World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:13, No:04, 2019

Effect of Leaks in Solid Oxide Electrolysis Cells Tested for Durability under Co-Electrolysis Conditions

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Abstract : Solid oxide electrolysis cells have an immense potential in converting CO₂ and H₂O into syngas during co-electrolysis operation. The produced syngas can be further converted into hydrocarbons. This kind of technology is called power-to-gas or power-to-liquid. To produce hydrocarbons via this route, durability of the cells is still a challenge, which needs to be further investigated in order to improve the cells. In this work, various nickel-yttria stabilized zirconia (Ni-YSZ) fuel electrode supported or YSZ electrolyte supported cells, cerium gadolinium oxide (CGO) barrier layer, and an oxygen electrode are investigated for durability under co-electrolysis conditions in both galvanostatic and potentiostatic conditions. While changing the gas on the oxygen electrode, keeping the fuel electrode gas composition constant, a change in the gas concentration arc was observed by impedance spectroscopy. Measurements of open circuit potential revealed the presence of leaks in the setup. It is speculated that the change in concentration impedance may be related to the leaks. Furthermore, the cells were also tested under pressurized conditions to find an inter-play between the leak rate and the pressure. A mathematical modeling together with electrochemical and microscopy analysis is presented.

Keywords : co-electrolysis, durability, leaks, gas concentration arc
Conference Title : ICLPSOFC 2019 : International Conference on Lifetime and Performance of Solid Oxide Fuel Cells
Conference Location : Tokyo, Japan
Conference Dates : April 22-23, 2019