

## LIST OF FIGURES

Figure No.	Figure Caption	Page No.
1.1	Classification of luminescence in term of emission time.	3
1.2	Mechanism of fluorescence emission.	3
1.3	Mechanism of phosphorescence emission.	4
1.4	Luminescence emission occurring due to the luminescent activator only.	5
1.5	Energy transfer mechanism and occurrence of luminescence phenomenon.	6
1.6	Schematic classification of luminescence kinds.	6
1.7	Thermoluminescence mechanism.	7
1.8	Classification of perovskite structure.	13
2.1	Flow chart of combustion route of material synthesis.	27
2.2	Bruker D8 Advance diffractometer.	28
2.3	Carl Zeiss Model Supra 55 FESEM.	29
2.4	JASCO-4600 IR spectrometer.	30
2.5	Shimadzu Spectro-fluorophotometer (model: RF5301 PC; Shimadzu Japan).	31
2.6	PC-controlled TL reader of type TL1009, designed by Nucleonix.	32
2.7	Risø TL/OSL reader DA 15 (Bøtter-Jensen et al., 2003) instrument.	33
3.1	XRD of $\text{Sr}_2\text{YNbO}_6$ : x mol% $\text{Eu}^{3+}$ (x= 0-5) phosphors along with standard ICDD reference.	39
3.2	Rietveld refined XRD pattern of pure $\text{Sr}_2\text{YNbO}_6$ phosphor.	40
3.3	Magnified diffraction patterns of undoped and $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YNbO}_6$ phosphors.	41
3.4	W-H plots of $\text{Sr}_2\text{YNbO}_6$ (a) and $\text{Sr}_2\text{YNbO}_6$ :1% $\text{Eu}^{3+}$ (b).	43
3.5	SEM micrographs of 4% $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YNbO}_6$ .	44
3.6	FTIR spectrum of $\text{Sr}_2\text{YNbO}_6$ : x $\text{Eu}^{3+}$ (x =0-5 mol%).	45
3.7	Photoluminescence excitation and emission spectra of pure $\text{Sr}_2\text{YNbO}_6$ .	46
3.8	PL excitation (a) and PL emission (b) spectra of $\text{Sr}_2\text{YNbO}_6$ : 1 mol% $\text{Eu}^{3+}$ phosphor.	47
3.8	(c-j) PL excitation and respective PL emission spectra of 2 mol% to 5 mol% $\text{Eu}^{3+}$ activated $\text{Sr}_2\text{YNbO}_6$ phosphors.	49
3.9	Photoluminescence excitation spectra of $\text{Sr}_2\text{YNbO}_6$ : x mol% $\text{Eu}^{3+}$ (x =1-5)	

phosphors.	52
3.10 PL emission spectra of $\text{Sr}_2\text{YNbO}_6$ : x mol% $\text{Eu}^{3+}$ (x =1-5) recorded under (a) 274 nm, (b) 396 nm, and (c) 467 nm excitation wavelengths.	53
3.11 Plot of PL intensity vs. doping concentration.	54
3.12 PL emission spectra of $\text{Sr}_2\text{YNbO}_6$ : 4 mol% $\text{Eu}^{3+}$ at different temperatures (a); plot of PL intensity vs. Temperature (b).	56
3.13 Plot of $\ln[(I_0/I)-1]$ vs. $1/kT$ .	57
3.14 PL decay lifetime curves of $\text{Sr}_2\text{YNbO}_6$ : 4% $\text{Eu}^{3+}$ .	58
3.15 CIE diagram of $\text{Sr}_2\text{YNbO}_6$ :4 mol% $\text{Eu}^{3+}$ .	59
3.16 Thermoluminescence glow curves of $\text{Sr}_2\text{YNbO}_6$ :x mol% $\text{Eu}^{3+}$ (x=0, 1, 3, 5).	62
3.17 TL intensity response to different $\text{Eu}^{3+}$ concentrations.	63
3.18 TL glow curves of $\text{Sr}_2\text{YNbO}_6$ :x mol% $\text{Eu}^{3+}$ (x=0, 1, 3, 5) phosphors at different beta doses.	64
3.19 Dose response of $\text{Sr}_2\text{YNbO}_6$ :x mol% $\text{Eu}^{3+}$ (x=0, 1, 3, 5) phosphors towards beta rays.	65
3.20 Deconvoluted TL glow curves of $\text{Sr}_2\text{YNbO}_6$ :x mol% $\text{Eu}^{3+}$ (x=0, 1, 3, 5) phosphors after beta irradiation of 10 Gy.	68
