surface decomposes only at a temperature of ~850 °C at atmospheric pressure.

Technology Developed: A Multicycle rapid thermal annealing (MRTA) system with ultrafast sub-second heating and cooling cycle rates (>1000 K/s). The MRTA allows shorter temperature pulses and achieves a higher maximum peak temperature in GaN without decomposing the material. The short cycled multiple heating pulses provide better conditions for diffusional processes in GaN, better restore the device structure damaged by ion implantation, and improve activation of the implanted dopants while also preserving the the GaN surface integrity. The final MRTA system will be capable of delivering <2% temperature uniformity and achieving ~2500 oC steady-state heating on wafers up to 4 inches in diameter.

Warfighter Value: Higher productivity from rail guns, missiles, and AMDR

WHEN

Contract Number: N68335-22-C-0112 **Ending on:** Sep 30, 2025

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Determine Feasible MRTA Process	Low	Simulations in Phase I Established Feasibility	3	2nd QTR FY21
Optimize Heating Mechanism of 4” Wafer	Low	Design Completed	2	1st QTR FY23
Optimize Cooling Mechanism of 4” Wafer	Low	Design Completed	2	3rd QTR FY23
Multicycle Rapid Thermal Annealing System Design	Low	Design Completed	2	2nd QTR FY25
System Assembly	Medium	System Operational	4	1st QTR FY26
Qualify and Test the Multicycle Rapid Thermal Annealing System	Medium	Desired Specs Achieved	8	1st QTR FY26

HOW

Projected Business Model: Once the technology has been demonstrated we have data to show the capability of our tool, we will be marketing our technology through various sources while directly contacting potential clients that could benefit from our technology the most.

Company Objectives: Revolutionize the capability of wide bandgap semiconductive material to advance the applications they are applied to in the market

Potential Commercial Applications: Electric Vehicles, Fast Charging, Data Centers, Renewable Energy, Communications, Lidar

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