Project Introduction

Very low CO2 concentrations that accumulate quickly from human respiration can have dramatic health effects, and thus in NASA’s history many technical removal strategies for CO2 from a confined atmosphere have been suggested and explored. A CO2 removal system that functions in a is a new area of research, as the primary CO2 removal component in the state-of-the-art system doesn’t have the adsorption performance behavior necessary to function in a Martian atmosphere. We propose to use an alternative adsorbent with unique and highly applicable CO2 adsorption properties - a diamine-appended metal-organic framework (MOF) - as a drop-in replacement for Zeolite 5A, the CO2 adsorbent onboard the ISS. Importantly, the mechanism for CO2 adsorption is disparate from the water adsorption mechanism, allowing the material to be the foundation of newly efficient CO2 removal processes.

Anticipated Benefits

Carbon dioxide (CO2) removal for breathing life support will always be a necessary component to human NASA missions. This proposal validates a new class of materials with remarkable CO2 removal properties at the low partial pressures relevant to human toxicity. Additionally, these materials are uniquely suited to perform in a Mars atmosphere. The chemistry of CO2 removal is more challenging on Mars than in a space vacuum, making the results applicable to any future Mars or non-Mars mission.

Industrial chemistry is a bedrock of modern society. Making chemicals, such as making the ethylene in polyethylene (grocery) bags, has two required components: making the chemical and separating it from any other molecules from the process. While this separation step could seem like an afterthought, in fact it is responsible for at least 10% of global industrial energy use! MarsMOF and the class of materials it belongs to have the potential to improve the cost of the world’s largest separations.

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Efficient CO2 and H2O Removal with Novel Adsorbents for Life Support Applications on Mars, Phase I
Completed Technology Project (2018 - 2019)

Primary U.S. Work Locations and Key Partners

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<th>Organizations Performing Work</th>
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<td>Johnson Space Center (JSC)</td>
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<td>NASA Center</td>
<td>Houston, TX</td>
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<tr>
<td>Mosaic Materials, Inc.</td>
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<td>Berkeley, CA</td>
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<tr>
<td>University of California at Berkeley</td>
<td>Supporting Organization</td>
<td>Academic</td>
<td>Berkeley, CA</td>
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Organizational Responsibility

**Responsible Mission Directorate:**
Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**
Johnson Space Center (JSC)

**Responsible Program:**
SBIR/STTR

Project Management

**Program Director:**
Jennifer L Gustetic

**Program Manager:**
Carlos Torrez

**Principal Investigator:**
Thomas Mcdonald

Technology Maturity (TRL)

Start: 3
Current: 3
Estimated End: 4

For more information and an accessible alternative, please visit: https://techport.nasa.gov/view/94568
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Images

Zeolite 5A: High T swing, low working capacity

MarsMOF: Low T swing, high working capacity

Project Image
(https://techport.nasa.gov/image/34827)

Technology Areas

Primary:
- TA6 Human Health, Life Support, and Habitation Systems
  - TA6.1 Environmental Control and Life Support Systems and Habitation Systems

For more information and an accessible alternative, please visit:
https://techport.nasa.gov/view/94568