

Preparation and spectral characteristics of ZnS:Cu modification with nanoparticles ZnO

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The nanoparticles ZnO had been prepared on the surface of ZnS:Cu by homogeneous precipitate method. The urea was used as precipitator in the process of hydrolysis reaction. X-ray diffraction (XRD) and infrared (IR) spectra indicated that ZnO was formed. We also observed fluorescence spectra, there was some difference between the raw material and coated materials in fluorescence intensity.

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Surface coating is a frequently applied technique to modify or to adjust specific properties of fine powders^[1]. Powder's dispersion property and surface property can be improved by it. To phosphor, it is also important. Phosphors have wide application areas such as in lamps and in TV screen^[2]. In view of the outside factors and their own factors, problems such as easy to agglomeration, unstable of surface electricity property and chemical property are existed in raw phosphor materials^[3]. Usually these problems can be solved by coating phosphor surface with organic or inorganic materials.

ZnS:Cu as a common electro luminescence phosphor is widely used in lighting and color television tubes. But in atmosphere, ZnS-type phosphor is apt to analyze then zinc is separate out, therefore, the construction of luminescent is destructed^[4]. For their stability, surface coating are introduced to make it insulate from the outside. To some extent, its steady property is improved^[5].

In this paper, we try to coat the nanoparticles ZnO on the surface of ZnS:Cu phosphor using a liquid precipitation method. X-ray diffraction (XRD) was employed to characterize the coatings, infrared (IR) spectra was used to ascertain the chemical composition of the phosphor, and luminescence measurements were carried out to confirm their spectral characteristics.

A commercially available green-emitting phosphor ZnS:Cu was used as ZnS raw material. The concentration of dopant was in the ppm-region. XRD data were obtained with a diffraction meter (Daojin, XRD-55, Japan); luminescence measurements of phosphors were carried out with a spectrophotometer (PE, LS-55, American); IR spectra were obtained with an IR spectrograph (Bruker, Equinox-55, German)^[6]

The samples were pretreated as follows^[7,8]. ZnS:Cu was suspended in demineralized water and deagglomerated., and the pH was set to 8.0. Then proper H₂O₂ (3.0%) was added. The suspension was stirred for one hour at room temperature and its pH was kept constant. Afterward the suspension was filtered, washed, and dried.

The pretreated sample was suspended in demineralized water, the pH of the suspension was set to 10.0. Surface active agent OP was added as disperser, then deagglomerated by ultrasonic.

ZnO particles were prepared based on the homogeneous precipitation method^[9]. 0.45-mol/L Zn(NO₃)₂ was placed in a breaker, then the same volume of 1.5-mol/L urea and OP were added, and the mixture were stirred vigorously. It was heated within 30 min to 80 °C. Then the prepared ZnS:Cu suspension was dropped into

the solution in 30 min and the temperature of mixture was maintained in this process. Afterward the mixture was heated below the boil point. After an addition two hour, the heating and stirring were stopped, then the suspension of the coated phosphor was allowed to sediment in water bath. Thereafter the solid was filtered, washed, dried, and fired in a muffle. Then the ZnS:Cu modified with ZnO was obtained^[10].

Figure 1 shows the XRD curves of the coated and uncoated ZnS:Cu. It clearly shows that there is some difference between (a) and (b). In curve (b), there are peaks of ZnO, which suggest that ZnO particles were coated on the surface of phosphor.

From the excitation spectrum curve of the uncoated ZnS:Cu in Fig. 2, it is clearly shown that the peaks of 295, 336 and 384 nm contribute most to the excitation. In the fluorescence spectrum, 336 nm was used as excitation wavelength.

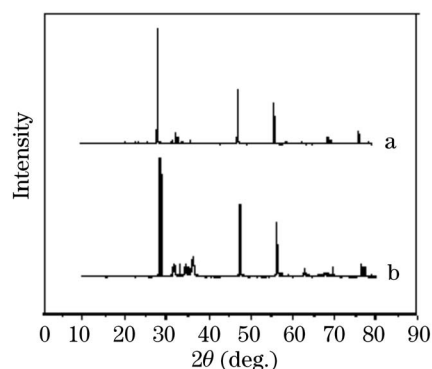


Fig. 1. XRD patterns of phosphor. (a) Uncoated, (b) coated.

