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Metal-supported solid oxide fuel cells (Metal-supported SOFCs) are expected to offer several potential advantages over conventional anode (Ni-YSZ) supported cells, such as increased resistance against mechanical and thermal stresses and a reduction in materials cost. When Ni-YSZ based anodes are used in metal supported SOFC, electrode material from the active anode layer may interdiffuse with the metallic support during sintering. Interdiffusion causes formation of a Ni-Cr-Fe alloy in the anode layer, which is detrimental to cell performance and stability (see e.g. (1) and references therein). The interdiffusion problem was the main motivation for exploring cell designs where this problem is minimized.

The purpose of this work is to illustrate how the interdiffusion problem can be circumvented by using an alternative anode design based on porous and electronically conducting layers into which electrocatalytically active materials are infiltrated after sintering. The paper presents the recent results on the electrochemical performance and durability of the novel planar metal-supported SOFC design. Furthermore, the future outlook and initial results from corrosion and mechanical behavior of the developed metal-supported cell design will be discussed in the paper.

The cell design is based on a multilayered structure obtainable by conventional ceramic processing techniques. A porous metal support and a cermet layer, containing electronically conducting metal particles together with an ionically conducting ceramic component, are co-sintered together with an electrolyte (see a cross-section of the half cell in Figure 1). After co-sintering, the electrocatalytically active phase, comprising a ceria-based material, is infiltrated into the porous structure. The cathode layer is then applied as the last component and consists of a LSCF:CGO composite.

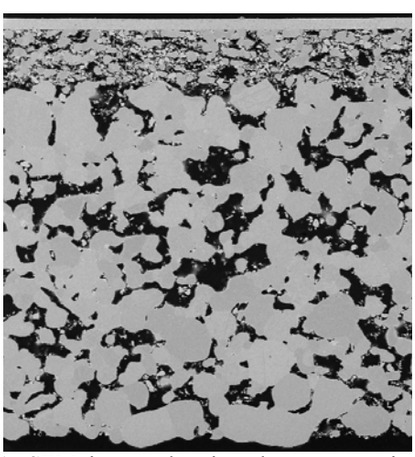

Figure 1. SEM image showing the cross-section of the planar metal-supported half cell. The electrolyte is shown in the top, followed by the cermet layer, and the metal support (total thickness ~300µm).

The electrochemical performance has been measured in the range 600 – 800 °C with humidified hydrogen as fuel. The results show that power densities up to 1.2 Wcm^{-2} can be obtained at 750 °C and a cell voltage of 0.6 V. Galvanostatic durability tests has been carried out for approximately 1000 h at 650 °C. The results demonstrate fair long-term stability and excellent performance at intermediate temperatures.

The anode polarization resistance of an infiltrated cermet anode structure has been measured to be 0.12 Ωcm^2 and 0.06 Ωcm^2 in humidified hydrogen at 650 ºC and 750 ºC, respectively. These measurements were conducted in a symmetrical cell configuration in a one-atmosphere set-up. The low polarization resistance was achieved by infiltrating the porous cermet structure with Gd-doped CeO_2 together with very small amounts of Ni.

The results presented in the paper show that the novel cell and anode design has a promising performance and durability at a broad range of temperatures and is especially suitable for intermediate temperature operation.

REFERENCES

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