CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The performances of solid-polymer mixed matrix membranes using two different MOFs, i.e., MOF-199 and ZIF-8, as a dispersed phase and Ultem®1000 as a continuous phase for CO_2/CH_4 separation were investigated at room temperature and pressures of 50 psi and 100 psi. All membranes were fabricated via the solution-casting technique with 13 wt% Ultem polymer and each of MOF loading from 10 wt% to 30 wt% on a solvent free basis. Based on single gas permeability measurements, both CO_2 permeance and CO_2/CH_4 selectivity increased with increasing the MOF-199 loading as compared to the reference Ultem membrane. For the increased loading of ZIF-8 particles, the CO_2 permeance increased substantially while the CO_2/CH_4 selectivity remained unchanged in comparison with the reference Ultem membrane. Nevertheless, an increase in differential pressure across a membrane resulted in an insignificant decrease in CO_2/CH_4 selectivity under the studied pressure range due to the dual-mode behavior of glassy polymers. In comparison of gas permeance obtained from the experiments and by Maxwell model, the experimental gas permeances of both MOF-Ultem MMMs and ZIF-Ultem MMMs matched well with those of predicted by the Maxwell model at low volume fraction (<20%) of dispersed particles.

5.2 Recommendations

Two types of MOFs used in this work, MOF-199 and ZIF-8, have been the most widely used as fillers in the literature. From this work, it was found that both MOF-199 and ZIF-8 were incorporated into Ultem polymer successfully enhanced the permeance of polar gas. Moreover, MOF-199 MMMs helped enhance CO_2/CH_4 selectivity significantly, in contrast to ZIF-8 MMMs, which showed insignificant improve CO_2/CH_4 selectivity. This is due to the sieve in a cage morphology in ZIF-8 MMMs. To improve the MMMs performance, future work should focus on

controlling the interface morphology between filler and polymer matrix. There are many method to avoid these interfacial defects such as surface modification by crosslinking (Hunger *et al.*, 2012), particle modification using sizing techniques (Aroon *et al.*, 2010), and adding copolymer (Kim *et al.*, 2006).