Characterization of Cathode Supported Thin Film Electrolytes

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The deposition of gas tight thin film electrolytes onto a cathode substrate by scalable, low cost technologies is a challenging task. The gas tight electrolyte layer has to be applied onto the porous cathode substrate using sintering temperatures << 1300 °C to avoid a densification of the cathode substrate as well as the formation of insulating reaction products at the cathode/electrolyte-interface.

Cathode supported double layer thin film electrolytes were produced by screen printing and metal organic deposition (MOD). The conductivity of the electrolyte layers was evaluated by impedance spectroscopy. The microstructural properties were investigated by SEM.

LSM ($La_{0.75}Sr_{0.2}MnO_3$) was used for the cathode substrates, which were sintered at temperatures below 1300 °C to achieve a sufficient open porosity. To avoid higher processing temperatures for the electrolyte, at first a 5 to 15 µm thick yttria stabilized zirconia (YSZ) resp. gadolinia doped ceria (CGO) layer was screenprinted onto the substrate. This layer was sintered at temperatures in between 1000 °C and 1250 °C and therefore still exhibited an insufficient density (Fig. 1).

In the second step, the remaining pores were filled and the surface of the screen printed layer was coated using an MOD-process. Applying these two consecutive steps, the production of gas tight double layer electrolytes seems to be feasible. (Fig. 2).

The microstructure and the conductivity of the double layer thin film electrolytes is significantly influenced by the processing conditions. With increasing density the conductivity increased. But even for nearly dense electrolyte layers the expected conductivity values of a dense planar YSZ electrolyte substrate were not achieved (Fig. 3).

An improvement of the screenprinted layer as well as the MOD-coating will be necessary to enhance the density as well as conductivity of the cathode supported thin film electrolyte.

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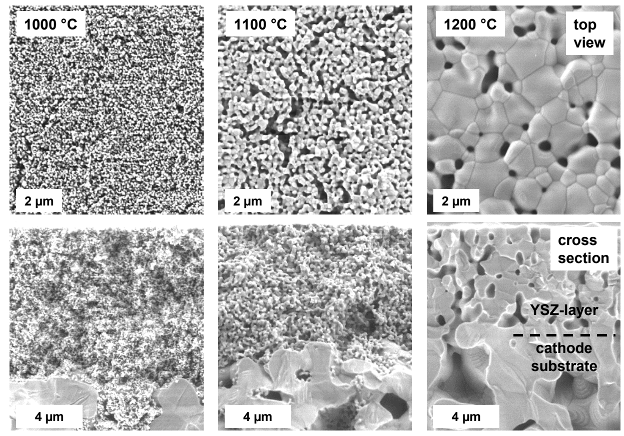

Figure 1: SEM-micrographs of screenprinted YSZ-layers sintered at different temperatures.

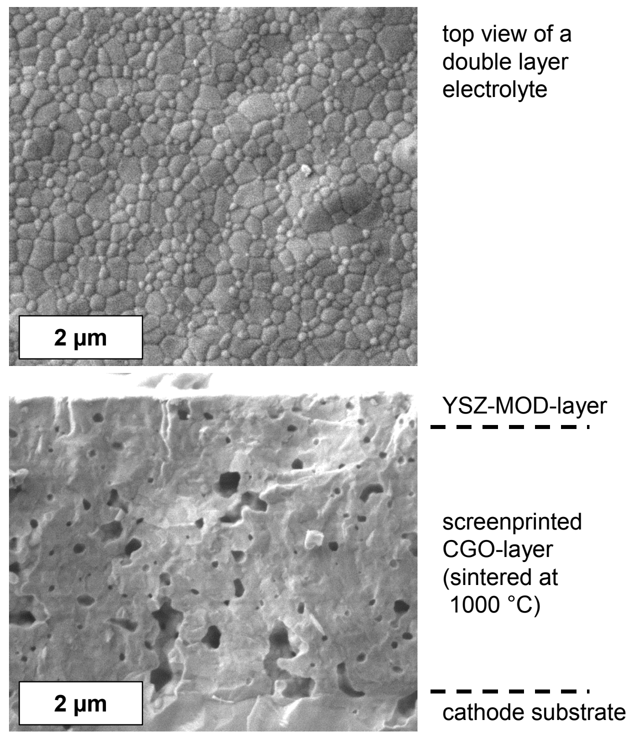

Figure 2: SEM-micrographs of a double layer electrolyte consisting of a screenprinted CGO-layer and a YSZ-MOD-layer.

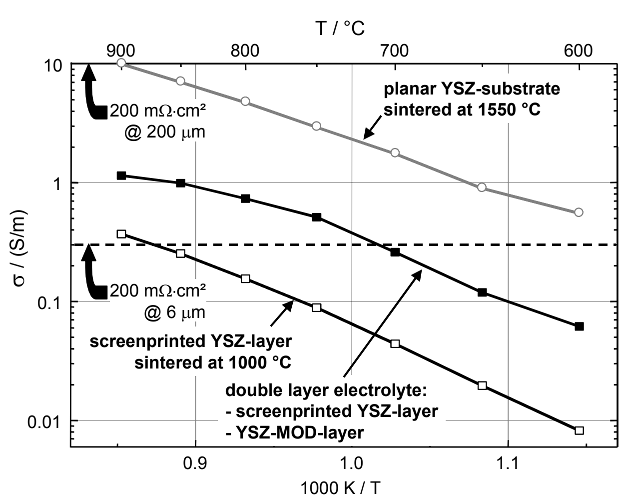

Figure 3: Conductivity of a double layer electrolyte consisting of a screenprinted YSZ-layer which was densified and coated by a YSZ-MOD-layer.