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One-step fabrication and characterization of reinforced microcomposite membranes for polymer electrolyte membrane fuel cells

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Abstract

The mechanical durability of hydrocarbon membranes in polymer electrolyte membrane fuel cells remains insufficient. To resolve this issue, in contrast to the conventionally used method, reinforced composite membranes were fabricated by simultaneous electrospinning and spraying. A hydrophobic polysulfone (PSf) was used as a non-conducting substrate to increase the membrane's mechanical strength, and hydrophilic sulfonated poly(arylene ether sulfone) (sPAES) was used as an electrolyte. The properties and performance of a reinforced microcomposite membrane comprising electrospun PSf/sprayed sPAES were compared with those of (i) sPAES homogeneous membrane, (ii) sprayed PSf/electrospun sPAES membrane, and (iii) PSf/sPAES blend membrane. Although the electrospun PSf/sprayed sPAES membrane was slightly more durable than the others, we think that the developed membrane fabrication method holds great promise and can be further improved by utilising more compatible materials.

Abbreviations

BP, 4,4'-dihydroxy biphenyl; DCDPS, bis(4-chlorophenyl) sulfone; SDCDPS, bis(4-chlorophenyl-3-sulfophenyl) sulfone disodium salt; sPAES, sulfonated poly(arylene ether sulfone); PSf, Udel P-3500 LCD MB polysulfone; electrospun PSf/sprayed sPAES reinforced nanocomposite membrane, PSf(ES)+sPAES(SP); sprayed PSf / electrospun sPAES reinforced nanocomposite membrane, PSf(SP)+sPAES(ES); homogeneous membrane, sPAES homogeneous membrane; DMAc, *N,N*-dimethylacetamide; Ac, acetone; ES, electrospinning; SP, spraying; PEMFCs, polymer electrolyte membrane fuel cells; RH, relative humidity; OCV, open circuit voltage

Keywords: electrospinning; spraying; hydrocarbon membrane; polymer electrolyte; fuel cell

1. Introduction

The increasing global energy consumption necessitates the development of alternative power sources and energy storage systems. Among the numerous power sources, fuel cells have attracted increased attention due to their high energy efficiency, low operating temperature,

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