



Direct synthesis of spherical YAG:Ce phosphor from precursor solution containing polymer and urea

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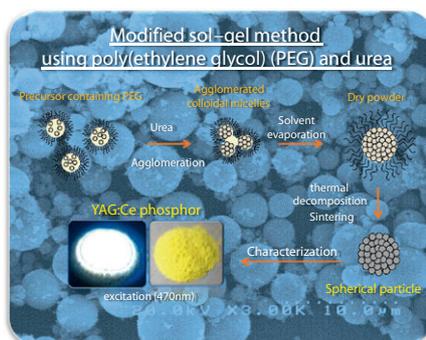
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HIGHLIGHTS

- ▶ This is the first report on the direct synthesis of a spherical YAG:Ce phosphor.
- ▶ The spherical phosphor were prepared by a sol–gel method using PEG and urea.
- ▶ The mechanism of the particle formation are proposed based on experimental results.
- ▶ PEG caused micelle formation and urea acted as an agglomeration promoter.
- ▶ The presented method is a direct preparation and produces large amounts of product.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 1 June 2012

Received in revised form 28 August 2012

Accepted 4 September 2012

Available online 21 September 2012

Keywords:

Phosphor
Yttrium aluminum garnet
Spherical particle
Photoluminescence
Sol–gel
Micelle

ABSTRACT

In this study, spherical cerium-doped yttrium aluminum garnet (YAG:Ce) phosphor particles were directly synthesized by a modified sol–gel method using poly(ethylene glycol) (PEG) and urea. In the absence of PEG and urea, only irregularly shaped particles were obtained through aggregation and sintering after solvent evaporation. In contrast, adding both PEG and urea to the precursor solution resulted in the formation of spherical particles. The spherical morphology was attributed to micellization by PEG and micelle agglomeration by urea in a liquid phase. Scanning electron microscopy and X-ray diffraction analyses revealed that the spherical particles were of size around 5 μm , and the obtained crystal was pure a YAG phase. The emission band of the YAG:Ce phosphor prepared at 1600 $^{\circ}\text{C}$ for 2 h was observed at 530 nm under excitation at 470 nm, and the maximum internal quantum efficiency was found to be 57.6%.

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1. Introduction

Cerium- or rare-earth-doped yttrium aluminum garnet (YAG:Ce/RE) is a well-known phosphor material used in white-light-emitting diodes because of its relatively high absorption efficiency of blue excitation radiation, high quantum efficiency, and good stability in

high-temperature and high-humidity environments [1,2]. In the preparation of YAG:Ce phosphor particles, the formation of spherical particles is very important for high brightness and high resolution because these particles have lower scattering of evolved light and higher packing densities than those of irregularly shaped particles prepared by conventional solid-state reaction methods [1,3].

According to previous research, spherical YAG:Ce phosphor particles can be synthesized using spray [2,4–6] and solvothermal methods [7,8]. The particles prepared by spraying are generally spherical and rel-

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