Catalyst coated diaphragms for alkaline water electrolyzers

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Alkaline electrolysis is a well-established technology and does not require scarce metal catalysts. However, the current density is currently too low in comparison to alternative technologies like polymer electrolyte electrolysis. Most importantly, the ionic conductivity of the diaphragm and the performance of the electrodes need to be improved.

We developed the approach of blade-coating a Raney nickel cathode directly onto a diaphragm [1] yielding a catalyst-coated diaphragm (CCD). The influence of the coating composition and thickness was investigated and the electrochemical performance characterized in a single cell electrolyzer. The overvoltage at 300 mA cm^{-2} was reduced by 270 mV compared to the benchmark nickel foam cathode [2], mainly because of the large active surface area of Raney nickel. Despite employing standard Zirfon Perl UTP 500 as separator and a only nickel foam as anode, a remarkable current density of 870 mA cm^{-2} was reached at 2 V.

A long term test over 1000 h at 2 V revealed a low degradation rate of only 22 µA cm^{-2} h^{-1}. In addition, the gas purity was measured with partially separated electrolyte cycles, which reduces cross over via electrolyte mixing [3]. The amount of H_2 in O_2 was well below the lower explosion limit, even at a low current density of 50 mA cm^{-2}.

These results indicate the potential of the newly developed and easily scalable CCD approach.

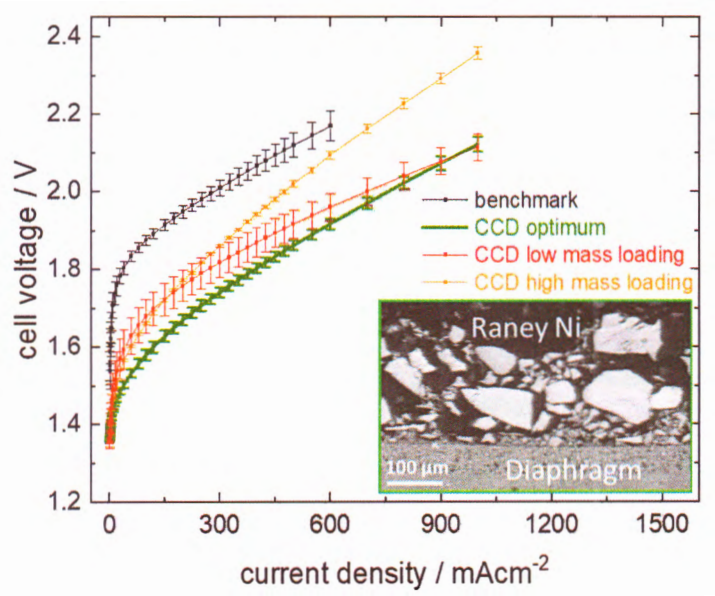

Figure 1. Polarization curves of CCDs with different mass loading. Inset: SEM image of a CCD.

References
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[3] P. Haug et al., Int. J. Hydrogen Energy 42, 2017, 9406-9418.