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Preparing Nano-ZnS by Solid State Reaction at RoomTemperature

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Abstract: ZnS nanoparticles were prepared by using solid-state reaction method at room temperature in agate mortar for the first time. The average particle size was about 20nm. This reaction is affected by the structure of reactant, crystal water and defects.

Keywords: Zn nanoparticle, solid-state reaction, room temperature.

Solid-state reaction has been studied for a long time[1-3]. In recent years, some researches have been focused on the preparation of coordination compounds at low temperatures or even at room temperature[4-5]. In this letter, preparation of ZnS nanoparticles by using solid state reaction at room temperature is reported.

ZnS nanoparticles were prepared as follows: $Zn(CH_3COO)_2$ and $Na_2S{\cdot}9H_2O$, in equal molar ratio, were ground in agate mortar. After 20 minutes, the powder was washed by water and alcohol, respectively, and then dried at 80°C. The products were light yellow powder. The samples were analyzed by X-ray diffraction technique with a Rigaku X-ray diffractometer and TEM (THILPS-EM400ST).

Figure 1 The x-ray diffraction patterns of nano-ZnS

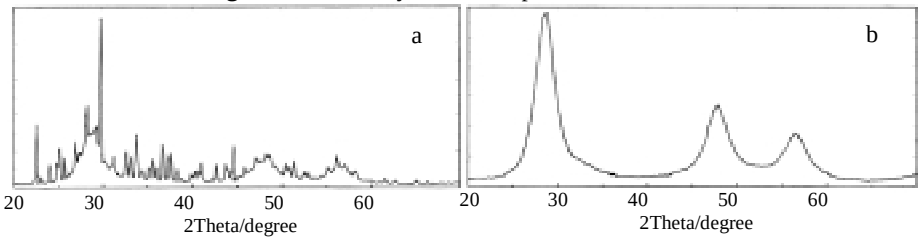

Figure 1a shows the pattern of the X-ray diffraction of not washed ZnS nanoparticles, and **Figure 1b** shows the pattern of washed sample. From **Figure 1a**, it can be seen that there were many impurities in the sample. However the peaks of ZnS appear, indicating that ZnS was formed during grinding. **Figure 1b** shows that the particles exhibit a zinc-blende crystal structure, and the peaks are broader, which is the characteristic of nanoparticles. The average size of the particles, estimating form Debey-Scherrer formula, is 20.4 nm. The TEM result is shown in **Figure 2**. From the

TEM micrograph, the particles average size is about 20~40 nm, which agrees with the result of the X-ray diffraction patterns.

The $Zn(Ac)_2 \cdot 2H_2O$ structure and crystal water affect the reaction[6]. In $Zn(Ac)_2 \cdot 2H_2O$, the Zn—O bond lengths are equal and the O—Zn—O bond angles deviate strongly from 90°, which produces distortion of the octahedron. So that $Zn(Ac)_2 \cdot 2H_2O$ with distorted octahedron structure is more active. Vaporized crystal water forms a liquid bridge on the interface, which also accelerates the reaction. In the course of reaction, part of the crystal water may evolve from the system, which produces a large point defect concentration in the crystal lattice and facilitates the reaction.

Figure 2 The TEM micrograph of nano-ZnS

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