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Protective coatings for interconnects for solid oxide cell stacks

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Summary. Long term operation of solid oxide cell stacks with low degradation requires use of protective interconnect coatings with low chromium permeation and high electrical conductivity. This work summarizes research and development efforts in the field of protective coatings carried out at DTU Energy.

Abstract. High temperature corrosion of steel interconnects (IC) is an important degradation issue of solid oxide cell stacks. Due to a continuous growth of relatively poorly conductive oxides, resistance of the interconnect increases over time [1], contributing to increasing stack losses. In addition, on the oxygen side of the IC, evaporation of Cr species can occur and poison the electrodes further lowering stack performance. On the hydrogen side, interdiffusion of Cr, Fe and Ni can occur and cause austenitization [2,3] of the alloy and change of its thermal expansion and carbon solubility. For mitigation of these negative phenomena protective coatings can be used. This work summarizes coating solutions currently used at DTU Energy.

For the oxygen side, protective coatings include Mn-Co spinels, which have been proven to block chromium diffusion, have high electronic conductivity and good thermal expansion coefficient match to other stack components. These coatings, typically ~10 µm thick, are prepared by the electrophoretic deposition method, allowing covering large shaped ICs. In addition to the spinel, thin reactive elements coatings based primarily on yttria are considered for even further lowering corrosion rates. When used together with the spinel, these coatings offer synergistic effect of slow oxide growth and low Cr diffusion on the oxygen side.

For the hydrogen side, coatings based on yttria and doped ceria are being considered. They can slow the oxide growth and block interdiffusion between the alloy and the hydrogen electrode.

By combining coatings both for the oxygen side and for the hydrogen side, an advanced and effective coating solution can be achieved.

References:

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