Topic: MDA05-068

Touchstone Research Laboratory, Ltd.

Metal Matrix Composite Axial Propulsion Missile Components

Touchstone Research Laboratory, an award-winning developer of advanced materials for commercial and government customers, has developed an innovative prepreg tape made from continuous fiber aluminum metal matrix composite (MMC) material that is four times stronger and stiffer than standard aluminum alloys. When applied to aluminum hulled ships, the MMC prepreg tape can both prevent cracks and retard crack growth and, thus, significantly reduce maintenance and repair costs. The higher strength and stiffness compared to traditional composite patches makes the MMC prepreg suitable for repairs on mechanically loaded structures as well. These benefits translate into increased time on mission across a wide range of ship classes. The plan is to add MMC prepreg to the current patch repair kit.

Technology Category Alignment:

Materials & Manufacturing Processes

Propulsion and Extreme Environments

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SYSCOM: NAVAIR

Contract: N68936-18-C-0011

Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68936-18-C-0011

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2018-913

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Metal Matrix Composite Axial Propulsion Missile Components

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WHO

SYSCOM: NAVAIR

Sponsoring Program: PMA-242

Transition Target: Tactical missile systems

TPOC:
(760)939-7661

Other transition opportunities: Aluminum Metal Matrix Composite (MMC) in strategic missile systems and space launch vehicles would also benefit from this technology.

Notes: An AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) is test fired on an F/A-18 at China Lake, Calif. during development. (Image courtesy of US Navy/NAVAIR)

http://www.navair.navy.mil/img/uploads/AARGM.jpg

WHAT

Operational Need and Improvement: Innovative materials and manufacturing methods are needed to develop lighter rocket motor case designs in order to maintain performance superiority and improve the safety of current and future missile systems. Most of the current missile designs call for motor cases made from steel. Aluminum MMC (Al MMC) material has a much lower density than steel and reacts more favorably to bullet and fragment impacts under insensitive munitions situations.

Specifications Required: Demonstrate the capability of producing full-length, full-diameter MMC cylinders that meet the requirements for outer diameter tolerance. Once this is accomplished, full-scale test articles will be produced for validation testing. It is anticipated that implementing MMC technology will result in at least one of the following compared to the baseline design: significant weight reduction, better kinematics, passing grade on bullet impact and fast cookoff Intensive Munitions (IM) tests.

Technology Developed: An Al MMC motor case, comprised of aluminum reinforced with high-strength ceramic fibers, is being developed to reduce weight and improve performance of tactical missile systems. Trade studies have confirmed these attributes. This MMC material also has a 64 pct greater specific bending stiffness and is more damage tolerant than polymer composites. The processing of this material uses an innovative MMC filament winding process that is analogous to polymer composite “wet” winding. The MMC material can also improve IM performance through case fragmentation on impact.

Warfighter Value: Motor cases made from MMC materials can be designed lighter and stiffer and result in enhanced kinematic performance and improved insensitive muntions responses. The application of MMC manufacturing process technology to axial propulsion missile components will also lead to greater reliability and minimal maintenance. MMC materials offer high-temperature capability with excellent specific stiffness, specific strength, and toughness.

WHEN

Contract Number: N68936-18-C-0011 **Ending on:** May 26, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Increase Length Capability of Process	Low	Produce 60-Inch Long Cylinder	3	September 2018
Improve Helical Lay-up Process	Med	Meet OD Tolerance Requirement	4	April 2019
Produce Analog or Simplified Test Articles	Med	95% of Burst Strength of Sub-Scale Articles	4	November 2019
Produce Full-Scale Test Articles	Med	90% of Burst Strength of Sub-Scale Articles	5	May 2021

HOW

Projected Business Model: Touchstone has a history of successful technology commercialization. The main avenues have been technology licensing to commercial ventures and spin-outs. For its most significant product offering, carbon foam (CFOAM) , Touchstone built a manufacturing business and found an investor to take the CFOAM technology public under the name, CFOAM, Ltd. Touchstone is in the process of spinning out another business, Touchstone Advanced Composites, to manufacture aerospace composite tooling. It raised money to build this business through traditional financing, West Virginia Economic Development Authority, and an Air Force Title III program. Touchstone has a similar a plan to scale up and spin-out MetPreg® fiber reinforced aluminum to serve motor case applications. This could possibly be a joint venture between Touchstone and a current motor case supplier.

Company Objectives: Touchstone will use the Forum for SBIR/STTR Transition (FST) to solicit teaming alliances and investigate investor-partner relationships to forge a path towards a subsequent product release. Navy program funding will also be pursued by working with the Naval Air Warfare Center Weapons Division (NAWCWD) Technical Point of Contact (TPOC) to gain exposure to the program managers (PMs) for programs of record for existing tactical systems. Additional opportunities will be sought to leverage the SBIR work for obtaining funding under subsequent relevant Broad Agency Announcements (BAAs). The FST will also present an opportunity to meet with PMs and technical personnel from Aerojet, Northrop Grumman, and Nammo Talley and Raytheon to update them on this technology.

Potential Commercial Applications: commercial applications include, e.g., pressure vessels, sporting goods, aerospace, and automotive components. Filament wound MMC could be used for pressure vessels, e.g., gas or liquid storage, or for fatigue resistant liners for composite overwrapped pressure vessels. Tennis rackets, skis, ski poles, and bicycle frames are potential sporting goods applications. Aircraft landing gear or seating components and space launch vehicles cryotanks could also be applications. Automotive applications could include drive shafts, push rods, and brake drums.

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