Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2018-0491

Topic # N15A-T010

Reliable Manufacturing of Scandia-doped Tungsten Powders for Thermionic Cathodes

nGimat LLC

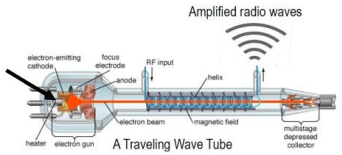
WHO

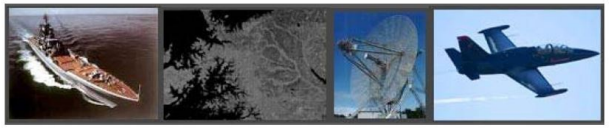
SYSCOM: NAVSEA

Sponsoring Program: NAVSEA PEO IWS

Transition Target:

TPOC:
(812)854-5264





Other transition opportunities: The Scandia-doped tungsten nanopowders developed within this program are known to enhance the current density and life expectancy of thermionic cathode devices. Transition opportunities include any users of systems incorporating cathode devices and vacuum electron devices, including communications, radar and other systems.

WHAT

Operational Need and Improvement: Commercial scale production of scandium-doped tungsten powder is consistent with the needs of the US domestic cathode industry in meeting Navy requirements. Many existing Navy weapon systems, including radar and electronic warfare (EW) systems, rely on microwave vacuum electronics (microwave tubes) as the primary source of Radio Frequency (RF) power. Future RF sensors will require unprecedented performance in output power and bandwidth. Proposed solutions based on vacuum electronics demand advanced, high current density cathodes. Microwave tubes will exist in Navy systems for many decades to come due to the sustainment of legacy systems, and the deployment of future systems for which size, weight, and power-bandwidth make vacuum electronics the only viable option. The production of scandium doped tungsten powder for use in advanced high current density thermionic cathodes supports these requirements.

Specifications Required: Compared to conventional M-type cathodes, the composite scandate nanomaterials developed in this program will enable 10X longer cathode lifetime by lowering the required operating temperature, or enable higher cathode loadings (5X power) for applications such as THz generation, with anticipation that the flow-through cost difference of the fully configured device (radar or other electron gun enablement) will be less than 5%.

Technology Developed: nGimat can provide high quality tungsten-scandate cathode nanopowder, as a “drop-in” replacement for conventional tungsten powder, to a cathode manufacturer such as 3M/Ceradyne. Using the nanopower, the manufacturer will produce and sell enhanced performance cathodes to system integrators (e.g. NGC, Teledyne). These integrators will incorporate these cathodes into enhanced devices (e.g., radar systems) sold to the U.S. Navy.

Warfighter Value: nGimat’s well-mixed Scandia-decorated tungsten nanopowders provide step-wise improvement in the performance and life expectancy of thermionic cathodes. RF systems that incorporate cathodes, such as satellites and communications systems, can operate at higher power or higher frequency, expanding the boundary of their operational performance. Additionally, the extended life span of the cathode can prevent downtime and costly repairs of critical systems.

WHEN

Contract Number: N00253-17-C-0014 **Ending on:** July 20, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Cathode validation in simulated test vehicle	Low	At-temperature work function testing feedback	TRL 4	September 2018
Demonstrate consistency, reliability	Low	At-temperature work function testing feedback	TRL 5	January 2019
Implement QC measures	Low	Consistency of results	TRL 6	July 2019
Successful prototype demonstration in operation by Tier 1	Med	Successful cathode performance	TRL 7	July 2020
Begin manufacturing of powder in volume for customer	Med	Reliably meet product spec for customer	TRL 7	July 2021

HOW

Projected Business Model: nGimat will manufacture Scandia-doped tungsten nanopowders and provide these to cathode manufacturers. Production is currently possible in trial quantities, and can be increased significantly to meet customer requirements; nGimat currently produces dozens of different nanopowders used in various applications by many customers. Through the DON SBIR program, nGimat has formed a strategic partnership with 3M/Ceradyne, who is capable of manufacturing thermionic cathodes incorporating nGimat’s nanopowders.

Company Objectives: nGimat’s objective is to increase awareness of the improved performance of thermionic cathodes that is enabled by our newly-developed Scandia-doped tungsten nanopowders, and to establish contact with various manufacturers of relevant RF systems.

Potential Commercial Applications: The US domestic vacuum device industry supplies microwave tubes for a variety of specific (fusion research), industrial (microwave heating) and communication (satellite uplink stations) applications. All of these can potentially benefit from the enhanced performance cathodes resulting from this program.

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