IJASRM
International Journal of Advanced Scientific Research and Management, Volume 4 Issue 5, May 2019
www.ijasrm.com
ISSN 2455-6378

Photoluminescent Analysis of $MgAl_2O_4$:xDy(x=1,2,3) Synthesised by Combustion Technique

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Abstract

Magnesium Aluminates doped with dysprosium [$MgAl_2O_4$:xDy] phosphors in the formula of $MgAl_2O_4$: xDy (x = 1, 2, 3,mol %) were prepared by the Combustion of starting materials at 550˚C. The Excitation & Emission Photo-Luminescence (PL) spectra of Magnesium aluminates with different concentrations of dysprosium were recorded using Shimadzu RF-5301 XPC spectrophotometer and then analyzed. The PL spectrum of MgAl2O4:Dy^{3+} showed intense excitation band at 286nm and intense emission band at 475 nm. PL analysis confirms Magnesium Aluminates doped with dysprosium is excellent candidate for Blue Light Emitting Diodes (LEDs).

Keywords: *Nanophosphors, Luminescence, Aluminates, XRD, FTIR*

1. Introduction:

The solid state lighting technology offers an opportunity for clean and green energy supply. In its advent the need for development of inorganic luminescent materials with characteristic feature to convert UV radiations to visible radiations is generated. Luminescent materials also termed as Phosphors, Phosphors converted to light emitting diode is characterised with no toxicity, high conversion efficiency, long life and low effective cost in comparison to conventional lighting devices. In principle white light can be generated by mixing of three primary colour, Blue, Red and green, these can be generated by employing three different phosphors materials emitting in these distinct regions. Aluminate based phosphors doped with rare earth elements are known to exhibit persistence luminescence, high quantum efficiency in visible region and are known to be chemically stable[1-5].The luminescent properties of materials strongly depends on particle size, kind of dopand, host material and method of synthesis. With an objective to develop a phosphor for application for solid state lighting present work was taken.

In this work the photoluminescent properties of $MgAl_2O_4$:xDy(x=1,2,3) prepared by Combustion Synthesis is investigated.

2.Materials and Methods:

The starting materials, Magnesium Nitrate [Mg $(NO_3)_3$] (99.99%), Aluminium Nitrate [Al $(NO_3)_3$] (99.99) Urea [NH_2-CO-NH_2] & Dysprosium oxide [Dy_2O_3] (99.99%), were mixed thoroughly in an agate mortar. The mixing was followed with the addition of a nitric acid. The mixture so prepared was placed in an electrical muffle furnace for about 20mins. at 550˚C for combustion.The combustion resulted in formation of white foamy material, the sample taken from material so formed was characterised using XRD, FTIR and Electron Microscopy. The photoluminescent measurements were made using Shimadzu RF-5301 XPC spectrophotometer .The Excitation & Emission PL spectra of Magnesium aluminates with different concentrations of Dysprosium were recorded.

