

Abstract

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This dissertation thesis deals with the study of plasma-initiated grafting of microporous polymer membranes intended for their application as separators in alkaline water electrolyzers. The main aim of the work was the optimization of plasma treatment conditions in order to achieve the highest possible long-term stability of the grafted polymer in an alkaline environment. Polysulfone (PSU), polypropylene (PP), and polytetrafluoroethylene (PTFE) membranes were investigated in this work. The samples were activated by low-pressure radio-frequency plasma in argon or oxygen and subsequently grafted with acrylic acid. The work included a comparison of grafting after activation in argon and oxygen plasma, as well as a study of the effect of adding selected crosslinking agents into the grafting solution. The results showed significantly higher stability of PP membranes activated in argon plasma compared to oxygen plasma. Good stability of modified PTFE membranes was also observed, whereas the stability of modified PSU membranes was considerably lower. Further improvement of long-term stability was achieved by adding the crosslinking agent methylene bisacrylamide to the grafting solution. It was also shown that the power supplied to the oxygen plasma significantly affects the mechanical properties of PP membranes. ATR-FTIR, XPS, and SEM analyses confirmed the presence of the grafted polymer throughout the entire membrane structure. Measurements under alkaline electrolysis conditions showed that the prepared membranes achieved favorable values of ionic resistance and hydrogen permeability. The results confirm the potential of plasma-initiated membrane grafting as a promising method for the preparation of separators for alkaline water electrolyzers.

Keywords: plasma activation, polymer grafting, alkaline water electrolysis, long-term stability, crosslinking agents