PREPARATION OF NON-AGGREGATION YAG-Ce PHOSPHOR PARTICLES BY SPRAY PYROLYSIS

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KEYWORDS
YAG, Phosphor, Spray Pyrolysis, Ultrasonic, FEAG

Yttrium Aluminum Garnet (Y₃Al₅O₁₂, YAG) materials have been widely studied in the application of fluorescent and solid state lasers (Scholl and Trimmier, 1986; Robbins, 1982). YAG is a hard material which does not damage easily under conditions of high irradiance with an electron beam. Therefore, rare earth doped YAG materials are promising phosphor candidates in cathode-ray tubes (CRTs), field emission display (FED), scintillation, vacuum fluorescent displays (VFDs), and electroluminescent (EL). Recently, spray pyrolysis was successfully applied to the preparation of phosphor materials (Kang et al., 1997a, b). In this work, we prepared YAG:Ce green phosphors by spray pyrolysis using ultrasonic and FEAG process.

In the system of YAG phosphors, the directly prepared particles in spray pyrolysis have amorphous phase, and activation of doping component was not occurred because of short residence time of particles inside hot wall reactor as several seconds. Therefore, annealing process at high temperatures is required for the crystallization and activation of cerium-doped YAG particles. The peaks of cubic structure YAG appeared after annealing from 800 °C, and high crystallinity YAG was formed above 1000 °C. In all samples, small peak of CeO₂ was appeared, and intensity of peak was increased with increasing doping concentrations of dopant.

Fig. 1 shows the SEM photographs of particles prepared by different processes. The overall solution concentration was 0.4M. The prepared particles have spherical morphology and submicron size in both processes. Additionally, the particles had non-aggregation and sphericity after annealing at high temperatures. The YAG:Ce particles prepared at low flow rate of carrier gas had more solid morphology and sphericity than those of high flow rate of carrier gas.

The photoluminescence characteristics of YAG:Ce particles with spherical morphology were investigated. The all particles for the measurements of PL were prepared by ultrasonic spray pyrolysis at the conditions of 2 l/min and 900 °C. The excitation spectra of YAG:Ce particles have maximum peak at wavelength of 465 nm. The emission spectra have a maximum intensity at 527 nm. The optimum brightness was obtained at doping concentration of 1 at.% The effect of calcination temperature on the luminous intensities of particles at constant doping concentration(1 at.%) was shown in Fig.2. The luminescence of particles was increased with increasing annealing temperatures because of good activation of Ce component into YAG matrix. In the XRD spectra, the peak intensity of CeO₂ was decreased with increasing annealing temperatures.
The mean particle size is very important in the processing and brightness of phosphor materials. Fig. 3 shows the PL spectra of particles according with different sizes. The mean size measured from the SEM photographs was increased from 0.48 to 1.2 μm when the overall solution concentration was changed from 0.03 to 1.5 M. The PL spectra of YAG:Ce particles were strongly affected by mean sizes of particles.

REFERENCES


Fig. 1 SEM photographs of particles prepared by ultrasonic and FEAG process.

Fig. 2 PL spectra of particles at different temperatures.

Fig. 3 PL spectra of particles of different sizes.