Highly efficient high temperature electrolysis

High temperature electrolysis of water and steam may provide an efficient, cost effective and environmentally friendly production of H-2 Using electricity produced from sustainable, non-fossil energy sources. To achieve cost competitive electrolysis cells that are both high performing i.e. minimum internal resistance of the cell, and long-term stable, it is critical to develop electrode materials that are optimal for steam electrolysis. In this article electrolysis cells for electrolysis of water or steam at temperatures above 200 degrees C for production of H-2 are reviewed. High temperature electrolysis is favourable from a thermodynamic point of view, because a part of the required energy can be supplied as thermal heat, and the activation barrier is lowered increasing the H-2 production rate. Only two types of cells operating at high temperature (above 200 degrees C) have been described in the literature, namely alkaline electrolysis cells (AEC) and solid oxide electrolysis cells (SOEC). In the present review emphasis is on state-of-the art electrode materials and development of new materials for SOECs. Based on the state-of-the-art performance for SOECs H-2 production by high temperature steam electrolysis using SOECs is competitive to H-2 production from fossil fuels at electricity prices below 0.02-0.03 is an element of per kWh. Though promising SOEC results on H-2 production have been reported a substantial R&D is still required to obtain inexpensive, high performing and long-term stable electrolysis cells.