**Project Introduction**

The Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) will be the first in-situ resource utilization (ISRU) technology demonstration on Mars. Competitively selected in 2014, MOXIE will fly on the Mars 2020 rover in 2020, to land on Mars in 2021. Sponsored by HEOMD and the Space Technology Mission Directorate (STMD), MOXIE will utilize solid oxide electrolysis to process Mars’ CO$_2$ atmosphere to produce O$_2$. MOXIE will be a critical first step in long-duration mission architectures that would require use of local resources to reduce risk and control cost. By partnering with Science Mission Directorate on the Mars 2020 mission, human exploration leverages existing investments in the Mars program while advancing a key technology for NASA.

Experiment objectives are to intermittently operate an oxygen production plant on Mars across a range of diurnal conditions during the primary mission year and producing at least 6 grams of O$_2$ per hour with 99.6% purity. The technology will demonstrate resilience with respect to dust and other environmental challenges and will return performance parameter data that are critical to the design of a full-scale system.

MOXIE consists of a CO$_2$ acquisition system (a scroll pump) and a solid oxide electrolysis (SOXE) system to process the atmosphere producing O$_2$. O$_2$ will be processed on a batch basis as rover resources allow but of sufficient amounts to test system resiliency. By monitoring the production rate, power usage, and other performance characteristics of the system, MOXIE will provide an assessment of the prospects for extension to a full-scale system in support of a human mission.

Mars atmosphere enters the system through an inlet valve and dust is filtered out. A scroll pump delivers up to 50 g/hour of atmosphere to the SOXE subsystem. The Mars atmosphere is processed as follows: the SOXE is warmed to 800 C; the pump is started and the filtered air will flow continuously at >1 torr to the SOXE. The O$_2$ and CO are separated and the flow rate is measured. The O$_2$ and CO are vented out the side of the rover.

**Anticipated Benefits**

A key element of NASA’s plans to send humans to Mars is the ability to utilize resources at the destination; this will reduce mass launched from Earth and increase mission resiliency.

Once demonstrated on Mars, incorporation of ISRU technologies in future missions will be key to realizing the vision of a sustainable and resilient space exploration architecture. ISRU is expected to play a key role in NASA’s expansion beyond low-Earth orbit. For example, future crewed missions will be enabled by use of in-situ resources to produce oxygen for propellant and other consumables.
By flight qualifying ISRU, NASA supports the development of a new technology readily available for use by commercial resource prospecting missions. This can create new markets for commercial missions anywhere in the Solar System.

**Primary U.S. Work Locations and Key Partners**

<table>
<thead>
<tr>
<th>Organizations Performing Work</th>
<th>Role</th>
<th>Type</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Jet Propulsion Laboratory (JPL)</td>
<td>Lead Organization</td>
<td>NASA Center</td>
<td>Pasadena, CA</td>
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<tr>
<td>Ceramatec, Inc.</td>
<td>Supporting Organization</td>
<td>Industry</td>
<td>Salt Lake City, UT</td>
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<td>MIT Haystack Observatory</td>
<td>Supporting Organization</td>
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<td>Westford, MA</td>
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Technology Areas

Primary:
- TA7 Human Exploration Destination Systems
  - TA7.1 In-Situ Resource Utilization

Target Destination
Mars

Supported Mission Type
Planned Mission (Pull)

Images

Untitled
MOXIE Expanded View
(https://techport.nasa.gov/image/36637)

Project Website:
https://mars.nasa.gov/mars2020/mission/instruments/moxie/