Compact in situ Polyethylene Production from Carbon Dioxide, Phase I Project

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

ABSTRACT

Opus 12 has redesigned the cathode of the commercially available PEM water electrolyzer such that it can support the reduction of carbon dioxide into ethylene and suppress the competing hydrogen reaction. When coupled with an ethylene polymerization reactor to make polyethylene our technology could make plastics out of the Martian CO2 atmosphere in a simple two-step process. PEM water electrolyzers have already been proved space worthy and are commercially available at various scales. Ethylene polymerization is well understood. Our innovation enables the creation of polyethylene from the most basic starting materials: CO2, water and electricity. During Phase I, Opus 12 will show the feasibility of ethylene production in a single step by hitting key performance targets to optimize our existing prototype reactor. This optimization will be done by creating and testing different ratios of the catalysts to the other material components of the reactor. During Phase II, we will integrate our reactor design into commercially available PEM electrolyzers with a commercial partner and add a polymerization reactor to the system to produce polyethylene for additive manufacturing.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Plastics for manufacturing in space traditionally have been shipped from earth. Opus 12 is developing a breakthrough technology, which will enable the creation of plastics using only CO2, water, and electricity as feedstocks. Our technology can take water and CO2 from the Martian atmosphere, and transform these molecules into polyethylene plastic. This opens up a variety of space manufacturing applications, including 3d printing to make tools and building materials.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The

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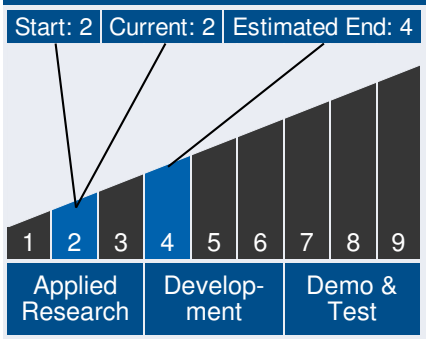
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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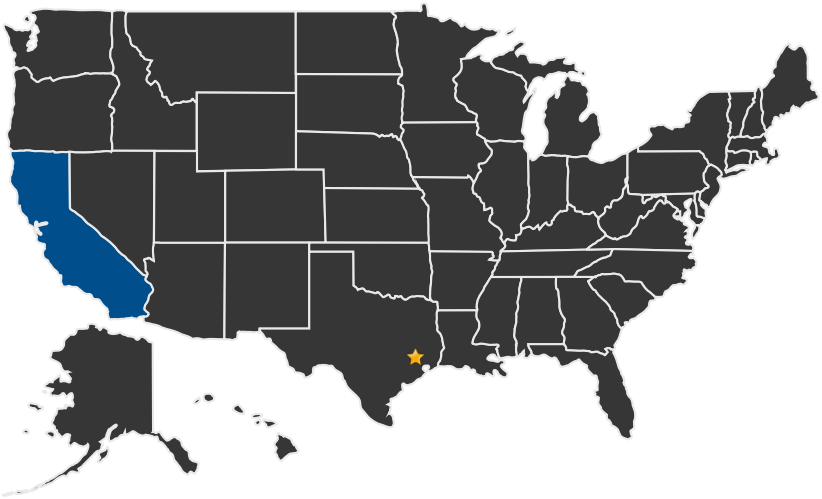
electrochemical conversion of carbon dioxide (ECO2R) is a platform for novel, renewable, zero land use chemicals and fuels. Across the U.S., 48 million tons of CO2 emissions from fermentation and biogas can be converted into 15 million tons of low-carbon ethylene. ECO2R will provide a new platform for manufacturing products from the most basic compounds: CO2, water, and electrical energy. ECO2R ethylene is just the beginning: our team has demonstrated ECO2R production of 16 different fuels and chemicals, including fuels such as ethanol and propanol.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Johnson Space Center

Other Organizations Performing Work:

- Opus 12, Inc. (Berkeley, CA)

Management Team *(cont.)*

Principal Investigator:

- Etosha Cave

Technology Areas

Primary Technology Area:
Human Exploration Destination Systems (TA 7)
└ In-Situ Resource Utilization (TA 7.1)
  └ Manufacturing Products and Infrastructure Emplacement (TA 7.1.4)

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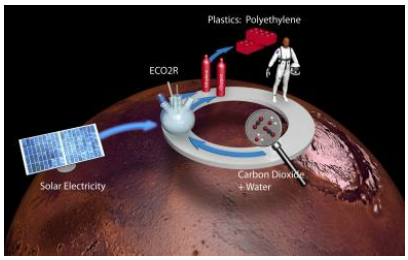
PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23356)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

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