

論文内容の要旨 Abstract of Dissertation

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The combination of blue LED and yellow phosphors are the simplest combination in the fabrication of white LEDs. It observed that yellow phosphors with high thermal stability are required to produce high-power-efficiency-white LEDs as it begins to deteriorate at 150 °C during operation. Generally, the most widely used blue excited yellow phosphors for white LEDs is YAG:Ce³⁺ because of its high luminous efficiency and high chemical stability. However, there is a main problem regarding low thermal stability, which effect the power efficiency of white LEDs. To resolve this problem, silicate phosphors were investigated, which have high luminescent properties, physical, chemical stability and high thermal stability for the possibility replacement of YAG:Ce³⁺ phosphors.

For the silicate phosphors, Eu is used as doping agent instead of Ce, which has high luminescent efficiency and the ionic radius of both Sr and Eu ions are almost same. Sr is commonly used in substitution of Eu. Moreover, emission wavelength also can be tunable by modifying host lattice. Instead of using Garnet in YAG:Ce³⁺ phosphor, alkaline earth orthosilicate phosphor were used. Besides that, Si sources can be easily found and existed in large quantities in the earth's crust according to Clarke number, indicating that silicate compound can get easily to synthesize the strontium silicate phosphors. In this study, Eu doped silicate phosphor were synthesized by improved polymerized complex method (PCM) using TEOS, which has advantages in the aspect of uniformity of atomic component of the samples and can be synthesized at low temperature.

The simplest compounds made from alkaline earth Sr, Si and O is Sr₂SiO₄. Therefore, Sr₂SiO₄:Eu²⁺ phosphors were synthesized by improved PCM using TEOS as basic phosphors. Generally, Sr₂SiO₄ have two different crystal phases: (1) α' phase – high temperature phase and (2) β phase – low temperature phase, with phase transition at 85 °C. In this study, β phase Sr₂SiO₄:Eu²⁺ phosphors were successfully synthesized by PCM using HCl under H₂/N₂ atmosphere at 1150 °C with 3% Eu concentration. The α'→β → α' phase transition and hysteresis of the samples can be observed. The appearance of proper phase transition indicates that β phase Sr₂SiO₄:Eu²⁺ phosphors show good characteristics and properties by using improved PCM. In this study, Sr₂SiO₄:Eu²⁺ phosphors show good crystallinity by improved PCM, indicating that the efficiency of improved PCM in the preparation of silicate phosphors.

As Sr₂SiO₄:Eu²⁺ phosphors have phase transition, Li was introduced to lock the phase transition in the host lattice. Li₂SrSiO₄:Eu²⁺ silicate phosphor is one of the well-known

yellow phosphors with high luminescent properties and was synthesized by the improved PCM. The optimum synthesis of $\text{Li}_2\text{SrSiO}_4:\text{Eu}^{2+}$ phosphors are 900 °C under H_2/N_2 atmosphere and 0.5% Eu concentration. Eu concentration and temperature quenching of the samples were discussed. The PL intensity at 150 °C was about 80% compared to room temperature and obtained high activation energy (0.43 eV), indicating that $\text{Li}_2\text{SrSiO}_4:\text{Eu}^{2+}$ phosphors have high thermal stability compared to $\text{YAG}:\text{Ce}^{3+}$ (0.14 eV). The study show that $\text{Li}_2\text{SrSiO}_4:\text{Eu}^{2+}$ phosphors have high thermal stability and possibly applicable in high-power-efficiency-white LEDs application.