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Lyoluminescence characterizations in (KNa)Cl phosphor for LL dosimetry.

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ABSTRACT
The lyoluminescence (LL) in γ-irradiated KCl, NaCl and KNaCl phosphors are reported. LL of all phosphors has been recorded for different γ-doses. The nature of variations of peak LL intensities is found sublinearly with γ-irradiation dose. The variation of peak TL intensity in all samples is also found as sublinear with different γ-irradiation dose.

Keywords lyoluminescence (LL), γ-irradiation, KCl, NaCl and KNaCl phosphors.

INTRODUCTION

The measurement of radiation dose have become a science of ever increasing importance to the estimation of the risk and benefits inherent to the uses of and exposure of ionizing radiation. When strongly energized crystals are dissolved in a liquid solvent like water, light is emitted as a result of recombination of hydrated electrons with the holes on the surface of crystallites. This phenomenon is called lyoluminescence [1] and has been investigated by many workers for use in dosimetry application. Ahnstrom [2] and Arnikar et. al. [3] supports the formation of hydrated electron (e^-_{aq}) as the prerequisite for the emission of light. Recent work in this field appears to deal more with the improvement of techniques, both of detection and preparation of materials, aimed at achieving more reliable dosimetry [4].

However there are a number of factors that influence the light yield during the dissolution of γ -irradiated alkali halides in water, and which have not been investigated in detail Various studies have been undertaken to understand the mechanism of LL [5]. The parameters that influence the LL intensity are, for example, grain size, mass of the irradiated alkali halide, pH of the solvent, temperature of the solvent, irradiation dose, type of impurity etc. These experimental factors, which affect the LL intensity, require detailed investigation, for the purpose of developing LL dosimetric material. [6].

METHODOLOGY

All phosphors were prepared by wet chemical method. The solutions were evaporated at 80 ^{0}C in oven for about 4-5 days. The recrystallised residue were normally crushed to powder and heated at 500^{0}C in fabricated furnace for 1 hr and quenched. Analar Grade chemical were used in present investigation. The samples were exposed to γ-dose from ^{60}Co source having dose rate of 0.50 kGy/hr. Lyoluminescence were studied with the usual set-up consisting of LL cell, photomultiplier tube (RCA 931), amplifier and recorder at room temperature. Distil water containing 7 x 10^{-4} mol% Luminol was used as solvent. For recording the LL, 5 mg sample was dissolved in 2 ml solvent injected by syringe in a test tube having high transparency placed closed to window of PMT. Thermoluminescence were studied with PC based Thermoluminescence Analyzer (1009 I) system set-up. Glow cure were recorded by heating 1 mg sample in temperature range 10 to 300 ^{0}C with constant rate of 10 ^{0}C/min. All experiments were performed in identical conditions and it is observed that the results are reproducible.

RESULTS AND DISCUSSION

Lyoluminescence in KCl, NaCl and KNaCl are shown in Fig.1, using water containing 7 x10^{-4} mol% luminol as a solvent. LL glow curve shows the isolated single peak in all materials. KNaCl LL intensity peak height is in between the LL peak height of KCl and NaCl. The LL intensity of KCl is less and that of NaCl is more than KNaCl. The observed LL are due to, during the dissolution of materials in water containing 7 x10^{-4} mol% Luminol **as** solvents traps are released. Single LL peak shows the only one type luminescence centre is form during irradiation.

