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Eu^{2+} Activated Green Phosphor $Ba_2CaMgSi_2O_8$:Eu^{2+}

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Abstract

We report Eu^{2+} activated green phosphor $Ba_2CaMgSi_2O_8$:Eu^{2+}. The phosphor absorbs ultroviolet radiation and emits a green visible light. The phosphors were synthesized by conventional solid state reaction method. The high purity $BaCO_3$, $CaCO_3$, MgO, SiO_2, Eu_2O_3 were used as raw materials. The raw materials were mixed thoroughly with an appropriate amount of ethanol in an agate mortar and then dried at 90℃ for 2 hours. The mixture was sintered at 900℃ for 2 hours and reheated at the mild reducing atmosphere 5% H_2 gas mixed with 95% N_2 gas at about 900℃ to 1200℃ for 2 hours. The photoluminescence spectra of the phosphor powders were measured by a fluorescent spectrophotometer. The crystal structure of phosphor powders were investigated by X-ray diffractometer .

1. Introduction

In recent years, efficient luminescent materials under electron, blue visible light, and UV radiation have been drawn interest. The stability of oxide phosphors in high vacuum and the absence of corrosive gas emission from the oxide phosphors under electron bombardment offer advantages over commonly used sulfide phosphors. So various types of multicomponent oxide phosphors have been widely studied for using in flat panel display technologies, especially in FED and LED. We have studied Eu^{2+} activated green phosphor $Ba_2CaMgSi_2O_8$:Eu^{2+} for the application to the UV LED of long wave length range (380~400nm). The luminescence intensity as well as the excitation wavelength for UV-LED (380~400nm) applications was improved compare to the previously reported oxide green phosphors, $Ba_2MgSi_2O_7$:Eu^2 and $Ba_2Si_1O_4$:Eu^{2+}.

2. Experimental

The phosphors were synthesized by conventional solid state reaction method. The high purity $BaCO_3$, $CaCO_3$, MgO, SiO_2, Eu_2O_3 were used as raw materials. According to the normal composition $Ba_{3-x-y}A_yMgSi_2O_8$:Eu_x (A = Ca and Sr, 0 < x < 1, 0 y 1) the raw materials were weighed and mixed thoroughly with an appropriate amount of ethanol in an agate mortar and then dried at 90℃ for 2 hours. The mixture was sintered at 900℃ for 2 hours and reheated at the mild reducing atmosphere 5% H_2 gas mixed with 95% N_2 gas at 1200℃ for 2 hours. The photoluminescence spectra of the phosphor powders were measured by a fluorescent spectrophotometer. The crystal structure of phosphor powders were investigated by XD-D1 X-ray diffractometer.

3. Results and discussion

The emission spectra with the variation of Eu contents are shown in Fig.1.

