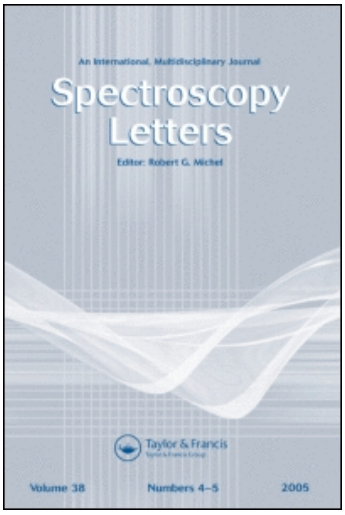

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Fluorescence Spectra of Tb^3 : Ln_2O_2S Powder Phosphors

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FLUORESCENCE SPECTRA OF Tb^{3+}: Ln_2O_2S POWDER PHOSPHORS

Key words: Fluorescence spectra - powder phosphor

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ABSTRACT

The photoluminescence spectra of Tb^{3+} doped lanthanide oxysulfides (Y_2O_2S, La_2O_2S and Gd_2O_2S) powder phosphors are reported. These phosphors display bright fluorescent green under a UV source. The colour emission richness has been understood by computing the colour co-ordinates ($\bar{X},\bar{Y}$). From their recorded photoluminescence spectra, the relative fluorescence intensity ratios have also been determined to examine the host material effects.

INTRODUCTION

There has been a great deal of interest to produce and characterise certain useful and promising colour emitting powder phosphors. Keeping in view the importance of these materials, over the last five years, we have reported the fluorescence properties of certain rare earth ions doped powder phosphors[1-5]. In recent times, lanthanide oxysulfide phosphors have been of greater importance due to their wide spread applications in colour televisions and in display devices. [8-11]. We have recently prepared and characterised the Ln_2O_2S: Eu^{3+} powder phosphors for red emission [12]. Now, we report studies on the photoluminescence spectra of Tb^{3+} doped Y_2O_2S, La_2O_2S and Gd_2O_2S powder phosphors.

EXPERIMENTAL

Ln_2O_2S: Tb^{3+} powder phosphors have been synthesised by employing a suitable procedure namely solid state method described earlier by Royce et al [6]. The starting materials such as Y_2O_3, La_2O_3, Gd_2O_3 and Tb_4O_7 with high purity have been fired with elemental sulfur and a flux material (Na_2CO_3) at 1100°C in an electric tubular furnace under a controlled (reduced) atmosphere. This controlled atmosphere is necessary to maintain a stable (tripositive) valance state of the activator (Tb^{3+}) ions and also the stoichiometry of the host material lattice. This also monitors the particle size distribution of the phosphors [7]. The solid state reaction which takes place in the method adopted is:

$$Ln_{2-x}O_3 + \frac{x}{2}Tb_4O_7 + 3S + Na_2CO_3 \rightarrow Ln_{2(1-x)}Tb_{2x}O_2S + \text{flux residue} + \text{gases}$$

The reacted chemicals have been washed with dilute (2-3%) HNO_3 to remove the flux residuals and dried up. As was done by us earlier [12], the dopant ion [Tb^{3+}] concentration has been fixed at 6 mol% in order to observe better emission from these Tb: powder phosphors. These phosphors show bright GREEN colour under a UV source. Both the excitation and the photoluminescence spectra of these phosphors have been recorded on a Hitachi 650-10S spectrofluorimeter fitted with a Hammamatsu 928F photomultiplier tube and a 150W Xenon arc lamp.

RESULTS AND DISCUSSION

The measured excitation and photoluminescence spectra of a Gd_2O_2S:Tb^{3+} phosphor, are shown in Fig. 1(a,b). From the recorded photoluminescence spectra, the following emission transitions have been identified.

