

SYNTHESIS AND CHARACTERIZATION THE COMPOSITE ORGANIC-INORGANIC MEMBRANE USING SOL-GEL PROCESS FOR PROTON EXCHANGE MEMBRANE FUEL CELL (PEMFC)

A. Mahreni, A. B. Mohamad, A. A. H. Kadhum, W. R. W. Daud
Department of Chemical and Process Engineering, Universiti Kebangsaan
Malaysia, (UKM) 43600, Bangi, Selangor DE, Malaysia

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ABSTRACT

Nafion-silicon oxide (SiO_2)-phosphotungstic acid (PWA) composite membrane has been synthesized for medium temperature Proton Exchange Membrane Fuel Cell (PEMFC) application using sol-gel method. X-ray diffraction (XRD) was used to determine saturated absorption of PWA in the silica matrix. A transparent film was achieved at annealing temperature of 140°C over 10 hours duration. The film than was characterized by Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) and Fourier Transform Infrared Spectroscopy (FTIR). The SEM and TEM results indicated homogenous structure of the Nafion- SiO_2 -PWA composite membrane with SiO_2 and PWA particles size less then 10 nm. X-Ray Diffraction (XRD) result showed that the maximum loading of PWA in the SiO_2 matrix is in the ratio of PWA/ SiO_2 equal to 0.45 (wt./wt.). The vibration absorption peak of Si-O-Si bond at 800 cm^{-1} and W-O-W at 755 cm^{-1} were observed thus indicated the inorganic compound was embedded in the Nafion matrix and did not leach out after washing treatment using acid and base solutions.

INTRODUCTION

Perfluorosulfonic acid (PFSA) membrane (e.g. Nafion) is not suitable for low relative humidity PEMFC application because the conductivity of PFSA membrane was dramatically reduced at low relative humidity (RH). Therefore, a need exists to develop membrane for PEMs application that are functional at low operating RHs.

Nafion based organic/inorganic composite membrane with heteropolyacid (phosphotungstic acid, PWA) additive using tetraethoxyorthosilicate (TEOS) as immobilizer to the PWA have been investigated as alternative material for low humidity PEMFC operation.