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Study of Porous Metallic Support for Intermediate-Temperature Solid Oxide Fuel Cells

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Abstract : Solid oxide fuel cells (SOFCs) are promising devices for energy conversion due to their high electrical efficiency and eco-friendly behavior. Their performance is not only influenced by the microstructural and electrical properties of the electrodes and electrolyte but also depends on the interactions at the interfaces. Nowadays, commercial SOFCs are electrically efficient at high operating temperatures, typically between 800 and 1000 °C, which restricts their real-life applications. The present work deals with the objectives to reduce the operating temperature and to develop cost-effective intermediate-temperature solid oxide fuel cells (IT-SOFCs). This work focuses on the development of metal-supported solid oxide fuel cells (MS-IT-SOFCs) that would provide cheaper SOFC cells with increased lifetime and reduced operating temperature. In the framework, the local company TIBTECH brings its skills for the manufacturing of porous metal supports. This part of the work focuses on the physical, chemical, and electrical characterizations of porous metallic supports (stainless steel 316 L and FeCrAl alloy) under different exposure conditions of temperature and atmosphere by studying oxidation, mechanical resistance, and electrical conductivity of the materials. Within the target operating temperature (i.e., 500 to 700 ° C), the stainless steel 316 L and FeCrAl alloy slightly oxidize in the air and H2, but don't deform; whereas under Ar atmosphere, they oxidize more than with previously mentioned atmospheres. Above 700 °C under air and Ar, the two metallic supports undergo high oxidation. From 500 to 700 °C, the resistivity of FeCrAl increases by 55%. But nevertheless, the FeCrAl resistivity increases more slowly than the stainless steel 316L resistivity. This study allows us to verify the compatibility of electrodes and electrolyte materials with metallic support at the operating requirements of the IT-SOFC cell. The characterizations made in this context will also allow us to choose the most suitable fabrication process for all functional layers in order to limit the oxidation of the metallic supports.

Keywords : stainless steel 316L, FeCrAl alloy, solid oxide fuel cells, porous metallic support
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