

SiO₂ coating of ZnS:Cu,Cl blue-green nano phosphor

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Abstract : ZnS:Cu,Cl phosphor was coated by solid-gel reaction with SiO₂ outside layer. The effect of Cu²⁺-doping concentration has been investigated on the luminescence characteristics of ZnS:Cu,Cl blue-green phosphors for inorganic electro luminescent device. Also, SiO₂ coated layers' effect on luminescence characteristics. Evaluation of luminescence characteristics dependent on the synthesis conditions is important to get high-performance phosphors properties. EL and PL properties such as luminescence intensity and chromaticity of ZnS:Cu,Cl phosphors synthesized with different concentration of activator, Cu²⁺, were analysed separately

1. Introduction

ZnS:Cu,Cl phosphor was synthesized by solid-liquid state reaction with two firing steps. Each stage of the process was carefully monitored so that the final product was comparable to commercially-available phosphor. The effect of Cu²⁺-doping concentration has been investigated on the luminescence characteristics of ZnS:Cu,Cl blue-green phosphors for inorganic electroluminescent device. Inorganic EL devices have been used as backlights for some displays for long time [1]. In order to be a candidate for more various applications including backlight for flexible LCD, however, there are limitations in luminous efficiency, brightness and chromaticity to overcome. To get high-performance phosphors can be an approach, understanding their luminescence characteristics dependent on the synthesis conditions. EL and PL properties such as luminescence intensity and chromaticity of ZnS:Cu,Cl phosphors synthesized with different concentration of activator, Cu²⁺, was studied in this work.

2. Procedure and Results

Both of PL and EL intensities of the ZnS:Cu,Cl phosphor increased with increase of Cu concentration, and decreased when Cu was added

Table1. Composition for ZnS:Cu,Cl phosphor synthesis

Sample (No)	CuSO ₄ ·5H ₂ O(99.99%) addition											
	1	2	3	4	5	6	7	8	9	10	11	12
1 st mol%	0.02	0.03	0.04	0.05	0.06	0.08	0.10	0.12	0.13	0.14	0.16	0.20
2 nd mol%	0.4											

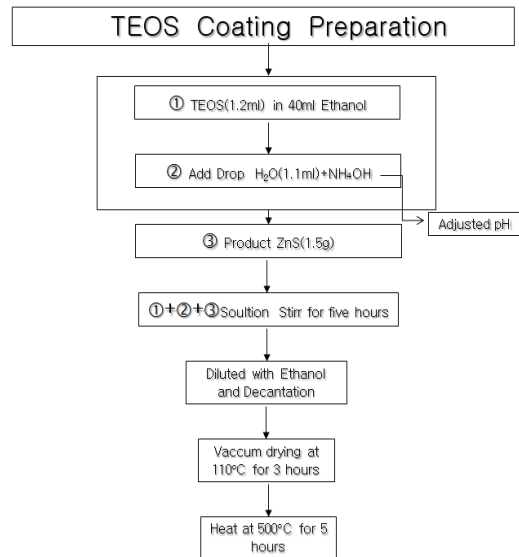
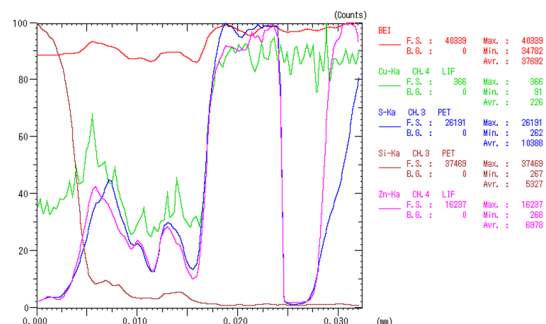


