Preparation and characterization of SPEEK/MMT-STA composite membrane for DMFC application

Abstract

A silicotungstic acid (STA) was successfully impregnated onto K10 montmorillonite (MMT) in an effort to improve the properties of SPEEK membrane. Several characterizations such as Fourier transform infrared (FTIR), X-ray diffraction (XRD) and field emission scanning electron microscopy (FESEM) were carried out in order to confirm the entrapment of STA molecule onto MMT. It was found that the STA possessed good adhesion with MMT due to the low STA leaching from the composite membranes. The SPEEK modified membranes with the newly developed material, SMMT (with 30 and 50 wt% STA entrapped onto MMT) were characterized and its performance was compared with pristine SPEEK and Nafion 112 membranes. The FESEM micrograph confirmed that the fillers were well dispersed in the membrane. The results also revealed that the water uptake and proton conductivity at ambient temperature and 100% relative humidity of the composite membranes were higher than the pristine SPEEK membrane which were (49.50 ± 1.67) wt% water uptake and (6.08 ± 0.65) × 10⁻³ S cm⁻¹ for 50SMMT, respectively. On the other hand, the lowest methanol permeability of the developed membranes in this study was (3.50 ± 0.53) × 10⁻⁷ cm² s⁻¹ which was lower than the Nafion 112 membrane. These characteristics make the newly developed composite membranes as a promising electrolyte for direct methanol fuel cell (DMFC) application.