Paper ID: 65191
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IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Life Support, habitats and EVA Systems (7)

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DEVELOPMENT OF ELECTROLYTIC OXYGEN RECOVERY SYSTEM FOR ADVANCED LIFE SUPPORT

Abstract

The oxygen (O2) recovery system for the International Space Station (ISS) can recover approximately 50 percent of O2 from metabolic carbon dioxide (CO2). Increasing the O2 recovery rate and closing the open loop for future long duration crewed missions in space beyond Low Earth Orbit (LEO) is essential. There are several developmental efforts underway to increase the recovery rate. However, most of these technologies result in a complex, heavy, and power consuming system. The desired exploration O2 recovery system would be reliable and efficient with maximum O2 recovery. Marshall Space Flight Center (MSFC) is currently investigating an electrolytic O2 recovery approach that will increase the O2 recovery to greater than 70 percent as well as lowering the complexity, mass, and power consumption than most other technologies currently under development. The electrolytic O2 recovery system consists of a Microfluidic Electrochemical Reactor (MFECR) that is based on the electrochemical reduction of CO2 to O2 and ethylene (C2H4) using water (H2O) as precursor and operates at standard condition with a theoretical recovery rate of 73 percent. In 2016, NASA's Game Changing Development Program awarded the University of Texas Arlington (UTA) a grant to initiate the development of the MFECR. Since 2019, MSFC and UTA have been collaborating with the current goals of increasing the O2 recovery efficiency, advancing the technology readiness to a Technology Readiness Level (TRL) 4, and maturing the system to process CO2 of one crew-member. Based on the results from UTA's initial efforts, the following were identified as key areas of improvement in order to maximize O2 recovery for the system: further development of the anode material and cathode catalyst, model-based cell design optimization, and the addition of a separation system and fuel cell. This paper will present the current developmental efforts of the electrolytic system including MFECR design and overall system enhancements as well as results from single cell stack testing.