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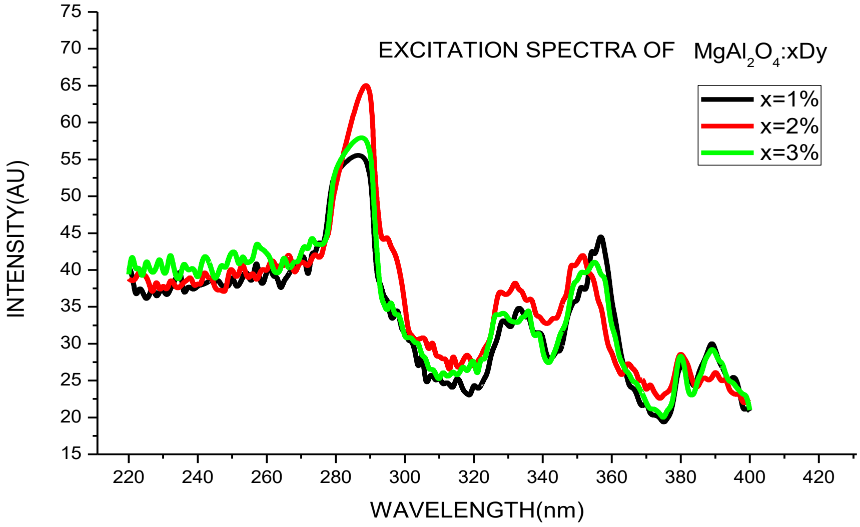
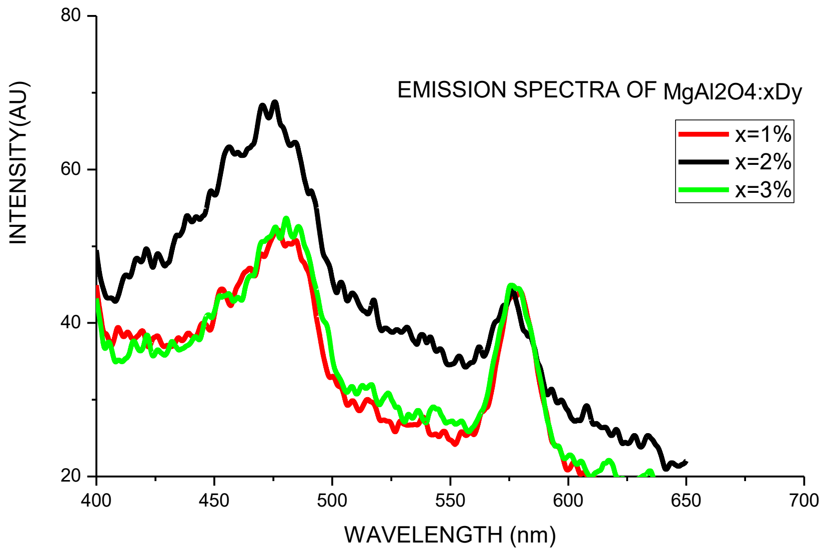
Figure 1



(a)



(b)

Figure 1.(a) & (b) shows the Excitation & Emission PL spectra of Magnesium aluminates with different concentrations of Dysprosium.

4. Results and Discussion:

Figure 1(a) & (b) shows the Excitation & Emission PL spectra of Magnesium aluminates with different concentrations of Dysprosium (1, 2 & 3%).The excitation spectrum (Fig.3a) of $MgAl_2O_4$:Dy^{3+}covers the range 270-390 nm with intense bands at 286 nm. The peaks at 286nm is assigned transition$^4f_8$–$^4f_7{}^5d_1$ transitions of Dy^{3+}

which results due to the allowed dipolar electric parity transitions the other f-f transitions between energy levels of the $^4f_8$ configuration of Dy^3 are assigned tothe electronic transitions ($^7F_6$-$^5L_9$) at 350 nm, and ($^7F_6$-$^5D_3$) at 386 nm[6]. These transitions are confirmed by the peaks position extending from 200 to 400nm. The emission spectra of $MgAl_2O_4$ phosphors (x = 1, 2, 3, mol %) is broad, with peak at 480nm spectra for different compositions od Dy are compared in Fig. 3(b).On comparing the Pl spectra of$MgAl_2O_4$ phosphor doped with varying concentrations of dysprosium(Dy^{3+}), maximum luminescent intensity is observed for 1 mol% of Dy^{3+}. As can be seen in Fig. 3, a prominent and significant blue emission has been noticed for 1 mol% Dy^{3+}, which implies that this concentration in $MgAl_2O_4$ phosphor could used as a potential and efficient luminescent material[7-8].

5. Conclusion

The Photoluminescence spectra of $MgAl_2O_4$:Dy3+ synthesised using combustion technique isexhibits prominentPhoto luminescence spectra under visible range of UV Radiation with peak at 490 nm. Thus it can be used as potential candidate for development of Blue LEDS and hence can be used in development of White light emitting diode[7-8].

6. References

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