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School of Petroleum and Chemical Engineering, State Key Laboratory of Fine Chemicals, Research and Development Center of Membrane Science and Technology, Dalian University of Technology, Panjin 124221, P. R. China.

Corresponding author: Gaohong He, E-mail: hgaohong@dlut.edu.cn

Abstract

A high performance of anion exchange membranes (AEMs) is highly demanded in anion exchange membrane fuel cells (AEMFCs) and has been extensively studied. However, the poor ionic conductivities and the alkaline stability might limit their applications. Herein, we developed a novel strategy to improve the ionic conductivity and alkaline stability of AEMs by introducing hydrophilic oligo(ethylene glycol)(OEG) groups. Continuous ion-conducting channels were efficiently formed thanks to the dynamic aggregation of water molecules assisted by the hydrophilic side chains. The resultant AEMs with low IEC values showed significant enhancement in hydroxide conductivity compared to the AEMs functionalized by the conventional 1,2-dimethylimidazolium (PSf-Im), as the hydroxide conductivity of PSf-2 membrane with an IEC of 1.05 $mmol \cdot g^{-1}$ was 59.5 $mS \cdot cm^{-1}$ at 60 °C while the hydroxide conductivity of PSf-Im membrane with an IEC of 1.27 $mmol \cdot g^{-1}$ was 36.7 $mS \cdot cm^{-1}$. In addition, the alkaline stability and the mechanical properties of the resultant AEMs were improved remarkably. The density functional theory (DFT) study showed that the introduction of OEG part can significantly increase the LUMO energy of functional group and then enhance the alkaline stability.

Keywords: Anion exchange membrane; Ion-conducting channel; Imidazolium; oligo(ethylene glycol); DFT study