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ELECTRIC FIELD EFFECT ON THE RECOMBINATION MECHANISMS IN KI DOPED WITH DIVALENT IONS

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The influence of an electric field on radiative recombinations in alkali halides gives often contradictory results since the processes depend on the nature and concentration of impurities, the nature, the condition and the doses of irradiation. In a first study devoted to $KI:Tl^+$ we found that the application of an electric field modified the capture cross section of the recombination centers or traps and that led to striking effects in the radio and thermoluminescence spectra[2]. With the same techniques we undertook a systematic study with KI doped with divalent ions such as Sr^{2+}, Mn^{2+}, Eu^{2+} and Sm^{2+}. After X or β irradiation at low temperature, all these crystals exhibit important glow peaks having their maxima at temperatures lower than the migration temperature of V_K centers. However their emission spectra are at 290 and 380 nm (except for $KI:Eu^{2+}$ at high concentration) and correspond to the excitonic luminescence observed in ultrapure material. The application of the field for a short period of time (1s) enhances considerably the intensity of the emission while, on the other hand, under constant DC field the glow peaks are simply shifted toward lower temperature without any characteristic changes in the shape of the curve. These effects are almost independent of the nature of the impurities. We suggest that the ionising irradiation creates essentially V_K centers and weakly bound electrons trapped on defects preexisting in the crystal, such as complexes formed by a divalent ion associated with the cationic impurity. The application of the field enhances the probability of the electron detrapping and leads to the observed effects. Using a simple theory of thermoluminescence both phenomena can be explained quantitatively and the activation energies of the mechanism and their field dependence can be obtained. Similar effects are also found in photostimulated luminescence and phosphorescence phenomena at LHeT. Moreover the dipolar character of the electron traps leads also to important polarization phenomena and the use of the techniques previously described allows a precise measurement of the internal field.

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