This subtopic solicits innovative research for advanced composite materials, processing and characterization concepts that support the development of lightweight structures technologies that should be applicable for space transportation vehicle systems, propulsion systems, and planetary access and operations. Reduction in structural mass translates directly to additional up-and-down mass capability that would facilitate logistics and increase science return for future missions. Advanced composites are targeted that could be implemented into vehicle and propulsion systems for launch vehicles, lunar landers, and habitats. Innovations in technology are needed to increase specific strength and stiffness, provide radiation shielding, enhance thermal management, reduce Micrometeoroid/Orbital Debris (MMOD) damage potential, and provide effective nondestructive verification and characterization, while maintaining safety, reliability, and reducing costs.

Advanced composite material systems and their corresponding manufacturing, processing and verification techniques are desired. Examples would include, but are not limited to, material systems and mature applications of nano-structured materials. Processing examples would include, but are not limited to, automated composite fiber/tape placement, non-autoclave curing, processing innovations for multifunctionality, ceramic processing, nano materials processing, freeform fabrication, and bonding of composites.

Development of concepts can include material system characterization, proof-of-concept demonstrations for integrated lightweight structures, innovative multifunctional concepts, enabling performance and affordability (including life cycle costs) enhancement, damage tolerance/control techniques, methods of validation, and/or predictive analysis methods that improve understanding of the technology to reduce risk and need for conservatism in design and demonstration of integrated system performance. Preferred processing and verification techniques would include non-contact, high-resolution nondestructive evaluation 2D and 3D imaging and characterization approaches using electromagnetic techniques such as Terahertz and millimeter waves with resolutions of 1-5 mm. Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward a Phase 2 prototype demonstration.