Phosphorescence Produced by Mechanical Means

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(*Received November 16, 1946*)

Recent development of theory of luminescence demands that lattice defects are directly responsible for the phenomena of phosphorescence. There are many evidences supporting this view. It seems to us there is a new method of testing this theory. This method is to investigate whether it is possible to produce the phosphorescence by purely mechanical means. Following is a report of some experimental results concerning this question.

Two large natural crystals of calcite were taken. One of them was found to be phosphorescent after exposure to sunlight and then brought to darkness, while the other was not phosphorescent. They were referred to as sample I and II respectively.

Sample II was slitted into small crystals, three of these small crystals were taken under mechanical compression. The stress was at first kept so low that no macroscopic fault occurred. The stress was then increased until many macroscopic cracks were seen. Under this condition the three crystals tested were found to be phosphorescent. The one with larger number of macroscopic flaws was associated unmistakably with the one of brighter luminescence.

Two small crystals of sample II were again taken. They were heated in an ordinary coal stove (temperature around 800°C) for about ten minutes. One of the two was suddenly thrown into a bath of cold water (15°C) while the other was cooled in the air (15°C). The former was distorted very seriously that it became milky white and non-transparent. Both of them are found to be phosphorescent.

Of all the samples treated by mechanical or thermal means only the one distorted (by thermal means) most gave an emission with intensity comparable with that of sample I. All samples, including sample I, phosphoresced in the green region (visually only!) and with rather short lifetimes (of order of a few seconds).

The results given above thus support the theory that lattice defects, which, in our case, are produced by mechanical and thermal treatment of the crystals, are directly responsible for the phenomena of phosphorescence.

It may also be mentioned that one of the "stress-produced" luminescent calcite gave an emission which came apparently from a very small region of the crystals. This may tentatively be attributed to the accumulation of stress at this region.

Besides, a preliminary test was also carried out to detect the effect of stress upon the phosphorescent properties of some phosphors. The sample used were luminescent calcite and solid solutions of fluorescein in boric acid (prepared in the form of a small stick) and in aluminum sulphate. No. marked change of the decay lifetimes had been found upon the application of stress. It seemed to have an indication of the change of the luminescent intensity. Quantitative measurements have, however, not yet been carried out owing to unfavorable circumstances in war time.