High-temperature oxidation of the Crofer 22H ferritic steel with Mn1.45Co1.45Fe0.1O4 and Mn1.5Co1.5O4 spinel coatings under thermal cycling conditions and its properties

The aim of the presented study was to deposit protective-conducting Mn1.45Co1.45Fe0.1O4 and Mn1.5Co1.5O4 spinel coatings on the Crofer 22 H ferritic steel by means of electrophoresis and to evaluate their physicochemical properties after high-temperature oxidation under thermal cycling conditions. When the Crofer 22 H steel – whether uncoated or coated with the two spinels – was oxidized in 48-h cycles involving a temperature of either 750 or 800 °C, its oxidation kinetics approximately obeyed the parabolic rate law. The oxidation rate observed for uncoated steel was higher than that for the studied coating/steel systems. The Fe-doped spinel coating material improved the oxidation resistance of steel to a higher degree than the undoped spinel coating. The obtained bulk spinels exhibited a regular phase composition and high electrical conductivity, while the Mn1.45Co1.45Fe0.1O4 and Mn1.5Co1.5O4 coatings were dual-phase, compact, and exhibited good adhesion to the metallic substrate. The area-specific resistance values measured for the steel/coating systems indicate that the coatings significantly improve the electrical properties of the studied ferritic steel, especially at 800 °C. The conducted research confirmed the suitability of the Mn1.45Co1.45Fe0.1O4 and Mn1.5Co1.5O4 spinels as coatings on the Crofer 22 H ferritic steel to be applied in the production of interconnects used in intermediate-temperature SOFCs.

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