$$^5D_4 \rightarrow {}^7F_4 \text{ (590 nm)}$$

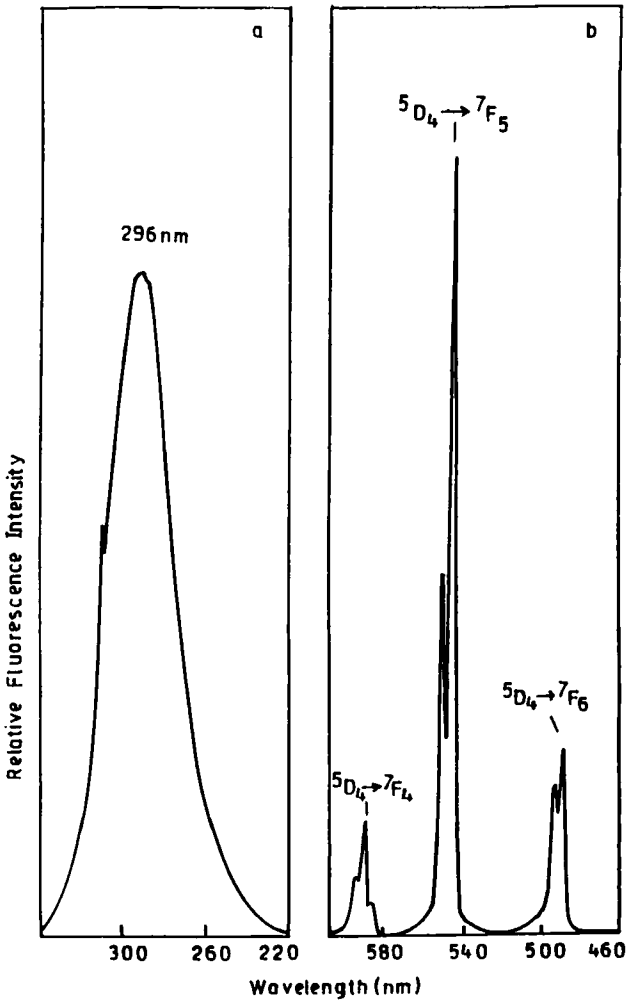

Fig. 1 : Excitation[a] and Photoluminescence[b] Spectra of $Gd_2O_2S:Tb^{3+}$ Powder Phosphor

TABLE - 1

Colour Co-ordinates of $Ln_2O_2S : Tb^{3+}$ Powder Phosphors
(Ln=Y,La and Gd)

Phosphors	$\bar{X}$	$\bar{Y}$
$Y_2O_2S : Tb3+$	0.2918	0.5805
$La_2O_2S : Tb3+$	0.3055	0.5725
$Gd_2O_2S : Tb3+$	0.2629	0.5975

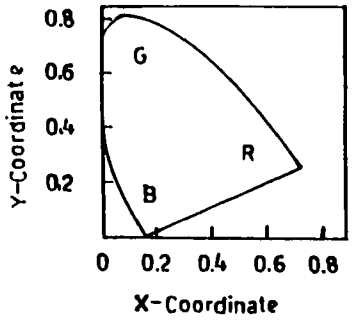

Fig.2 : CIE Chromaticity diagram

$\rightarrow {}^7F_5$ (545 nm)

$\rightarrow {}^7F_6$ (490 nm)

Of these transition ($^5D_4 \rightarrow {}^7F_5$) has been responsible for the strong GREEN emission in all $Ln_2O_2S : Tb^{3+}$ powder phosphors. The green colour emission was confirmed and analysed with the computation of the colour co-ordinates $(\bar{x},\bar{y})$ by following the standard procedures recommended by CIE (France) and the results are presented in Table 1. Fig. 2 describes the CIE chromaticity diagram with the three primary colours (Blue, Green & Red). The computed colour co-ordinates $(\bar{x},\bar{y})$ have been found to fitt

TABLE - 2

Relative Fluorescence Intensity Ratios of $Ln_2O_2S : Tb^{3+}$ Powder Phosphors (Ln = Y, La and Gd)

Ratios between the transition	$Y_2O_2S:Tb^{3+}$	$La_2O_2S:Tb^{3+}$	$Gd_2O_2S:Tb^{3+}$
$\frac{^5D_4 \rightarrow {}^7F_4}{^5D_4 \rightarrow {}^7F_6}$	0.305 0.583 0.194	0.375 0.750 0.250	0.326 0.6309 0.195
$\frac{^5D_4 \rightarrow {}^7F_5}{^5D_4 \rightarrow {}^7F_6}$	1.833 3.611	2.000 5.062	1.956 4.195
$\frac{^5D_4 \rightarrow {}^7F_6}{^5D_4 \rightarrow {}^7F_6}$	0.722 1	0.875 1	0.804 1

well in the Green colour region of this diagram (Fig.2) and the co-ordinates are also in good agreement with the standard values [13]. In order to compare the fluorescence efficiencies, we have estimated the relative fluorescence intensity ratio's (R) and the results are given in Table 2. In summary, it is concluded that the Tb^{3+}:Gd_2O_2S (based on the emission spectral features) and La_2O_2S: Tb^{3+} (from the relative fluorescence intensity ratios) powder phosphor could be suggested as two good materials for their use in the screens of TV's and CRT's .

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