

Field emission lamp for LCD backlight based on RGB phosphors and vertically-aligned CNTs

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Keywords: Field emission lamp, phosphors, Carbon nanotubes

Abstract

Zinc gallate-based RGB phosphors and vertically aligned carbon nanotube emitters are prepared for flat field-emission lamp. The blend phosphors of blue ZnGa_2O_4 , green $\text{ZnGa}_2\text{O}_4:\text{Mn}^{2+}$, and red $\text{ZnGa}_2\text{O}_4:\text{Cr}^{3+}$ are coated on the front glass, and the carbon nanotubes are chemically bonded on the rear ITO glass as a cathode.

1. Introduction

Cold cathode fluorescent lamps (CCFLs) are used as the backlight of liquid crystal displays (LCDs). However, CCFLs contain hazard mercury gas, and need additional components such as reflector, diffuser, and prism sheet to obtain uniform white light. Recently, flat field-emission lamps (FEL) using carbon nanotubes (CNTs) as emitters were reported [1, 2]. Here, we fabricated FEL using a carbon nanotube field emitter and ZnGa_2O_4 series phosphors only.

2. Experimental

Three kinds of blue ZnGa_2O_4 , green $\text{ZnGa}_2\text{O}_4:\text{Mn}^{2+}$, and red $\text{ZnGa}_2\text{O}_4:\text{Cr}^{3+}$ phosphors are synthesized through a conventional solid-state reaction at 1100 °C for 4 hours under a reducing ambient. The anode is formed by screen-printing the mixture of three different phosphors [3]. The cathode is formed by chemical bonding of CNTs on ITO glass. The prototype of FEL consisting of the anode and cathode is set up in vacuum chamber, and it is driven at more than 1000 V.

3. Results and discussion

The FEL driven at 1000 V gives the white light as shown in Fig .1. The blue emission at 360 nm, the

green emission at 505 nm, and the red emission at 702 nm are originated from the self-activated Ga-O host, Mn^{2+} ions, and Cr^{3+} ions, respectively.

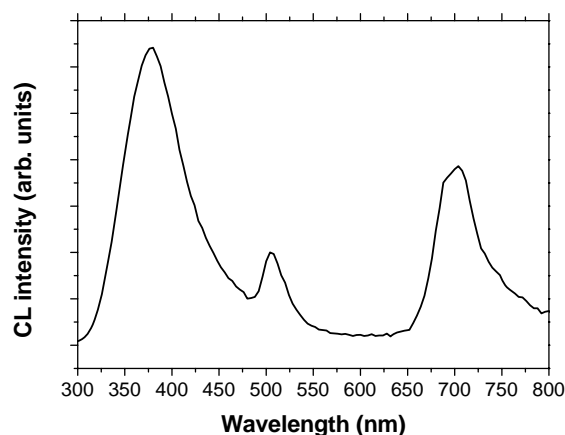


Fig.1. Field Emission Lamp using a mixture of blue ZnGa_2O_4 , green $\text{ZnGa}_2\text{O}_4:\text{Mn}^{2+}$, and red $\text{ZnGa}_2\text{O}_4:\text{Cr}^{3+}$ phosphors and CNTs as emitters.

4. Summary

Our prototype of FEL based on a mixture of blue ZnGa_2O_4 , green $\text{ZnGa}_2\text{O}_4:\text{Mn}^{2+}$, and red $\text{ZnGa}_2\text{O}_4:\text{Cr}^{3+}$ phosphors and CNT emitters is fabricated. It can give the possibility to realize a lightweight, Hg-free, and a high quality of color reproduction in the light source of LCD.

Acknowledgements

This research was financially supported by the Ministry of Commerce, Industry and Energy (MOCIE) and Korea Industrial Technology Foundation (KOTEF) through the Human Resource Training Project for Regional Innovation.

5. References

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