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Bridging the Gap Between Fundamentals and Application

courtesy of Udo Starzacher
Improved Cell Performance of the Plansee MSC by Stepwise Optimization of the Microstructure

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Metal-supported Solid Oxide Fuel Cells (MSCs) are promising candidates for mobile applications like range extenders or auxiliary power units, however they need increased power density. The initial Plansee reference cell consists of a screen printed LSCF cathode, an 8YSZ gas-flow-sputtered thin-film electrolyte, a screen printed Ni/GDC functional layer, two Ni/YSZ interlayers and a substrate made of porous ITM metal. As a key role, the interface between electrolyte and anode as well as the adjacent functional layers provide the highest potential to improve the cell performance. In this region, three parameters were changed to optimize the microstructure properties 1) Ni/GDC or Ni/YSZ interlayer material, 2) layer thickness and 3) sinter temperature of the anode.

By screen printing of the anode on a porous substrate, two effects generally appear: With every additional layer, the surface roughness reduces, but the cell also tends to form a bowl shape (deflection).

However, for a high-quality interface, roughness, cell shape deviation and micro-roughness must be minimized. By changes in the anode thickness, anode material and sintering temperature, the roughness and deflection of the interface could be reduced. The higher surface-quality could be even demonstrated by an improved leakage rate of cells with 4 μm electrolyte.

Another well-known measure to improve the performance is to lower the ohmic resistance of the cell by reducing the electrolyte thickness. By varying between 2 and 6 μm, limiting effects were shown by using results from SEM, leakage rate and deflection measurements, OCV and cell performance. The anode has the highest potential for improvement but also needs the most requirements to be practically fulfilled: high specific surface, high permeability, high tortuosity. The precise selection of materials, layer thicknesses and sintering temperatures led to measureable improvements in permeability and cell performance, which could be increased from 1.29 A/cm² to 1.79 A/cm².