SUMMARY

One of the major topics that has captured the attention of solid state scientists is the study of luminescent materials and its practical applications. It provides fascinating variety even though its basic physical mechanism is conceptually simple. For the fundamental researches on phosphors, alkali halides have been widely used as host-crystals, because they are the best known of the halide structures. It has been found that though alkali halides have been extensively studied for their optical properties, there are certain aspects in the field of luminescence which evade proper explanation.

Thallium doped alkali halide systems that have been studied in detail in regard to their absorption and emission spectra are KCl:Tl, KBr:Tl and KI:Tl. It has been generally assumed that the luminescent behaviour of all the thallium doped alkali halide phosphors is more or less similar and hence the luminescence study of NaBr:Tl phosphor was not carried out in more detail. The present investigations, however, reveal that such an assumption is in error.

Luminescence of Tl^+ ion in alkali halide crystals has been investigated extensively since early

decades from both the theoretical and experimental aspects. Such a study was mainly initiated because of the fact that the electronic transitions involved in either emission and absorption are considered to take place within the Tl^+ ion, and the model of the luminescence centre is quite simple. Subsequent study however revealed that a more complex model should be dealt with in order to explain the characteristic features of the phosphor. This understanding is very well borne out by the results obtained in the present measurements. The types of luminescence centres suggested are : (i) Isolated substitutional Tl^+ ion, generally accepted both on theoretical and experimental basis in thallium doped alkali halides, (ii) TlBr - - molecule, (iii) Tl^+ ions in pairs (dimers), (iv) Negatively charged complex ions of the type $(TlBr_n)^-$, and (v) Na^+ ion occupying substitutional Tl^+ ion position in TlBr lattice. In a related study, the investigation of the nature of the centre responsible for luminescence in undoped sodium bromide is also undertaken.

The theoretical and experimental study of the luminescence of thallium doped alkali halides reported

before mainly concerned with the phosphors containing low concentration of thallium[1-3]. In fact there are typically new luminescent features which are observed if the phosphor is doped heavily. One of the aims of the present work is to examine the luminescent behaviour of lightly as well as heavily doped sodium bromide phosphors.

All the measurements in the present study have been carried out at room temperature. The specimens were examined in the microcrystalline form. The investigation involves the excitation and emission spectra of the undoped and doped sodium bromide phosphors in as-received condition and also after various pretreatments. In addition, the excitation and emission spectra of TlBr -- powder, aqueous TlBr-solution and NaBr-solution are also examined.

The thesis is divided mainly into five chapters. The first chapter includes a general introduction to the present work. The general aspects of luminescence together with the different theories associated with the luminescence phenomena constitute the second chapter. The third chapter deals, in general, with the excitation

and emission characteristics of a phosphor and also with a brief survey of the literature in the field of luminescence of thallium doped alkali halides. The experimental details and description of the experimental apparatus are presented in the fourth chapter. The fifth chapter includes the results obtained and their interpretations.