3.21 Notation of peak shape method.	69
4.1 Rietveld refined XRD pattern of $\text{Sr}_2\text{YVO}_6$ phosphor.	80
4.2 XRD patterns of $\text{Sr}_2\text{YVO}_6$ : x mol% $\text{Eu}^{3+}$ (x= 0-5) phosphors.	81
4.3 Magnified diffraction patterns of undoped and $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YVO}_6$ phosphors.	82
4.4 W-H plots of $\text{Sr}_2\text{YVO}_6$ (a) and $\text{Sr}_2\text{YVO}_6$ :1% $\text{Eu}^{3+}$ (b).	83
4.5 SEM micrographs of 3% $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YVO}_6$ phosphor.	84
4.6 SEM micrographs of 3% $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YVO}_6$ phosphor at scanning resolution of 200 nm.	85
4.7 EDAX of 3 mol% $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YVO}_6$ phosphor.	86
4.8 Elemental mapping of 3% $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YVO}_6$ .	86
4.9 FTIR spectra of undoped and 3 mol% $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YVO}_6$ phosphors .	87
4.10 Photoluminescence excitation and emission spectra of pure $\text{Sr}_2\text{YVO}_6$ .	88
4.11 PL excitation (a) and PL emission (b) spectra of $\text{Sr}_2\text{YVO}_6$ : 1 mol% $\text{Eu}^{3+}$ phosphor.	89

4.11 (c) PL excitation and (d) PL emission spectra of $\text{Sr}_2\text{YVO}_6:2 \text{ mol\% Eu}^{3+}$ phosphor;	
(e) PL excitation and (f) PL emission spectra of $\text{Sr}_2\text{YVO}_6:3 \text{ mol\% Eu}^{3+}$ phosphor;	
(g) PL excitation and (h) PL emission spectra of $\text{Sr}_2\text{YVO}_6:4 \text{ mol\% Eu}^{3+}$ phosphor;	
(i) PL excitation and (j) PL emission spectra of $\text{Sr}_2\text{YVO}_6:5 \text{ mol\% Eu}^{3+}$ phosphor.	91
4.12 Photoluminescence excitation spectra of $\text{Sr}_2\text{YVO}_6: x \text{ mol\% Eu}^{3+}$ ( $x=1-5$ ) phosphors.	94
4.13 (a) PL emission spectra of $\text{Sr}_2\text{YVO}_6: x \text{ mol\% Eu}^{3+}$ ( $x=1-5$ ) phosphors monitored with 278 nm excitation wavelength.	94
4.13 (b) PL emission spectra of $\text{Sr}_2\text{YVO}_6: x \text{ mol\% Eu}^{3+}$ ( $x=1-5$ ) phosphors monitored with 320 nm excitation wavelength; and (c) Magnified image of PL emission spectra of $\text{Sr}_2\text{YVO}_6: x \text{ mol\% Eu}^{3+}$ phosphors within 630-750 nm.	95
4.13 (d) PL emission spectra of $\text{Sr}_2\text{YVO}_6: x \text{ mol\% Eu}^{3+}$ ( $x=1-5$ ) phosphors monitored with 396 nm; and (e) PL emission spectra of $\text{Sr}_2\text{YVO}_6: x \text{ mol\% Eu}^{3+}$ ( $x=1-5$ ) phosphors monitored with 467 nm excitation wavelength.	96
4.14 Plot of PL intensity as a function doping concentration.	98
4.15 CIE diagram of $\text{Sr}_2\text{YVO}_6:3 \text{ mol\% Eu}^{3+}$ phosphor.	99
4.16 Thermoluminescence glow curves of $\text{Sr}_2\text{YVO}_6:x \text{ mol\% Eu}^{3+}$ ( $x=0, 1, 3, 5$ ) phosphors.	101
4.17 TL intensity response to different $\text{Eu}^{3+}$ concentrations.	102
4.18 TL glow curves of $\text{Sr}_2\text{YVO}_6:x \text{ mol\% Eu}^{3+}$ ( $x=0, 1, 3, 5$ ) phosphors at different beta doses.	103
4.19 TL response of undoped and $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YVO}_6$ phosphors to beta irradiation.	104
