Improving the Long-Term Stability of MSC Cathodes by Adapted Processing

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Metal supports are responsible for the excellent robustness of metal-supported solid oxide fuel cells (MSCs), but also imply a major challenge of this design. Cathode sintering in ambient air at temperatures above 1000 °C, usually applied to anode-supported cells, is not applicable to MSCs. This is due to the strong oxidation of the supporting metal and of the nickel used in the anode during such treatments. Furthermore, cathode sintering under hydrogen atmosphere, preferentially applied to the metallic substrate, is excluded, as it causes strong phase decomposition of cathode materials like (La,Sr)(Co,Fe)O_3. Therefore, state-of-the-art MSC cathodes are utilized for stacking in the green state and in-situ activated during stack joining and startup at 850 °C for 100 h. Such in-situ activated cathodes show poor adherence to the $Ce_{1-x}Gd_xO_{2-\delta}$ diffusion barrier layer as well as limited mechanical properties leading to insufficient performance and long-term stability of these cells. The present work aims on improving the cathode adherence, mechanical stability, and electrochemical performance by optimization of the MSC cathode processing. Areas of investigation cover (i) sintering and phase stability studies of the cathode material in atmospheres with well-defined p_{O_2}, (ii) utilization of finer powder and sintering aids to lower the required sintering temperature, and (iii) characterization of the cathode/electrolyte interface to ensure sufficient bonding between the layers.