Fig.1 Flow sheet of nano ZnS:Cu,Cl phosphor preparation



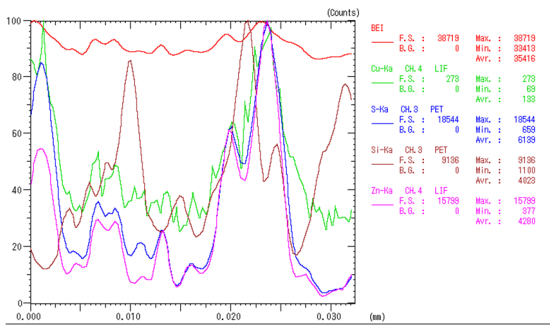


Fig.2 EPMA Analysis for SiO₂ coating evaluation
a) partly coated b) fully coated

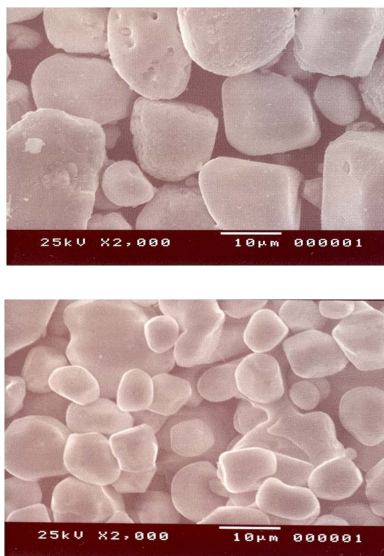


Fig.3 SEM morphology of ZnS:Cu,Cl phosphor
a) partly coated b) fully coated

over 0.13 mol%. 0.13 mol% Cu-added sample at the 1st blending step showed the highest EL intensity, 164 cd/m² at an operating condition of 100V, 400Hz, having a main emission peak at 508

Fig.3 EPMA Analysis of SiO₂ coated nano powder

nm and a color coordinate at x = 0.1947, y = 0.4426 of green region, while the PL intensity was 107 cd/m² by 353 nm-excitation with a main emission peak at 501 nm and a color coordinate at x = 0.1893, y = 0.4345. The more Cu was added, the more the color coordination was green-shifted from blue region .

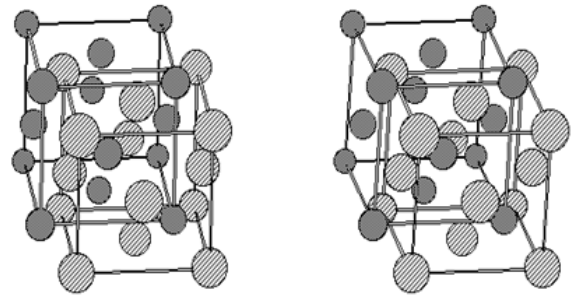


Fig.4. Crystallographic structure of wurtzite

Further investigation such as the Cu concentration effect at the 2nd blending step and the flux effect on the EL characteristics is in progress. The luminescence characteristics of ZnS:Cu,Cl green-blue emitting phosphor is dependent on copper concentration. The more Cu was added at the 1st blending step for synthesis of ZnS:Cu,Cl phosphor, the more the color coordination was green-shifted from blue region. Based on well-optimized process, high-performance phosphors comparable to those commercially available were prepared, which exhibit high luminescence intensity and good chromaticity.

3.Results

Photoluminescence and electroluminescence spectra of the phosphors with various copper concentrations were investigated. After ZnS:Cu,Cl phosphor nano powder obtained SiO₂ outlayer was coated by Sol-Gel process for sensitizing function. SiO₂ coated layer was evaluated with EPMA analysis. Following results were obtained.
1) Both of PL and EL intensities of the ZnS:Cu,Cl phosphor increased with increase of Cu concentration, and decreased when Cu was added over 0.13 mol%. The more Cu was added, the more the color coordination was green-shifted from blue region
2) SiO₂ layer was fully coated around out layer when b state of Sol condition

Reference

[1] K. Wanger, "Thin SiO₂ coating on ZnS phosphor for Cathodoluminescence", *J. Mater. Res.*, 15 2288(2000)
[2] Shigo, S. "Phosphor handbook", CRC Press, 2002