Chapter 6

Conclusion and Future Scope of the Study

The most exciting phrase to hear in science, the one that heralds new discoveries, is not Eureka! It's rather, "hmm... that's funny...".
(Isaac Asimov)

Conclusion

The experimentally observed changes in photoluminescence and thermoluminescence properties of $Sr_3Al_2O_6$ doped with R.E. (rare earths) can be explain on the promise of change in micro-electrical and mechanical fields in host lattice created due to differences in charge and sizes of impurities introduce in host lattice.

The formation of single phase compound in the $SrO-Al_2O_3$ system is a challenge. Many researchers have adopted different synthesis techniques as well as annealing conditions to obtain single phase. But the appearance of secondary phases is impossible to restrict. Also the single phase formation, in this system, is possible only at higher annealing temperature. The phase studied in the thesis, $Sr_3Al_2O_6$, of the $SrO-Al_2O_3$ system, is earlier considered as an intermediate phase, which doesn't have many applications, except as a mechanoluminescent phosphor. The $Sr_3Al_2O_6$ phase synthesized by sol-gel reflux technique in this thesis has appeared to be single phase at 900 °C.

Earlier researchers have described the application of all the phases of strontium aluminates in the field of long lasting phosphorescence. None of the researchers has reported the application of $SrO-Al_2O_3$ system in the field of TL dosimeters. The $Sr_3Al_2O_6$ phase, known for its mechanoluminescent properties, studied in this thesis has found to be consider as a good for thermoluminescence dosimetry as well as it has good fluorescent emission when excited with 254 nm.

The $Sr_3Al_2O_6:Eu^{3+}$ phosphor, described in Chapter -3 of this thesis, has emission in the red region of the visible spectra. It shows formation, of traps responsible for thermoluminescence peaks, when coped with Dy^{3+}. The peak was formed at 190 °C which has very weak TL intensity and also fades easily. Hence this phosphor cannot consider for dosimetric applications, but found its application as a red emitting phosphor.

The $Sr_3Al_2O_6:Tb^{3+}$ phosphor shows efficient green emission when excited with 254nm wavelength. The specimens have also been examined for their TL properties. They have exhibited good TL glow curves. The well defined TL main peaks observed in different impurities activated $Sr_3Al_2O_6$. The TL from any material is sensitive to internal structure of host lattice, nature and content of the impurity, defect pattern and crystalline fields exist in host matrix. The sizes of ions and charges of impurities and host also play an important role in disturbing the transient micro-mechanical and electrical fields. These also change the location of impurity level from conduction band. The observed changes in TL properties including peak temperature, intensity, activation energy (E), frequency factor (s) and order of kinetics (l) etc. have been explain on the basis of this present understanding of TL in different materials. The TL properties of this phosphor also satisfy all the criteria of the TL dosimetric phosphor, like low fading, reproducibility, linear dose response in the higher dose levels from 25-450 Gy. The TL dosimetric as well as photoluminescence characteristics of this phosphor is described in detail in chapter 4 of this thesis.

The effect of copdoping of the $Sr_3Al_2O_6$:Eu^{3+} and $Sr_3Al_2O_6$:Tb^{3+} phosphors are studied and described in chapter – 5 of this thesis. In the $Sr_3Al_2O_6$:Eu,Mg, $Sr_3Al_2O_6$:Eu,Sm and $Sr_3Al_2O_6$:Eu,Er phosphors, shows reduction in the intensity , on addition of the codopant. While addition of Ce^{3+} as a codpant in $Sr_3Al_2O_6$:Eu^{3+}, increases the PL intensity. Also, the addition of Ce^{3+} in the $Sr_3Al_2O_6$:Tb^{3+} phosphor also increases the $^5D_3$ emission of the Tb^{3+}, which results in the emission of Tb^{3+} in the green as well as blue region of the visible spectra. Also the $Sr_3Al_2O_6$:Tb,Ce phosphor shows good TL response and also found its applicability as a dosimetric material.

The above mentioned experimental results have been explained on the basis of recent knowledge available in RE doped materials. It is proposed that nature of impurity (tri-valent), ionic size of dopant, structure of $Sr_3Al_2O_6$ host matrix, and crystalline interactions are responsible for the particular emission in the specimens. And the change in fluorescence spectra observed in different chemical conditions are supposed to be due to variations in the interactions and other parameters mentioned above. The different emissions and corresponding excitations observed are suggested to be associated with [F $\leftrightarrow$ D] electronics transitions in RE impurities.

The qualifications required for the use of phosphors as lamp phosphor have been assessed for the present materials. It has been found that the materials under investigation satisfy most of the requirements of efficient lamp phosphors. It has been found that some of them are found to be useful in lamp industry. The investigations brings out following applications of the present studied materials.

i) Eu^{3+} and Eu^{3+}:Ce^{3+} activated $Sr_3Al_2O_6$ are found good Red-emitting phosphors.

ii) Amongst them, Eu^{3+} and Ce^{3+} doped $Sr_3Al_2O_6$ specimens are better and later one is the best Red-emitters.

iii) $Sr_3Al_2O_6$:Tb^{3+} can be considered as green emitting phosphor may be useful as for TL dosimetric purpose.

iv) $Sr_3Al_2O_6$:Tb,Ce can be considered as good emitter in the bluish green region, and may find its applicability in the dosimetric field.

Finally it is concluded that the $Sr_3Al_2O_6$:Tb^{3+} can be used as lamp phosphor as well as TL dosimetry phosphor for accidental radiation monitoring.