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Short communication

Solvent and acidification method effects in the performance of new sulfonated copolyimides membranes in PEM-fuel cells

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Abstract

A series of new sequenced sulfonated naphthalenic polyimides were synthesized containing a flexible aromatic–aliphatic diamine. The obtained membranes present the advantage of being soluble in *N*-methyl pyrrolidone (NMP) which is a less toxic solvent than the previously used *m*-cresol. In this work, we report on the solvent and acidification method effects on the properties of the membranes such as density, water uptake, proton conductivity as well as on the performance of these membranes in fuel cell operation. The membranes prepared from NMP solution and acidified with ion-exchange resins give the best results. They have good mechanical properties as well as high ionic conductivity (14.4×10^{-2} S cm^{-1} at 80 °C) and good performances as proton exchange membrane (PEM) in fuel cell at 70 °C.
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1. Introduction

One recent and promising application of the polymeric materials is their use as ion-conductive membranes for batteries [1] or proton exchange membranes for fuel cells (PEMFC) [2–4]. For instance, perfluorosulfonated ionomer (Nafion) membranes have been used for this purpose due to their efficient proton conduction (10^{-1} S cm^{-1} in the fully hydrated protonic form) and long lifetime [5–8]. However, the high cost of this ionomer is the major drawback for the development of this technology. Lower cost polymers with similar properties are therefore strongly desired as alternative materials [9–13]. In the last few years, several non-fluorinated membranes have been studied as alternatives to Nafion such as the sulfonated polynaphthalimides. These naphthalenic polyimides described previously are however only soluble in *m*-cresol. In this paper, we describe the synthesis of new naphthalenic copolyimides obtained from 2,2′-benzidinedisulfonic acid (BDSA, a sulfonated diamine) and the bis[(4 aminophenyl-oxy)methyl] 2,2-propane (APMP, a non-sulfonated diamine). APMP diamine allows managing some important properties of the copolyimides [14–20], like the solubility in water and solvents, the mechanical properties and others. The APMP was selected because of its flexibility induced by the neopentyloxy catenation. Then, it has been possible to improve the solubility of such polymers in solvents different to *m*-cresol, such as NMP. This improvement offers to prepare membranes in better conditions. The goal of this paper is to investigate the properties of these new copolyimides such as proton conductivity, density and water sorption as well as their performance in fuel cell operation with respect to the casting solvent and the acidification method.

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