

CHAPTER I

INTRODUCTION

Since the discovery of the so-called M41S silicas, much research work has been concentrated on this new class of mesoporous materials. Originally, this family has been classified into three subgroups: a hexagonal (MCM-41), a cubic (MCM-48), and a lamellar phase (MCM-50) (Sayari *et al.*, 1996, Vinu *et al.*, 2003). The materials with three-dimensional channel network are much more desirable than MCM-41 or SBA-3 with monodimensional channel system because of their promising applicability to adsorbents and catalysts. It is surmised that three-dimensional pore arrangements are more resistant to pore locking and allow faster diffusion of reactants (Che *et al.*, 2002).

Among the mesoporous silicas, SBA family have been attracted much attention because of thicker walls, better hydrothermal stability and larger pore size than M41S. It is well known that SBA-1 material is analogous to the cubic assemblage of globular micelles in amphiphilic surfactant solutions. Its structure has been suggested to be a cage type with open windows, following the clathrate-like model proposed for the surfactant mesophase by Charvolin and Sadoc (Kim *et al.*, 1999, Sakamoto *et al.*, 2002). Typically, SBA-1 mesoporous silicas have been synthesized by using cetyltriethylammonium bromide (C₁₆TEABr) with large head group and organic silica source in highly acidic or alkaline condition (Chao *et al.*, 2005). Up to now, however, few researches have been reported on SBA-1, compared to other mesoporous materials such as MCM-41, FSM-16 or SBA-3. One of the reasons might be that the large head-group surfactants are not commercially available (Ji *et al.*, 2003). Many researchers almost used tetraethoxysilane (TEOS) as a silica source so we introduced another source of silica from metal alkoxides precursor.

Additionally, the inclusion of guest molecules in mesoporous materials is one of focused subjects. Some efforts have been made to incorporate aluminum or other atoms such as V, Mo, Co, Fe and Ti into mesoporous silica materials by using silatrane as a precursor, and the products with catalytic functionality were named by TS-1 (Phonthammachai *et al.*, 2003), Ti-MCM-41, Mo-MCM-41 (Thanabodeekij *et al.*, 2005), VS-1 and Fe-MFI (Phiriyawirut *et al.*, 2003). Dendritic guest molecules

(poly(propyleneimine) dendrimers) containing amidoferrocenyl moieties were also incorporated into a mesoporous silica hosts (MCM-41) with highly ordered channels (Diaz *et al.*, 2003). This is a novel type of redox-active materials. Meanwhile, poly(propyleneimine) tetrahexacontaamine dendrimers (DAB-Am-64) was used as a single molecule template to produce mesoporous silica from TEOS (Larsen *et al.*, 2000). X-ray diffraction (XRD) patterns revealed the occurrence of mesoporous silica but transmission electron microscopic (TEM) analysis of a stained product showed the images of “globular” and “disordered filaments”. The 4.0th generation (G4) poly(amido amine) (PAMAM) dendrimer was also used as a template for the sol-gel reaction of TEOS (Larsen *et al.*, 2000).

During the last few years, Wongkasemjit and coworkers (2001-2005) synthesized moisture stable metal alkoxides, namely, silatrane, alumatrane, cerium glycolate, zirconium glycolate, titanium glycolate, tin glycolate and molybdenum glycolate, directly from inexpensively corresponding metal oxides using ethylene glycol solvent via the “Oxide One Pot Synthesis (OOPS)” process. The reaction gives highly pure metal alkoxides. Both synthesized silatrane and alumatrane have been successfully used for syntheses of various zeolites, such as, LTA (Sathupanya *et al.*, 2002), ANA, GIS (Sathupanya *et al.*, 2003), MFI (Phiriyawirut *et al.*, 2003), TS-1 (Phonthammachai *et al.*, 2003) and MCM-41, Ti-MCM-41, Mo-MCM-41 (Thanabodeekij *et al.*, 2005).