Department of the Navy SBIR/STTR Transition Program

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Topic # N202-128
Innovative Approaches in Design and Fabrication of 3D Braided Ceramic Matrix Composites (CMC) Fasteners
Advanced Ceramic Fibers, LLC

WHO

SYSCOM: ONR

Sponsoring Program: Office of Naval Research

Transition Target: U. S. Navy Aviation and Missile Platforms

TPOC: Anisur Rahman
anisur.rahman.civ@us.navy.mil

Other Transition Opportunities: Turbine engine and assorted airframe fastener components, hypersonic airframes and weapons platforms, space vehicle structures, helicopters, and transport vehicles. In fact, anywhere a high-performance fastener is required, regardless of structure type, the Advanced Ceramic Fibers (ACF) Fastener will satisfy the requirement.

F-35B Lightning II, STOVL Variant. PAX River, Md. Mil.gov Photo by: Kyra Helwick, 220216-N-PF253-0014.jpg

Notes: ACF's focus on this project is increasing the performance parameters of Ultra High Temperature (UHT) fasteners, included higher temperatures, greater strength (tensile and shear), corrosion and abrasion resistance in aerospace and space platforms, similar to those used on the F-35B shown in the photo.

WHEN

Contract Number: N68335-22-C-0354 **Ending on:** Jul 30, 2024

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Mechanical Testing	Medium	Tensile 2,400lb. Load/24Ksi. Shear 850lbs., 8Ksi.	4	3rd QTR FY23
UHT Temperature Test	Medium	1,800C in air, 30 minutes	4	4th QTR FY23
Relevant Environment Testing	High	2,000C in air, 1 hour	4	1st QTR FY24
Prototype Demonstration in Relevant Envionment	High	Thermo-Mechanical Testing	5	2nd QTR FY25
Prototype Demonstration in an Operational Environment	High	Prototype Fastener Passed Operational Testing	7	4th QTR FY26

WHAT

Operational Need and Improvement: ACF is developing high-performance fasteners for use in aerospace, space, hypersonic, and weapons applications. Our technology, developed under this ONR SBIR project, extends the performance utility of carbon fiber materials for use in the extreme environments applications included as the Navy's operational needs. ACF's patented converted carbon fiber (Fi-Bar™), adds value to the underlying base carbon fiber materials, thereby extending their useful applications beyond that of the plain carbon fiber relative to ultra-high temperatures, oxidation and corrosion resistance, lightweight, with the added benefit of suppression of carbon at high temperatures, while significantly reducing the cost of production. ACF is a wholly-owned, U. S. small business managed and operated by veterans.

Specifications Required: The Navy's performance objective is to demonstrate, develop, and test high-performance fasteners that will achieve sustained operating times and temperatures for aerospace, space, hypersonic, and weapons platforms, meeting or exceeding 2700F, allowing faster, more reliable, and sustainable, inflight times, 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 Ceramic Matrix Composite's (CMC) components and configured for the development of critical, high performance components (Quad-XE™) and systems. ACF's Fi-Bar™ will enhance the operating range of CMC's to address the challenges faced by Original Equipment Manufacturers (OEM's) to increase their product's operating temperatures and performance characteristics, while extending the useful service life, greatly enhancing the capabilities to support the needs of our warfighters, ACF's ultimate customer.

Warfighter Value: Today's warfighter faces enhanced performance and technological challenges never before imagined. Aircraft and weapons systems performance have leapfrogged due to advances in materials, artificial intelligence, information processing speeds, battlefield simulation, and human factors research. ACF's high-performance fasteners will help to ensure the reliability and sustainability of the aircraft delivery systems. The ACF fastener combines the ideal performance characteristics that are specifically configured to support our warfighters critical assets, whenever and where ever they called upon.

HOW

Projected Business Model: ACF, is a small, advanced materials development and prototype demonstration company, established in 2012. Our niche is the design, development, demonstration, and testing of advanced material products. The "Jewel in our Crown", is the patented, "Direct Conversion Process" (DCP™). The DCP™ system converts plain carbon fiber tow, tape, braid, chopped, and CNT feedstock (AS4C, T300, etc.), by infusing a metal carbide on the surface of each, individual filament in a fiber tow. Fi-Bar™ is an essential ingredient used in the fabrication of our patented CMC's (Quad-XE™), including our high-performance fastener products. We will work with manufacturing company's to scale production to satisfy production orders for our products, or obtain significant resources to scale our own manufacturing capabilities.

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: The same Fi-Bar™ an Quad-XE™ materials that go into our CMC fasteners can be incorporated into other high performance components requiring the same level of "extreme environment" applications. When In the form of "chopped Fi-Bar™, ACF's materials can be used for automotive brake liners, aircraft brakes, and stationary turbine engine power plants to improve their efficiencies and operational lifespans.

Contact: Kenneth G. Koller, President/CEO
kkoller@acfibers.com (208) 522-6008 x2