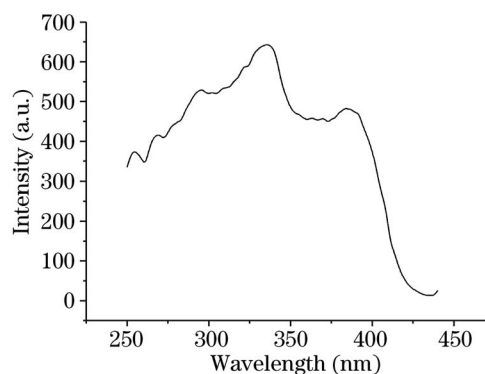


Fig. 2. Excitation spectrum of ZnS:Cu.

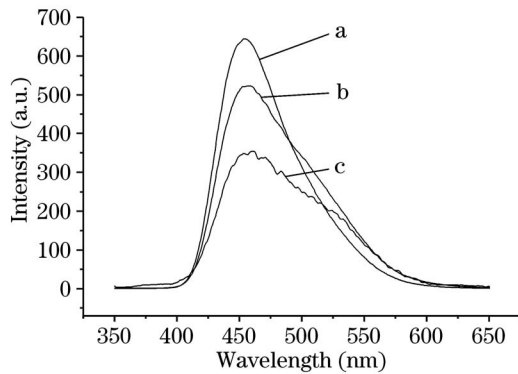


Fig. 3. Fluorescence spectra of the samples. (a) ZnS:Cu, (b) ZnS:Cu coated with 1.5 wt.-% ZnO particles, (c) ZnS:Cu coated with 7.5 wt.-% ZnO particles.

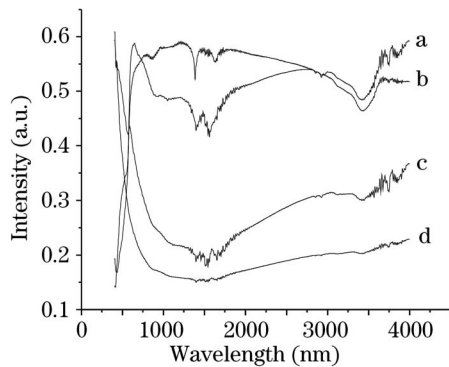


Fig. 4. IR spectra of the samples. (a) ZnS:Cu, (b) ZnS:Cu coated with 1.5 wt.-% ZnO particles, (c) ZnS:Cu coated with 7.5 wt.-% ZnO particles, (d) ZnO.

The fluorescence spectral curves of uncoated ZnS:Cu particles, ZnS:Cu coated with 1.5 wt.-% ZnO particles and ZnS:Cu coated with 7.5 wt.-% ZnO were shown in Fig. 3. It is clearly shown that their wavelengths of fluorescence peaks are all about 454 nm, but peak intensity is different. It indicates that the fluorescence peak intensity is weakened with the increase of ZnO coating, but compared

with their improved stability and separate characteristics, weakened fluorescence intensity can be accepted.

Figure 4 shows the IR spectra of ZnS:Cu, coated ZnS:Cu and ZnO. These spectra are structured with the absorption maximum at about 1500, 1700 and 3550 nm in curves (b), (c), and (d). These peaks are the characteristic absorption peaks of ZnO. The results indicate that nanoparticle ZnO was coated on the surface of ZnS:Cu.

IR and XRD spectra confirm that ZnO nanoparticle was coated on the surface of ZnS:Cu. And results of the fluorescence spectra prove that ZnO coating cannot change the fluorescence character of phosphor, only have some influence on their fluorescence intensity. Therefore, proper surface coating can improve stability of phosphor without changing their fluorescence characteristics.

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