

Optimization of highly active Raney-Nickel cathodes for alkaline water electrolysis (AWE) during the hydrogen evolution (HER) at high current-densities

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INTRODUCTION

In this work we optimize Raney-Nickel electrodes as cathode for alkaline water electrolysis (AWE) at high current densities.¹ Further variation of the catalyst loading, characterization, degradation properties and high-current resistance of the obtained and structured electrodes show a high potential for high-current electrolyzers, scale-up and industrialization.² Goal is to obtain a high and mechanically stable catalyst surface after activation of the electrodes.

EXPERIMENTAL/THEORETICAL STUDY

The electrodes are prepared via spray coating of a Nickel-Aluminium-slurry with different loadings (2-20 mg/cm²) on a nickel substrate (plate, expanded metal, foam) followed by a thermal treatment under various atmospheres at 700 °C for 15-30 min. In a three-electrode-setup and full cell electrolyzer the performance of the electrodes were tested via cyclic voltammetry (CV), chronopotentiometry (CP) and electrochemical impedance spectroscopy (EIS) quantitatively.³ Qualitative characterization is carried out with SEM-imaging, EDX-mapping and BET-measurements.

RESULTS AND DISCUSSION

The produced Raney-Nickel electrodes show different activity and durability with loading change (see Fig. 1). With a variation of the loading of the Al-slurry on the Ni-bulk and long-term measurements up to > 500 h in a 100 cm² alkaline electrolyzer the adaptation of the electrode structure to the high currents and a high long-term stability can be reached. Low overpotentials of 220-350 mV at current densities from 0.2 - 1 A/cm² are resulting.

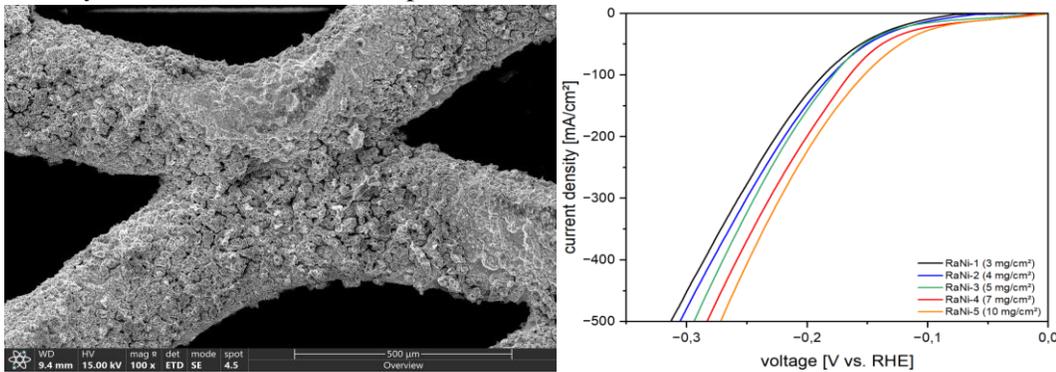


Fig. 1 Activated Raney-Nickel electrode with Nickel expanded metal as substrate

Fig. 2 CV-curve of the electrodes with different loadings during the hydrogen evolution reaction (HER)

CONCLUSION

A variation of the catalyst loading of Raney-Nickel electrodes lead to a performance increase and higher long-term stability. To fulfill the goal of < 1.7 V at 1-2 A/cm² for alkaline electrolysis this type of electrode is suitable.⁴

REFERENCES

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ACKNOWLEDGMENTS

The authors gratefully thank the Bavarian State Ministry of Economic Affairs, Regional Development and Energy as well as Oberland-Mangold GmbH for the funding and sample supply for the commissioned research in the field of alkaline water electrolysis.