High Performance Nano-Ceria Electrodes for Solid Oxide Cells - DTU Orbit (10/08/2019)

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In solid oxide electrochemical cells, the conventional Ni-based fuel-electrodes provide high electrocatalytic activity but they are often a major source of long-term performance degradation due to carbon deposition, poisoning of reaction sites, Ni mobility, etc. Doped-ceria is a promising mixed ionic-electronic conducting oxide that could solve these issues if it can be integrated into an appropriate electrode structure. Two new approaches to obtain high-performance nanostructured doped-ceria electrodes are highlighted. The first is an infiltration-based architecture with $\text{Ce}_{0.8}\text{Pr}_{0.2}\text{O}_{2-\delta}$ forming the active surfaces on a porous backbone with embedded electronic current collector material, yielding one of the highest performances reported for an electrode that operates either on fuel or oxidant. The second is a nano-$\text{Ce}_{0.9}\text{Gd}_{0.1}\text{O}_{2-\delta}$ thin film prepared by spin-coating, which provides an unprecedented electrode polarization resistance of $\sim 0.01 \, \Omega \, \text{cm}^2$ at 650 °C in $\text{H}_2/\text{H}_2\text{O}$. These results demonstrate that nano-ceria has the ability to achieve higher performance than Ni-based electrodes and show that the main challenge is obtaining sufficient electronic current collection without adding too much inactive material.

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