Ion-Exchange Membranes for PEM Electrolyzers

During high-pressure electrolysis operation, hydrogen permeation through the ion-exchange membrane acts to reduce the current efficiency within the cell. This permeation increases with increasing pressure. Technological approaches are sought that significantly reduce this permeation. Areas of interest include:

- Demonstrated hydrogen permeability reduction >50% for Nafion membranes.
- Concurrent conductivity reductions
- Additionally, such membranes should have low acid generation rates to avoid degrading other elements within the cell stack, and must maintain good water transfer capability, bubble point, and tensile strength for use with cathode liquid-feed systems.

Solid Oxide Fuel Cell Systems

Technologies are sought that improve the durability, efficiency, and reliability of SOFC systems fed by oxygen and fuels such as propellant-grade methane and those generated by ISRU systems (e.g., CO, syngas). Primary SOFC components and systems of interest:

- Power outputs in the 1 to 3 kW range.
- Offer thermodynamic efficiencies of 70% (fuel source-to-DC output) when operating at the current draw corresponding to optimized specific power.
- Operate as specified after at least 50 start-up cycles (from cold to operating temperature within 20 minutes) and 50 shut-down cycles.
• Operate as specified after at least 2500 hours of steady state operation on propellant-grade methane and oxygen. System should startup dry but after reaching operating conditions an amount of water/H₂ consistent with what can be obtained from anode recycle can be used. Amounts must be justified.

• Minimal cooling required as obtained by way of conduction through the stack to a radiator exposed to space and/or by anode exhaust flow.

Technology Readiness Levels (TRL) of 3 to 4 or higher are sought.

Potential NASA Customers include:

• International Space Station.

• Human Exploration and Operations Mission Directorate.