NASA SBIR 2009 Phase I Solicitation

X7.03 Fuel Cells for Surface Systems

Lead Center: GRC

Participating Center(s): JPL, JSC

Advanced primary fuel cell and regenerative fuel cell energy storage systems are baselined to provide descent power for the Altair lander and stationary power for lunar bases. Technology advances that reduce the weight and volume, improve the efficiency, life, safety, system simplicity and reliability of PEM fuel cell, electrolysis, and regenerative fuel cell systems are desired. Proposals are sought which address the following areas:

Advanced Conductive Fuel Cell Water Separator

Research directed towards improving the water separating capability of a planar separator internal to each fuel cell in a fuel cell stack. Proposals directed at developing such advanced separator materials must meet the following criteria to be considered relevant.

The separator:

- Must be wettable with water, and have a contact angle less than 30 degrees;
- Must allow water to penetrate and be transferred through the plane of the separator at a rate of at least 0.33 grams of water per hour per square centimeter of separator planar area;
- Must not permit gas vapor to penetrate through the separator up to at least 30 psid (i.e., a bubble pressure point of at least 30 psid);
- Must be electrically conductive, and have a resistivity of no more than 7.0 x 10^{-3} Ohm-cm;
- Ideally should be compatible with a fuel cell fabrication process step that occurs at 1000Â°C with a compressing force of at least 600 psi. (The separator will not need to operate at these conditions, but could be subjected to these conditions during fuel cell fabrication). This bullet is not a requirement but a desirable characteristic.

Hydrogen/Oxygen Dual Gas Pressure Regulator

Research directed towards improving the regulators that regulate hydrogen and oxygen gases down to a usable pressure for the fuel cell. The regulated pressure needs to be controlled so that the pressure differential between the gases is within a few psi. NASA is interested in developing a single mechanical component which functions as a dual gas regulator that can reliably regulate these gases from high pressure source (>500psi) down to

Advanced Electrocatalyst Materials for Fuel Cells and Electrolyzers

Research directed towards improving the kinetics of oxygen reduction and oxygen evolution. Nano-phase, high-surface area unsupported platinum-alloys, incorporating cobalt, nickel and iron are potential candidates for improving the kinetics of oxygen reduction. Oxides of ruthenium and iridium are particularly promising electrocatalysts for the oxygen evolution reaction. In addition to performance, the new materials must exhibit durability for over 10,000 hours of operation with no more than 20% loss in performance. Proposals directed at developing such advanced nano-phase materials, understanding composition/property relationships, and demonstrating their characteristics in operating fuel cells will be considered directly relevant to achieving the long-term goals of the Explorations Missions.

- Fuel cell MEA efficiency >75% (>0.92volts) @ 200 mA/cm^2;
- Electrolysis MEA efficiency >85% (2.

Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward a Phase 2 hardware demonstration, and when possible, deliver a demonstration unit for functional and environmental testing at the completion of the Phase 2 contract.