CHAPTER V
CONCLUSIONS

The S-PSF was prepared by a mild sulfonation method. The FT-IR and NMR results showed the successful attaching of sulfonic acid groups onto PSF backbone. The XPS and SEM results also confirmed the functionalized GO by sulfonation. The effects of zeolite Y and S-GO on the performance of composite membranes were investigated; the series of PEMs were prepared by incorporation of filler into S-PSF. For the effect of zeolite Y content, the proton conductivity increased with increasing zeolite Y content. However, the methanol permeability increased with increasing zeolite Y due to its hygroscopic property. For the composite membranes based on S-PSF with S-GO, the incorporation of S-GO particles improved the proton conductivity of S-PSF membranes up to 4.27×10^{-3} $S.cm^{-1}$, which can be attributed to the increase in the sulfonic acid groups of S-GO forming interconnected ionic clusters for proton migration. The S-GO particles positively influenced and efficiently blocked water and methanol molecules, leading to the decreases in the water uptake and methanol permeability. The hybrid membranes were investigated for further improvement. They showed lower performances when compared with S-PSF/S-GO (3%v/v) membranes but still showed better performances than Nafion117 membrane. Consequently, the selectivity of all composite membranes exhibited a superior performance relative to the Nafion117 membrane. It can be concluded that the fabricated composite membrane (3%v/v S-GO) is the most promising material for use as a PEM in DMFC applications.