In-line Fiber Tow Coating for Ceramic Matrix Composites

PROBLEM / OBJECTIVE

CMCs are required to achieve improved acceleration, speed and fuel efficiency in advanced turbine engines. Full-Rate production of these engines requires that CMC parts be manufactured at a greater throughput that has ever been achieved as well as manufacturing these parts at substantially lower costs.

A key component of fabricating CMC parts goes back to proper coating of the silicon carbide (SiC) fiber tows. The current machines to coat CMC fiber tows require long start-up, cool-down, and maintenance cycles. These steps were required for each coating run, adding further to the cost of entitlement and reducing capacity.

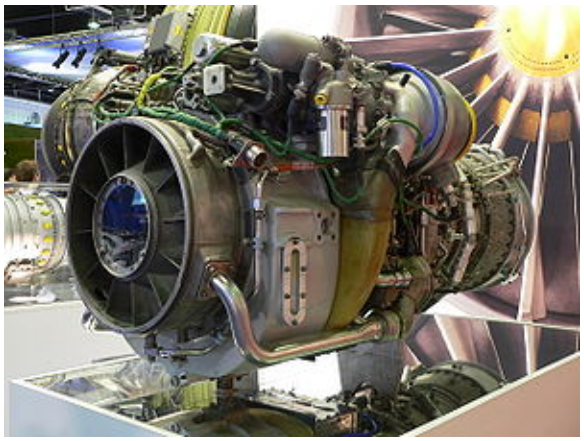
The In-Line Fiber Tow Coating for CMCs effort converts a CMC multi-step batch process to a single step process thereby reducing new and legacy engine manufacturing costs.

This project will result in a stream-lined manufacturing process with higher throughput, which will achieve future CMC demands for the T700 and other legacy engines, and opens the door for the technology's use in other applications.

ACCOMPLISHMENTS / PAYOFF

Process Improvement:

- General Electric project engineers have implemented a 100 percent increase in the coating run length resulting in an increased coating capacity from 137 meters to 275 meters of fiber.



- The resulting materials were validated during CMC panel fabrication and mechanical property testing.
- Implementation of the goal capability will enable a 70 percent reduction in touch labor for the coating process.

Background:

One of the Department of Defense's (DoD's) Ceramic Matrix Composites Manufacturing Initiative (CMCMI) goals is to reduces risks related to the implementation of CMCs for use in advanced turbine engines. Current superalloy engine components are dense and require frequent maintenance. The weight of these materials decreases fuel efficiency and results in repeated repairs for aerospace engines. Repeated maintenance and lower fuel efficiency raises the lifecycle costs of aerospace systems.

The DoD seeks producible and supportable CMCs for both near and far-term improvements in fuel efficiency. The current CMCMI effort focuses on development and transition of CMCs to meet T700 production goals on cost and cycle time. Specifically, the effort targets replacement of current superalloy T700 airfoils.

AFRL's ManTech, The Defense-Wide Manufacturing and Technology (DMS&T) Program, and General Electric Aviation are

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working to transition changes necessary to optimize the manufacturing process for these CMCs. Advancements in state-of-the-art coating technologies are necessary to achieve long-term production capacity for Silicon Carbide (SiC) components.

Technology Implementation and Technology Transfer:

- Successful demonstration of conventional prepregging process for SiC/SiC prepreg system - 3Q2010.
- Completion/update of material and process specs - 4Q2010.
- Source substantiation for production - 4Q2010.

Expected Benefits and Warfighter Impact:

- Decreasing the density of aerospace system components by replacing metal alloys with CMCs can lead to a significant reduction in fuel costs over the lifetime of an engine.
- Incorporation of lighter weight CMC components will increase the speed and acceleration capabilities of Air Force systems.
- The improved durability of CMC components will result in less frequent maintenance and lower lifecycle costs.
- Introduction of CMCs for the T700 engine is projected to save $23 million in fuel costs over 10 years.

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