SBIR/STTR

Small Business Innovation Research / Small Business Technology Transfer

NASA SBIR 2018 Phase I Solicitation

H5.02 Hot Structure Technology for Atmospheric Entry Vehicles

Lead Center: LaRC

Participating Center(s): AFRC, JSC, MSFC

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

This subtopic encompasses the development of reusable, hot structure technology for primary structure that is exposed to extreme heating environments on atmospheric entry vehicles. A hot structure system is a multifunctional structure that can reduce or eliminate the need for a separate thermal protection system (TPS). The potential advantages of using a hot structure system in place of a TPS with underlying cool structure are: reduced mass, increased mission capability such as reusability, improved aerodynamics, improved structural efficiency, and increased ability to inspect the structure. Hot structure is an enabling technology for reusability between missions or mission phases, such as aerocapture followed by entry, and has been used in prior NASA programs (HyperX and X-37) on control surfaces and leading edges, and Department of Defense programs.Â

This subtopic seeks to develop innovative low-cost, damage tolerant, reusable and lightweight hot structure technology applicable to atmospheric entry vehicles, exposed to extreme temperatures between 1000Â° C to 2200Â° C. Â The material systems of interest for use in developing the hot structure technology include: advanced carbon-carbons (C-C), ceramic matrix composites (CMC), or advanced high temperature metals. Potential applications of the hot structure technology include: primary load-carrying aeroshell structure, control surfaces, and propulsion system components (such as hot gas valves and passively-cooled nozzle extensions). Proposals should address one or more of the following:Â

- Employing advanced materials in novel structural system concepts for thermal management associated with atmospheric entry and/or hypersonic flight.
- Utilizing preceramic polymers for producing advanced material systems with tailored chemical, mechanical, and physical properties. Of particular interest are polymers yielding ceramics in the SiOC, SiNBC, SiNC or SiC families in the form of ceramic foams, fibers, coatings, and fiber-reinforced CMC, for use in a hot structure concept.
- Material/structural architectures and multifunctional systems providing significant improvements of interlaminar mechanical properties while maintaining in-plane and thermal properties compared to state-of-the-art C-C or CMC. Examples include: incorporating through the thickness stitching or 3D woven preforms.
- Improvements in manufacturing process and/or material design to achieve repeatable and uniform material properties, scalable to actual vehicle components; specifically, data obtained from flat-panel test coupons should represent the properties of future flight vehicles.
- High temperature oxidation resistant coating integrated with a hot structure concept to extend performance for multiple cycles up to 2200^{o} C.

For proposals to this subtopic, research, testing, and analysis should be conducted to demonstrate technical feasibility during Phase I and show a path towards Phase II hardware demonstration. Phase I feasibility studies should also address cost and risk associated with the hot structures technology. At completion of Phase I, project deliverables should include: coupon specimens of components adequate for thermal/mechanical and/or arc-jet testing and a final report that is acceptable for publication as a NASA Technical Memorandum.Â Emphasis should be on the delivery of a manufacturing demonstration unit for NASA testing at the completion of the Phase II contract. In addition, Phase II studies should address vehicle integration.Â Opportunities and plans should also be identified and summarized for potential commercialization.