

SPACE POWER SYMPOSIUM (C3)  
Space Power Technologies and Techniques (2)

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EXPERIMENTAL STUDY ON FUEL CELLS AND WATER ELECTROLYZERS FOR THE  
WATER-ENERGY-CYCLE SPACE SYSTEM

**Abstract**

For future long-term manned space missions and moon bases, it is required to provide not only energy storage and power generation but also life support system and propulsion for attitude and orbit control. We have proposed and studied the Water-Energy-Cycle Space System, which consists of a solar panel, a water electrolysis system, a fuel cell, and a propulsion system. Therefore, this system can support long-term and large-scale space activity. During periods of darkness etc, the hydrogen and oxygen which were stored are used for power generation by fuel cells, or are used as propellant of a spacecraft. In addition, it is highly efficient by using hydrogen/oxygen as propellants, and non-toxic to humans.

We have previously made a proof model of the Water-Energy-Cycle Space System when it will be assumed to install International Space Station (ISS) module "JEM", and executed the system performance examinations. As the results, the fundamental knowledge was sufficiently provided. However, aiming to further establish the appropriate system and each component for demonstration experiments in orbit, it is essential to overcome the following technical issues in terms of the power generation and energy storage; (i) development of the fuel cell for space uses diverted from ground-based technology, (ii) basic study on the water electrolysis system and its turning into actual utilization, and (iii) gas and liquid supplement systems containing humidifier/dehumidifier under micro gravity environment.

So, as to (i) and (ii), we carried out trial manufacture and basic characteristic measurement for the single cell, performance comparison by the difference of cell assemble method, and evaluation of 100 W-class fuel cell and water electrolysis stacks. On the other hand, as to (iii), the dehumidifier using a Starling cooler and a polymer membrane, pressurization systems for hydrogen and oxygen storage, and a circulation system of gas and liquid have been designed, manufactured and tested. Additionally, we make a system study on the application of the Water-Energy-Cycle Space System. In the symposium, the experimental results about the above investigations will be reported.