4.20 Deconvoluted TL glow curves of $\text{Sr}_2\text{YVO}_6:x \text{ mol\% Eu}^{3+}$ ( $x=0, 1, 3, 5$ ) phosphors after beta irradiation of 10 Gy.	105
4.21 TL glow curves of $\text{Sr}_2\text{YVO}_6:\text{Eu}^{3+}$ phosphors along with undoped $\text{Sr}_2\text{YVO}_6$ when exposed to UV irradiation for 60 min.	109
4.22 TL glow curves of $\text{Sr}_2\text{YVO}_6:\text{Eu}^{3+}$ phosphors at different at different UV exposure time.	111
4.23 Plot of TL intensity vs. UV exposure period.	111
4.24 TL glow curves of Undoped and $\text{Eu}^{3+}$ doped $\text{Sr}_2\text{YVO}_6$ phosphors with PSM notations.	112

5.1	Rietveld refined XRD pattern of $\text{Ca}_3\text{WO}_6$ .	122
5.2	XRD patterns of $\text{Ca}_3\text{WO}_6$ : x mol% $\text{Tb}^{3+}$ (x= 0-2.5) phosphors.	123
5.3	Magnified diffraction patterns of undoped and $\text{Tb}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphors.	124
5.4	W-H plots of $\text{Ca}_3\text{WO}_6$ (a) and $\text{Ca}_3\text{WO}_6$ :0.5 % $\text{Tb}^{3+}$ (b).	125
5.5	(a-d) SEM micrographs of 1 mol% $\text{Tb}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphor.	126
5.6	EDAX spectrum of 1 mol% $\text{Tb}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphor.	127
5.7	Elemental mapping of the 1 mol% $\text{Tb}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphor.	127
5.8	FTIR spectra of $\text{Ca}_3\text{WO}_6$ : $\text{Tb}^{3+}$ double perovskite phosphors.	128
5.9	Photoluminescence excitation and emission spectra of pure $\text{Ca}_3\text{WO}_6$ .	129
5.10	PL excitation and PL emission spectra of $\text{Ca}_3\text{WO}_6$ : 0.5% $\text{Tb}^{3+}$ phosphor.	129
5.11	PL emission spectra of $\text{Ca}_3\text{WO}_6$ : x% $\text{Tb}^{3+}$ (x=0.5, 1, 1.5, 2, 2.5) phosphors.	131
5.12	Plot of PL intensity as a function doping concentration.	131
5.13	CIE diagram of 1 mol% $\text{Tb}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphor.	132
5.14	TL glow curve of $\text{Ca}_3\text{WO}_6$ :2.5% $\text{Tb}^{3+}$ phosphor irradiated with 50 Gy of beta rays.	133
5.15	TL glow curves of $\text{Ca}_3\text{WO}_6$ :x% $\text{Tb}^{3+}$ (x=0.5-2.5) phosphors after 50 Gy of beta irradiation.	134
5.16	TL intensity response to different $\text{Tb}^{3+}$ concentrations.	134
5.17	TL glow curves of $\text{Ca}_3\text{WO}_6$ :2.5% $\text{Tb}^{3+}$ phosphor at different doses of beta irradiation.	135
5.18	Dose response of $\text{Ca}_3\text{WO}_6$ :2.5% $\text{Tb}^{3+}$ phosphor towards beta rays.	136
5.19 (a)	TL glow curves of $\text{Ca}_3\text{WO}_6$ :2.5% $\text{Tb}^{3+}$ after 30 days of irradiation.	137
5.19 (b)	Comparative TL intensities of $\text{Ca}_3\text{WO}_6$ :2.5% $\text{Tb}^{3+}$ after 30 days of irradiation.	137
5.20	Deconvoluted TL glow curve of $\text{Ca}_3\text{WO}_6$ :2.5% $\text{Tb}^{3+}$ phosphor.	138
5.21	XRD patterns of $\text{Ca}_3\text{WO}_6$ : x mol% $\text{Ho}^{3+}$ (x= 0-5) phosphors.	140
5.22	Magnified diffraction patterns of undoped and $\text{Ho}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphors.	141
5.23	W-H plots of $\text{Ca}_3\text{WO}_6$ (a) and $\text{Ca}_3\text{WO}_6$ :1% $\text{Ho}^{3+}$ (b).	142
