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GROWTH AND CHARACTERIZATION OF ZnS NANOPARTICLE

Motlan[1] dan Makmur Sirait[1]

[12]jurusan Fiskia FMIPA Universitas Negeri Medan, Jl. Willem Iskandar Psr V Medan Estate, *Medan 20221*, E-mail: motlan@yahoo.com

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Abstract. ZnS nanoparticle has been syntesized from zinc asetat and thiorea 0.2 M using copresipitation method. The structure of the ZnS nanoparticle are wurtzite with hexagonal and blende (sphalerit) with cubic shape with average size of 39.56 nm. The elements of the ZnS measuring using EDS it was found that Zn has a mass of sebesar 52.20% with disperse energy of 8.630 keV and S element of 18.92% with disperse energy of 2.307 keV.

Kata kunci:
ZnS, nanoparticle, EDS, morphology

Introduction

The research on ZnS nanoparticle has atrracted a great interest due to its many applications in electronics and possibly in heath area. The ZnS nanoparticle for example has been used for elecroluminescence device, solar cell, coating [1-6]. Zinc sulfida is belong to II-VI semiconductor. The optical and electrical properties of the Zinc sulfida depend on the particle size [3-4]. The band gap is within the range of UV light which is in the range of 3.50 – 3.70 eV [2-5]. These band gaps can be used as the main component of LED. The race of getting an optimum nanoparticle growth has been intensified in recent years. Nanoparticles with average size below 100 nm will significantly alter its physical properties from its bulk material.

There are several methods of sintesizing of nanoparticle semiconductors. It ranges from very highly sopisticated tehniques such as *Metalorganic Chemical Vapor Deposition* (MOCVD) [7-8] and *Molekul Beam Epitaxy* (MBE) [9] to a very simple methods such as wet chemistry [2,5,8]. Todays researchers tend to use colloidal synthesis due to its simple chemical proses and relatively chieve. The solution proses methods can be devided into five cathegories: (1) sol-gel processing, (2) precipitation method, (3) water-oil microemulsions method, (4) polyol method and (5) hydrothermal synthesis. The mixture, precipitation, heating, and the stirring of the solution are greatly affecting the qualities of the nanopartilces [1,10-12].

Borah et.al. (2008) grew ZnS semiconductor nanoparticle at Polyvinyl alcohol matrix with chemical reaction. Nanoparticles at the average size within 5 - 7 nm with peak intensities, at room temperature, of 315 nm and 425 nm have been obtained. Low temperature growth with a mixture of $Zn(CH_3COO)_2.2H_2O$, water, and thioasetamid produced solid white phase ZnS [2,5]. Using . thioglycerol Duta et.al.[4] produced ZnS nanoparticle of 5 nm size with peaks at between 270 and 330 nm.

In this work the growth of the ZnS particles was by copresititation method whrere zinc asetat and thiourea with amonium solution as a stabilizator. The morphology of the samples were characterized using Scanning Electron Microscopy (SEM) and the structure using X-Ray Difraction (XRD).

Experiment

The formation of the ZnS was by copresipitation method were Zinc asetat (2 M) was deluted in water (50 ml) and thiourea (2

M) deluted in 50 ml water. The two solutions then mixed and stirred with speed of 300 rpm in 6 seconds. The mixed solution then 4 ml amonium of pH 10 is drop until it reaches its pH of about 10. After 6 hours the preciatated then washed with distille water and ethanol. The samples then heated in oven for 24 hour and put in a decicator,

The structure and the morphology of the samples were consecutively characterized using XRD and SEM, and the size of the partcles were calculated using Scherer equation. The composition of the ZnS nanoparticle was analized by using *energy dispersive spectroscopy* (EDS).

Results And Discussion

ZnS nanoparticle has been synthesized with copresipitation method. The solution of 0.2 M zinc acetate and 0.2 M thiourea deluted in 50 ml destile water at room tempeture. Then amonium is droped into the solution in order to keep the growth of the ZnS particle in nanosize. The synthesized nanoparticle has a white color and after cooling to room temperature it formed two different layers, the upper layer was clear color and very thin and the second layer was solidified due to precipitation.

We then washed the samples with destile water, and then centrifused to separate the solid sample. The washed samples then dried in oven which was white ZnS nanopartice powder. The XRD result is shown in Figure 1.

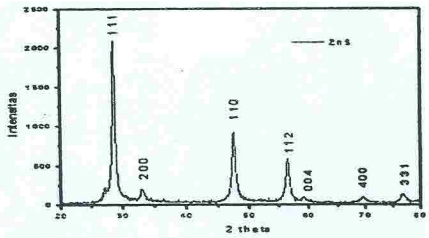

Figure 1. The XRD of ZnS Nanoparticle

The XRD results show that the grown particle has sfalerit and blende structures with cubic shape and wurtzite structure with hexagonal shape. Figure 1 show that at 2θ = 28.55° reflected from (1 1 1) plan, at 2θ = 33.08° reflected from (2 0 0) plan, at 2θ = 47.53° reflected from (1 1 0) plan, at 2θ = 56.39° reflected from (1 1 2 2) plan, at θ = 59.01° reflected from (0 0 4) plan, at 2θ = 69.51° reflected from (4 0 0 2) plan, and at θ = 76.80° reflected from (3 3 1) plan. Using Scherer equation we found the size of the ZnS particle of about 39.56 nm. This size is considered to be nanoparticle. Although the size below 100 nm is considered as nanoparticle [13-14], this size is still considerably big, this may be due to the environtment and unstable heating prosses. According to Borah et. al. (2008) and Kousik et. al. (2009), the size of the nanoparticle is influenced by the strring prosses and the pH of the solution.

