NASA SBIR/STTR Technologies

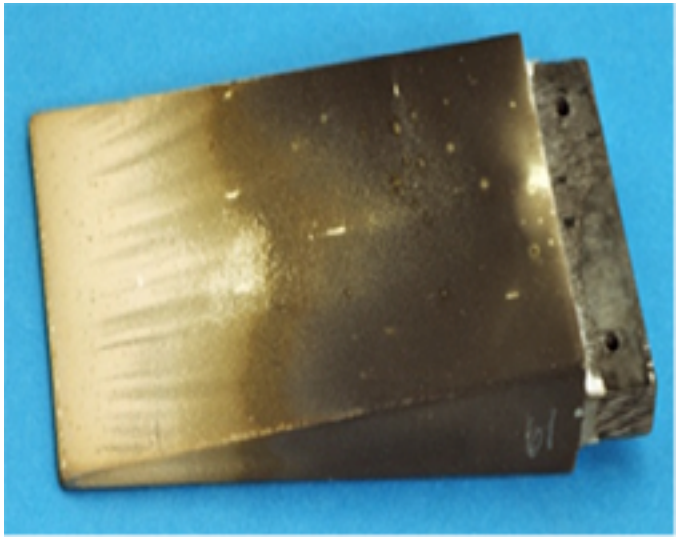
H5.04-9377 - Reduced Cost Composite Hot Structures with Oxidation Protection

PI: Daniel Butts

Plasma Processes, LLC. - Huntsville, AL

Identification and Significance of Innovation

Low cost, high performance technologies are critical to the affordability of future missions. Carbon/carbon (C/C) has significant advantages over metallic solutions. However, C/C composites are known to have high costs and long lead times. Recent efforts by ATK and Plasma Processes have focused on increasing capability of 2D C/C, while reducing cost and lead-time. Studies by ATK have reduced manufacturing schedule by up to 60% and improved mechanical performance. Plasma Processes has developed protective coatings for C/C deposited via additive manufacturing techniques that have performed well in flight tests. These advances can reduce the cost and mass of future hypersonic vehicles. However, additional efforts are needed to optimize economical oxidative protective solutions for C/C. The objective of a Phase I is to merge advancements in C/C manufacturing with additive manufacturing coating application techniques to yield economical hot structures for future hypersonic vehicles.



Estimated TRL at beginning and end of contract: (Begin: 3 End: 4)

Technical Objectives and Work Plan

The goal will be to enhance the capability and performance of C/C with oxidation protective coatings. Initially, thermal analysis will predict conditions of the appropriate hot structure components. These predictions will guide the selection of suitable oxidation protective coatings. Plasma Processes will focus on improving deposition procedures; improving adhesion of coating in the presence of extreme temperature gradients; and maintaining low material and application costs.

Work Plan:

Task I Select Candidate Materials, Gradient Layers, Diffusion Barriers
Task II Thermo-Structural Modeling
Task III Manufacturing Trials
Task IV High Heat Flux Torch Testing
Task V Enhance Adhesion of Optimized Protective Coating

NASA Applications

The proposed work promises to improve performance and reduce cost of hot structures for future hypersonic vehicles. Specifically, the proposed technology can provide a structural, re-usable thermal protection system. A partial list of existing and future NASA programs that could also benefit from this enhanced capability include robotic Moon or Mars missions; human Lunar accent/decent; and the nozzle extension liquid engines.

Non-NASA Applications

Potential non-NASA applications that could benefit from the proposed technology include nozzle extensions of upper stage engines for nanosatellite launch or ISS resupply; nosetips, leading edges and control surfaces for DoD hypersonic vehicles; and exit cones and control vanes for tactical missiles.

Firm Contacts

Daniel Butts
Plasma Processes, LLC.
4914 Moores Mill Road
Huntsville, AL, 35811-1558
PHONE: (256) 851-7653
FAX: (256) 859-4134