CHAPTER I

INTRODUCTION

1.1 Background

Nanostructure materials have attracted much attention in the last few year because of their unique characteristics that can hardly be obtained from conventional macroscopic materials owning to its quantum size effects. Especially, such attention has been paid to synthesis of group II-VI semiconductor materials due to their excellent values in catalysis, optical devices, magnetic fields, and so on. Large variety methods used for synthesizing ZnS nanocrystals, including laser ablation, electrochemical fabrication, epitaxy, high-temperature reactions and solvothermal method [1] has been developed. But water-in-oil (w/o) microemulsions or reverse micelles method has several advantages over others, for instance, soft chemistry, demanding no extreme pressure or temperature control, easy to handle, and requiring no special and expensive equipment.

Regarding to technical definition, microemulsions are isotropic, thermodynamically stable dispersion of oil, water, surfactant, and often cosurfactant. Water-in-oil microemulsions are composed of nanometer-sized water droplets that are dispersed in a continuous oil medium and stabilized by surfactant molecules, which are localized at water/oil interfaces. These droplets can serve as nanoreactors for producing ultrafine and monodisperse nanoparticles. At the present, microemulsion method is widely used for synthesizing nanoparticles, especially for inorganic materials and metal such as Cu, CuS, AgI, and NiS [2-5].

It is also known that addition of cosurfactant can help reduce the concentration of surfactant in preparing microemulsion. Normally, low molecular weight alcohols, such as n-butanol can be used for this purpose. Their short hydrophobic chain and terminal hydroxyl group is known to enhance the interaction with surfactant monolayers at the interface, which can influence the curvature of the interface and internal energy. The amphiphilic nature of cosurfactants could also enable them to distribute between the aqueous and oil phase.[6]

The most challenging problem in this synthesizing method is to control shape and size of nanoparticles. The uniformity of shape and size of the synthesized product is expected for being effective utilization in some specific applications, such as optical sensitizers, photocatalysts, light converting electrodes and inorganic light emitting diodes (ILEDs).

There are some tehnical evidents that ZnS nanoparticles and nanorods could be in ternary water-in-oil microemulsion by varying some parameters such as the molar ratio of water to surfactant (w_o) and temperature. Uniform nanorods could be obtained at w_o of 11 and reactant concentration of 0.1 mol/dm^3 after aging for 2 days[1]. Similarly, AgI nanowires of uniform diameter could also be prepared from a system of Triton x-100 microemulsion with n-pentanol as a cosurfactant at w_o of 11[3]. There is another report which ZnS nanowires synthesis using AOT micelle-template inducing reaction was proposed . It is found that the morphology and size of ZnS nanoparticles would also be affected by reactant concentration and w_o[7]. Moreover, ZnS nanotubes could be obtained from O/W microemulsion by using CS_2 as oil phase and Triton x-100 as a surfactant[8].

1.2 Objectives

Study the effects of types of cosurfactant and anions on ZnS nanoparticle synthesis in microemulsion and find out the suitable conditions for synthesizing ZnS nanoparticles with uniform size and shape.

1.3 Scopes of Research

1. Design the experimental method to prepare microemulsion
2. Synthesize ZnS nanoparticles in ternary W/O microemulsion (without cosurfactant) with surfactant concentration of 0.6 mol/kg
3. Study the effect of cosurfactant (n-butanol, n-pentanol and n-hexanol) on synthesizing ZnS nanoparticles at molar ratio of water to surfactant, w_o 5 to 20 with constant cosurfactant concentration of 0.6 mol/kg
4. Study the effect of anions (Cl^- and Br^-) on synthesizing ZnS nanoparticles with constant concentration of 0.001 M
5. Characterize obtained nanoparticles using SEM (Scanning Electron Microscopy), TEM (Transmission Electron Microscopy) and EDX (Energy Dispersive X-ray Analysis)

1.4 Procedure of Research

1. Explore and review the related researches
2. Design the experimental method to synthesize microemulsion
3. Synthesizing ZnS nanoparticles in ternary W/O microemulsion (without cosurfactant)
4. Conduct the experiment by adding cosurfactants and anions in ternary W/O microemulsion
5. Study properties of obtained particles
6. Discuss experimental result
7. Draw conclusion
8. Write the thesis

1.5 Expected benefits

1. Knowledge of synthesis nanoparticles in microemulsion
2. Understanding of the effect of cosurfactants and anions on synthesizing ZnS nanoparticles in microemulsion
3. Capability to synthesize ZnS nanoparticles with uniform size and shape