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H2-CO2 FUEL CELL AS A PROMISING ALTERNATIVE TO PRODUCE ELECTRICITY AND USEFUL ORGANIC MATERIALS ON MARS

Abstract

The Japan Aerospace Exploration Agency (JAXA) is now developing life support systems for closed environments in space, and the reduction reaction of carbon dioxide is an important technology for the sustainable manned operations in space. Recently, Umeda et al., from Nagaoka University of Technology (NUT) reported that the reduction reaction of carbon dioxide (CO2) proceeded by using a fuel cell and supplying CO2 and H2 to the cathode and anode, respectively. This electrochemical reduction of CO2 generates electricity and produces different organic materials depending on the alternated potential and operation temperature. The continuous operation of the CO2-H2 fuel cell has been proved by carrying out experimental tests. An eight-cells-stack system was prepared, and the continuous generation of electricity was demonstrated for five hours showing a stable potential operability. Water, methane, methanol, ethanol, acetic acid and formic acid have been detected as by-products of the electrochemical reduction of CO2, the generation of these by-products has a dependency on the operational potential and temperature of the fuel cell. The atmosphere of Mars has a high concentration of CO2, and hydrogen and oxygen can be generated using water electrolyzers, the hydrogen can be used as a fuel to reduce the CO2 generated form human activity or taken from the atmosphere of Mars. The management of the resources for the life support is very important for manned missions in space. The by-products from the electrochemical reduction of CO2 could be used as raw materials to produce consumption articles. Further improvements are necessary to increase the electricity generation and to control the selectivity of the by-products, however, the use of CO2-H2 fuel cells seems to be a promising alternative to support human exploration of Mars.