Perovskite and spinel-based protective coatings

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Metallic interconnects for planar intermediate temperature solid oxide fuel cell (IT-SOFC) stacks are almost exclusively fabricated with Fe-16÷25 wt.-% Cr ferritic stainless steels. These metallic materials offer such advantages as low cost, good corrosion resistance in the dual oxidizing/reducing atmosphere due to chromia or chromia-rich scale growth and, finally, thermal expansion match with ceramic cell components. The disadvantage of metal interconnects is the growth of an oxide scale which increases the bulk resistance and contact resistance, and is prone to spalling [1-2]. Furthermore, chromium in the scale forms volatile species such as $CrO_2(OH)_2$ or CrO_3 which have been associated with cell poisoning, particularly on the air electrode side [3]. In this work, Crofer 22APU and DIN 50049 ferritic steel covered with perovskite $(La,Ca)CrO_3$, $(La,Sr)CrO_3$, $(La,Sr)(Co,Fe)O_3$ films and spinel $Mn_{1.5}Co_{1.5}O_4$, $Mn_{1,5}Cr_{1,5}O_4$ compounds were investigated. These films were obtained via pulsed laser deposition (PLD), screen-printing and cobalt electroplating methods. Uncoated and coated specimens were thermally oxidized in air and H_2/H_2O gas mixture at 700-900°C for up to 1000 hrs. The aim was to study the oxidation properties of coated Fe-Cr steels with regard to microstructure development of the conducting multilayer formed as a result of interaction between the thick films and the steel substrate. Finally, the performance of the investigated metal/ceramic materials is discussed in terms of electrical properties and Cr vaporization rate.

Figure 1 shows the polished taper cross-sectional morphology of LCCr film deposited on DIN50049 steel and oxidized in air at 800°C for 200 hrs. From this figure, it follows that the LCCr layer exhibits good adhesion to the metallic core and was porous. This film, having the same thickness on the whole cross-section of about 20 μm, consists of oval grains with sizes from about 0.1 to 0.5 μm. The XRD diffraction, taken from the coating successively thinned down by polishing, revealed the presence of $La_{0.2}Ca_{0.8}CrO_3$, $LaCrO_3$ and $(Mn,Fe)Cr_2O_4$.

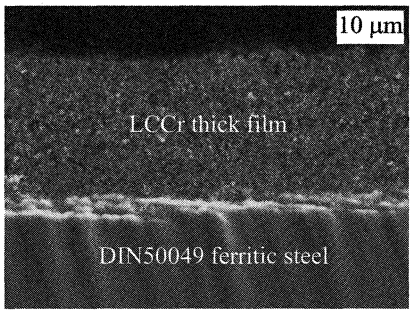

Fig. 1 SEM micrograph of cross-section of LCCr film coated on DIN50049 steel and oxidized in air at 800°C for 200 hrs.

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