

CHAPTER V

CONCLUSIONS

In this study, S-DDM was successfully sulfonated by using the 98% sulfuric acid and the 65% fuming sulfuric acid. 2 sulfonated groups were contained in S-DDM monomer, and the positions of sulfonated groups were confirmed by $^1\text{H-NMR}$. The S-coPI membrane was synthesized by the polycondensation method using the thermal imidization to obtain the imide structure; the four monomers at various mole ratios of S-DDM were used to control the amount of sulfonated groups. The characteristic peaks of the sulfonated group are at 1298, 1159, 1098, and 1065 cm^{-1} as confirmed by FTIR. TGA shows the thermal stability of S-coPI; it has 2 structure decompositions at 320 °C and 560 °C. The DS of the membranes from titration is lower than the expected DS about 10-15%. The crystallinity of the S-coPI membrane decreases with increasing DS due to the effect of the sulfonated group which disrupts the polymer chain packing. The proton conductivity of the membranes increases with increasing sulfonated group in the polymer chain; the highest proton conductivity is $1.16 \times 10^{-2} \text{ S cm}^{-1}$ for S-coPI-3 at the highest S-DDM feed ratio. The S-coPI membranes are of lower methanol permeability than Nafion117 and the membrane selectivity of S-coPI-3 is $2.89 \times 10^5 \text{ S s cm}^{-3}$, a higher value than that of Nafion117 about 6 times.