

Ultra-violet Luminescence of Sodium Chloride

SINCE the fluorescence and phosphorescence of sodium chloride are extremely weak in the ultra-violet, there have been few investigations of them until now¹. Our measurements were carried out by a very sensitive photon counter. Samples of clear sodium chloride crystals were exposed to X-rays of 50 kv. and then irradiated by visible light for periods of a few seconds. Investigating the radiations of such crystals with the photon counter, we found a distinct ultra-violet phosphorescence which is remarkably changed if the crystal is plastically deformed.

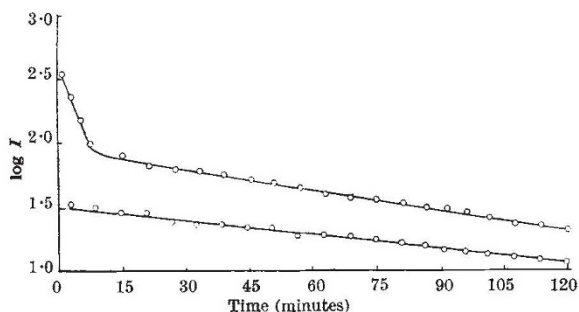


FIG. 1.

Fig. 1 shows the results. Curve I represents the decay of the intensity *I* of the ultra-violet phosphorescence of a sample of sodium chloride, which is perfectly free from deformation. Curve II shows the same for a crystal which was plastically deformed (bent) after irradiation with X-rays.

Comparing the two curves, it is evident that in the case of the bent crystal there are two monochromatic components in the ultra-violet phosphorescence of sodium chloride. One of these has a short half-life and is only present in deformed crystals while the other one (large half-life) is noticeable in all cases.

We have investigated the wave-length of these two components by means of a quartz monochromator. Component I has the wave-length $\lambda = 2350 \text{ \AA}$.; while for component II, $\lambda = 2950 \text{ \AA}$.

Comparing these results with the absorption measurements of Hilsch and Pohl² we find that component I ($\lambda = 2350 \text{ \AA}$.) corresponds to a transition of the electron from the level of the *F*-centres (*Farb-Zentren*) to the ground-level, whereas component II ($\lambda = 2950 \text{ \AA}$.) corresponds to a transition from the level of the *F*-centres to the level of the *U*-centres. It is interesting to find that the transition probability of component II is greatly dependent on the degree of deformation of the crystal.

Finally, we measured the excitation curve of the ultra-violet fluorescence of sodium chloride and we got more information about the origin of component II. The results of these investigations will be published later.

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¹ J. O. Perrine, *Phys. Rev.*, **22**, 48 (1923). W. Kudrjawzowa, *Z. Phys.*, **90**, 489 (1934). Otto Glaser and F. E. Beasley, *Phys. Rev.*, **47**, 570 (1935).

² R. Hilsch and R. Pohl, *Götting. Nach.*, **46**, 322 (1933); **52**, 406 (1933); **1**, 115 (1934).

Ultra-violet Band Systems of the Emitters GeCl and GeBr

THE available data for the band systems of diatomic halides of Group IV(*b*) elements are fragmentary and give conflicting indications of the nature of the ground states, for which either ² Σ or ² Π is theoretically possible, and the latter has been regarded as more probable¹. We have recently made observations of band systems of GeCl and GeBr, which seem to clarify the situation considerably.

Through the kindness of Sir Gilbert Morgan and Dr. G. R. Davies, we have been able to use a quantity of their germanium and germanium dioxide for the preparation of the tetrachloride and tetrabromide. Heavy-current tube-discharges through the vapours of these compounds develop the desired band systems with sufficient intensity to be photographed in a quartz Littrow spectrograph (Hilger's *E 1*). Each system consists of bands degraded towards shorter wave-lengths, the band-heads being represented approximately by :

$$\text{GeCl} : \nu = \begin{Bmatrix} 33,992.2 \\ 33,017.2 \end{Bmatrix} + (526.6 u' - 0.3 u'^2) - (408.4 u'' - 1.6 u''^2)$$

$$\text{GeBr} : \nu = \begin{Bmatrix} 33,413.4 \\ 32,263.4 \end{Bmatrix} + (383.7 u' - 0.7 u'^2) - (296.6 u'' - 0.9 u''^2)$$

where $u' = v' + \frac{1}{2}$ and $u'' = v'' + \frac{1}{2}$.

The observed electronic separation in germanium chloride is, as would be expected, intermediate between those in the lowest states of SiCl² and SnCl^{3,4} and smaller than that in GeBr. Analogy suggests that these two separations of 975 cm.⁻¹ and 1150 cm.⁻¹ occur in the lower (presumably the ground) states of GeCl and GeBr. The first of these emitters has the same number of electrons and nearly the same mass as SiBr, the lower electronic state of which is apparently single⁵, while the second stands in the same relation to SnCl, the lowest state of which is known⁴ to be ² Π . For each of these isoelectronic pairs certain similarities in the results of analysis of the band systems are to be expected, and are, in fact, observed, except in regard to the lack of electronic doubling in SiBr.

A possible explanation of the apparent anomaly in the lower state of SiBr may lie in the fact that the electronic separation to be expected is of the order 400–450 cm.⁻¹, which is rather near the separations of the vibrational levels, $424.6u'' - 1.3u''^2$, and may thus be difficult to recognize; and if it happened to lie between, say, 420 and 425 cm.⁻¹, it might well pass entirely unnoticed in the analysis of the band system with the dispersion hitherto employed. A study of the intensities of the bands seems to support this suggested explanation. The further apparently anomalous case of the lead halides^{6,7} has already been discussed.

1. Electronic energy ν_0 of upper state				2. Electronic interval $\delta\nu_0$ in lower state			
	F	Cl	Br		F	Cl	Br
Si	34,639	34,103	33,570	Si	161	208	—
Ge	—	33,992	33,413	Ge	—	975	1,150
Sn	—	33,582	—	Sn	—	2,360	—
Pb	32,565	21,867	20,884	Pb	—	—	—
3. Value of ω_0'				4. Value of ω_0''			
	F	Cl	Br		F	Cl	Br
Si	1011.2	(698.7)	578.3	Si	856.7	535.4	424.6
Ge	—	526.6	383.7	Ge	—	408.4	296.6
Sn	—	432.5	—	Sn	—	353.5	—
Pb	397.8	228.6	152.5	Pb	506.9	304.2	207.5

The above tables of data for this *MX* group show that the electronic separations $\delta\nu_0$ in the lower