



## CHAPTER I INTRODUCTION

### 1.1 Introduction

Adsorption of surfactant at the solid / aqueous solution interface has been extensively studied to understand interactions between the surfactant and the solid surface. Layers of adsorbed surfactants on a solid surface can be considered as a two - dimensional solvent. This concept opens up a variety of applications, including both separation and reaction processes on the surface of the solid such as a previously explored separation process, known as admicellar chromatography. Hydrophobic molecules can concentrate and react within a surfactant layer on a hydrophilic surface to form a polymer-modified solid oxide surface, to produce corrosion barriers and to create self-lubricating surface. The adsorption of surfactants from aqueous solution is a phenomenon of great importance with applications in processes ranging from ore flotation, lubrication, paint technology, enhanced oil recovery and wastewater treatment (Clint, 1992).

The International Union of Pure and Applied Chemistry (IUPAC) classification of pores according to their diameter is utilized in defining the porous solids: materials having pore with diameters below  $20\text{Å}$  are called microporous. The predominant presence of pore diameter above  $500\text{Å}$  defines macroporous materials. In between (pore diameter between  $20$  to  $500\text{Å}$ ) is defined mesoporous solids.

To achieve a significant adsorptive capacity, an adsorbent must have a high specific surface area, which implies to have a highly porous structure with very small micropores. Microporous and mesoporous inorganic solids have found great applications as catalysts and sorption media because of

their large internal surface areas. The utility of these materials is manifested in their microstructures which allow molecules access to large internal surfaces and cavities that enhance catalytic activity and adsorptive capacity. Developing frameworks with pore diameters within the mesoporous range, the largest synthesized to date being ALPO<sub>4</sub>-8 (Dessau *et al.*, 1990), VPI-5 (Davis *et al.*, 1992), and Cloverite (Estermann *et al.*, 1991) which have pore diameters within the 8-13 Å<sup>0</sup> range. Mesoporous materials are typically amorphous or paracrystalline solids, such as silica or transitional alumina or modified layered materials such as pillared clays and silicates. The pores in these materials are generally irregularly spaced and broadly distributed in size.

It was reported that the highly ordered mesoporous materials could be synthesized from a layered polysilicate used pillaring method which means the insertion of robust inorganic species as pillars between layers (Occelli and Robson, 1992). Then, nanoengineered porous solids have been found widely in various industrial applications. The unique features of their attractiveness comprise of an internal structure with discrete opening (pores), which provides extra volume and surface area for molecular recognition, storage and processing, as compared to the nonporous solids. In the search for large pore zeolites, it has been intuitively anticipated that the use of larger templates (larger organic molecules and cations), would lead to larger pore sizes. This concept has been successfully applied recently, when the templating approach for induction of molecular sieving properties has been extended to the mesopore range (20-100 Å<sup>0</sup>) by utilizing supramolecular surfactant templates. M41S represents a new family of silica-based mesoporous molecular sieve materials. MCM-41 (Mobile Composition of Matter), one of the members of this extensive family of mesoporous sieves, possesses a hexagonal array of uniform mesopores and has been synthesized with uniform channels from approximately 15Å<sup>0</sup> to greater than 100 Å<sup>0</sup> in size. It also has a high surface area, and high hydrocarbon sorption. This mesoporous pore materials typically

have surface areas above 700 m<sup>2</sup>/g and hydrocarbon sorption capacities of 0.7cc/g or greater (Beck *et al.*, 1992). A liquid crystal templating mechanism (LCT) in which surfactant liquid crystal structures serve as organic templates has been proposed for the formation of these materials (Kresge *et al.*, 1992). In support of this templating mechanism, the structure and pore dimensions of MCM-41 materials are intimately linked to the properties of the surfactant, such as surfactant chain length, solution chemistry. In this experimental study, MCM-41 type materials with varied pore sizes were directly synthesized by using organic- guest species acting as void filters, structure – directing agents and templates and controlling the preparation conditions. The MCM-41 have attracted great interest which generates the potentiality for the applications in catalysis, separation, and sorption for very bulky molecules.