

COMPARISON OF ANODE AND ELECTROLYTE SUPPORT CONFIGURATION OF SINGLE CHAMBER SOLID OXIDE FUEL CELL

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The single chamber SOFC has recently received considerable attention. This type of fuel cell operates in the mixed reactant gas and therefore does not require separation of the fuel and oxidant gases. In this paper the anode and electrolyte supported configurations of the single chamber SOFC has been studied. The system based on typical fuel cell composition has been examined: yttrium stabilized zirconia (YSZ) as an electrolyte, nickel/YSZ cermet as an anode while lanthanum strontium manganese oxide (LSM) used as a cathode. The cells were prepared by tape casting and screen printing techniques. Fig.1 shows cross section of anode supported cell.

The fuel cell operation is based on the difference in catalytic activity between cathode and anode in the mixed reactant gas. Hydrocarbons may be converted into carbon monoxide and hydrogen mainly due to oxidation and steam reforming reactions. If those reactions occur at the anode and not at the cathode, an oxygen concentration gradient will be obtained in the cell. Once oxygen gradient is formed and electrical energy can be obtained like in conventional fuel cell systems. Recently published results show improvement in fuel cell performance, however the mechanisms of operation are not fully understood (1).

The objective of this study was to compare the performance of electrolyte and anode supported single chamber SOFCs. Conventional fuel cell materials (YSZ electrolyte, Ni/YSZ cermet anode, LSM cathode) were used in order to better understand the mechanisms of fuel cell operation.

Fig. 2 shows the power density as a function of furnace temperature of the electrolyte supported cells with the different cathode microstructure. The low temperature sintered cells show lower performance than cells sintered in higher temperature. The relatively higher power densities measured for the fuel cells using LSM (sintered at 1000°C and 1050°C) may be a result of lower overpotential and lower ohmic resistance. This appears to be a result of a decrease of the fuel endothermic reforming reaction at the cathode electrode. Therefore, one possible explanation is that the LSM microstructures obtained at 900°C and 950°C favor fuel reforming at the cathode. This may be explained by higher LSM catalytic activity than in the case of cathode sintered at 1000°C and 1050°C.

Fig. 3 shows comparison of electrolyte supported and anode supported single chamber SOFC performance. The performance below 500°C is much better than electrolyte supported cell. Even when the temperature of the cell was relatively low it was possible to obtain much higher power densities than for electrolyte supported cells. This may be explained by low anode overpotential and low electrolyte resistance.

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1. T.Hibino, A.Hashimoto, T.Inoue, J.Tokuno, S.Yoshida, M.Sano, *Science* **288**, 2031 (2000).

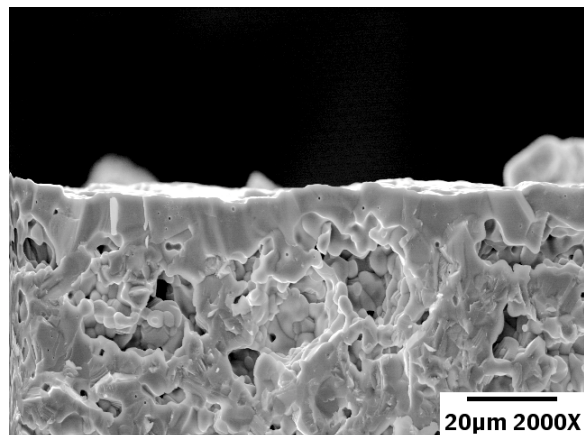


Fig. 1. Cross section of the anode supported cell

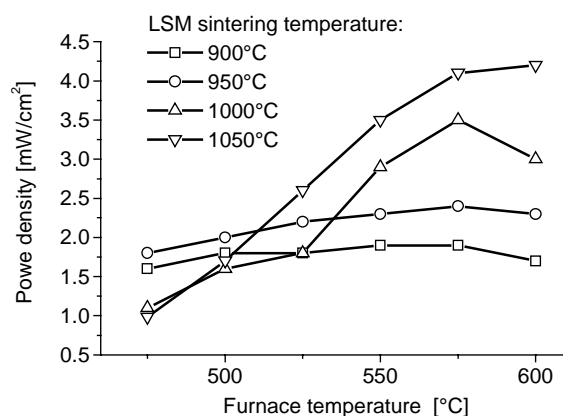


Fig. 2. Power density of electrolyte supported cells as a function of furnace temperature.

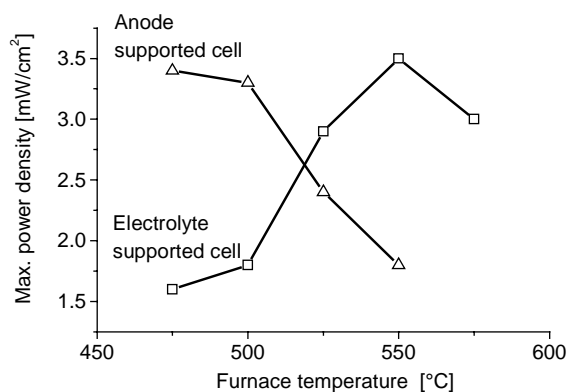


Fig. 3. Comparison of power density for anode and electrolyte supported cells.