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Impact of biosyngas and its components on SOFC anode performance

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Biomass gasification is a well-known technology for thermochemical conversion of solid biomass into gaseous fuel. Hydrogen, carbon monoxide, carbon dioxide, nitrogen, methane etc are the main components of this gas, which is known as biosyngas. Biosyngas contains various contaminants also. This gas is being considered widely as a fuel for solid oxide fuel cells. Biosyngas will have to be cleaned properly before using in SOFCs. Design of suitable cleaning systems requires extensive information on levels of contaminants in the fuel gas as well as the sensitivity of the SOFCs for all contaminants that will be found in the fuel gas. As the fuel reacts in the anode, the performance of anodes with the gas from the gasifier is studied in detail.

Impedance measurements are carried out with Ni/GDC as well as SDC symmetric test cells at different temperatures ranging from 1173 K to 1023 K with varying gas composition. Effect of dilution of hydrogen with different gases like CO, CO_2 and N_2 are studied. Measurements with simulated gas with compositions that of biosyngas had shown reasonable performance of the anode when compared to pure hydrogen as fuel even though flow dilution appears to make an impact. No significant carbon deposition is observed on the cells. C-H-O ternary diagrams have indicated that the gas is in thermodynamically safe region with respect to carbon deposition. Ni/GDC anodes were tested also with H_2S, which is one of the contaminants present in biosyngas. H_2S was mixed with humidified H_2 up to 9 ppm. At each of these concentrations, test cells were kept for 90 minutes each and impedance variation was measured. No significant increase in impedance is observed at 1123 K and 1023 K. Results of the experiments with a detailed analysis and the influence of these observations on design of biomass gasifier-solid oxide fuel cell systems is presented.

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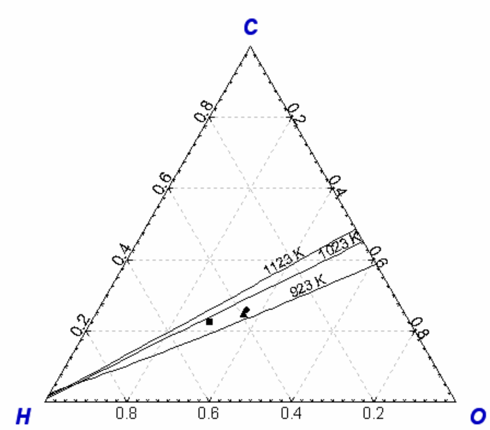

Fig 1. C-H-O equilibrium at with representative biosyngas compositions-. • 40% H_2, 40% CO, 20% CO_2, ▲ 20% H_2, 20% CO, 10% CO2, 50% N_2,, ■ 50% H_2, 40% CO, 10% CO_2 (all mixtures humidified at 30 °C).

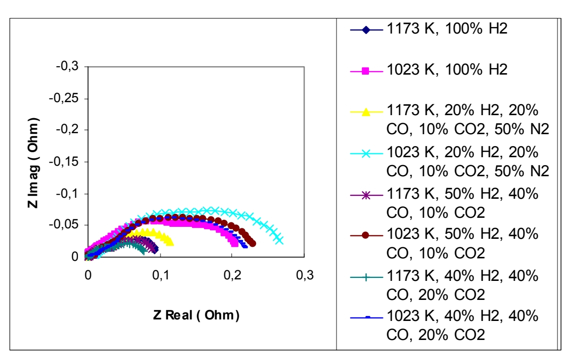

Fig 2. Impedance for Ni/GDC anodes with different biosyngas compositions at 1173K and 1023K (all mixtures humidified at 30 °C).