SBIR/STTR

Small Business Innovation Research / Small Business Technology Transfer

NASA SBIR 2016 Phase I Solicitation

Z4 Lightweight Structures and Materials

The Lightweight Materials, Structures, and Advanced Manufacturing/Assembly SBIR topic area will focus on technologies that will enable mass reduction, improved performance, lower cost and scalability of the material and structural systems that will be critical to NASA's space exploration and science missions. As NASA strives to explore deeper into space than ever before, improvements in all of these areas will be critical. For example, mass reduction is an ever-present goal in the development of space-exploration systems. Reductions in structural mass can either enable additional payload to be launched to orbit or reduce the mass of the payload that must be returned to Earth or landed on another planetary surface. Application areas for the material, structural, and manufacturing/assembly technologies developed under this SBIR topic include launch and crew vehicles, in-space transportation elements, habitation and crew-transfer systems, surface systems, and other systems used for space exploration.

Since this topic area has a broad range of interest, subtopics are selected by the Space Technology Mission Directorate to enhance and/or fill gaps in the exploration technology development programs and to complement other mission directorate topic areas. Advances in composite, metallic, and ceramic material systems are of interest in this topic, as are advances in the associated manufacturing methods for these various material systems. Significant advances can be realized by improvements in material formulation through improvements in the capabilities to manufacture and assemble large-scale structural components. Therefore, subtopics of interest will include but will not be limited to nanomaterial and nanostructures development, advanced metallic materials and processes development, and large-scale polymer matrix composite structures, materials, and manufacturing technologies. Other sub-topic areas may be added as required to address specific agency needs.

The subtopic of interest for FY16 addresses joining techniques and designs for large segmented polymer matrix composite (PMC) structures. The intent of this specific focus is to address needs for large composite hardware applications for programs such as SLS as well as future composite structure applications for exploration such as habitat, transit vehicles and surface systems. Joining technologies (bonded or mechanical) to enable 5 – 9 m diameter composite structures will be of interest, as will new concepts for lightweight separation joints. The specific needs and metrics of this focus area is described in the subtopic description.

Research awarded under this topic should be conducted to demonstrate technical feasibility (proof of concept) during Phase I and show a path toward a Phase II hardware demonstration, and when possible, deliver a full-scale demonstration unit for functional and environmental testing at the completion of the Phase II contract.

References:

- (http://www.nasa.gov/directorates/spacetech/home/index.html).

Subtopics

Z4.01 Joining for Large-Scale Polymer Matrix Composite (PMC) Structures

Lead Center: MSFC

Participating Center(s): GSFC, LaRC

The subtopic area for Large-Scale Polymer Matrix Composite (PMC) Structures and Materials concentrates on developing lightweight structures, using advanced materials technologies and new manufacturing processes. The objective of the subtopic is to advance technology readiness levels of PMC materials and manufacturing for launch vehicles and in-space applications resulting in structures having affordable, reliable, and predictable performance. A key to better understanding predictable performance and faster qualification of components includes integrating the analytical tools between the materials and manufacturing process.

This subtopic will focus efforts on innovative low cost, light weight, high reliability composite joint concepts/techniques to enable the fabrication of complex geometry and/or large composite structures (5 to 9 meter) diameter by 10 meters long. The specific area of interest is focused on:

- Novel concepts for joining (mechanical or bonded) large and/or complex segmented PMC structures together are of interest. Useful concepts can consider metallic-to-composite and composite-to-composite material interfaces. Examples of joints of interest include, but are not limited to, longitudinal and circumferential joint configurations for launch vehicle structures. In addition, cylinder to cylinder, and cylinder to frustum/conical ("Y" shaped) designs are of interest.
- Innovative joint designs with integrated sensing for the purposes of assisting with qualification of the joint design and interrogation of the joint during use to assess its performance and capability are also of interest.
- For bonded structure, novel, reproducible, and scalable surface treatments, bonding methods and techniques for very large structure, and novel adhesives are of interest as well as techniques to verify bond quality and predict/validate strength. Useful concepts can consider metallic-to-composite and composite-to-composite bond interfaces.
- New concepts for lightweight separation joints, both longitudinal and circumferential designs.

Concepts must consider end-to-end process evaluation with considerations to modeling of the joint/joining process and to full-size scale-up factors which will limit autoclave and oven access for joint cures (if needed). Concepts that are amenable to in-situ and/or on-orbit implementation are also of interest. Research should be conducted to demonstrate novel approaches, technical feasibility, and basic performance characterization for large-scale PMC structures and joint concepts during Phase I, and show a path toward a Phase II design allowables and prototype demonstration. Emphasis should be on demonstrable manufacturing technology that can be scaled up for very large structures.

References:

- Kirsch, M. T., “Composite Crew Module: Primary Structure,” (http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20110020665.pdf).
- Tenney, D. R. et al., “NASA Composite Materials Development: Lessons Learned and Future Challenges,” (http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20090037429.pdf).