

## List of Figures

	Page
1.1. Energy level Scheme of the luminescent ion A.	3
1.2. Types of Luminescence	6
1.3. Classification of luminescence on the basis of duration of emission	7
1.4. An illustration of how a phosphor emits light. The dark circle denotes an activator ion which is surrounded by a host lattice.	9
1.5. Periodic Table	10
1.6. Observed energy levels of the trivalent rare-earth ions.	13
1.7. Schematic representation of luminescence process	15
1.8. Schematic representation of the possible luminescence processes of a crystal system with donor D and acceptor A ions. Following excitation D may: (1) emit radiatively, (2) decay nonradiatively, (3) transfer energy to another D ion, or (4) transfer energy to an A ion. In the last case, energy transfer to A is followed by either radiative or nonradiative decay.	16
1.9. The Jablonski diagram, which explains the photophysical processes in molecular systems. (1) photoabsorption; (2) vibrational relaxation; (3) internal conversion; (4) intersystem crossing; (5) radiative transition; and (6) nonradiative transition.	17
1.10. Configurational Coordinate diagram (Energy Levels of transitions taking place).	18
1.11. Energy-level representation of TL process	24
1.12. Schematic representation of Applications of TL	37

2.1.	Block diagram of RF-5301 PC	49
2.2.	Optical System of RF-5301PC	51
2.3.	Spectrofluorophotometer, RF-5301PC	54
2.4.	Spectrofluorophotometer Powder Sample Holder	55
2.5.	Thermoluminescence Setup	57
2.6.	Kanthal Strip and TL detection head	58
2.7.	Block Diagram of TL Set-up	59
2.8.	X-ray diffractometer line diagram	63
2.9.	Calculated phase diagram compared with experimental data (S = SrO, A = Al <sub>2</sub> O <sub>3</sub> )	67
2.10.	Representation of the Al <sub>6</sub> O <sub>18</sub> rings. The shaded tetrahedra represent AlO <sub>4</sub> units and the circles the Sr atoms.	68
2.11.	Experimental setup of synthesis of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :R.E. phosphor by reflux sol-gel technique.	71
3.1.	Partial energy level diagram of the Eu <sup>3+</sup> ion in solids. Each level can be split into 2J + 1 sublevels.	80
3.2.	X-ray diffraction pattern of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> (1%),Dy <sup>3+</sup> (0.1%)	83
3.3.A.	Excitation Spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> .	85
3.3.B.	Emission Spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> .	86
3.4.	Excitation Spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> in the range 300-550nm at room temperature.	87
3.5.A.	Excitation spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> ,Dy <sup>3+</sup>	89
3.5.B.	Emission spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> ,Dy <sup>3+</sup>	90
3.6.A.	PL excitation spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> (1%), Dy <sup>3+</sup> (0.1%), annealed at different temperatures	91
3.6.B.	PL emission spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> (1%), Dy <sup>3+</sup> (0.1%), annealed at different temperatures	91
3.7.A.	PL excitation spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> (1%), annealed in different atmospheres.	92
3.7.B.	PL emission spectra of Sr <sub>3</sub> Al <sub>2</sub> O <sub>6</sub> :Eu <sup>3+</sup> (1%), annealed in different atmospheres.	92

