

Relation Between the Temperature of Treatment and the Intensity of Luminescence of Phosphors.

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According to the theory developed by Wagner and Schottky,¹ and by Jost², the number n of disordered points produced inside a crystal is given by

$$n = N e^{-E/2kT},$$

when the crystal is in thermodynamical equilibrium at a temperature T . Here E is the disorder energy, and N the total number of lattice points. Recent development of the theory of phosphorescence supported by many experimental facts demands that the lattice defects are directly responsible for the phenomenon of luminescence. Therefore, according to this theory there should be a temperature dependence of luminescent intensity of the type shown by the above

formula. With this view in mind we have analyzed the experimental data given by Kabakjian³ by plotting the luminescent intensity against the temperature of treatment. The results are shown in Figs. 1, 2, and 3. These

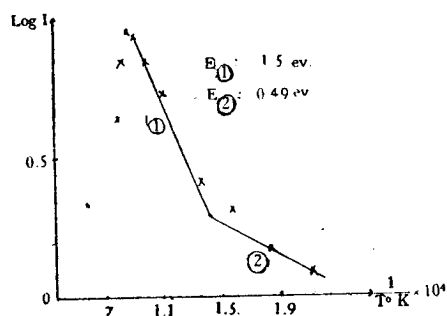


Fig. 2. Ba Cl₂.

figures indicate clearly that the dependence is of the exponential type.

The value of disorder energy E can also be computed easily. They are given in the corresponding figures. They come out of right order. The nearly constant value of the intensity of luminescence in the case of the anhydrous radium bromide (Fig. 1. curve I) at a temperature of about 450°C and downwards is attributed by us to the relatively high value of disorder energy

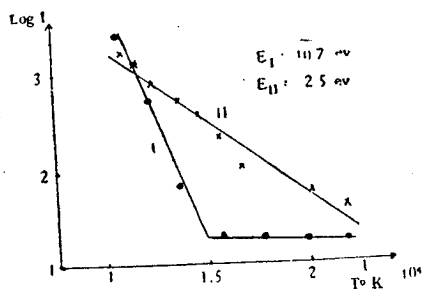


Fig. 1. I • anhydrous radium B bromide,
II × Ra SO₄.

(10.7 ev.). For such a high value of disorder energy no disordered points can occur appreciably in the crystal unless at comparatively higher temperature. For BaCl_2 (Fig. 2), the curve begins to fall at about 900°C . This temperature is very near to the transition point (925°C) from monoclinic to

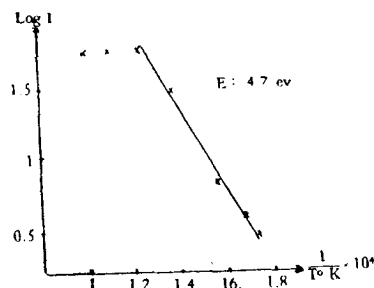


Fig. 3. BaBr_2 .

cubic structure and the melting point (960°C) of the crystal. Thus the reason for the fall of intensity in this case is explained as due to the change of structure of BaCl_2 at that temperature. The presence of the two values of dis-

order energy for BaCl_2 at first leads us to think that both the cation and anion diffuse into interstitial positions. But according to Tubandt⁴ the BaCl_2 is a pure anion conductor. Hence the above suggestion seems to be untenable. We are thus inclined to suggest that either there are two different disorder energy for the two Cl^- ions attached to the same Ba^{++} ion, or that one of the Cl^- ions is evaporated away while the other goes into interstitial positions. We have made some efforts to compare the disorder energy calculated by us in this way with those obtained from the electrolytic conductivity measurements. Owing to the shortage of materials since the outbreak of the war we are unable to get the required data. The data for barium halide had been obtained by Vaillant⁵ and Tubandt⁶. But both the periodicals are unavailable for us.

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