NASA STTR 2014 Phase I Solicitation

T6 Human Health, Life Support and Habitation Systems

Human Health, Life Support and Habitation Systems, includes technologies necessary for supporting human health and survival during space exploration missions and consists of five technology subareas: environmental control and life support systems and habitation systems; extravehicular activity systems; human health and performance; environmental monitoring, safety, and emergency response; and radiation. These missions can be short suborbital missions, extended microgravity missions, or missions to various destinations, and they experience what can generally be referred to as “extreme environments” including reduced gravity, high radiation and UV exposure, reduced pressures, and micrometeoroids and/or orbital debris.

Subtopics

T6.01 Synthetic/Engineering Biology for NASA Applications

Lead Center: ARC

Participating Center(s): JSC, KSC, MSFC

Synthetic Biology (SB) provides a unique opportunity to engineer organisms that reliably perform necessary functions for future exploration activities. NASA is interested in harnessing this emerging field to create technological advances that will benefit both spaceflight and future surface missions in a variety of enabling areas. Proposals must use a biologically-based approach, such as synthetic biology, to engineer novel biologically-based (or inspired) functions that do not exist in nature. Proposed projects may include creating new capability by designing microorganisms, plants, and/or cell-free systems for air revitalization, water recovery, in situ resource utilization, and/or the production of novel chemicals and biomolecules of benefit to space exploration. Applications may include (but are not limited to) more reliable and efficient life support systems; the acquisition and utilization of in situ resources; and the production of consumables such as feedstock for advanced manufacturing or food. Proposals should address how systems and technologies will reduce the required up-mass and dependence on consumables, resupply, and energy.

Of additional interest is the miniaturization and automation of critical technologies required to monitor and implement synthetic biology beyond low Earth orbit.

All proposals should consider the novel environment in which these systems will eventually be deployed – this includes altered gravity, temperature extremes, high radiation, etc.

T6.02 Metal Organic Framework Sorbents for Spacecraft Medical Applications

Lead Center: JSC

Participating Center(s): GRC

Metal Organic Frameworks (MOFs) are a new class of porous materials in which metal-to-organic ligand interactions yield structured three dimensional porosity. MOFs have several important attributes:

- They have ultrahigh porosity.
- MOFs have demonstrated thermal and chemical stability.
- They can be synthesized into a wide variety of structures with a wide range of pore sizes.
- They can be synthesized to be superhydrophobic.

Because of these attributes, MOFs show promise to improve the efficiency and effectiveness of practical gas separation systems.

To ensure human health for space exploration, NASA seeks the capability to administer therapeutic oxygen in a medical emergency. In a traditional hospital setting, medical oxygen can be delivered, and the excess oxygen is diluted and ventilated. In a confined spacecraft, administering medical oxygen by conventional means can cause ambient oxygen levels to exceed flammability limits. If oxygen could be efficiently concentrated from spacecraft cabin air, medical oxygen could be administered without increasing oxygen levels in the cabin. State of the art oxygen concentrators are too large and use too much energy to effectively operate in a spacecraft environment, in part because the oxygen separation sorbents are adversely affected by the presence of water vapor.

Much attention is being paid on using MOFs to store fuels such as hydrogen under practical conditions. This solicitation, however, is focused on exploiting the properties of MOFs to separate oxygen from cabin air. Thermal and chemical stability, selectivity in the presence of water, and selectivity under dynamic gas separation conditions are especially important. In addition to water selectivity, some operational scenarios require oxygen separation from air that contains elevated levels of CO, CO_2, HCN, and HF.