Application of a Novel PVA-based Proton Exchange Membrane Modified by Reactive Black KN-B for Low-temperature Fuel Cells

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doi: 10.20964/2019.09.16

Received: 1 May 2019 / Accepted: 18 June 2019 / Published: 31 July 2019

A novel proton-conducting membrane using poly(vinyl alcohol) (PVA) as matrix and Reactive Black KN-B as conductive component was fabricated through a solution casting method combined with a colour-fixing process. Fourier transform infrared (FT-IR) spectroscopy, X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD) analysis and scanning electron microscopy (SEM) showed that KN-B dye was successfully grafted onto the PVA macromolecules and that the internal structure of the membrane became denser and rougher due to cross-linking of the colour-fixing agent DE. The H⁺ conductivities of the synthesized membranes were evaluated using alternating current (AC) impedance measurements. The results indicated that the H⁺ conductivity of PVA/KN-B membranes could reach 0.124 S cm⁻¹ at 20 °C. Thermal analysis and the investigation of mechanical properties, water uptake and swelling behaviour also showed that the membranes possessed excellent physical stability. When immersed in a solution of 30 wt.% hydrogen peroxide, PVA/KN-B/DE membranes showed excellent oxidative stability and their weights remained at approximately 72.8 wt.% of the original sample weight within 168 h at room temperature.

Keywords: Membrane; Proton conductivity; Vinyl-sulfone reactive dyes; Fuel cell; Oxidative stability

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