PERFORMANCE AND DURABILITY OF MEMBRANE ALKALINE WATER ELECTROLYZER WITH ANION SELECTIVE MEMBRANES AND NON-PLATINUM CATALYSTS

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Alkaline membrane water electrolysis (AMWE) represents a hydrogen production method offering some advantages over competing technologies. One of the major advantages is the replacement of noble metal electrocatalysts with low-cost transition metal-based catalysts. But AMWE is still a developing technology; therefore, prior to the commercialization, the energy efficiency, stability, and flexibility need to be improved.
The energy inefficiency is mainly caused by overpotential on the electrodes, which can be reduced by using active, and preferably, non-platinum catalysts. Moreover, deposition of the catalyst directly on the membrane (CCM – catalyst coated membrane) was proven to be the way of the catalyst utilisation enhancement. In addition, CCM approach allows the concentration of liquid electrolyte to be reduced. CCM thus increases energy efficiency and the flexibility of the technology. Main problem represents the poor chemical and mechanical stability of anion-selective materials (ASM) and low activity of some catalysts.
The aim of this work is to compare novel and commercial materials using CCM approach and to evaluate their suitability for AMWE.
A stable ASM made from chloromethylated block copolymer polystyrene-ethylene-butylene-styrene (PSEBS-CM) functionalized with 1,4-diazabicyclo[2.2.2]octane (DABCO) groups is used as both the separator and binder of the catalyst layer. Commercially available Fumapem® FAA-3-50 membrane is used for comparison reason. $NiCo_2O_4$ or $Ni_xFe_yO_z$ and $NiFe_2O_4$ or Mo_2C are used as anode and cathode catalysts, respectively. Load curves are measured in 1 – 15wt.% KOH at 50 °C. Stability of the CCM is measured in 10 wt.% KOH at 50 °C. Electrochemical impedance spectroscopy is used to evaluate the resistances. Morphology of the layers is examined by scanning electron microscopy. The results show the possibility of using PSEBS-CM-DABCO as well as the potential of the non-platinum catalysts.

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