Department of the Navy SBIR/STTR Transition Program

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Topic # N141-074
Robust 2700 F MC/C Fiber Reinforced Matrices for Turbine Engines
Advanced Ceramic Fibers, LLC

WHO

SYSCOM: ONR

Sponsoring Program: Code 33

Transition Target: JSF, Engines operating ~2700 F

TPOC:
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Other transition opportunities: Hypersonic components and leading edge materials for aerospace applications; light-weight, blast mitigating shipboard superstructures; heat resistant tiles; personnel and vehicle armor; lighter-weight, high-pressure/high-temperature shipboard piping; and more efficient electrical conductors on all platforms; projectile armor reinforced decks on CH-53K helicopters, rail-gun heat-dissipating components, stationary shore-power generation system components and more efficient heat exchangers.

F-35B Lightning II (U.S. Marine Corps Photo by Cpl. Jonah Lovy/Released, Navy.mil/F-35B.160308-M-BL734-841.jpg)

Notes: ACF's focus on this project is the hot section components of the gas turbine engine similar to those used on the F-35B shown in the photo.

WHAT

Operational Need and Improvement: The Navy is seeking to increase the operating temperature of gas turbine engines up to 2700F. This will enable the warfighter to have a tactical advantage during combat. ACF is focused on exceeding this objective by providing improved performance, reduced weight, and lower costs of platforms that support the warfighter. Ceramic matrix composites (CMC's) extend operating temperatures to achieve the Navy's goal of a 2,700F turbine engine. There is a need for more robust matrices, chemically tailored to re-grow protective external scales, and to heal cracks that may extend into the CMC. The capability to manufacture self-healing matrices will be invaluable in extending the durability of critical turbine engine components leading to greater performance, extended life-times and significant cost savings.

Specifications Required: The Navy's performance objective is to achieve sustained operating times and temperatures for gas turbine engine components that meet or exceed 2700F, allowing faster, safer, more reliable, sustainable and enhanced operating performance.

Technology Developed: ACF's unique Fi-Bar™ material combines exceptional performance characteristics ideally suited for extreme environments. These unique characteristics allow the Fi-Bar™ to be incorporated into a variety of CMC's configurations for the development of critical components and systems. ACF's Fi-Bar™ will enhance the operating range of CMC's to address the challenges faced by turbine engine designers to increase their operating temperatures and performance characteristics while extending the engine service life, greatly enhancing the capabilities of the warfigther.

Warfighter Value: ACF's goal is to increase the warfighter's turbine engine efficiency by 15%-20%, realizing fuel savings >$1M/aircraft/year by incorporating Fi-Bar™-infused CMC's into hot-section engine components. With increased operational temperatures, gas turbine engines can operate at higher levels of performance, giving the warfighter greater tactical advantages. In addition, increased turbine engine operating temperatures extend the operating lifetimes of critical components,reduce emissions, increase the time between inspections, and provide greater performance reliability.

WHEN

Contract Number: N00014-16-C-2020 **Ending on:** August 7, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Process Optimization and Validation/Build Database	Low	Database Structure/Population Initiated	3	June 2017
Achieve a-FRCMC Thermal-Mechanical Target Properties	Med	Achieve Thermal-Mechanical Creep Properties	4	July 2017
Generate CMC Data to 2,900+F and 10 Hr. Test	High	Achieve 2,700+F/190 MPa-10 Hr. Test	4	August 2017
Complete Cyclic Fatigue/Modeling/100 Hrs	Med	Cyclic Fatigue Model Results for 100 Hr Test	5	April 2018
Complete Cyclic Fatigue/Modeling/1000 Hrs.	High	Cyclic Fatigue Model Results for 1,000 Hr. Test	6	April 2019

HOW

Projected Business Model: ACF, a small, advanced composite materials company, established in 2012, will control the manufacture and distribution of our patented Fi-Bar™ products, providing licensing opportunities within six, target market segments: Infrastructure, Transportation, Energy, Aerospace, Industrial, and Defense. ACF will provide a broad range of advanced composite materials that will allow our customers to dominate their marketplace. The distinct competitive advantages of Fi-Bar™ products include unmatched performance characteristics at significantly lower cost than our competition. "We don't make turbine engines, we just make them run faster, longer, and safer!"

Company Objectives: Enabling our customers to dominate their marketplace by using Fi-Bar™ is our primary objective. Achieving this objective will have significant beneficial impacts, not only to the warfighter's performance, but also the ability to apply the same technology for commercial, land-based turbine engine applications for greater energy efficiency, and independent power production. The high-performance characteristics of Fi-Bar™ demonstrated in turbine engines will translate well into other applications generating commercial licensing opportunities with OEM's.

Potential Commercial Applications: Commercial airlines are compelled to reduce fuel consumption to improve profitability, reduce emissions, and to promote the manufacture of high performance, more efficient, environmentally friendly, gas turbine engines. The need to meet or surpass increasingly stringent emission standards set by federal, state, and local codes, has required industrial and commercial gas turbine manufacturers to develop cleaner-burning turbines. In addition, the market pull for more efficient stationary power generation and heat exchangers will place ACF in an enviable position to leverage the high-temperature and high-thermal conductivity characteristics of Fi-Bar™.

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