Active Project (2015 - 2017)

Fabrication of T-SOFC via Freeze Cast Methods for Space and Portable Applications, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

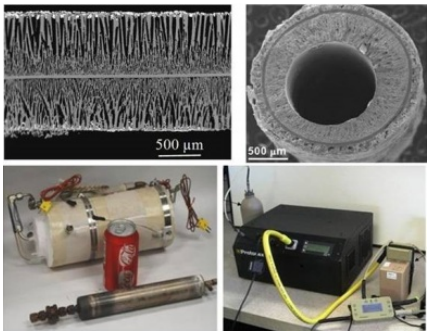
ABSTRACT

As NASA space missions become longer in duration the need for high efficiency power generator sets that can operate on NASA logistical fuel become critical. Historically NASA has used fuel cells as part of the energy solution. Space bound energy and power systems require rapid start and stop cycle times as well as high power densities. The high operational efficiency, coupled with the use of logistical fuel options make fuel cells vital to the extended future missions of NASA. Solid Oxide Fuel Cells (SOFCs) have been demonstrated on a variety of gaseous and liquid hydrocarbon fuels. Our team has developed tubular SOFC systems capable of cycling from room temperature to 700C and full power in less than 15 minutes. The system has been cycled more than 250 times and demonstrated life times greater than 2000hrs. Coupling the freeze cast microstructure with the rapid cycling and portability of the tubular systems will lead to a high power density robust SOFC system operating on methane and oxygen capable of space missions.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: For the past 4 decades electrical requirements on human space flight missions have been supplied by alkaline fuel cells (AFC). These systems are costly and aging rapidly and will soon be unsatisfactory for future NASA missions. Replacing these systems with solid oxide systems allows for increased fuel flexibility and compatibility with energy density fuels greatly expanding mission length. Increasing the power density of T-SOFCs is a vital step in achieving NASA's objective. Specifically, cells developed during this program can be further used in the following systems: 1. Energy storage and maintenance for the international space station 2. High altitude balloons 3. High altitude aircraft 4. Energy storage for future missions and settlement on the moon and Mars



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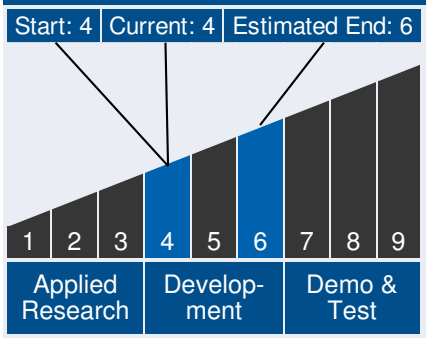

Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

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To the commercial space industry:

Potential Non-NASA Commercial Applications: Summarized below are potential post applications. The customer needs we are addressing are: For DoD: Highly compact electric power sources for portable and wearable battlefield electronics; compact, quiet power units for battlefield communications stations and auxiliary power on military vehicles. For private-sector customers of high-value portable or mobile devices (e.g. UAV's, emergency lighting, and communications): A power unit with smaller size than possible with batteries, as well as quick refueling vs long recharge time. Versus combustion engines, the system provides for quiet, clean energy generation. Our potential initial key customers for 1 kW-class T-SOFC fuel cells and stacks include: 1. DoD programs for portable and wearable battlefield electronics – prime contractors and subcontractors. 2. Private-sector makers of unmanned aerial vehicles (UAV's), portable emergency lighting, and communications devices – prime contractors and subcontractors. 3. Fuel cell power system manufacturers (buyers of freeze cast T-SOFC anodes, single cells, or stacks for integration into power units for the above applications).

Management Team *(cont.)*

Program Manager:

- Carlos Torrez

Principal Investigators:

- Benjamin Emley
- Joshua Persky

Technology Areas

Primary Technology Area:

Space Power and Energy Storage (TA 3)

- Power Generation (TA 3.1)
  - Chemical (TA 3.1.2)
    - Solid Oxide Fuel Cells (SOFC) (TA 3.1.2.2)

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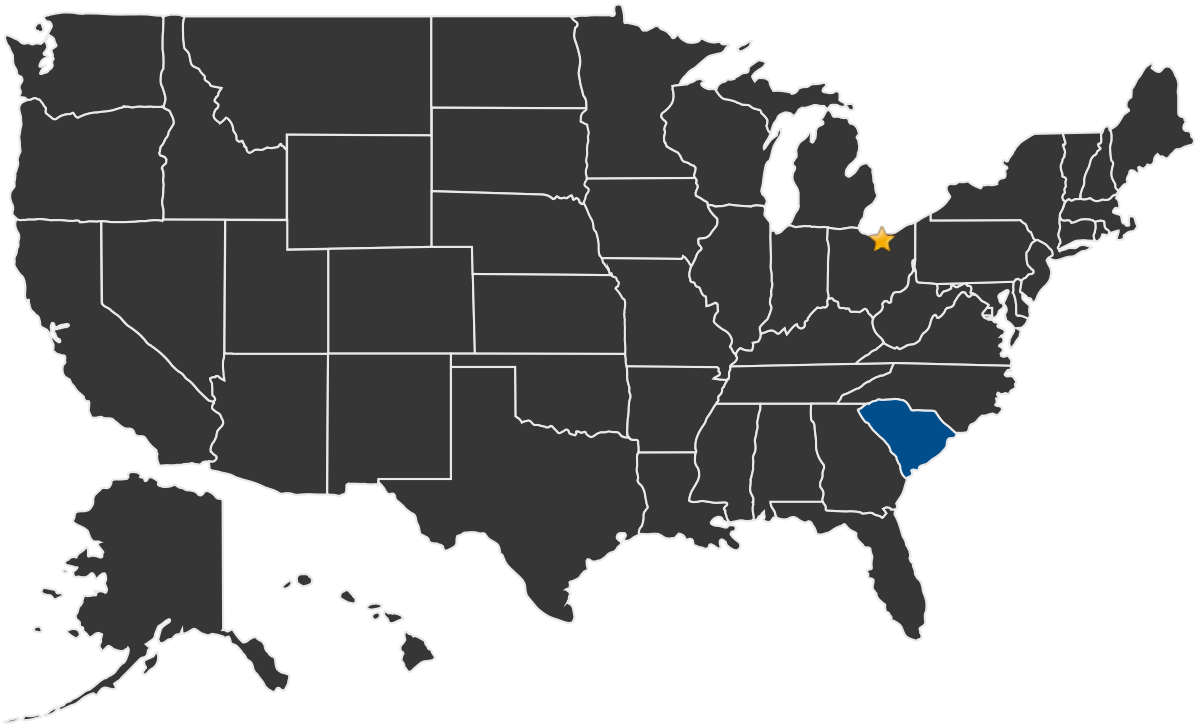
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Other Organizations Performing Work:

- Yanhai Power, LLC (Irmo, SC)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/17984)

DETAILS FOR TECHNOLOGY 1

Technology Title

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