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Design of pendent imidazolium side chain with flexible ether-containing spacer for alkaline anion exchange membrane

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Abstract

A novel approach is proposed to design anion exchange membranes (AEMs) containing pendent imidazolium side chains with flexible ether-containing spacer by the Williamson etherification between chloromethylated polysulfone and as-synthesized hydroxyl-bearing imidazolium. The introduction of long flexible ether-containing spacer chains enhances the mobility of terminated imidazolium groups and ion interactions. It facilitates the formation of a good hydrophilic/hydrophobic micro-phase separation structure, which is confirmed by the scattering peak of SAXS. As a result, the membranes exhibit high conductivity and excellent anti-swelling ability. The membrane with IEC of 1.55 mmol g^{-1} shows considerable hydroxide conductivity (72 mS cm^{-1}, 60 ^{o}C), low swelling ratio (7.3 %, 60 ^{o}C), and great tensile strength in hydrated state (43.4 MPa, 20 ^{o}C). The existence of long spacer chain also improved the alkaline stability. After immersion in 60 ^{o}C, 1 M KOH solution for 168 h, hydroxide conductivity and tensile strength of the membrane remain constant. The ether-containing side chains fabricated in this work provides a universal promising method to balance hydroxide conductivity and dimensional and alkaline stability.

Keywords: anion exchange membrane; ether-containing spacer; micro-phase separation; hydroxide conductivity; dimensional and alkaline stability