Sulfur poisoning of ceria-based SOFC model composite anodes: Identifying elementary processes in degradation behaviour

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Resume: In the past decade solid oxide fuel cell (SOFC) research mainly focused on the cathode side and vast improvement was achieved by substituting the triple phase boundary active lanthanum manganite (LSM) electrodes with mixed ionic electronic conductors (MIEC) such as lanthanum cobaltite based electrodes (LSC and LSCF). SOFC anodes, however, still rely on nickel/yttria-stabilized zirconia (YSZ) cermet structures. An analogous development to MIEC materials on the anode side is therefore expected to significantly improve SOFC performance. One promising candidate is gadolinia doped ceria (GDC), which has been reported in literature to exhibit high H2S tolerance as well. In this contribution thin film GDC anodes with specially shaped buried current collectors were applied, which allow a separation of elementary processes such as electronic and ionic conductivity, surface exchange resistance and chemical capacitance. By means of these model composite anodes it is possible to show that GDC anodes undergo significant electrochemical changes in H2S containing atmospheres. Moreover, the sulfur poisoning of GDC anodes can be mainly attributed to an increase of the surface exchange resistance, while the other probed parameters undergo only minor changes relevant to SOFC performance. In addition sulfide uptake into GDC bulk was investigated by secondary ion mass spectrometry (SIMS) and diffusion as well as surface exchange coefficients were estimated from the obtained diffusion profiles.

Atom probe tomography (APT) Analysis of the Grain Boundary Region in BSCF and BSCF10Y

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Resume: Mixed ionic-electronic conducting perovskite oxides (ABO3) are used for ceramic high-temperature (700...900 °C) oxygen-transport membranes (OTMs). Ba0.5Sr0.5Co0.8Fe0.2O3-δ (BSCF) shows outstanding oxygen-permeation properties and is the most promising candidate for such an OTM. Its superior performance, however, depends on its cubic perovskite structure. This presents a problem at temperatures below 840 °C where detrimental secondary-phase formation occurs – preferably along the grain boundaries. By suitable B-site doping with, e.g., yttrium, the cubic phase stability range can be expanded to lower temperatures. Generating an atomic three-dimensional (3D) reconstruction of the chemistry of perovskite ceramic bulk samples by means of atom probe tomography