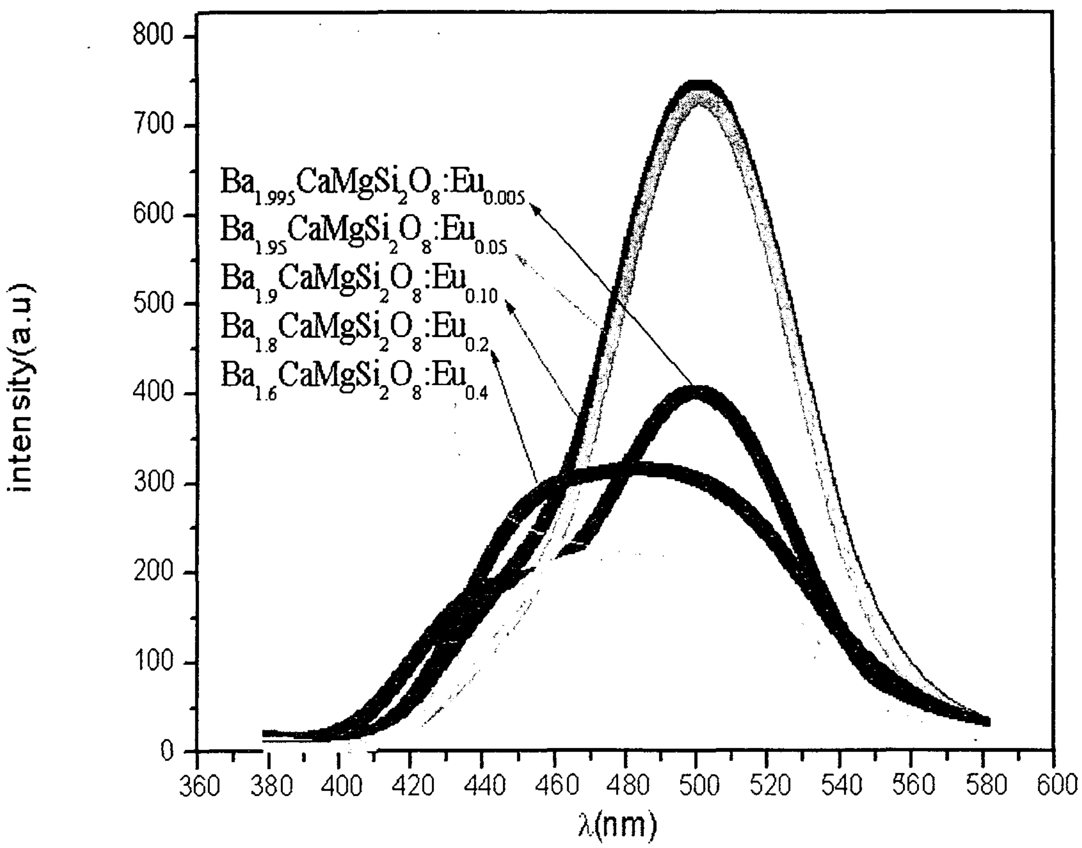

Fig.1. PL emission spectrum of $Ba_{3-x-y}A_yMgSi_2O_8$:Eu_x

As can be seen in Fig.1 the emission intensity of $Ba_{3-x}CaMgSi_2O_8:Eu_x$ were varied from the europium concentration. The main peak positions are in the range of 485nm to 505nm. The main peak position shifts from 505nm(green) to blue-side. The relative intensity of the blue emission (about 450nm) increases with the increase of Eu contents. It reaches a maximum emission intensity at x=0.1 and then diminishes with increasing Eu content. The doping of Eu^{2+} in $Ba_2CaMgSi_2O_8$ host material results in excellent green emission. The X-ray diffraction patterns of $Ba_2CaMgSi_2O_8:Eu^{2+}$ powders fired at 900℃ with ambient air and reheated at 1200℃ with 5% H_2 gas mixture is shown in Fig.2. The XRD pattern did not matched with any of the following compounds: $Ba_3MgSi_2O_8$ (JCPDS # 10-74), $BaMg_2Si_2O_7$ (JCPDS # 10-44), $BaMgSiO_4$ (JCPDS # 16-573), $Ba_2MgSi_2O_7$ (JCPDS # 36-375), $Ca_2BaMgSi_2O_8$ (JCPDS # 31-129).

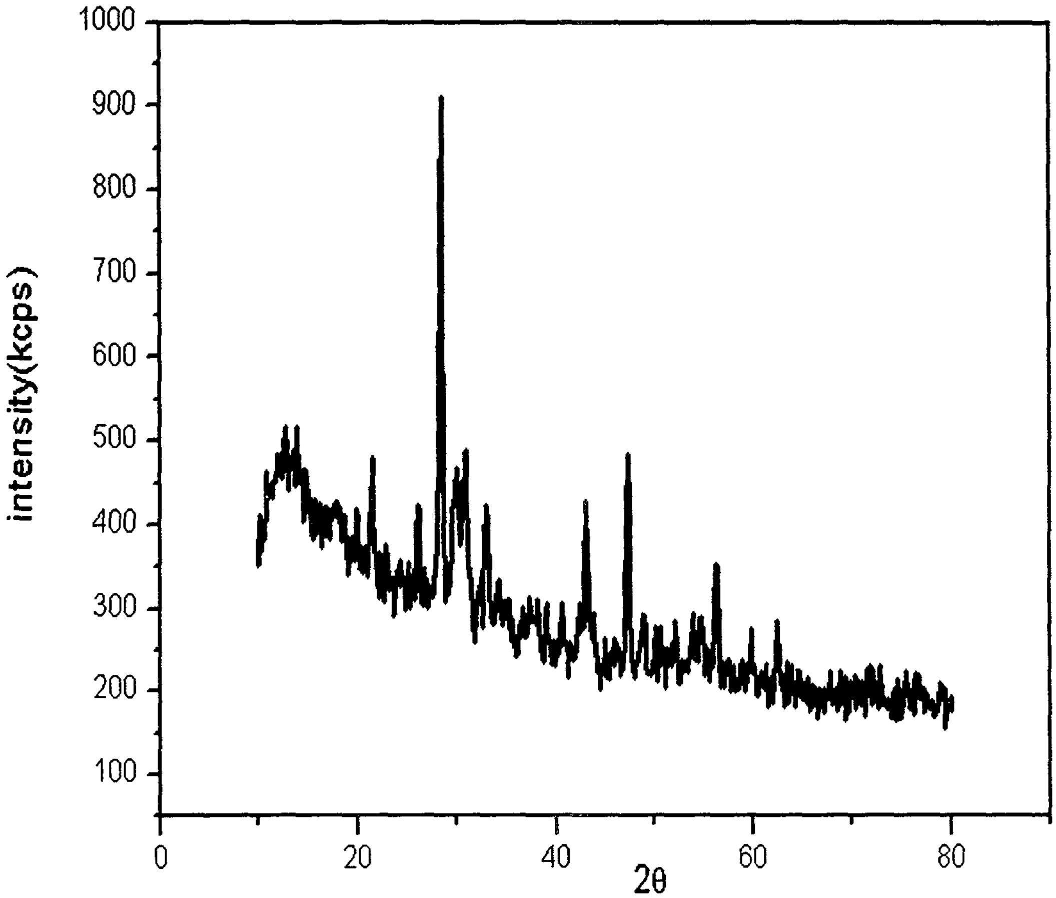

Fig.2. X-ray diffraction patterns of samples fired at 900℃ and reduced at 1200℃

4. Conclusion

Phosphors developed in this study can be applied in the light-emitting devices, especially UV-LED of 390-405nm range. We find that Eu^{2+} activated green phosphor of $Ba_2CaMgSi_2O_8{:}Eu^{2+}$ have excellent photoluminescence properties. Especially, Eu-doped green phosphors are excited by 390nm ~ 405nm UV light and emit 500nm green light. The wavelength of the green ligh light can be controlled by the amount of the Eu-doping. The luminescence intensity was improved compare to the previously reported oxide green phosphors, $Ba_2MgSi_2O_7{:}Eu^{2+}$ and $Ba_2Si_1O_4{:}Eu^{2+}$. The crystal structure of the present phosphors are different from the previously reported phosphors of $BaO-(CaO)-MgO-SiO_2$ systems.

5. Acknowledgements

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6. References

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