CONCLUSION

Large number of materials have been investigated for their application as solid-state dosimeteres of ionizing radiation. Among them, thermoluminescent Lithium Fluoride and radiophotoluminescent silver activated phosphate glasses, have been found most useful in practical application. In alkali halides, sodium, and potassium chlorides doped with mono-and di-valent cation impurities [thallium, Sr, Ba, Ca etc.] have been recently explored as dosimeter materials. Survey of literature indicated that sodium fluoride has been developed as a radiophotoluminescent dosimeter but none or very few have systematically explored the possibility of pure and potassium doped NaF as solid state TL dosimeter materials. Therefore, the present work has been undertaken to develop the use of TL of NaF and NaF:K in radiation dosimetry.

The present reports of TL behaviours of untreated and pre-heat treated, pure NaF as well as NaF:K with four different concentrations of K^+ impurity, namely, 200, 500, 1000 and 2000 ppm after irradiation with standard beta dose, 2.1×10^3 rads clearly bring out the following experimental facts.

(i) Pure NaF in as-obtained condition exhibits 120°C glow peak while 400°C air-quenched NaF (designated as NaF(T)] displays dominant peak around 150°C. It is suggested that inherent impurity - negative ion vacancy pair [In | -] situated in normal region of the NaF lattice is responsible for the occurrence of the peak at 120°C, while that located in discloation region is associated with 150°C.

(ii) The K^+ doped sodium fluoride exhibits peaks at 165, 190, 230, 300 and 360°C.

(iii) It is observed that the increase in K^+ concentration does not significantly change the intensities of the observed glow peaks at 120 and 165°C in the case of NaF:K specimen as-received from solution. On the other hand, the glow curves for the heat treated NaF:K(T) specimen exhibit substantial increase in the intensities of the two observed peaks, with the increase in K^+ concentration. Between the two peaks, 120 and 165°C, the peak at 165°C appears to be markedly influenced by the heat treatment as well as K^+ concentration.

It is inferred that because of the large size of K^+ ion compared to Na^+ ion [K^+ = 1.33A^0, Na^+ = 0.95A^0] the introduction of K^+ ion in NaF lattice becomes difficult in the case of NaF:K specimen as-obtained from solution. The heat treatment of the specimen favours a large number of K^+ ions to go in solid of NaF lattice which leads to the enhancement in the intensity of 165°C peak in the case of heat treated NaF:K specimen. The same effect becomes pronounced if along with heat treatment the concentration of potassium in NaF:K is increased to 1000 ppm [NaF:K(T)].

It is presumed that the 165°C peak in NaF:K is because of single K^+ ions located in the dislocation regions. In other words the TL centre related to 165°C glow peak in NaF:K is K^+ - negative ion vacancy pair $\boxed{K^+ \mid -}$, in the dislocation region.

(iv) If the concentration of the K^+ ion is increased beyond 1000 ppm, it is observed that the peak at 165°C is suppressed whereas a new peak develops at 190°C. The latter peak was found to grow markedly in intensity if heavily doped heat treated NaF:K [concentration 2000 ppm] specimen was subjected to the thermal cycling. The similar effect is also observed if instead of thermal cycling the 400°C air-quenched NaF:K (concentration 2000 ppm) was exposed to increasing beta radiation dose. Therefore, it is suggested that the peak at 190°C is the property of heavy doping. It is inferred that thermal cycling or exposure to beta radiation is conducive to the diffusion of K^+ ions to the dislocation regions where two K^+ ions occupy near neighbour position. It is believed that 190°C peak in NaF:K is due to a pair of K^+ ions in the dislocation regions in which the two K^+ ions occupy position such that the interaction between them is significant.

(v) The thermal glow peaks at 230 and 300°C observed in the present phosphor NaF:K are suggested to be associated respectively with the higher aggregates of K^+ ions, namely, trimer and tetramer located in disturbed regions of NaF matrix.

(vi) The peak at 360°C exhibited very interesting properties. Like other alkali halides, NaF and NaF:K also shown dominant peak at 360°C during first thermal cycle without or with excitation and disappeared in the second and further successive heating runs. Therefore, it is proposed that, like other alkali halides, the peak at 360°C in the present phosphor is also the spurious TL peak, where the excitation is achieved by means other than radiation, particularly through mechanical pressure exerted during handling and spreading the phosphor on specimen holder to record TL glow curve.

In most of the alkali halides reported earlier and in the present NaF, the 360°C spurious TL peak has disappeared all the time after completion of first thermal cycle. But it is very important to note that unlike above mentioned reports, the peak around 360°C did appear in second and second onwards successive heating runs with significant intensity in beta irradiated NaF and NaF:K specimens. Therefore, it is believed that there exists either two separate peaks, namely spurious (s) and radiation induced (RI) peaks or overlaping of 'S' and 'RI' peaks around 360°C temperature. It is found that the latter one appears only at a particular critical incident beta dose [4.66×10^2 rads] and remains absent below this critical dose. This clearly reveals the fact that the peak around 360°C observed in the present phosphor without excitation or with irradiation below this critical beta dose is spurious one. Other experimental results encourage the author to suggest that the higher aggregates of K^+ ions namely, pentaners are responsible for generation of this peak.

(vii) The specimens of NaF:K (1000 ppm) annealed and quenched from 400°C in air [NaF:K(T)] exhibited intense TL output with a well defined and isolated glow peak at 165°C. The 165°C peak in NaF:K(T) specimen was selected and examined for dosimetry properties. NaF(T) and NaF:K(T) materials were tested for the different basic requirements of an efficient TLD material. The High TL Efficiency and sensitivity, resistance to radiation and magnetic fields damages, linear TL output versus incident beta dose, response for the large dose range, low fading, desirable shape and size of TL dosimeter, excellent reproducibility and easy availability of present NaF:K(T) material at cheapest price made the author to suggest that NaF:K(T) phosphor can be used as a suitable TLD Material in beta radiation dosimetry.