NASA SBIR 2012 Phase I Solicitation

H5.02  Advanced Manufacturing and Material Development for Lightweight Metallic Structures

Lead Center: LaRC

Participating Center(s): GRC, MSFC

The overall objective of this subtopic is to advance technology readiness levels of lightweight metals and manufacturing techniques for launch vehicles and in-space applications resulting in structures having affordable, reliable, predictable performance with reduced costs.

The current state-of-the-art for fabrication of launch vehicle structure is multi-piece welded and riveted construction to assemble parts that are heavily machined from thick wrought products. Fabrication of single-piece launch vehicle structure using near-net shape (NNS) manufacturing methods can reduce mass and cost while increasing safety and reliability, primarily through elimination of welds and parasitic weld land weight and reduction in the number of manufacturing steps. However, to fully realize the benefits of these NNS manufactured components, methods to add structural elements and/or locally enhance material properties of these structural elements are needed. Structural elements added by welding or deposited by additive manufacturing methods typically have dissimilar microstructures and reduced mechanical properties compared with the NNS fabricated component. Materials of construction are typically aluminum and aluminum lithium (Al-Li) alloys. Some examples where this technology would be applied include adding stiffeners to thin-walled single-piece monocoque shells such as cylinders, bulkheads, domes, and frustums, and for reinforcing cut outs and windows.

Proposals are sought that offer innovative manufacturing processes and/or materials to locally increase the stiffness and strength of structural elements added to NNS components. Manufacturing methods of interest include additive manufacturing methods that employ wire feedstock, fusion and friction stir welding. Of specific interest in materials are advances in aluminum wire and tape feedstock materials, including customized alloy chemistry and metal matrix composites (MMCs) incorporating either discontinuous or continuous reinforcements. Of specific interest in manufacturing and processing are proposals that address issues such as residual stress and distortion control, post-deposition processing to develop service mechanical properties, and energy source / reinforcement interactions.

Research should be conducted to demonstrate technical feasibility in Phase I and show a path toward demonstration in Phase II of material fabrication and/or manufacturing process improvement. When possible proposals should include delivery of sample material for test and evaluation by NASA and/or a component demonstration article.
Technology Readiness Levels (TRL) of 4 to 6 or higher are sought.

Potential NASA Customers include:

- Office of Chief Technology - Integrated Manufacturing Modeling with Experiment.
- Space Launch System.
- Multi Purpose Crew Vehicle.
- Fundamental Aeronautics - Fixed Wing, High Speed, Aerosciences Projects.