High Temperature Electrolysis - DTU Orbit (08/11/2017)

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High temperature electrolysis of carbon dioxide, or co-electrolysis of carbon dioxide and steam, has a great potential for carbon dioxide utilisation. A solid oxide electrolysis cell (SOEC), operating between 500 and 900. °C, is used to reduce carbon dioxide to carbon monoxide. If steam is also input to the cell then hydrogen is produced giving syngas. This syngas can then be further reacted to form hydrocarbon fuels and chemicals. Operating at high temperature gives much higher efficiencies than can be achieved with low temperature electrolysis. Current state of the art SOECs utilise a dense electrolyte, commonly yttria-stabilised-zirconia (YSZ), with porous fuel and oxygen side electrodes. The electrodes must be both electron and oxide ion conducting, and maximising the active surface area is essential for efficient operation. For the fuel electrode a cermet of nickel and YSZ is often used, whereas a lanthanum strontium manganite - YSZ mix is utilised for the oxygen electrode. Long term durability and performance are key for commercialisation of SOEC technology. To date, experimental tests of 1000. h on electrolysis stacks operated at low current density have shown little or no degradation when inlet gas cleaning is employed; however, operation at higher current density leads to cell degradation, which still needs to be overcome. Advances in materials and morphology are needed to further decrease cell degradation.

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