Figure 2 show the *Scanning Electron Microscope* (SEM) and EDS results of ZnS nanoparticle at magnification of 1000 times.

The microstructure analysis show that the particles are homogen with aglomerating forming sperichal shape like balls that distributed evenly over the surface. At magnification of 2000 times the surface of the nanoparticle becomes more clear like aglomerating balls since ZnS has a property that easily absorbs water (hydropilic).

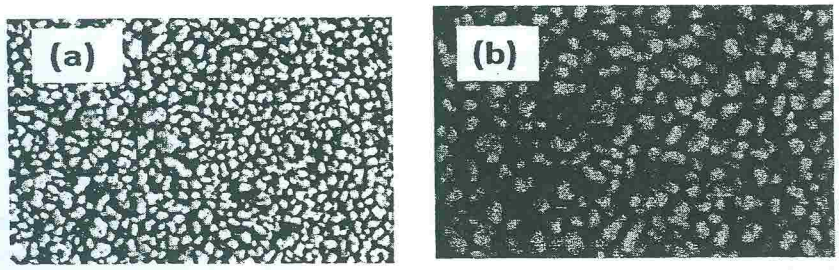

Figure 2. The SEM of ZnS nanoparticle with macnifications of (a) 1000 X dan (b) 2000 X

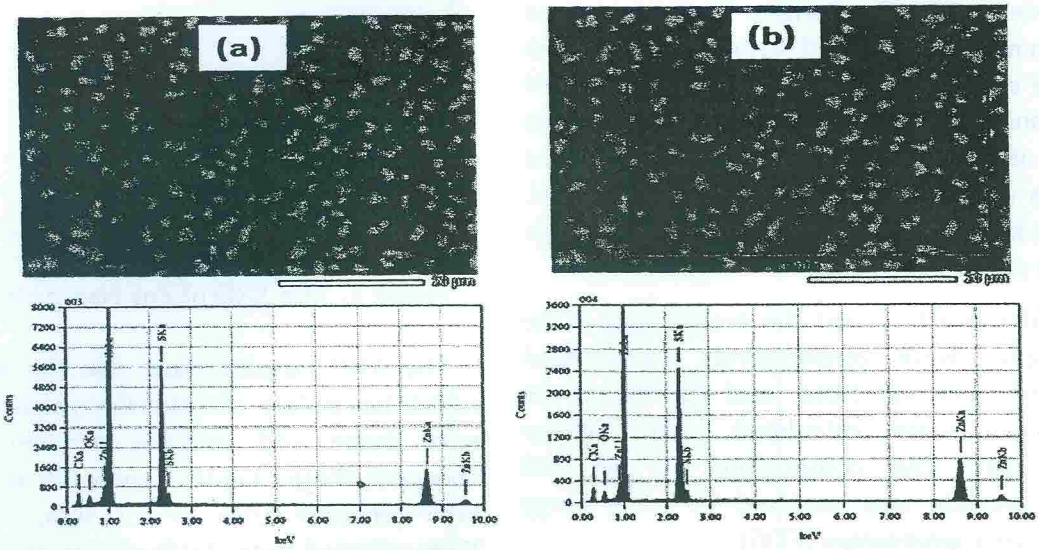

Figure 3. The EDS of ZnS nanoparticle (a) from one point (b) from a wide area

The *Energy Disperse Spectroscopy* (EDS)determines the element content of in the nanoparticle and the disperesed by of each atom. The EDS results are shown in Figure 3.

Figure 3 (a) shows that the EDS analyzed of a certain point of some samples. The EDS shows that some elements are present in the nanoparticle samples such as C of about 24.72% with dispertion energy of 0.277 keV, O of about 4.41% with dispertion energy of 0.525 keV, S of about 21.31% with dispertion energy of 2.307 keV, and Zn of about 49.55 % with dispertion energy of 8.630 keV.

Figure 3 (b) shows that the area under investigation is a wider area and represents almost all part of the samples. The EDS results show that the sample contains C of about 25.62 % with dispersion energy of 0.277 keV, O of about 4.94% with dispersion energy of 0.525 keV, S of about 18.42% with dispersion energy of 2.307 keV, Zn of about 51.01 % with dispersion energy of 8.630 keV.

These results show that the nanoparticles are considerably homogen and only small amount of impurity presents. The composition of the elements in the particle remains the same regardless EDS from a point or from a large area. This is prove that the growth nanoparticles are highly homegenous and well distributed. The percentages of Zn and S are considerably higher compared to other elements that present in the nanoparticles, this is confirm that the nano particle is ZnS.

CONCLUSION

In this work we have been able to grow ZnS nanoparticle by copresitation method. The structure of the ZnS nanoparticles are blende and wurtzite with average size of 39.56 nm. This is prove that the growth nanoparticles are highly homegenous and well distributed. The percentages of Zn and S are considerably higher compared to other elements that present in the nanoparticles, this is confirm that the nanoparticle is ZnS.

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