ISBN 978-602-18820-0-9

Innovation in Polymer Science & Technology
IPST 2011
Asian Polymer Association (APA) & Indonesian Polymer Association (HPI)

Proceedings

The International Conference on

INNOVATION IN POLYMER SCIENCE AND TECHNOLOGY 2011

(IPST2011)

November 28 - December 1, 2011
Sanur Paradise Plaza Hotel, Bali
INDONESIA

Published by

PERHIMPUNAN POLIMER INDONESIA (HPI)

Indonesian Polymer Association (HPI)
October 2012

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The International Conference on the Innovation in Polymer Science and Technology 2011 (IPST2011)
Bali, Indonesia, November 28 – December 1, 2011

Improvement of Proton Transport via Preparation Composite Membrane of SPSF/Nafion

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Abstract

SPSF/Nafion proton exchange composite membrane has been prepared by phase inversion technique. Here, the matrix of SPSF was impregnated with a 5% Nafion solution in various time of evaporation. The presence of Nafion in the matrix is presumed to affect on structure formation of membrane, consequently affect on physicochemical and proton transport properties. Characterization of the composite membrane was performed include water uptake, ionic exchange capacity, membrane morphology and proton conductivity. As the result, water uptake and hydration capacity decrease with increasing evaporation time up to 10 min, the further evaporation time increase significantly. The proton conductivity of the composite membrane increase up to 10 min the further evaporation times tend to decrease. Nevertheless, compared with SPSF membrane, the composite membrane shows improvement the proton conductivity.

Keywords: Composite membrane; proton exchange membrane; phase inversion; proton transport.

Introduction

In fuel cell applications, Nafion is commonly used as the proton exchange membrane (PEM) due to mechanical and thermal stability and high proton conductivity (0.08 S/cm). However, this material have some drawbacks such as high cost (600-1000 $/m^2$), high methanol crossover and undergo dehydration when operated in high temperature [1,2]. Hence, exploring to alternative membrane materials which can be overcome the major drawback of Nafion is very necessary.

The sulfonated polysulfon-based electrolyte membrane is one of the PEM alternatives to replace Nafion for fuel cell application. Polysulfone (PSF) has been chosen because of their good mechanical and thermal stability, toughness, and easy to be processed [3] and in the presence of the sulfonate groups in the polymer chains produces ionic polymer or polyelectrolyte. Increasing the sulfonation degree is one of the efforts to achieve higher proton conductivity. However, an extensive sulfonation leads to swell the polymers and some even change them to become soluble in water, thus they lose their mechanical stability. This is the general problem of sulfonation process of polymers, includes polysulfon, therefore it has to be optimized in order to reduce the loss in mechanical stability without decrease proton conductivity [4,5].

In several study, especially regarding synthesis and modification membranes of sulfonated polysulfone-base (SPSF)[6-8], in generally showed that the resulting membranes could improve some properties such as thermal, mechanical stability and methanol permeability, however proton conductivity still lower if compare with nafion membrane. Therefore, proton conductivity improvement of this membrane is still necessary. In this work, the SPSF membrane has been modified by introducing Nafion in the SPSF membrane. Incorporating Nafion into SPSF matrix provided an additional electrolyte component lead to improve the proton conductivity.

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