Electrochemical Characterization and Degradation Analysis of Large SOFC Stacks by Impedance Spectroscopy

As solid oxide fuel cell (SOFC) technology is moving closer to a commercial breakthrough, lifetime limiting factors, and methods to measure the “state-of-health” of operating cells and stacks are becoming of increasing interest. This requires application of advanced methods for detailed electrochemical characterization during operation.

An experimental stack with low ohmic resistance from Topsoe Fuel Cell A/S was characterized in detail using electrochemical impedance spectroscopy (EIS). An investigation of the optimal geometrical placement of the current feeds and voltage probes was carried out in order to minimize measurement errors caused by stray impedances. Three different stack geometries were investigated by impedance spectroscopy and the stack geometry with the minimum effect of stray impedances was selected.

A 13-cell experimental SOFC stack was tested during 2,500 h of operation with hydrogen as fuel with 52% fuel utilization and constant current load (0.2 A cm⁻²) at 750 °C. Stack interconnects were coated with six different coatings to prevent chromium poisoning on the cathode side. Four repeating units (RUs) with different coatings were selected for detailed impedance analysis. EIS allowed a distinction to be made in terms of the degradation between the four RU types that is not possible from IV-data only.

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