8th Annual International Conference Partnering & Exhibition
29th March 2012 | Gallery Suite, NEC, Birmingham UK
Poster Presentation

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

Our work looks at testing the effect of mixture fuel (Hydrogen-Methane) on the performance of the IP-SOFC [1,2],(Figure1) through accelerated aging techniques including load and thermal cycles aiming to simulate in weeks years of damage and degradation in performance. The function of a cycling test is to investigate the fuel cell stability and degradation behaviour under unsteady operating conditions. IP-SOFC plate is heated in furnace to 900°C at 1°C a minute. The tube is then run on pure hydrogen to record the initial IV curve (comprised of gradual increase the load from 0 to 1.8 A in 0.1 A steps). Following this, the tube was fed with Hydrogen-Methane mixture as fuel, the fuel managed by reducing the step when decreasing Hydrogen and increasing Methane by 5% for each experiment where the total amount was 1.5 L per min, according to operating conditions as stipulated by the manufacturer's guidelines for a unit of this type. Then steady operation at 1 A commenced for 48 hours followed by the load being decreased to 0A. This processes (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. After each 7 load current cycles the fuel changed from mixture to pure hydrogen for 48 hours after which period IV curves were recorded for comparison purposes.

The tube was operated under various fuel mixtures (H_2 and CH_4) at 900°C to investigate its degradation behavior. The results have shown that the open circuit voltage increases with increasing the amount of methane in fuel mixture. The OCV was 31.392 V for 30 cells when using pure hydrogen whereas the OCV increased to 32.35, 34.421, 36.156 and 36.291for 5%, 10%, 15% and 20% CH_4, respectively. However, the voltage produced by all the fuel mixtures was close to around 27 V at current density around 0.1 A cm^{-2} as shown in Figure 2. This indicates that the IP-SOFC does not have any sensitivity when operated either with pure hydrogen or with up to 20% content of CH_4 as can be clearly seen from the IV curves presented in Figure 2. This initial run was repeated but, due to equipment failure, it is not possible to draw firm conclusion considering the influence of fuel composition on the longevity, potential carbon clogging and other aspects of tube behavior over extended period of operation. Further work to investigate this in detail is ongoing.

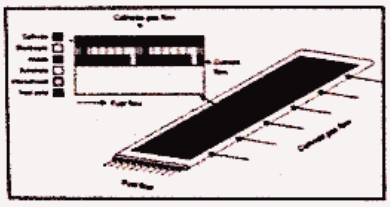

Figure 1 IP-SOFC tube

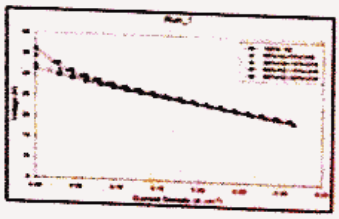

Figure 2 IV Curve

References:

[1] J. P. Wilcoxon, The Journal of Physical Chemistry B, 104(31) (2000). [2] Z.Y. Li, N.P. Young, M. Di Vece, R.E. Palmer, A.L. Bieloch, B.C. Curley, R.L. Johnston, J. Jiang, J. Yuan, Nature 451(46-48) (2008).