High Temperature Alkaline Electrolysis Cells with Metal Foam Based Gas Diffusion Electrodes

Alkaline electrolysis cells operating at 250°C and 40 bar are able to convert electrical energy into hydrogen at very high efficiencies and power densities. In the present work we demonstrate the application of a PTFE hydrophobic network and Ag nanowires as oxygen evolution electrocatalyst in the metal foam based gas diffusion electrodes. A novel cell production method, based on tape casting and hot pressing, was developed which allows to increase the cell size from lab scale (1 cm²) to areas of 25 cm² or larger. The thickness of the electrolyte matrix could be adjusted to only 200 μm, achieving a serial resistance and total area specific resistance of only 60 mΩ cm² and 150 mΩ cm², respectively, at 200°C and 20 bar, yielding a record high current density of 3.75 A cm⁻² at a cell voltage of 1.75 V. Encouraging long-term stability was obtained over 400 h of continuous electrolysis. This novel cell concept promises more than a 10-fold improvement in power density, compared to conventional alkaline electrolysis cells, and thereby equivalent reduction in stack size and cost.