Mechanical Properties of Supports and Half-Cells for Solid Oxide Electrolysis Influenced by Alumina-Zirconia Composites

In order to improve the durability and robustness of solid oxide electrolysis cells (SOEC) and stacks, it is necessary to improve the strength of its components. In cathode supported SOEC, the main structural component is the Ni(O)-YSZ support. But the strength of the half-cell or cell is also determined by the strength of other weaker components and by the residual stress state induced by the thermal expansion mismatch. In this study, the mechanical properties of Ni(O)-3YSZ supports with a reference composition and with substitution of 3YSZ by 20A3YSZ (3YSZ with 20 wt.% Al2O3) have been tested and compared. The initial interest of this substitution are a decrease of the coefficient of thermal expansion (CTE) mismatch within the half-cell and the fact that 20A3YSZ is stronger than 3YSZ. The influence of the process on the composition, strength, elastic properties and electrical conductivity of the supports have been measured and analyzed. The short and long-term evolution of these properties is linked to the formation of a NiAl2O4 phase. The samples properties were measured at room temperature or high temperature (800 °C) and in oxidized or reduced conditions. The impact of these supports on residual stresses and strength of half-cells is also discussed.