NASA STTR 2009 Phase I Solicitation

T6 Innovative Technologies and Approaches for Space

To accomplish the Agency's goals and objectives for a robust space exploration program, innovative technologies and approaches are needed to meet these major challenges for human space explorers. This topic solicits technologies to support outposts, habitats, science packages, and state-of-the-art materials that will be safe as well as provide specific energy for primary or secondary batteries in excess of 300 mAh/g. The high specific energy will greatly help to reduce the mass of batteries that will have to be launched for the various applications for long duration Lunar as well as Mars Exploration Missions. The anticipated proposed technologies shall have a dramatic impact on achieving the goals of the Space Exploration Vision.

Subtopics

T6.01 Safe High Energy Density Batteries and Ultracapacitors

Lead Center: JSC

Commercial batteries have been used extensively by NASA to provide portable power for space applications for more than four decades. The cells range in capacity from 0.75 Ah to about 100 Ah, with a wider range of capacities and voltages at the battery level. Due to the high energy densities and the nature of the cell components, most battery chemistries are not inherently safe and have a tendency to be hazardous under off-nominal conditions. The top level requirement for crewed space vehicles and environments is two-fault tolerance to catastrophic failures.

With the future long duration manned missions to Moon and Mars in mind, NASA seeks to develop high specific energy (reduced mass) primary and secondary batteries that are safe and capable of performing under a wide temperature range and/or vacuum environments.

This solicitation seeks state-of-the-art materials that will be safe as well as provide specific energy for primary or secondary batteries in excess of 300 mAh/g. The high specific energy will greatly help reduce the mass of batteries that will have to be launched for the various applications for long duration Lunar as well as Mars Exploration Missions.

A second area that requires improvement is in the area of safe performance under the wide temperature ranges seen on Moon or Mars. The goals at this time are to obtain materials that will provide operation and be safe in a temperature range of -40 to +60°C. At least 50% performance should be obtained at the quoted extreme temperatures as compared to that at ambient (23°C).

A third area that would benefit from improvements is with respect to safe performance of pouch cells under vacuum conditions. Both primary and rechargeable batteries may be expected to perform in unpressurized environments for long periods on Lunar as well as Mars surfaces. Pouch cells provide a very high advantage in mass as well as design flexibility over hard case containers, but they do not provide stable performance under vacuum conditions. This solicitation seeks pouch cell designs for primary or secondary battery chemistries that are capable of safely providing greater than 95% of the capacity obtained at ambient pressures at the beginning of life and greater than 80% capacity after 500 cycles.

A fourth area of interest is in the field of ultracapacitors. Ultracapacitors with a voltage range of 2.0 to 4.0 V (single unit), low self discharge (

For the above-mentioned areas of interest, Phase 1 will require demonstration of feasibility of concept at the lab scale and Phase 2 will require demonstration of concept in prototype or small capacity completed cells.

T6.02 Planetary Surface Analog Support Technologies

Lead Center: JSC

Current testing of Lunar Surface System elements (such as rovers, habitats, space suits, etc.) is performed either piecemeal in laboratory testing facilities or in an integrated fashion at remote site field exercises. Large-scale controlled facilities in which lunar surface outpost elements and operations can be tested in integrated scenarios are needed to reduce the risk of future human lunar missions and eventually Mars missions. Development of such facilities provides many advantages to planetary exploration programs but also poses many technological challenges. Such technology development challenges include non-hazardous lunar/Mars soil/regolith simulants, lunar/Mars lighting systems, lunar/Mars gravity off-load systems, etc.