

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

A silatrane precursor obtained from the Oxide One Pot Synthesis (OOPS) process has been successfully used to synthesize well-ordered and stable SBA-1 mesoporous silica via the sol-gel method using small head group of C_nTMAB under mild conditions. Triethanolamine molecules generated from the silatrane precursor significantly influenced the structure of the surfactant micelle by decreasing the surfactant packing parameter. When changing the template from cationic surfactant to G4 PAMAM dendrimer, the mesoporous silica was also formed. At the optimum conditions, spherical particles with smooth surface were obtained. The ordered crystal arrays were observed in TEM images. Two kinds of the crystal arrays were created in the mesoporous silica. One array is the same as the conventional dendrimer-incorporated mesostructures while the other is belong to oligomers of hydrolyzed silatrane interacting with dendrimer porogen, giving rise to the strict ordering of nanopores. In addition, silatrane can also be a highly reactive precursor for the preparation of transition metal-bearing SBA-1 mesoporous materials. SBA-1 framework can accommodate up to 6wt% Fe and 10wt% Ti without perturbing mesopore order. Dilation of the mesoporous lattice with metal loading is consistent with crystallochemical framework replacement of Si⁴⁺ by Fe³⁺/Ti⁴⁺ and the predominant retention of the metals in tetrahedral co-ordination to oxygen. However, to maintain charge balance as Fe³⁺ replaces Si⁴⁺ some edge-sharing octahedral FeO₆ clusters may be present, as suggested by ESR spectroscopy. These materials were used as a catalyst in the catalytic activity of styrene epoxidation. Both Fe- and Ti-SBA-1 show good activity and selectivity in this reaction. For Fe-SBA-1, the selectivities of benzaldehyde and styrene oxide reached 74 and 11%, respectively, at styrene conversion of 67% over 4%Fe in SBA-1 while those of styrene oxide and benzaldehyde reached 48 and 50%, respectively, at styrene conversion of 69% over 2%Ti in SBA-1.

Recommendations for future work

1. The dendrimer-incorporated metal, such as Au, Ag, is useful for applications like catalysis, molecular segregation, etc., because dendrimers have enough void volumes in the internal to include guest molecules.

2. Other interesting metals, such as Cr, Co and Cu, should be loaded into SBA-1 support to study the efficiency of the catalyst.

3. Other types of catalytic activity need to be further studied, such as, hydrotreating process.