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SYNTHESIS AND CHARACTERIZATION OF RARE EARTH DOPED PHOSPHOR $Y_2O_3:Dy^{3+}$ WITH DIFFERENT CONCENTRATIONS OF Dy

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ABSTRACT

The present paper reports on the synthesis, characterization and thermoluminescence (TL) studies of Dydoped Y_2O_3phosphor. The sample was prepared by the conventional solid state reaction method, which is the most suitable for large-scale production.The prepared phosphor was characterized using PXRD (Powder X-ray Diffraction technique), TL, and FTIR techniques and average crystalline sizes were calculated by Scherer formula.The Structural characteristics were showed by XRD pattern of the sample. The TL glow curves were recorded for different concentration of $Dy^{3+}$for 25 min UV exposure time at a heating rate of 6.7˚Cs^{-1}The samples shows TLpeaks at 196˚C. The high temperature peak shows the less fading and more stability in prepared sample.

Key words: Thermo luminescence, FTIR, XRD, UV exposure.

INTRODUCTION

Y_2O_3 is known as a very important material owing to its chemical and physicalunique property, which has been used and also shows versatile potential applications in broad fields, such as transparent ceramics [1], catalysts [2], sensors [3], and biological labels [4]. In particular, Y_2O_3 and Dy^{3+}doped transparent ceramics are outstanding upto functional materials and have been widely studied as promising materials for laser ceramics [5, 6] and scintillation ceramics [7]. As is well known, morphology and size of nano or micro-scale materials have great influence on their properties [8] as well as reactivity when preparing bulk materials such as transparent ceramics. Therefore, it is very important to synthesize powder materials with controllable morphology so as to control the reaction procedure and production quality of the bulk material. During the last several decades, various methods have been attempted to the morphology controllable fabrications of Y2O3or Y2O3 doped materials with certain size and shape to improve its properties and then to explore its multifunctional applications [8-22].The rare-earth ions show abundant emission colors.

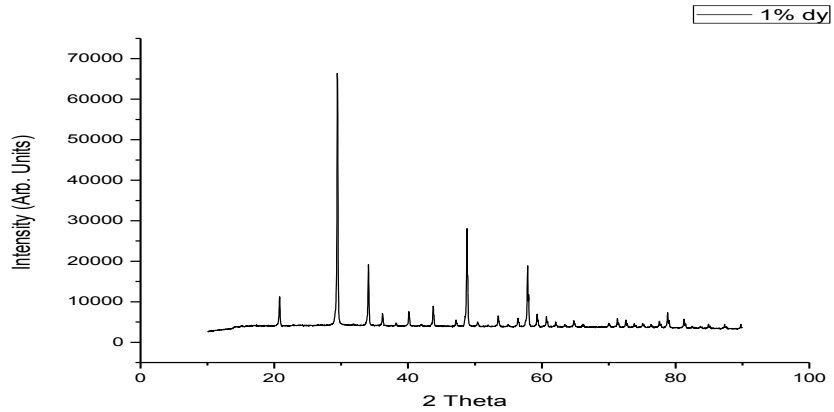
Experimental:

For synthesis of samples by solid state reaction method, Y_2O_3 and Dy_2O_3 were mixed in proper stoichiometric ratio by dry grinding with mortar & pestle for nearly 45 minutes. The mixture is taken in alumina crucible and is fired in air at 1300°C for 3 hours. Sample was characterized using thermoluminescence (TL), XRD, FTIR. The XRD measurements were carried out using Bruker D8 Advance X-ray diffractometer. The X-rays were produced using a sealed tube and the wavelength of X-ray was 0.154 nm (Cu K-alpha). FTIR spectra recorded using Bruker, Germany Model 3000 Hyperion Microscope with Vertex 80 FTIR System.Thermally stimulated luminescence glow curves were recorded at room temperature by using a TLD reader (I1009 supplied by Nucleonix Sys. Pvt. Ltd., Hyderabad) [22-32].

Results and Discussion

Figure 1 shows the X-ray powder diffraction (XPRD) pattern of $Y_2O_3:Dy^{3+}$ doped phosphor.It shows a cubic structure match with COD card no. 89- 9069 [13]. The crystallite size was calculated using Scherer's formula

[14]. From the XRD patterns,the peak indexedrevealed the pure cubic phase of Y_2O_3. The XRD pattern of Y_2O_3:Dy crystals indicates 5 diffraction intensepeaks of cubic structure at 2θ = 30.54, 35.44, 50.67, 60.49 and 63.13 .The calculate size of crystalline solid of doped Dy^{3+}phosphor is~205 nm.



Figur1 :XRD pattern of Y_2O_3:Dy

Figure 2 shows the FTIR spectra of Y_2O_3:Dyphosphor with strong peaks centred at 409-479 is due to Y-O vibration. The broad peak centered at 587cm^{-1} is due to Dy-O vibration in the sample. The FTIR spectra also confirm the formation of Y_2O_3 doped with Dy phosphor prepared by solid state reaction method.

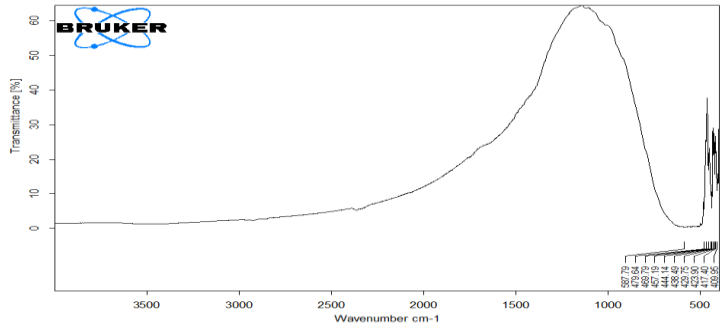


Figure2 : FTIR spectra of Y_2O_3:Dy doped phosphor

Figure 3 reports the TL glow curve of yttrium oxide doped with dysprosium phosphor with the variation of Dy concentration (1 – 3mol%). The TL glow curve intensity increaseswith increasing the concentration of Dysprosium due to more number of impurity ions was responsible for increase in TL glow curve intensity. The peak centered at 196^0 C for every TL glow curve which indicates that the impurity ions does not shifts the peak position of TL glow curve but only increase the TL glow curve intensity. Higher temperature peak indicates high stability and less fading in the prepared sample.

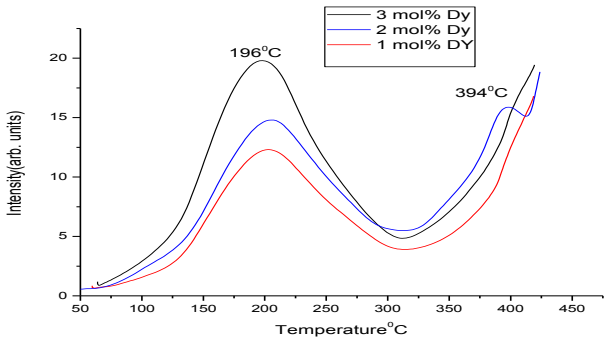


Figure 3: TL glow curve of UV-irradiated Y_2O_3:Dy phosphor variation with Dy concentration at fixed UV exposure time

Conclusion

The prepared phosphor exhibits cubic structure prepared by solid state reaction method. The TL glow curve for UV irradiation shows the major peak at 196^0C. TL glow curve shows the linear response with variable concentration on Dysprosium TL intensity increases with increasing the Dy concentration. The easy method of preparation and better TL response, and negligible fading are some of the good features of the Y_2O_3:Dy^{3+} doped phosphor. Therefore it can be useful as a dosimeter for the estimation of UV dose over the wide range.

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