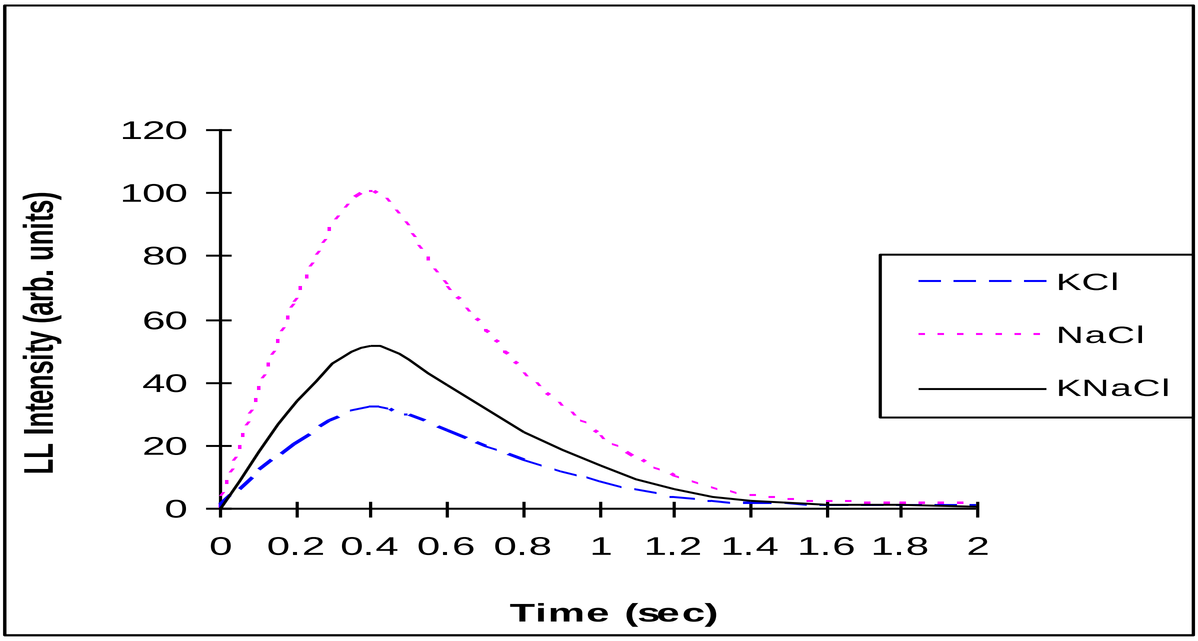

Figure 1:- LL glow curve of (KNa)Cl dissolved in water containing 7 x10^{-4} mol% Luminol, exposed to -dose = 0.50 kGy/hr

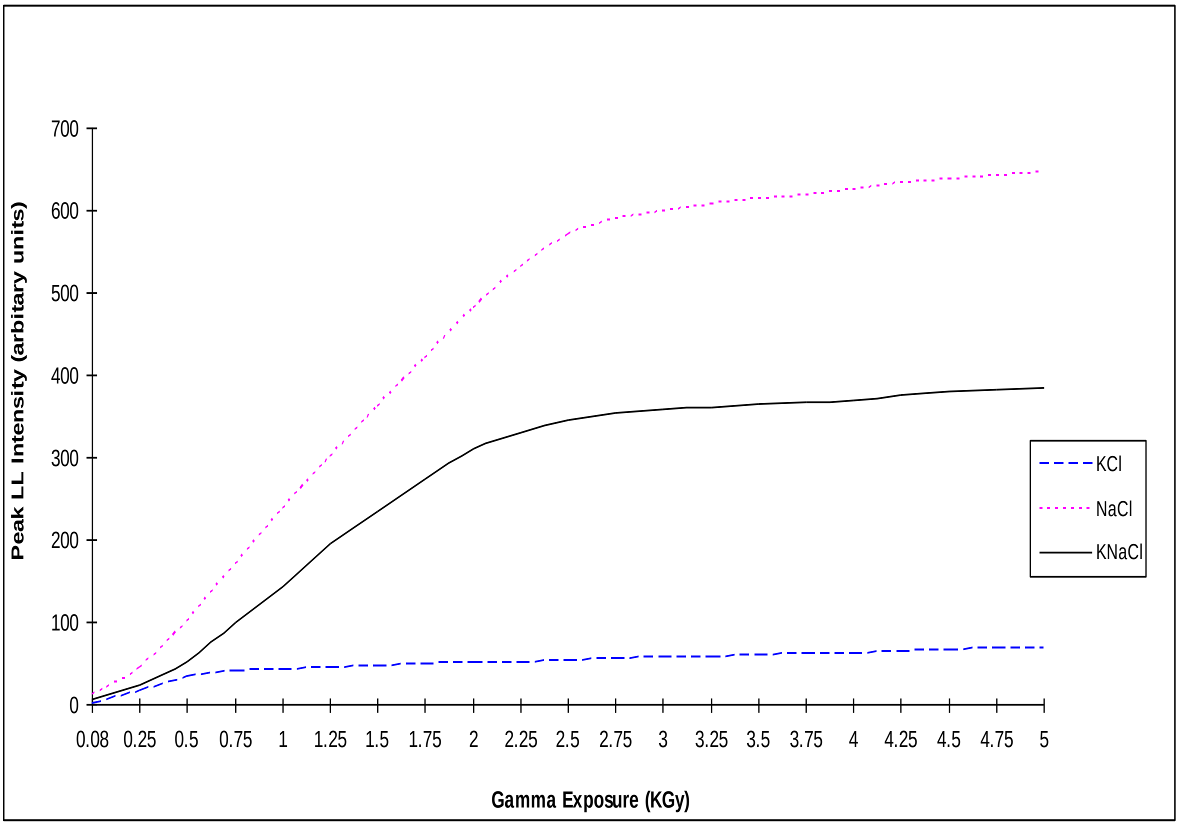

Figure 2:- Variation of Peak LL Intensity with different gamma exposure of (KNa)Cl dissolved in water containing 7 x 10^{-4}mol% Luminol.

