View Abstract

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Abstract

TITLE: Development and Characterization of Crosslinked PPO-Based Anion Exchange Membranes for AEM Fuel Cells

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ABSTRACT BODY:

Abstract Body: This work describes the synthesis and characterization of a series of poly (2,6-dimethyl-1,4-phenylene oxide) (PPO)-based anion exchange membranes (AEMs), crosslinked with bis-imidazolium cations, and investigated as potential ionic conductors for AEM fuel cells. PPO has excellent mechanical and thermal properties, and its backbone can be functionalized by means of several possible routes. Among them, bromination has been carried out with a quantitative control of the amount of the linked halogens. PPO with bromination degrees (BD) of 14% and 33% have been crosslinked by employing a novel procedure with 1,6-bis(2-methylimidazol-1-yl)hexane (bimh). This new crosslinking method has granted a fast and highly efficient crosslinking reaction, resulting in an almost quantitative substitution of bromine atoms (higher than 94%). The obtained cast membranes have been thoroughly characterized by ATR-FTIR and EDX spectroscopies, scanning electron microscopy (SEM), thermogravimetry and differential scanning calorimetry (DSC). Their functional properties have been assessed through four main tests, involving the evaluation of water uptake (WU) and swelling ratio (SR), ion exchange capacity (IEC), alkaline stability and ionic conductivity by means of electrochemical impedance spectroscopy (EIS). WU and EIS tests have been conducted as a function of temperature in the 20–100 °C range and in conditions of complete hydration (98% relative humidity). These analyses have revealed that the prepared AEMs are well-uniform with all the features properly controlled and affected by the increment of the bromination degree of PPO. This outcome is a consequence of the increased number of sites that can anchor OH^- ions and of the more crosslinked network, leading to the enhancement of ion exchange capacity and ionic conductivity. The membranes also exhibited a promising alkaline stability, since they have retained their robustness, transparency and functional properties with only minor changes, after being immersed in a strong alkaline environment (2 M KOH solution) for several days.
These promising features make the proposed AEMs worthy of application and further investigation is ongoing, aimed at assessing their mechanical behavior and fuel cell performance depending on the crosslinking degree.