UNIVERSITI TEKNOLOGI MARA

Preparation and Characterization of UV-Crosslinked Sulfonated Poly Ether Ether Ketone - Methyl Cellulose as Proton Exchange Membrane.

NORDIANA NABILLA BT RAMLY

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ABSTRACT

This research is aimed at developing an alternative proton exchange membrane (PEM) with ease of synthesis and more economical material without sacrificing the membrane's performance such as high conductivity and excellent dimensional stability. PEM composed of Sulfonated (poly ether ether ketone), SPEEK and Methyl Cellulose, MC are synthesized then modified by UV-crosslinking technique with Benzoin Ethyl Ether, BEE as photoinitiator. The effect of UV-irradiation period and photoinitiator composition on the proton exchange membrane is examined. The outcome indicates that both stirring and drying period play crucial role in determining the sulfonation degree of a PEM. 60 hours of sulfonation produces degree of sulfonation 68%. FTIR result proves the occurrence of sulfonation when new peaks of –SO3 groups appear. The FTIR results also reveal the crosslink reaction of SPEEK-MC membrane with BEE is initiated by C-C bonds instead of $-SO_3$ groups hence the membrane conductivity is maintained. By crosslinking the SPEEK with MC polymer the membrane water uptake is reduced. The MC gives more support to SPEEK membrane by enhancing the membrane's water binding capacity and maintaining the membrane dimensional stability at the same time. Although the crosslinked SPEEK-MC membrane has lower water uptake than the non-crosslinked PEM, the crosslinked PEM displays higher dielectric constant due to water presence in the channels or pores is bound stronger in the crosslinked PEM and therefore appear less bulky in character. The water molecules of the PEM can attach to the cellulose through hydrogen bonding which enables hydronium ions to travel between the ionic clusters easily consequently enhancing the conductivity. The conductivity of SPEEK-MC membrane is measured by impedance spectroscopy and the addition of MC into SPEEK polymer enhances the conductivity up to 4.69×10^{-3} $S.cm^{-1}$ at 30°C temperature and 80% relative humidity. The conductivity of the hybrid membrane increased from 4.69×10^{-3} $S.cm^{-1}$ to 8.76×10^{-3} $S.cm^{-1}$and 6.90×10^{-3} $S.cm^{-1}$ after radiated with UV-crosslink for 15 minutes and 30 minutes respectively. This new crosslinked hybrid PEM shows good prospect to be used in fuel cell.

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TABLE OF CONTENT