Influence of the anion-selective polymer membrane on the properties of the catalyst coated membrane-electrode-assembly

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Alkaline water electrolysis (AWE) becomes more and more point of interest of not only scientific groups, but also industrial companies. This is given by mainly two factors. The first one represents the increasing endeavor to eliminate the dependence of the society on the fossil fuels. However, many of the renewable sources of energy are instable in time and require thus balancing of their production. Such balancing can be done by water electrolysis converting excesses in electric energy output into the chemical energy in the form of hydrogen molecule. Two main technologies operating below 100 °C are considered. Proton exchange membrane water electrolysis (PEM WE) offers advantage of high production intensity. However, it utilizes expensive materials. Capital expenditure thus represents the second aspect why AWE is considered as it can utilize relatively abundant and thus cheap materials for the cell construction. Nevertheless, improvement of the AWE is highly needed in order to increase its production intensity and flexibility. Membrane alkaline water electrolysis (MAWE) could represent the solution of this need. Utilizing the anion-selective polymer membrane (ASM) as separator of the anode and cathode compartment, the concentration of liquid electrolyte can be decreased, due to ability of ASM to conduct charge. Even more, it is possible to deposit the catalyst layers directly on the surface of the ASM. In our previous study, we showed that this approach can allow significant reduction of the catalyst load due to more intimate contact of the catalyst with ASM [1]. In this study, we focus on the influence of the ASM, which is coated by catalyst layers. Membranes of different thicknesses and structures are used for catalyst coated membrane-electrode-assembly preparation and their performances under the conditions of the MAWE are compared. Results show the significant influence of the both selected parameters.

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[1] Hnát J, Plevova M, Tufa RA, Zitka J, Paidar M, Bouzek K. Development and testing of a novel catalyst-coated membrane with platinum-free catalysts for alkaline water electrolysis. International Journal of Hydrogen Energy. 2019;44:17493-504.