5.24 (a-d)	SEM micrographs of 4 mol% $\text{Ho}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphor.	143
5.25	EDAX spectrum of 4 mol% $\text{Ho}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphor.	144
5.26	Elemental mapping of the 4 mol% $\text{Ho}^{3+}$ doped $\text{Ca}_3\text{WO}_6$ phosphor.	144
5.27	FTIR spectra of $\text{Ca}_3\text{WO}_6$ : $\text{Ho}^{3+}$ double perovskite phosphors.	145
5.28 (a)	PL excitation spectra of $\text{Ca}_3\text{WO}_6$ : 4 mol% $\text{Ho}^{3+}$ (b) PL emission spectra of	

Ca <sub>3</sub> WO <sub>6</sub> : 4 mol% Ho <sup>3+</sup> phosphor.	146
5.29 PL excitation spectra of Ca <sub>3</sub> WO <sub>6</sub> : x mol% Ho <sup>3+</sup> (x =1-5) phosphors recorded under 454 nm excitation wavelength.	147
5.30 PL emission spectra of Ca <sub>3</sub> WO <sub>6</sub> : x mol% Ho <sup>3+</sup> (x =1-5) phosphors monitored with (a) 275 nm, (b) 303 nm, (c) 362 nm, and (d)722 nm excitation wavelengths.	148
5.30 PL emission spectra of Ca <sub>3</sub> WO <sub>6</sub> : x mol% Ho <sup>3+</sup> (x =1-5) phosphors monitored With (e) 422 nm, (f) 454 nm, and (g) 488 nm excitation wavelengths.	149
5.31 Plot of PL intensity vs. doping concentration.	150
5.32 (a) Temperature dependent PL of Ca <sub>3</sub> WO <sub>6</sub> :1 mol% Ho <sup>3+</sup> phosphor monitored with 454 nm.	151
5.32 (b) Plot of ln[(I <sub>0</sub> /I)-1] vs. 1/kT using plotted Arrhenius equation.	151
5.33 (a) Temperature dependent PL of Ca <sub>3</sub> WO <sub>6</sub> :1 mol% Ho <sup>3+</sup> phosphor monitored with 362 nm.	153
5.33 (b) Plot of ln[(I <sub>0</sub> /I)-1] vs. 1/kT using plotted Arrhenius equation.	153
5.34 CIE diagram of Ho <sup>3+</sup> doped Ca <sub>3</sub> WO <sub>6</sub> phosphors for the excitations of 362 nm and 454 nm.	154
5.35 TL glow curve of Ca <sub>3</sub> WO <sub>6</sub> :2% Ho <sup>3+</sup> phosphor irradiated with 50 Gy dose of beta rays.	155
5.36 (a) TL glow curves of Ca <sub>3</sub> WO <sub>6</sub> :x% Ho <sup>3+</sup> (x=1-5) phosphors after 50 Gy of beta irradiation, recorded at 2 °C/s heating rate.	156
5.36 (b) TL glow curves of Ca <sub>3</sub> WO <sub>6</sub> :x% Ho <sup>3+</sup> (x=1-5) phosphors after 50 Gy of beta irradiation, recorded at 4 °C/s heating rate.	157
5.36 (c) TL glow curves of Ca <sub>3</sub> WO <sub>6</sub> :x% Ho <sup>3+</sup> (x=1-5) phosphors after 50 Gy of beta irradiation, recorded at 6 °C/s heating rate.	157
5.37 TL intensity response to different Ho <sup>3+</sup> concentrations.	158
5.38 TL glow curves of Ca <sub>3</sub> WO <sub>6</sub> :2% Ho <sup>3+</sup> phosphor at different doses of beta irradiation with a fixed heating rate of 4 °C/s.	159
5.39 TL response of undoped and Ho <sup>3+</sup> doped Ca <sub>3</sub> WO <sub>6</sub> phosphors to beta irradiation.	160
5.40 TL glow curves of Ca <sub>3</sub> WO <sub>6</sub> :2% Ho <sup>3+</sup> phosphor after irradiated with 50 Gy beta dose at heating rates of 2 °Cs <sup>-1</sup> , 4 °Cs <sup>-1</sup> , and 6 °Cs <sup>-1</sup> .	160
5.41 Plot of TL intensity and temperature as a function of HR.	161
5.42 Deconvoluted TL glow curve of Ca <sub>3</sub> WO <sub>6</sub> :2% Ho <sup>3+</sup> phosphor recorded after 50 Gy beta irradiation.	162