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Tailoring the nanophase-separated morphology of anion exchange membrane by embedding aliphatic chains of different lengths into aromatic main chains

Xiaoming Yan, Baolin Zhao, Jiafei Liu, Xinyue Zhang, Gaohong He*

State Key Laboratory of Fine Chemicals, Liaoning Province Engineering Laboratory of High Efficiency and Energy Saving Separation Technology in Petrochemical Industry, School of Petroleum and Chemical Engineering, Dalian University of Technology, Panjin, LN 124221, China

* Corresponding author: Tel.: +86 411 84986291; *E-mail*: hgaohong@dlut.edu.cn (Dr. Gaohong He)

Abstract

Tuning the hydrophilic/hydrophobic nanophase-separated morphology to enhance the conductivity is a considerable challenge in the field of anion exchange membranes (AEMs). Here, a series of novel aliphatic-aromatic copolymer AEMs were designed by embedding flexible alkyl chains of different lengths into rigid main chain of poly(ether sulfone). Compared to traditional aromatic polymer, the aliphatic-aromatic copolymers had more flexible main chains and longer hydrophobic segments, both of which promoted the nanophase separation and the formation of ionic clusters. Increasing aliphatic chain length made the ionic clusters larger and more interconnected, but too long aliphatic chain led to the formation of smaller ionic clusters because the ionic groups were far away from each other. An optimum length of the aliphatic chain (8 C) existed for the nanophase-separated morphology with the biggest ionic clusters (around 8 nm), with which the membrane showed the highest conductivity. A peak power density of 159 mW cm^{-2} was obtained for the cell incorporating the 8C membrane. Based on these, this study reveals a new direction to create a tunable nanophase-separated morphology for high-performance AEMs.

Keywords: anion exchange membrane, nano-phase separation, morphology