Department of the Navy SBIR/STTR Transition Program

Topic # N23A-T006
Low-Cost Microwave Curing of Aerospace Composite Materials
Physical Sciences Inc.

WHO

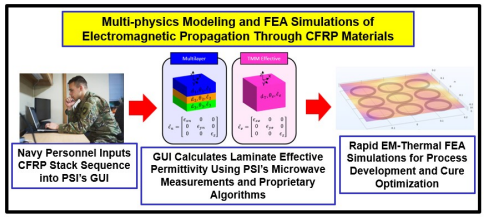
SYSCOM: NAVAIR

Sponsoring Program: NAVAIR Phase II STTR

Transition Target: PMA 265, Navy ManTech

TPOC: (301) 221-3054

Other Transition Opportunities: DoD and commercial CFRP component suppliers



Notes: The Phase II Option program is currently underway. The Phase II period of performance is 6/6/2024-7/21/2027.

Accomplishments To-Date:
• PSI electromagnetically cured a 12" sq. CFRP panel and showed equivalent or better mechanical properties (i.e. flexural modulus and strength) compared to conventionally cured panels
• PSI implemented an effective medium theory calculation for determining the orthotropic permittivity of multi-layer stacks of CFRP with various ply angles and ply thicknesses.
• PSI completed the Phase II Base with a GUI interface that allows Navy users to input the laminate stack sequence and output an effective permittivity with 10% error compared to experimental measurements

Future Work:
• PSI will expand our electromagnetic applicator to larger cure areas (i.e. several feet sq.) and contours
• PSI will design the electromagnetic applicator with COTS electronics and for high volume manufacturing
• PSI will update our effective medium model with a variety of CFRP laminates of various weave patterns and tow sizes.

WHAT

Operational Need and Improvement: The Navy requires a low-cost electromagnetic heating system for curing composite materials with reduced production costs and processing time. A key strategic priority of the United States military is to strengthen the domestic defense industrial base by expanding advanced manufacturing capabilities, reducing production costs, and accelerating throughput of critical aerospace and naval systems to ensure technological superiority and operational readiness.

Specifications Required:
• Energy and Cure Time Savings: ~40%
• Applicator Power: 600 W/ft^2
• Applicator Frequency: 10 kHz – 10 GHz

Technology Developed: PSI developed an electromagnetic applicator for curing 12" sq. laminates with thicknesses up to 10 mm. The laminates show improved mechanical properties compared to conventionally cured laminates, specifically flexural modulus. PSI co-developed a multi-physics model that uses an effective medium theory calculation to reduce computation time of electromagnetic-thermal FEA simulations.

Warfighter Value:
• PSI's electromagnetic applicator will reduce energy consumption and cure time of CFRP manufacturing processes by ~40%
• Predictive multi-physics modeling reduces the test runs required for composite part production and process development time
• Scheduling freedom through process modeling leads to adaptive production processes with reduced scheduling time and costs.

WHEN

Contract Number: N68335-24-C-0334 **Ending on:** Jun 17, 2025

Milestone	Risk Level	Measure of Success	Ending TRL	Date
1. Electromagnetic Applicator Prototype	Medium	Demonstrate a prototype of an electromagnetic heating system with ability to heat large (i.e., 2'x 2') and contoured (i.e., UUV monocues) CFRP components	5	4th QTR FY26
2. Electromagnetic Cure of Production Part	Medium	Demonstrate curing an aerospace production part with equivalent or better mechanical performance and lower cost using an electromagnetic heating system	6	2nd QTR FY27
3. Cost-Benefit Analysis	Low	Demonstrate via a cost-benefit analysis that electromagnetic curing reduces the production costs of military-grade carbon fiber/epoxy laminates with equivalent or better cured properties, with 40% reduction in cure time and energy use, and lower capital equipment costs	6	3rd QTR FY27

HOW

Projected Business Model: PSI will pursue Phase III research funding through the Navy's ManTech program and PMA 265 for further technology development. After Phase III, PSI will license our multi-physics modeling software to a DoD or commercial CFRP component supplier. PSI will either license or sell electromagnetic applicators to CFRP component suppliers. PSI will consider forming a spinout company to commercialize the technology.

Company Objectives: PSI aims to show the feasibility of our technology by partnering with prime contractors or CFRP component suppliers to integrate our modeling and/or electromagnetic applicator into existing CFRP production processes. The goal is to produce cost-benefit analyses to market our technology and show commercial viability.

Potential Commercial Applications: Organizations with technology need include DoD prime contractors, small DoD CFRP component suppliers, and commercial CFRP production companies.

• Northrop Grumman and Boeing are interested in electromagnetic applicators and associated modeling for CFRP component repair and part production processes, to support both DoD contracts and commercial aircraft production
• Smaller DoD CFRP component suppliers like Composite Energy Technologies are interested in electromagnetic curing applicators for thick, UUV monocoques

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