CHAPTER V
CONCLUSIONS

The sulfonic acid functionalized cubic *Ia-3d* mesoporous silica have been successfully synthesized by microwave and hydrothermal methods from the co-condensation of TEOS and MPTMS as the silicon sources in acidic condition by using Pluronic P123 as a structure directing agent. The surfactant was removed by extraction, the remaining propyl-thiol group was oxidized to propyl-sulfonic acid group by oxidation with H_2O_2. The pre-hydrolysis of MPTMS before TEOS addition, the ordered cubic *Ia-3d* mesostructure was obtained in the range of MPTES/(MPTMS+TEOS) = 5.8-8.2% by mole. The ordered 2d-hexagonal mesostructure can be synthesized by pre-hydrolysis of TEOS before MPTMS addition 1 hr. The microwave synthesis method can reduce the crystallization time from two days to 3 hours with giving the comparable cubic *Ia-3d* structure and also proficiency in esterification of glycerol with acetic acid to obtain triacetin at the same catalytic property. Because of the multi-dimensional channels, the cubic *Ia-3d* mesoporous silica with sulfonic functional group showed a bit higher catalytic activity than 2d-hexagonal mesostructure in case of glycerol and acetic acid esterification. Moreover, the cubic *Ia-3d* mesoporous silica synthesized form hydrothermal and microwave method exhibited high catalytic performance in esterification of glycerol with long chain free fatty acids compared to acidic polymeric resin Amberlyst-15 and 2d hexagonal structure SBA-15-Pr-SO_3H at similar condition.

The suggestion for future work

1. To study effect of microwave irradiation in other synthetic porous materials.

2. To acidic modify porous material with other alkyl sulfonic acid groups to improve the catalytic activity.

3. To study the efficiency of reused catalysts in esterification of glycerol