NASA SBIR 2017 Phase I Solicitation

H5.02 Hot Structure Entry Control Surface Technology

Lead Center: LaRC

Participating Center(s): AFRC, JSC, MSFC

Technology Area: TA12 Materials, Structures, Mechanical Systems and Manufacturing

The focus of this subtopic is the development of hot structure technology for entry vehicle control surfaces. A hot structure is a type of multifunctional structure that can reduce or eliminate the need for a separate thermal protection system (TPS) to protect the structure. The potential advantages of using a hot structure in place of a cool structure with a separate TPS are: reduced mass, increased mission capability such as reusability, improved aerodynamics, improved structural efficiency, and increased ability to inspect the structure. Hot structures is an enabling technology for reusability between missions or mission phases, such as aerocapture followed by entry, and have been used in many prior NASA programs: Space Shuttle (nosecap and leading edges), HyperX (nose and all-moving control surfaces), X-37 (flaperon and ruddervator control surfaces), and many Department of Defense programs.

This subtopic seeks to develop innovative low-cost, damage tolerant, reusable and lightweight 1450°C to 2200°C hot structure technology applicable to control surfaces for atmospheric entry vehicles such as body flaps, ailerons, and trim tabs. Proposals should address one or more of the following technical challenges:

- Fabrication technologies for stiffened structures that can be scaled to components as large as 3 meters in span and/or chord.
- Material/structural architectures providing significant improvements of in-plane and interlaminar mechanical properties, compared to current high-temperature laminated composites.
- Concepts for reliable integration of control surface deflection functionality (such as hinges and point attachment for actuators) which can integrate with a cool primary structure.
- Remote monitoring capability for high temperature structures and associated enviro-mechanical models to quantitatively diagnose the state of the structure between missions or mission phases.

For all above technologies, research, testing, and analysis should be conducted to demonstrate technical feasibility during Phase I and show a path towards Phase II hardware demonstration. Emphasis should be on the delivery of a manufacturing demonstration unit for NASA testing at the completion of the Phase II contract. Opportunities and plans should also be identified and summarized for potential commercialization.

Reference:

Glass, D. E. “Ceramic Matrix Composites (CMC) Thermal Protection Systems (TPS) and Hot Structures for Hypersonic Vehicles,” 15th AIAA International Space Planes and
Hypersonic Systems and Technologies Conference, Dayton, Ohio, AIAA-2008-2682, April 2008.

(http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080017096.pdf).