Luminous phosphor with modified surface composition and microwave treatment for plasma planar back light

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Abstract

Highly luminescent efficiency phosphors have been successfully produced by surface modification and microwave irradiation treatment. The SEM image and XRD analysis reveal that the surface morphology of the white-light phosphors can be notably modified by microwave irradiation and exhibit with better crystalline property. The VUV PL spectra show that the microwave irradiation treatment can effectively enhance the luminescent efficiency by a factor of 1.5 times for intensity compared to that without microwave treatment. A further improvement in all visible emission can be made by modifying surface composition through MgO coating on the phosphor powder. These results demonstrate that such a simple approach can provide for improving luminescent efficiency of phosphors for the optoelectronic devices.

1. Introduction

There exists tremendous market potential for flat panels display (FPD) for both home entertainment and computer applications. The development of large area panel such as high definition television and high information content presentation becomes a major trend in the FPD community. Enormous competition has being placed in the FPD industry including TFT-LCD, FED, and PDP etc. In TFT-LCD, it is most critical to develop an efficient illuminating technology. Illuminating phosphors are of the critical concern since they provide an illuminating source with improved brightness, cost-effectiveness, stability, and uniformity compared to currently-used cold cathode fluorescence lamp, CCFL.[1] However, the phosphor presents a poorer efficiency of illumination than the latter. This will become a critical issue if a large-area display panel is to be targeted.[2-4]

Efficiency, together with brightness and illuminous purity, of the white light illumination is strongly affected by surface characterization and particle morphology of the phosphor powder. Therefore, the surface characteristics and morphology of the phosphor particles will play an important role in the resulting illumination property. On the other hand, microwave dielectric heating can effectively modify surface morphology and crystalline characteristics of the phosphors than the conventional thermal treatment.[5] Therefore, in this work, we propose a simple method to develop highly luminescent efficiency white-light phosphors via surface coating and microwave irradiation treatment for the next generation back light.

2. Results and disscusion

Figure 1 shows the scanning electron microscopy images of white-light phosphor treated with various microwave irradiation conditions. Without microwave irradiations treatment, the white-light phosphor presents sheet-like shape with a homogeneous diameter of approximately ~2-5μm as shown in Fig. 1(a). However, when the phosphors were treated by microwave irradiation, it was found that the surface morphology of white-light phosphor becomes nearly spherical but their size was almost unchanged in the range of 2-5 μm, as shown in Fig. 1(b)-(d). This observation reveals that the particle morphology has been modified under microwave treatment. The x-ray diffraction pattern of phosphors in Fig. 2 illustrates that with microwave irradiation treatment, the crystalline phase remains unchanged, all corresponding to the reference of the white-light phosphor. Furthermore, it was found that the peak intensity of corresponding diffraction lines to the whit-light phosphors increases with the power of microwave irradiation up to 300 W but above that, it becomes decreased. This result illustrates that there exists an optimal microwave condition to up-grade the crystalline properties of those phosphor powder and maximize the luminous efficiency.

Figure 3 illustrates the effect of microwave irradiation treatment on photoluminescence (PL) properties of white-light phosphors under VUV excitation at 173 nm at room temperature. It clearly demonstrates that the luminescent efficiency can be improved by microwave irradiation treatment. The peak intensity of all visible emission increases with input power up to 300W but then it was decreased, this suggesting that a higher power microwave irradiation (600W) would supply the excess energy to merge the small white-light phosphor powder into large one. In this condition, many defects could be formed and therefore, reduce the luminescent efficiency of white-light phosphors would be reduced. However, these surface defects can be much reduced by surface coating with inert material such as MgO. As shown in Fig. 4, Submicron MgO particles were prepared with the polyol method suspending magnesium acetate tetrahydrate in 50ml diethylene glycol. As shown in Fig. 4, it was found that fine MgO particles were adhered on the phosphor surface. The present results reveals that microwave treatment and surface coating can effectively improve the luminescent efficiency.

3. Summary

In summary, we have demonstrated that highly luminescent white-light phosphors can be produced by microwave irradiation treatment. After post-treatment with the microwave irradiation treatment, the PL property measurement shows that the luminescent efficiency of the white-light phosphors can be improved by 1.5 times under the microwave irradiation treatment conditions at 300W and 180s. These results reveal that such a simple process provides a promising option for mass production of the high luminescent efficiency phosphors to apply to next generation back light device.

4. Acknowledgements

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5. References

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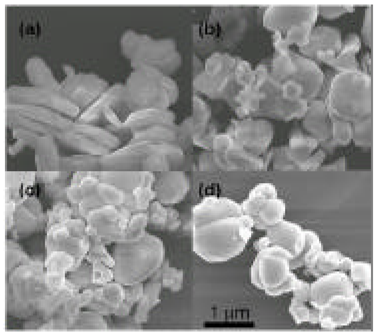

Fig. 1. SEM images of white-light phosphors (a) as-white phosphor) and with microwave irradiation (b) 100 W, 180s, (c) 300 W, 180s, and (d) 600 W, 180s.

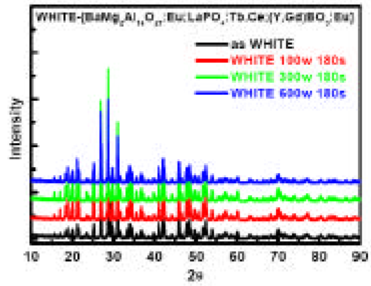

Fig. 2. XRD patterns of white-light phosphors with and without microwave irradiation.

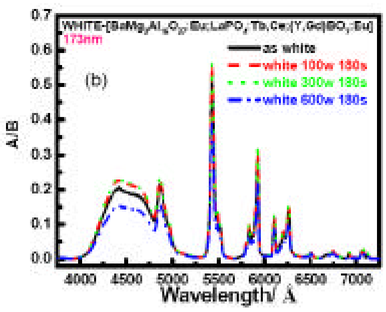

Fig. 3. PL spectra of white-light phosphors with and without microwave irradiation.

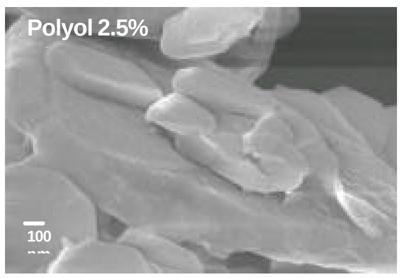

Fig. 4. SEM image of submicron MgO particles adhered on the surface of phosphor powders.