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Quaternary ammonium-functionalized poly(ether sulfone ketone) anion exchange membranes: The effect of block ratios

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ABSTRACT

Anion exchange membranes based on quaternary ammonium-functionalized poly(ether sulfone ketone) block copolymers (QA-PESK) with various hydrophilic–hydrophobic oligomer block ratios (10:7, 10:18, and 10:26) were synthesized, and the block length effect on the membranes' physicochemical and electrical properties were systematically investigated. The QA-PESK-10-18 membrane, prepared using a hydrophilic and hydrophobic block ratio of 10:18, displayed well-balanced hydrophilic/hydrophobic phase separation, the highest conductivity of 23.19 mS cm^{-1} at 20 °C and 57.84 mS cm^{-1} at 80 °C, and the highest alkaline stability among the three block ratios tested, indicating that the membranes' properties were closely related to their morphologies, which were determined by the hydrophilic/hydrophobic ratio of the block copolymer. The H_2/O_2 single cell performance using the QA-PESK-10-18 revealed a maximum power density of 235 mW cm^{-2}.

Introduction

Fuel cells are environmentally friendly power generators that efficiently convert chemical energy to electricity [1,2]. Proton exchange membrane-based fuel cells (PEMFCs) have been extensively developed for use in portable devices, residential power supplies, and electric vehicles [3]. Due to the acidic nature of proton exchange membranes (PEMs), however, noble metals, such as Pt and Pd, are typically required as electrocatalysts for the fabrication of PEMFCs, limiting the commercial applications of PEMFCs [4–6]. Anion exchange membrane-based alkaline fuel cells (AEMAFCs) are a potentially cost-effective alternative to PEMFCs [7–10]. In AEMAFCs, the oxygen reduction reaction (ORR) kinetics can be high, and non-precious metal electrocatalysts Ni, Ag can be used under alkaline conditions, thereby reducing costs [8,9]. The research in the AEMAFCs has been therefore accelerated for improving the overall cell performance [11–15], and also for the development of anion exchange membrane (AEM) as a key component for the AEMAFC [15].

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