Study on Biodiesel-fueled Solid Oxide Fuel Cells

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Abstract

Although most fuel cells require hydrogen as a fuel, solid oxide fuel cell (SOFC) operated at high temperature range between 700 and 1000^{o}C accepts the direct use of hydrocarbon fuels. Hydrocarbon fuels are reformed within the porous Ni-based anode producing H_2-rich syngas, which is eventually used to generate electricity and heat through electrochemical oxidation. Highly efficient fuel cells operated by fossil fuels can certainly contribute to suppress environmentally harmful emissions, but in view of exhaustion of fossil resources, the utilization of renewable bio-energies should be more promoted. The use of liquid biofuels is also attractive due to their easy storage and transportation with high hydrogen content. The aim of this research is, therefore, to investigate the viability of anode–supported type cells (Ni-ScSZ/ScSZ/LSM-ScSZ) operating with real biodiesel fuels and pure chemical fuels. The results of this research demonstrated that in principle direct-feeding of biodiesel fuels into SOFC is viable and decent voltage is obtainable. H_2 rich gas was obtained via internal reforming of biodiesel fuels, as well as electricity can be obtained from biodiesel fuels via SOFC technology. The highest power density of biodiesel-fueled SOFC was obtained 0.32 W cm^{-2} for palm-biodiesel at 0.4 A cm^{-2} and 800^{o}C under S/C = 3.5, which is comparable with 0.39 W cm^{-2} for dry H_2 at same operating conditions. Palm-biodiesel containing highest amount of saturated fatty acid methyl ester (FAME) among tested biodiesel fuels had led to most stable SOFC operation, and the amount of deposited carbon was considerably small compared to the other fuels with higher degree of unsaturation. Subsequent durability test revealed that internal reforming SOFC running on wet palm-BDF exhibited great stable voltage of around 0.8 V at 0.2 A cm^{-2} for more than 1 month with the degradation rate of approx. 1.5 % / 100 h as show in the figure.

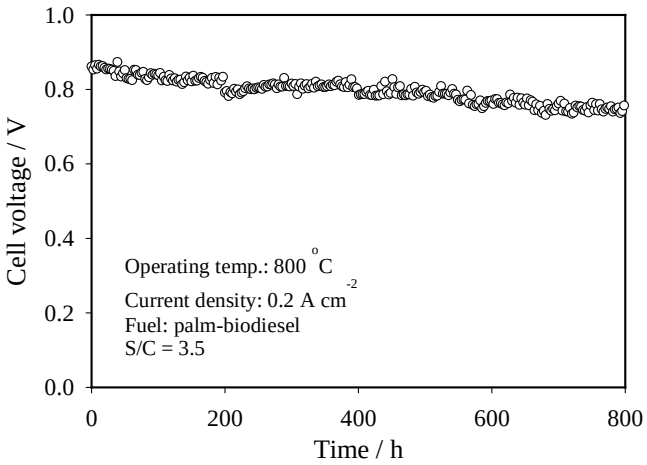

Figure - The result of durability test of internal reforming SOFC running on wet palm-BDF (S/C = 3.5) at 800^{o}C.