# NASA SBIR 2015 Phase I Solicitation

### H5.03 Multifunctional Materials and Structures

**Lead Center: LaRC**

**Participating Center(s): GRC, JSC, MSFC**

Multifunctional and lightweight are critical attributes and technology themes required by deep space mission architectures. Multifunctional materials and structural systems will provide reductions in mass and volume for next generation vehicles. The NASA Technology Roadmap TA12, â€œMaterials, Structures, Mechanical Systems, and Manufacturingâ€ (http://www.nasa.gov/sites/default/files/501625main_TA12-ID_rev6_NRC-wTASR.pdf), proposed Multifunctional Structures as one of their top 5 technical challenges, and the NRC review of the roadmap recommended it as the top priority in this area stating: â€œâ€¦ To the extent that a structure can simultaneously perform additional functions, mission capability can be increased with decreased mass. Such multifunctional materials and structures will require new design analysis tools and might exhibit new failure modes; these should be understood for use in systems design and space systems operations.â€

Some functional capabilities beyond structural that are in this multifunctional theme are: insulating (thermal, acoustic), inflatable, protective (radiation and micrometeoroids and orbital debris), sensing, healing, in-situ inspectable (e.g., IVHM), actuating, integral cooling/heating, and power generating (thermal-electric, photovoltaic â€¦), and so on. Because of the broad scope possible in this SBIR subtopic, the intent is to vary its focus each year to address specific areas of multi-functionality:Â

- That have high payoff for a specific mission.
- That are broadly applicable to many missions.
- That could find broader applications outside of NASA which would allow for partnerships to leverage the development of these technologies. For FY15, this SBIR subtopic seeks innovative structures and materials technologies and capabilities for three principle areas:
    - Integration of acoustic metamaterial concepts into the primary structure to reduce interior acoustic and vibration environments. Specifically, innovations are solicited which maintain the load bearing capability of the primary structure while simultaneously reducing interior noise and vibration levels below 400 Hz. Successful innovations are anticipated to enable the design of lighter and cheaper spacecraft and launch vehicle structures, as well as lower costs associated with ruggedizing and qualifying spacecraft and launch vehicle secondary structures.
    - Sensory materials incorporated into a primary structure to provide health monitoring data, and low-mass/wireless methods of transmitting localized structural responses to diagnostic models for material and structural state. Manufacturing technologies capable of producing structural components with embedded capability for sensing strain, damage initiation and propagation, and temperature are of particular interest. Ideally, the sensing technology should also augment the load carrying capability or some other structural design requirement. Technologies should enable weight reduction with similar or better structural performance when compared to traditional approaches.

- Thin film conformal layers on structures or integrated in structures with different functional capabilities. Examples include conformal solar cells, conformal antennas, conformal energy storage, and conformal energy harvesting. The conformal layer should provide additional functionality to the structure without adversely affecting the load bearing capability. The conformal functional layer offers the potential for significant weight reduction and reduced complexity for spacecraft, rovers, and habitats. For example, conformal photovoltaic layer on spacecraft, rover, or habitat can eliminate the need for separate solar array panels."