Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2017-0498

Topic # N131-056
Ceramic Matrix Composites for Advanced Tactical Missile Radomes
Applied Thin Films, Inc.

WHO

SYSCOM: NAVSEA

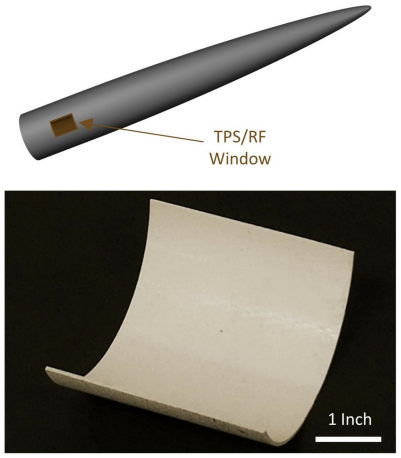
Sponsoring Program: PEO IWS

Transition Target: Hypervelocity Projectile (HVP)*

TPOC:
(301)227-4501

Other transition opportunities: Need for the technology is broad among various DOD agencies with potential uses including antenna covers, radomes, thermal protection systems for hypersonic missiles and vehicles and for aircraft exhaust nozzle system components.

Notes: *Currently HVP is an ONR FNC program, but there is potential for transitioning into an IWS 3.0 program (Navy Surface Ship Weapons)



The image shows a notional HVP design and location of the thermal protection system (TPS)/Radio-Frequency (RF)-transparent window located in the aft end for enabling GPS guidance and a photograph of ATFI's composite material fabricated in the desired form factor.

WHAT

Operational Need and Improvement: Future missile speeds will exceed Mach 4+ and their flight times will be longer, exceeding ninety seconds. New materials and low-cost manufacturing methods are sought for radomes to meet the extended capabilities of these future missiles to improve survivability and performance in severe environments such as those produced by weather conditions. Precision guidance for these missiles, projectiles, and other related weapon systems is critical to minimize collateral damage and is primarily enabled by embedded antenna electronics and integrated thermally stable, insulating, RF-transparent windows.

Specifications Required: Requirements for RF window materials include low dielectric constant (< 5) with minimal change as a function of temperature, ability to withstand high thermal gradients, material formability in complex-shapes, attachment methodology for metal airframe, coatings for thermal insulation and impact resistance.

Technology Developed: ATFI's innovative TPS/RF-transparent window material is a 3D woven ceramic fiber reinforced structural oxide/oxide ceramic matrix composite (3D Ox-Ox CMC) with high performance exterior coatings developed to address HVP requirements. The material is capable of withstanding high temperatures generated by Mach 4+ flight while maintaining the desired properties for HVP applications. For adequate thermal protection of electronic/antenna components embedded within the HVP, the 3D Ox-Ox CMC is designed with very low thermal conductivity and is further enhanced with thermally-insulating exterior coatings.

Warfighter Value: Speed and precision of missiles and projectiles provide key advantages to the warfighter and this technology will provide advancement in both respects. In addition, the full impact of the technology advancement is broad and will also serve to meet the needs of next-generation fighter aircraft engine components. ATFI's use of 3D woven architectures for the Ox-Ox CMC system will result in significant advances in production of components in net shape with high reliability and yield at reduced costs compared to legacy materials that offer little growth potential for extending missile flight speeds and times.

WHEN

Contract Number: N00024-15-C-4028 **Ending on:** February 28, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Aerothermal Testing (AFRL LHMEL Facility)	Med	Demonstrate material survivability in simulated Mach 4 aerothermal environment, no loss of material or delamination of composite	6	September 2017
Comprehensive Mechanical & Electrical Property Testing	Low	Adequate mechanical strength and electrical properties in simulated operational environment	6	December 2017
Completion of Phase II Option	Low	Demonstrate fabricability in net shape for a notional HVP design window material	5	January 2018
HVP Flight Testing	Med	Demonstrate survivability in flight environment	7	October 2019

HOW

Projected Business Model: ATFI intends to broadly commercialize the CMC technology via two options: a) through licensing/tech transfer, selling of raw materials to customers or b) launching an independent spin-off entity with dedicated manufacturing facilities to serve customers globally. The latter is preferred considering the blossoming and diverse nature of customer needs for Ox-Ox CMCs in both military and commercial applications.

Company Objectives: In the near term, ATFI is seeking additional funding to further enhance the TRL and MRL of the technology for the HVP program with guidance and support from PEO/IWS. In parallel, ATFI is pursuing other DOD programs and applications to enhance the product portfolio with the objective of attracting investment from private industry. With such investment, ATFI hopes to rapidly expand the capabilities of the technology and to gain competitive advantage in the market place for capturing tremendous future opportunities envisioned for these new and unique advanced materials

Potential Commercial Applications: ATFI is currently under consideration for private investment in the technology for commercial exhaust mixer applications.

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