

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-835

Topic # N181-013

Compact, Lightweight, Power-Dense, Integrated Fuel Cell System
NexTech Materials, Ltd. dba Nexceris, LLC

WHO

SYSCOM: NAVAIR

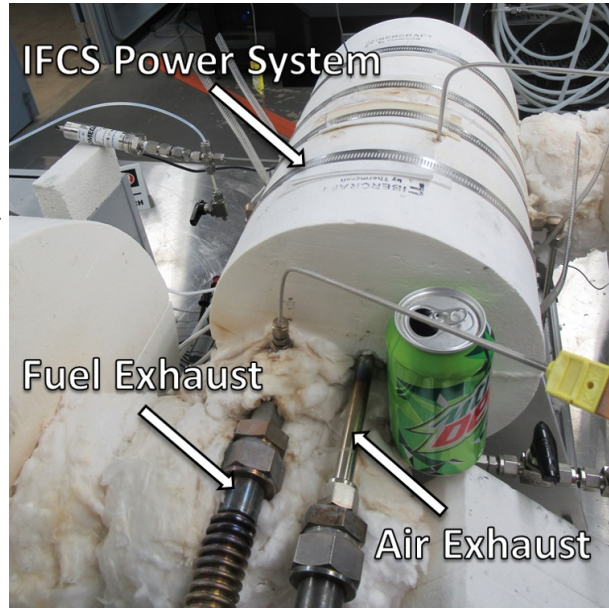
Sponsoring Program: PMA-263

Transition Target: Group II and Group III Unmanned Aerial Systems (e.g., the Stalker)

TPOC:

Other transition opportunities: Other military applications of SOFC based power systems include:

- Propulsion and auxiliary power on unmanned ground vehicles
- Auxiliary power units for tanks and military ground vehicles
- Portable power for exoskeletons and battery charging
- Transportable power for forward operating bases



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WHAT

Operational Need and Improvement: Solid oxide fuel cells provide a path to meet the following operational needs.

- Longer mission durations, larger payloads, and operation on military logistic fuels are needed for unmanned aerial systems.
- Silent, efficient, and robust power sources that operate on JP-8 fuel are needed for military ground vehicles.
- Small, lightweight, and efficient power sources are required for exoskeletons and battery chargers.

Specifications Required: The solid oxide fuel cell power system being developed for NAVAIR will meet the following specifications:

- Power level (nominal): 500 watts
- Electrical efficiency (JP-8 fuel): 30 percent
- Gravimetric power density: 65 to 120 W/kg
- Scalability: up to 10 kW
- Form factor: Tailored to specific platforms.

Technology Developed: A leading innovator in SOFC technology, Nexceris is developing logistic fueled power systems for range of high value military applications. Attributes of the technology include:

- Lightweight systems are enabled by an ultra-high power density SOFC stack design.
- SOFC cell and stack materials and operational modes enabling very high efficiency
- Custom stack and system design to application specific requirements
- Unprecedented tolerance to sulfur impurities in JP-8 fuels (up to 100 ppm after fuel reformation)

Warfighter Value: SOFC power systems based on Nexceris' technology offer the following benefits to the warfighter.

- Broader range of CONOPS for unmanned aerial systems
- New power generation capabilities that do not require modifications to existing logistic fuel infrastructure
- Ease of getting more power deeper into the field

WHEN

Contract Number: N68335-19-C-0603 **Ending on:** February 26, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Construction of testing apparatus complete	Low	Fabrication of testing apparatus complete	3	July 2020
Approach selected for system pre-heating	Low	Method for starting up in ≤30 minutes identified	3	July 2020
Target SOFC performance (stack/CPOX integration)	Med	Achieve ≥500 watts total stack power	4	September 2020
Target SOFC performance (stack/HX integration)	Med	Achieve ≥500 watts total stack power	4	November 2020
Target SOFC performance (full system integration)	High	Achieve 550 watts total stack power at 43 percent stack efficiency	5/6	February 2021
Target Performance in prototype system demonstrated at NAVAIR	Med	Achieve 550 watts total stack power at 43 percent stack efficiency	5/6	July 2021

HOW

Projected Business Model: Nexceris business model is to commercialize technology through product development and manufacturing.

- Nexceris plans to manufacture SOFC stacks and systems and establish partnerships with Military Primes for integration of the system into UAS platforms. Nexceris then will apply the technology to develop products for other military applications.
- We have considerable experience in producing SOFC materials, cell manufacturing, stack design and modeling, fabrication and testing of SOFC stacks, and integration of stacks into fuel cell systems.
- Because we are vertically integrated, we tailor our SOFC technology to meet application-specific requirements.
- Our current focus is the design and development of highly efficient and power dense SOFC stacks and systems. As a vertically integrated SOFC developer, Nexceris' commercial objective would be to manufacture the cells, stacks, and systems for the UAS and other military applications.

Company Objectives: Nexceris is an established player for 25 years and a pioneer in the alternative energy space, Nexceris is ISO 9001-2015 certified.

- Nexceris focuses our materials science expertise on creating innovative products that improve the quality, efficiency and safety of energy and environmental systems. Our vision is to create a better world through energy innovations.
- Nexceris SOFC strategy is to first develop technology and products for the military, and then to scale-up SOFC stack manufacturing and adapt the technology for commercial applications.

Potential Commercial Applications: There is a wide range of commercial applications where this technology can be applied:

- Residential (micro) combined heat and power (mCHP) systems
- Large scale commercial CHP systems
- Remote site power
- Electric vehicle range extenders

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