High-performing and durable catalyst coated diaphragms for alkaline water electrolyzers

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Alkaline electrolysis (AEL) holds great promise for hydrogen production at large scale, because it does not depend on scarce metals as catalysts. However, the current density is too low compared to competing technologies like polymer electrolyte electrolysis. To increase the current density the diaphragm and the electrodes need to be improved.

In this work, we took the novel approach of blade-coating a Raney nickel cathode directly onto a diaphragm [1]. The resulting catalyst-coated diaphragm (CCD) was optimized concerning the coating composition and thickness and thoroughly characterized. The overvoltage at 300 mA cm^{-2} was reduced by 270 mV compared to the benchmark [2], mainly because of the large active surface area of the Raney nickel. A current density of 870 mA cm^{-2} at 2 V was reached despite using standard Zirfon Perl UTP 500 and a simple nickel foam anode. Moreover, the new electrode system showed a low degradation rate of only 22 µA cm^{-2} h^{-1} over 1000 h at 2 V. Gas purity measurements with partly separated electrolyte cycle [3] showed that 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.

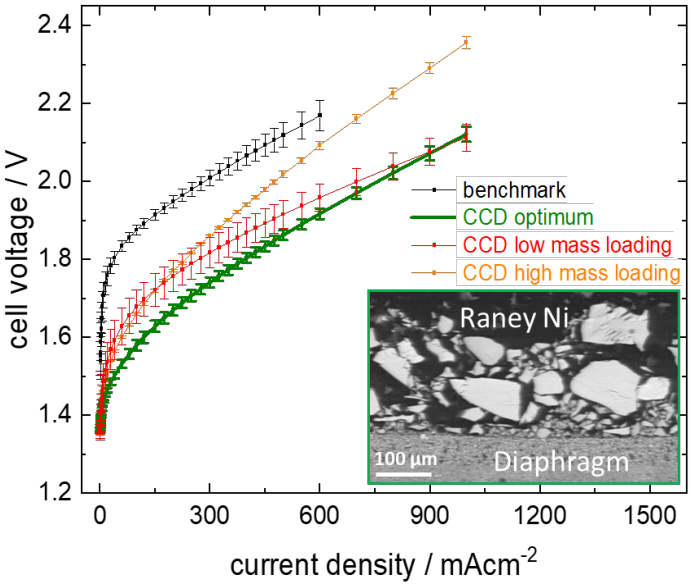

Figure 1. Polarization curves of CCDs with different mass loading. Inset: SEM image of a CCD.

Literature:
[1] C. Karacan et al., J. Electrochem. Soc., 2022, https://doi.org/10.1149/1945-7111/ac697f [2] C. Karacan et al., Int. J. Hydrogen Energy, 2021. [3] P. Haug et al., Int. J. Hydrogen Energy 42, 2017, 9406-9418.