Electrochemical Performance of Metal Supported Solid Oxide Cells Used for High Temperature Water Electrolysis

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Metal supported cells as developed at DLR for use as solid oxide fuel cells by applying plasma deposition technologies were investigated in operation of high temperature steam electrolysis. The cells consisted of a porous ferritic steel support, a diffusion barrier layer, a Ni/YSZ fuel electrode, a YSZ electrolyte and a LSCF oxygen electrode. During fuel cell and electrolysis operation the cells were electrochemically characterized by means of i-V characteristics and electrochemical impedance spectroscopy measurements including a long-term test over 2000 hours. The results of electrochemical performance and long-term durability tests of both single cells and single repeating units (cell including metallic interconnect) are reported. During electrolysis operation at an operating temperature of 850 °C a cell voltage of 1.28 V was achieved at a current density of -1.0 Acm^{-2}; at 800 °C the cell voltage was 1.4 V at the same operating conditions. The impedance spectra revealed a significantly enhanced polarization resistance during electrolysis operation compared to fuel cell operation which was mainly attributed to the hydrogen electrode. During a long-term test run of a single cell over 2000 hours a degradation rate of 3.2% per 1000 hours was observed for operation with a steam content of 43% at 800 °C and a current density of -0.3 Acm^{-2}. Testing of a single repeating unit proved that a good contacting of cell and metallic interconnect is of major importance to achieve good performance. A test run over nearly 1000 hours showed also a remarkably low degradation rate.