Improvement of luminescence and deterioration resistance of BAM phosphor in PDP application

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Introduction

The phosphor $BaMgAl_{10}O_{17}$:Eu^{2+} (BAM) is the most promising component as blue-emitting source of backlight in PDP. However, fabrication and operation processs of PDP will debase the performance of BAM, including luminescence and color purity. In this study, both luminescence and degradation resistance can be enhanced by coating MgO-SiO_2 film on BAM surface with the simple sol-gel method. The results in this work reveal a simple but efficient way to promote the performance of BAM phosphor in PDP.

Methods and Materials

The model blue-emitting BAM phosphor was purchased from Kasei (serial no. KX-501A). We prepared the precursor of MgO-SiO_2 with following steps: (i) dissolving magnesium nitrate in dilute water, (ii) adding tetraethoxysilane (teos) into the solution, (iii) adjusting the pH of the solution to 1~3 by HCl, (iv) keeping stirring the solution for 24 hours to aid hydrolysis of teos, (v) adding the BAM into the solution for surface modification, (vi) stirring the solution for another 24 hours at 50^{o}C, (vii) drying the BAM, and (viii) firing the BAM at various temperatures ranging from 250 to 450^{o}C to study the temperature effect. The luminescence properties of the blue-phosphor were analyzed by a photoluminescence spectrometer with VUV excitation source; in which the 147 nm VUV light was dispersed from a beamline coupled to a storage ring of synchrotron.

Results

From the TEM image, we found that MgO-SiO_2 film was coated on the surface of BAM(Fig. 1). Upon 147 nm excitation, we observed the photoluminescent intensity of modified BAM was enhanced by 30% compared with that of the uncoated BAM. Aging test of the modified BAM phosphor for PDP panel was examined with a Xe-discharge excitation source. The modified BAM phosphor in the panel possessed less luminescence degradation compared to the reference; the modified panel retained 90% luminescent intensity after driving 500 hours.

Discussion

From SEM images, we observed that the surface of the modified BAM is as smooth as the reference phosphor; this indicates the morphology deposited on the surface of the BAM is only film without formation of particle. The XRD patterns of the coated BAM do not show any peaks of MgO-SiO_2 phase; the result suggests that the protecting layer on the surface of BAM is either very thin or probably in amorphous nature. Fig. 1 shows the high resolution TEM of the modified BAM, it demonstrates that the BAM phosphor was successfully coated with a thin layer of MgO-SiO_2. Upon excitation at 147 nm dispersed from synchrotron, the PL of the modified BAM enhanced 20% in intensity compared to the reference phosphor; the effect is related to the decrease of the reflectivity at the BAM surface.[1] The coating layer also improved the thermal resistance by 10% after baking process. It is considered that the protecting layer enhanced the deterioration resistance as a result of reducing the adsorption of gaseous oxygen atoms in the conduction layer, which led to retard oxidation of divalent europium.[2] Fig. 2. shows the aging test of the modified BAM and the reference phosphor. The modified panel showed less degradation than the reference one and retained 90% its luminenescence after 500 hours of driving. The protecting layer on the modified BAM prevented its host from intercalation with –OH group (water) and resulted in enhancement on VUV resistance.[3] Our work demonstrates the surface processing with MgO-SiO_2 promotes the performance of the BAM phosphor.

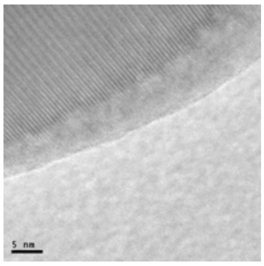

Fig. 1. TEM image of modified BAM

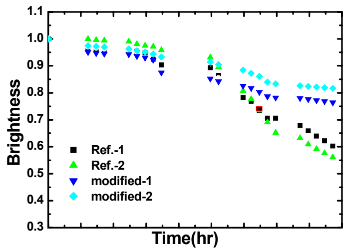

Fig. 2. Aging test of modified BAM and reference

References:

[1] K. Y. Jung, D. Y. Lee, Y. C. Kang, J. Lumin. **115**, 91-96 (2005).
[2] G. Bizarri, B. Moine, J. Lumin. **113**, 199-213 (2005).
[3] K. C. Mishra, M. Raukas, G. Marking, P. Chen, and P. Boolchand, J. Electrochem. Soc. **152 (11)**, H183-H190 (2005).