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Hybrid composite membranes of chitosan/sulfonated polyaniline/silica as polymer electrolyte membrane for fuel cells

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Highlights

- Hybrid membranes based on CS-PAni/SiO₂ were prepared using solvent casting technique.
- CS-PAni/SiO₂ membranes exhibit excellent mechanical and thermal stability.
- Chitosan membranes with 3 wt% PAni/SiO₂ shows high electrochemical selectivity.

Abstract

A series of novel ionic cross-linked chitosan (CS) based hybrid nanocomposites were prepared by using polyaniline/nano silica (PAni/SiO₂) as inorganic filler and sulfuric acid as an ionic cross-linking agent. The CS-PAni/SiO₂ nanocomposites show enhanced mechanical properties and improved oxidative stabilities. These nanocomposites can be effectively used as environmental friendly proton exchange membranes. Incorporation of PAni/SiO₂ into CS matrix enhances water uptake and facilitates the phase separation which enables the formation of hydrophilic domains and improves the proton transport. Moreover, the doped polyaniline also provides some additional pathways for proton conduction. The membrane containing 3 wt % loading of PAni/SiO₂ in chitosan (CS-PAni/SiO₂-3) exhibits high proton conductivity at 80°C ($8.39 \times 10^{-3} \text{ S cm}^{-1}$) in fully hydrated state due to its excellent water retention properties. Moreover, methanol permeability of the ionic cross-linked CS-PAni/SiO₂ nanocomposite membranes significantly reduces with the addition of PAni/SiO₂ nano particles. The CS-PAni/SiO₂-3 composite membrane displays the best overall performance as a polymer electrolyte membrane.

Keywords: Chitosan, fuel cell, polyaniline, proton conductivity

1 Introduction

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