



NASA SBIR 2016 Phase I Solicitation

H8.02 Solid Oxide Fuel Cells and Electrolyzers

Lead Center: GRC

Participating Center(s): JPL, JSC

Technologies are sought that improve the durability, efficiency, and reliability of solid oxide systems. Of particular interest are those technologies that address challenges common to both fuel cells fed by oxygen and methane and electrolyzers fed by carbon dioxide and/or water. Hydrocarbon fuels of interest include methane and fuels generated by processing lunar and Mars soils. Primary solid oxide components and systems of interest are:

- Solid oxide fuel cell, stack, materials and system development for operation on propellant grade direct methane in designs scalable to 1 to 3 kW at maturity. Strong preference for high power density configurations.
- Cell and stack development capable of Mars atmosphere electrolysis should consider feasibility at 0.4 to 0.8 kg/hr O₂; scalable to 2 to 3.5 kg/hr O₂ at maturity. CO₂ electrolysis or co-electrolysis designs must have demonstrated capability of withstanding 15 psid in Phase I with pathway to up to 50 psid in Phase II.

Proposed technologies should demonstrate the following characteristics:

- The developed systems are expected to operate as specified after at least 20 thermal cycles during Phase I and greater than 70 thermal cycles for Phase II. The heat up rate must be stated in the proposal.
- The developed systems are expected to operate with less than five percent degradation after at least 500 hours of steady state operation on propellant-grade methane and oxygen. Operation for 2500 hours and less than five percent degradation is expected of a mature system.
- Fuel reforming must be water neutral. Integrated systems that minimize components and complexity are favored.
- Minimal cooling is available for power applications. Some cooling in the final application will be provided by means of conduction through the stack to a radiator exposed to space or other company proposed solution that minimizes resources required.
- Minimal power (heating plus electrolysis) required for CO₂ electrolysis applications.
- Demonstrate electrolysis of the following input gases: 100% CO₂, Mars atmosphere mixture (95.7% CO₂, 2.7% N₂, 1.6% Ar), 100% water vapor, and 0.7 to 1.6:1 CO₂:H₂O mass ratio. A final test using pure CO₂ of 500 hours (or stopping at 40% voltage degradation) is required. Description of technical path to achieve up to 11,000 hrs for human missions is requested.