P.2-01

IP-SOFC OPERATED ON HYDROGEN- METHANE MIXTURE AS FUEL

G. Almutairi, A. Dhir and W. Bujalski
Centre for Hydrogen and Fuel Cell Research, School of Chemical Engineering, The University of Birmingham, B15 2TT, UK
Email: gna881@bham.ac.uk

Keywords: IP-SOFC, degradation; cycling tests, mixture fuel

Abstract:
Two kinds of experiments have been carried out in this work with the aim of testing IP-SOFC design. These tubes are screen printed with anode (Ni/YSZ based), cathode (LSM-based), and electrolyte (YSZ) [1,2]. Various mixtures of fuel in terms of hydrogen and methane content have been tested as described below:
First experiment: The tube was operated under four fuel mixtures (H_2 and CH_4) at 900°C to investigate its degradation behavior where methane content varied from 5%, to 20% with the remainder being hydrogen. Initial IV curve for pure hydrogen was taken as a reference and then the IV curves were recorded for each fuel mixture run.
Second experiment: The tube was fed with fuel mixture (95% Hydrogen-5% Methane and 80% Hydrogen-20% Methane) at a flow rate of 1.5 L per min. Then steady operation at 1 A load commenced for 48 hours followed by the load being decreased to 0A. This process (current load cycles) was repeated 7 times. The IV curves were recorded for every current load cycle in order to assess the performance (degradation) of the tube.
The results have shown that the open circuit voltage increases with increasing the amount of methane in fuel mixture. However, the repeated operation with a fuel mixture (H_2 and CH_4) affected the performance of tube. This is likely to be predominantly a direct consequence of the alteration of the anode, because of carbon deposition on its surface, leading to deactivation of catalysis. In durability experiment, testing was conducted at 900°C with a constant load of 1 A, using two different fuel mixtures of hydrogen and methane. When using 95% H_2 and 5% CH_4, the tube voltage degradation rate was 5% per 1000 hours, whereas when using 80% hydrogen and 20% methane, the voltage degradation rate was significantly higher, compared with previous work [3].
This result shows that the performance of IP-SOFC improves with increased methane amount in the fuel mixture but there was sensitivity when operated in long-term test mode. Clearly, there was the influence of fuel composition on the longevity due to potential carbon clogging and other aspects of tube behavior over extended period of operation. Further work to investigate this