Department of the Navy SBIR/STTR Transition Program

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited. 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)



© 2017 Applied Thin Films, Inc.

1 Inch

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.

WHEN Contract Number: N00024-15-C-4028 Ending on: February 28, 2018 **Risk** Ending TRL Milestone Level Measure of Success Date Aerothermal Med Demonstrate material survivability in 6 September 2017 Testing (AFRL simulated Mach 4 aerothermal LHMEL Facility) environment, no loss of material or delamination of composite 6 Comprehensive Low Adequate mechanical strength and December 2017 Mechanical & electrical properties in simulated Electrical operational environment Property Testing Completion of Demonstrate fabricability in net 5 January 2018 Low Phase II Option shape for a notional HVP design window material 7 HVP Flight Med Demonstrate survivability in flight October 2019 Testing environment

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.

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.

Contact: Christopher Garcia, Senior Materials Engineer cgarcia@atfinet.com (847)807-4077 ext.204