Department of the Navy SBIR/STTR Transition Program

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Topic # N201-072
Aligned Nanotube Reinforcement of Polymer-matrix Laminates
Goodman Technologies LLC

WHO

SYSCOM: ONR

Sponsoring Program: PMA265, JPO, Next Generation Air Dominance

Transition Target: F414-GE-400 Enhanced Engine for F/A-18E/F Super Hornet and EA-18G Growler, P&W F135 Engine for F35

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ONT(TM) applied to T650-35/AFR-PE-5

Other Transition Opportunities: Fire protection, thermal management, acoustic damping, energy harvesting, sensing, actuation, communication. Hypersonics stakeholders: ONR Division 351 and Conventional Prompt Strike (CPS) at Strategic Systems Programs (SSP), primary customers OPNA, COMUSSSTRATCOM, PEO (SUB), and PEO (Ships). Common Hypersonic Glide Body (C-HGB) and Carbon/Carbon composites. Meet Navy Flammability, Heat Release, and Smoke Emission Requirements: Landing Craft, Air Cushion (LCAC), Ship-to-Shore Connector (SSC) ramps and fan shrouds, the LPD 17 Mast, and DDG 1000 deckhouse

Notes:
GTNANO® Aligned Nanoforest Technologies (ANT™) and Nanoresins are compatible with a majority of manufacturing processes (additive, robotic) and composites systems from polymers to ceramics used in the Air, Space, Sea and Land Domains as proven by the results of 7 Phase II SBIR/STTR projects. Lighter, stronger, and tougher nanocomposites with improved interlaminar shear strength can survive extreme environments: hypersonics, deep-cryogenic, space radiation, and all-weather from manmade radiation. Aircraft become lighter, more fuel efficient, with greater range and can be low observable. Spacecraft are lighter, more dimensionally stable, and survivable. Dimensional tolerances are increased and scrap reduced for applications like fighter aircraft. Double to triple digit percentage performance improvements result from addition of GTNANO® materials to multiple composite materials systems. Applications for Air, Sea, Space, and Land Domains experience increased strength, toughness, shielding effectiveness, low observability, and even survive hypersonic flight.

WHAT

Operational Need and Improvement: High-temperature polymers like Polybismaleimides (BMIs) and polyimides are in current use in Navy systems. Existing components comprising these material trades to mitigate limitations in mechanical performance, for example interlaminar shear strength. The typical approach to reducing interlaminar stresses in corner radii, such as those that occur at the interface between airfoils and platform features on stator vane twin-packs, and up-turned flanges on fan ducts, is to increase the size of the radius and/or increase the laminate thickness causing other detrimental effects. A larger radius at the ends of an airfoil may reduce the aerodynamic efficiency, thicker laminates present material processing challenges for high-temperature PMCs, particularly for polyimides such as wrinkles and porosity.

Specifications Required: Demonstrate the materials and processing that results in a polymer matrix composite (PMC) prepreg material with aligned CNTs (ACNTs) that results in composite laminates with greatly improved orthogonal properties under dynamic loading at high-temperatures.

Technology Developed: GT successfully demonstrated double to triple digit percentage improvements in fracture toughness (G1c) using ACNTs

Warfighter Value: Replacing metals with composites reduces weight, increases performance, range, and fuel efficiency for aircraft. Addition of GTNANO® materials to multiple composite materials systems applications for Air, Sea, Space, and Land Domains will result in increased strength, toughness, shielding effectiveness, low observability, and even survive hypersonic flight.

WHEN

Contract Number: N68335-22-C-0208 **Ending on:** Apr 01, 2024

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Optimize Prepreg Application	High	Manufacture Panels	5	2nd QTR FY23
ANT(TM) Growth on T650-35	Medium	Verify Growth	5	4th QTR FY23
Mega-Matrix Coupon Testing	High	Compares Unimproved vs Enhanced Performance	5	2nd QTR FY24
Toughness & Bend Strength	Medium	Compares Unimproved vs Enhanced Performance	5	4th QTR FY23
Prototype with Prime	High	System Prime Validation	5	2nd QTR FY24

HOW

Projected Business Model: Business-To-Government (B2G) and Business-To-Business (B2B)

Company Objectives: 3 or more Programs of Record or Phase III Transition Projects with Navy and other Components

Potential Commercial Applications: GTNANO® Nanoforests provide multidirectional & multifunctional composite improvements for epoxy, polyimide, ceramic matrix, C/C, BMI and works with the majority of composite manufacturing processes (VARTM, RTM, etc.) NAVY & DoD Cross-Enterprise Solutions for composites used in Aircraft & Missiles, Ships, Turbine Blades, Spacecraft & CubeSats, Drones, EM & Weapons Effects Shielding, TPS & Hot Structures.

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