Anion exchange membranes of bis-imidazolium cation crosslinked poly(2,6-dimethyl-1,4-phenylene oxide) with enhanced alkaline stability

Partially crosslinked anion exchange membranes (AEMs) with imidazolium-based cationic functionalities were fabricated based on a poly(2,6-dimethyl-1,4-phenylene oxide) (PPO) matrix. The PPO was activated by bromomethylation and functionalized with methylimidazole and 1,4-bis(imidazolyl)butane at different ratios through a gentle and facile heat curing method. The use of 1,4-bis(imidazolyl)butane resulted in a membrane with cationic functionalities incorporated in covalent crosslinks, which allowed for high ion exchange capacities (IECs) without compromising on mechanical robustness. Comprehensive characterizations were performed in terms of thermal stability, water uptake, IEC, swelling, conductivity, mechanical properties and alkaline stability to investigate the correlation of the structure and physicochemical properties. Comparing with the un-crosslinked imidazolium PPO membrane, crosslinked membranes exhibited improved mechanical robustness and alkaline stabilities. The membrane with a crosslinking degree of 10% displayed an IEC of around 1.5 mmol g\(^{-1}\), tensile strength of 4.1 MPa, hydroxide ion conductivity of 40.5 mS cm\(^{-1}\), and a retained ratio in conductivity of 40% after tolerance test of nearly 150 h in 1 mol L\(^{-1}\) KOH (aq.) at 60 °C.

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