3.8.	TL Glow Curve of the samples	94
3.9.	Schematic representation of the possible transitions in the insulator 1 & 2. defect ionization; 3 & 4. trap ionization; 5. internal intra-center transition.	95
4.1.	XRD pattern of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}$ (1%)	102
4.2.	XRD pattern of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}$ (1%) measured at different annealing temperatures.	102
4.3.A.	Excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}^{3+}$	104
4.3.B.	Emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}^{3+}$	104
4.4.	Energy diagram for $\text{Tb}^{3+}$ ion in the $\text{Sr}_3\text{Al}_2\text{O}_6$ system.	105
4.5.	Schematic configurational coordinate diagram for $\text{Tb}^{3+}$ in $\text{Sr}_3\text{Al}_2\text{O}_6$ showing quenching of the higher level emission by cross-relaxation: the $^5\text{D}_3$ emission on ion 1 is quenched by transferring the energy difference $^5\text{D}_3 - ^5\text{D}_4$ to ion 2 which is promoted to $^7\text{F}_0$ level.	105
4.6.	Variation of the peak ratio ( $I_{490\text{nm}} / I_{545\text{nm}}$ ) with terbium concentration (mol%) of $\text{Sr}_3\text{Al}_2\text{O}_6$ from photoluminescence measurements.	106
4.7.	TL spectra 1% Tb. Dashed and dotted line shows the different peaks separated after performing the T-stop method.	108
4.8.A.	TL glow curves of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}$ phosphor with different $\text{Tb}^{3+}$ concentrations	110
4.8.B.	Integrated TL intensity for different Tb concentrations for respective peak temperatures.	110
4.9.	Fading effect of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}$ (1%) observed for 60 days.	111
4.10.A.	Study of dose response $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}$ (1%) with the TL intensity	113
4.10.B.	The dose response with respect to TL Intensity for 163 °C peak in the log scale.	113
4.11.	The reproducibility of a $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}$ (1%) for a number of TL readouts.	113
4.12.	Emission characteristics of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}(1\%),\text{Eu}(x\%)$ .	116

4.13.	PL spectra of $\text{Sr}_3\text{Al}_2\text{O}_6$ , activated with the trivalent ions of $\text{Tb}^{3+}$ and $\text{Eu}^{3+}$ .	117
4.14.	Schematic representation of the energy transfer in $\text{Sr}_3\text{Al}_2\text{O}_6$ , activated with the trivalent ions of $\text{Tb}^{3+}$ and $\text{Eu}^{3+}$ .	118
4.15.	Excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}^{3+},\text{Eu}^{3+}$ .	119
4.16.	Emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}^{3+}, \text{Eu}^{3+}$ measured for varying concentration of $\text{Tb}^{3+}$ and $\text{Eu}^{3+}$ as indicated in the figures.	121
4.17.	Thermoluminescence glow curve of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb}(1\%),\text{Eu}(x\%)$ phosphor	124
4.18.	Thermoluminescence glow curve of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb},\text{Eu}$ phosphor for varying concentration of $\text{Tb}^{3+}$ and $\text{Eu}^{3+}$	126
5.1.	Schematic representation of the possible luminescence processes of a crystal system with donor D and acceptor A ions. Following excitation D may:(1) emit radiatively, (2) decay nonradiatively, (3) transfer energy to another D ion,or (4) transfer energy to an A ion. In the last case, energy transfer to A is followed by either radiative or nonradiative decay.	132
5.2.A.	PL excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu},\text{Ce}$ with different concentrations of cerium.	134
5.2.B.	PL emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu},\text{Ce}$ with different concentrations of cerium.	134
5.3.A.	PL excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu}, \text{Mg}$ .	136
5.3.B.	PL emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu}, \text{Mg}$ .	136
5.4.A.	PL excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu},\text{R.E}$ .	137
5.4.B.	PL emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu},\text{R.E}$ .	137
5.5.	PL excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb},\text{Ce}$ .	138
5.6.	PL emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb},\text{Ce}$ .	140
5.7.	TL glow curve of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb},\text{Ce}$ .	141
5.8.A.	PL excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu},\text{H}_3\text{BO}_3$ .	144
5.8.B.	PL emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu},\text{H}_3\text{BO}_3$ .	144

5.9.A.	PL excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu, Dy, H}_3\text{BO}_3$ .	146
5.9.B.	PL emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu, Dy, H}_3\text{BO}_3$ .	146
5.10.A.	PL excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb, H}_3\text{BO}_3$ .	147
5.10.B.	PL emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb, H}_3\text{BO}_3$ .	147
5.11.A.	PL excitation spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb,Ce,H}_3\text{BO}_3$ .	148
5.11.B.	PL emission spectra of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Tb,Ce,H}_3\text{BO}_3$ .	148
5.12.	TL glow curve of $\text{Sr}_3\text{Al}_2\text{O}_6:\text{Eu,R.E.}$	150