S.p.22. SUDHA KARTHA, C–Nitrogen Laser Excited Fluorescence of some Rare Eart Doped Alkaline Earth Fluorides–1984–Dr. K. Sathianandan.

The spectroscopic studies of doped crystalline substances have revealed the possibility of their use in lasers. In the recent years to come, we may expect a large scale intensive search for laser crystals capable of efficient emission at room temperatures both in the ultraviolet and in the visible regions of the optical spectrum. The possibility of using rare earth ions in crystals as new laser materials has necessitated a complete understanding of the excitation and de-excitation mechanisms of these ions. The advent of lasers initiated the most interesting and highly detailed investigations into the spectroscopic features of laser crystals like $CaF_2:RE^{3+}$.

This thesis aims to present the results of the experimental investigations on the Nitrogen laser excited fluorescence of some rare earth doped alkaline earth fluorides. It also contains the details of a pulsed Nitrogen laser, a fluorescence emission spectrometerand a lifetime spectrometer.

The thesis begins with a brief introduction to the different aspects of the luminescence in crystals. The different factors affecting the luminescence and the application of luminescence are described in this chapter. A brief introduction to laser crystals and the spectral characteristics of rare earth ions are also discussed in the second half of the chapter.

It has been observed that a good number of rare earth ions in different crystals absorb the UV radiations of the Nitrogen laser to emit fluorescence in the visible region. Moreover, being a pulsed laser with very high peak power of extremely short duration, lifetime measurement of excited states can be successfully carried out using this laser. A Nitrogen laser was therefore used as the source of

excitation in the present investigations and the details of its design considerations are given in the second chapter. Some parametric studies like the power measurements, laser spectrum analysis and power variations with additives are also carried out on this laser and the results are presented in the same chapter.

The experimental details on the recording of the fluorescence spectrum and lifetime measurements are given in the successive chapters. Since a knowledge of the behaviour of the pure materials can provide a basis for understanding the behaviour of the doped materials, the fluorescence spactra of pure CaF_2, SrF_2 and BaF_2 were initially investigated with the Nitrogen laser excitation and the results are presented in chapter III

Fluorescence studies of $CaF_2:Ho^{3+}$ for different concentrations of Ho^{3+} are described in the next chapter. The emission spectra are recorded at both RT and LNT. Temperature dependent concentration quenching of fluorescence was observed for $CaF_2:Ho^{3+}$ and is discussed with the help of the energy level diagram of Ho^{3+}.

Visible fluorescence of Nd^{3+} in CaF_2, SrF_2 and BaF_2 for two different concentrations of Nd^{3+} is also studied with Nitrogen laser excitation and presented in chapter V. Strong blue emission was observed from these crystals. The energy levels and transitions involved in the visible fluorescence of Nd^{3+} are also included in this chapter.

The study of fluorescence of $CaF_2:Er^{3+}$ is given in chapter VI No visible fluorescence was observed under Nitrogen laser excitation and hence the emission of these crystals was studied with a Xenon are excitation. The results and conclusions of the investigations are summarised in a separate chapter at the end of the thesis.

The results of the above investigations have been communicated in the form of following research papers.

1. A simple and sensitive PMT preamplifier for low level fluorescence and luminescence studies S.M. Pillai, C. Raghavan, C. Sudha Kartha and C.P.G. Vallabhan, J. Inst. Soc. India, 2. 7 (1982).
2. Fluorescence of $CaF_2:Ho^{3+}$ under N_2 laser excitation. Sudha Vijayakumar, V.P.Nampoori and K. Sathianandan, Proceedings of DAE Symp. on NP & SSP held at Banaras Hindu University (1982) Paper SEC11.
3. Blue emission of Nd^{3+} in CaF_2 and SrF_2. Sudha Vijayakumar, V.P. Namboori and K. Sathianandan, Proceedings of DAE Symp. on NP & SSP held at Banaras Hindu University (1982) Paper SEC11.
4. New vibrational bands in the N_2 laser emission spectra. N. Subhash, Sudha C. Kartha and K. Sathianandan, Appl. Optics, 22, 3612 (1983).
5. Temperature dependent concentration quenching of fluorescence of $CaF_2:Ho^{3+}$. C. Sudha Kartha, T. Ramachandran, V.P.N. Nampoori and K. Sathianandan, Presented at the 3rd Symp. on Lasers and Applications held at IIT Kanpur (1983) Paper C 2Y-3.
6. Luminescence decay studies of Nd^{3+} in SrF_2. C. Sudha Kartha, V.P.N. Nampoori and K. Sathianandan, Proceedings of DAE Symp. on Np & SSP held at Manasagangothri, University of Mysore (1983), SDD5.