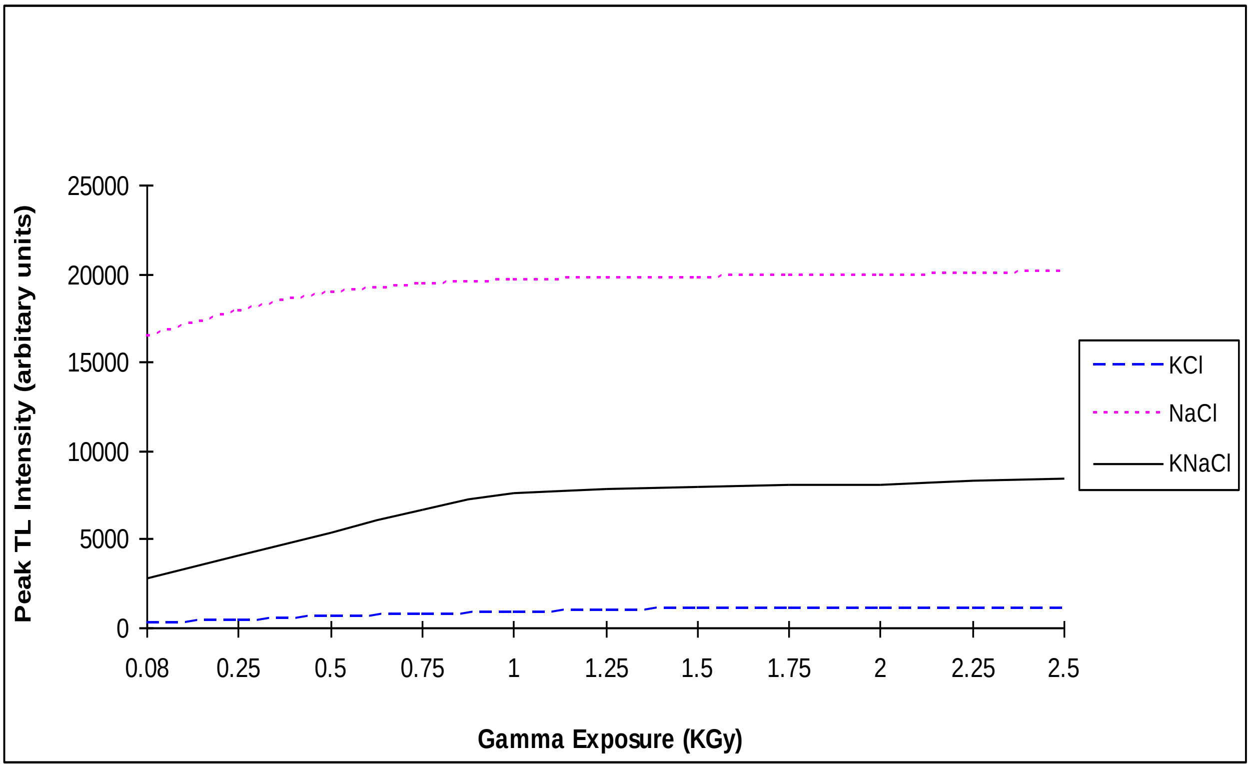

Figure 3:- Variation of Peak TL Intensity with different gamma exposure of (KNa)Cl.

Fig. 2 shows the variation of LL peak intensity with γ– rays exposure of KNaCl, NaCl and KCl. The LL intensity sublinearly increases with the γ– rays exposure upto 5kGy high exposure.

Fig. 3 shows the variation of TL peak intensity with γ– rays exposure of KNaCl, NaCl and KCl. The LL intensity sublinearly increases with the γ– rays exposure upto 2.5kGy high exposure.

Now a day the measurement of high dose radiation is challenging task and it is required for accidental dosimetry. The prepared phosphors show the dose measurements possible upto 5 kGy gamma exposure using lyoluminescence technique, therefore the prepared phosphors may be useful for accidental dosimetry.

CONCLUSION

Lyoluminescence in KCl, NaCl and KNaCl materials shows the single LL peak due to only one type luminescence centre is form and LL peak intensity increases with γ– ray exposure upto 5kGy high dose. These characteristics are shows the prepared (KNa)Cl phosphors may be applicable for LL dosimetry for high dose measurement.

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Conflicts of interest: The authors stated that no conflicts of interest.

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