Department of the Navy SBIR/STTR Transition Program

Pending SYSCOM
Review

Topic # N182-103
Carbon Nanotube Windshield Heater
Creare LLC

WHO

SYSCOM: NAVAIR
Sponsoring Program: PMA-275
Transition Target: V-22
TPOC:
(301)342-0286
Other transition opportunities: Rotary and fixed wing aircraft with laminate plastic windshields including rotorcraft and tilt rotorcraft.
Notes: Broken heaters in aircraft windshields can lead to long down time and significantly increase cost per flight hour. The current heater layer is brittle leading to microcracks and often premature failure. The nanotube-based windshield heater is highly resistant to high repeated strain and will be a robust technology for tilt rotorcraft and rotorcraft windshields.

Boeing (https://www.boeing.com/defense/v-22-osprey/)

WHAT

Operational Need and Improvement: Frequent changes in cabin pressure during routine operations cause the plastic windshield to flex causing microcracking of the brittle heating element and failure. Upon failure, the full windshield is replaced. Our drop-in replacement will meet high quality optical standards and heater performance while being repeatably flexed under high strain. An improved robust windshield heater layer will improve the aircraft flight readiness and decrease operating costs.
Specifications Required: Project Requirements: 1. Develop heater layer coating that only has 10% optical transmission loss across the visible and NVIS spectrum while having approx. 10 ohm/sq sheet resistance and low haze (<3%). 2. Drop-in replacement for the current windshield heater. 3. No performance degradation under repeated high strain (500 cycles at 2% strain). 4. High power output of 5 W/in2 using aircraft power supply. 6) High optical and heater uniformity across with full windshield.
Technology Developed: Creare develop technologies for a carbon nanotube based transparent windshield heater for the V-22 tilt rotorcraft. We have demonstrated high optical transparency and low haze in the visible and Night Vision Imaging System (NVIS) spectra, with high power density and mechanical robustness. Subscale coupons are used to develop the heater fabrication process, before adding laminates and scaling up to the full-sized windshield in the Option periods. With our ink development partner, we developed a one pot CNT hybrid ink that is shelf stable, sprays uniformly, results in low haze and low sheet resistance. To enable this size heater and make the transition to large substrates including a full-size V-22 windshield, we developed a completely new Maskless Spray System (MSS). This MSS includes an industrial 6-axis robot, spray head and system enclosure.
Warfighter Value: This technology greatly increases V-22 fleet readiness while decreasing maintenance costs.

WHEN

Contract Number: N68335-20-C-0144 **Ending on:** July 23, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstrate high optical transparency with low sheet resistance spray coated coupons.	Med	Produced flat and curved 10in square coupons with over 90% optical transparency in the visible and NVIS spectra, low haze and low sheet resistances. We partnered with a leading CNT manufacture to develop hybrid CNT inks for this application.	4	March 2021
Develop a spray system capable of full-size rotor craft and tilt rotor craft windshield heater layers	Low	Assembled and tested our maskless spray system (MSS) including an industrial 6-axis robot and full system enclosure. Completed programming to develop full spray parameters and tooling paths from a complex 3-D shape of a windshield. Fully tested using 10in	4	March 2021
Develop laminate coupons with the equivalent windshield stack layers	Med	Working with our manufacturing partner, we will produce coupon size laminates in flat and curved shapes and test for optical transparency, heater performance, and repeated strain.	4	December 2021
Demonstrate full size tilt rotor craft windshield prototype	Med	Produced a full-size prototype windshield heater layer and laminate to a prototype windshield. We will test the heater performance and optical properties. The prototype will also be available to the Navy for further testing to transition to flight testing	5	August 2022

HOW

Projected Business Model: At the end of the Phase II Options, we will have produced a full-scale prototype windshield for the Navy to evaluate. From that point, we will still need to fabricate and fly pilot production units. For this phase, we will work with a current V-22 windshield manufacturer and Edare, our sister small scale manufacturing company that we are working with during the options to transition this technology. Edare will be able to complete pilot manufacturing of flight capable windshield heaters under a Phase III program while working with a current windshield manufacturer to integrate those heaters into flight qualified windshields.
Company Objectives: Licensing our spray coated nanotube heater technology for high-quality drop-in replacements for rotorcraft and tilt rotorcraft.
Potential Commercial Applications: The commercial applications include windshields in fixed wing applications, automotive windshields and optically transparent covers for lighting, sensors, and imagers.

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