THE EMISSION AND ABSORPTION SPECTRA OF LUMINESCENT DIAMONDS

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Investigations made at this Institute by Dr. P. G. N. Nayar (1942) and Miss Anna Mani (1944) have shown that valuable information regarding the vibration spectrum of diamond is furnished by the study of the emission and absorption spectra of specimens which exhibit a blue luminescence under irradiation. For this purpose, it is necessary to cool the diamond to liquid-air temperature and record the emission or the absorption spectrum, as the case may be, under adequate resolving power. The vibration spectrum is then recorded in association with an electronic transition appearing at λ 4152, as a system of subsidiary bands at longer wavelengths in emission and at shorter wavelengths in absorption. Another system of vibration bands, not so well-defined, appears in association with an electronic line at λ 5032 in the case of diamonds which give a yellow or green luminescence. Numerous spectrograms showing these effects have appeared in papers published earlier in these *Proceedings*.

The principal line at λ 4152 is really a doublet, the separation of its components varying considerably with different specimens. Diamonds in which the components of the doublet are close together and sharp are naturally those most suitable for exhibiting clearly the discrete character of the vibration spectrum. Likewise, it is such diamonds which exhibit best the discrete structure of the vibration spectrum in absorption. It is necessary further to use a sufficient thickness for absorption. To obtain spectrograms capable of exhibiting the details clearly in a half-tone reproduction is largely a matter of photographic technique, and it cannot be said that the spectrograms published earlier in these *Proceedings* have been wholly satisfactory in this respect. The spectrograms and microphotometer records reproduced with this note are, it is hoped, somewhat better and they are intended to serve as demonstrations of the nature of the vibration spectrum of diamond.

Fig. 1 shows the emission spectrum of diamond reproduced as a negative together with a microphotometer record. The frequency shifts from the electronic emission at λ 4152 are also shown marked on the spectrogram

as well as on the microphotometer record. As shown in another paper appearing in these *Proceedings* (Ramanathan, 1947) there are eight distinct frequencies in the vibration spectrum. These are indicated against the microphotometer record. The two lowest, *viz.*, 752 cm.$^{-1}$ and 620 cm.$^{-1}$, are oscillations appearing in a region of frequency which is overlapped by the elastic vibration spectrum and is strongly perturbed thereby. They are therefore recorded as diffuse bands closely adjacent to each other. This is also evident in the absorption spectra reproduced as Figs. 2 and 3 in the plate. The absorption spectra have been photographed with an "intermediate" quartz spectrograph. An instrument of greater dispersion and resolution would probably have been more satisfactory. The microphotometric record in Fig. 2 (*b*) shows the two absorption lines at 1008 and 1088 cm.$^{-1}$ which appear much more clearly as emission lines in Fig. 1.

In conclusion the author is thankful to Sir C. V. Raman for his kind interest in the work.

Summary

Photographs of the emission and absorption spectra of blue-luminescent diamonds together with their microphotometric records are reproduced showing the discrete structure of the vibration spectrum.

References

1. Mani, Miss Anna .. *Proc. Ind. Acad. Sci.*, A, 1944, **19**, 231.
2. Nayar, P. G. N. .. *Ibid.*, 1942, **15**, 293.
3. Ramanathan, K. G. .. *Ibid.*, 1947, **26**, 481.

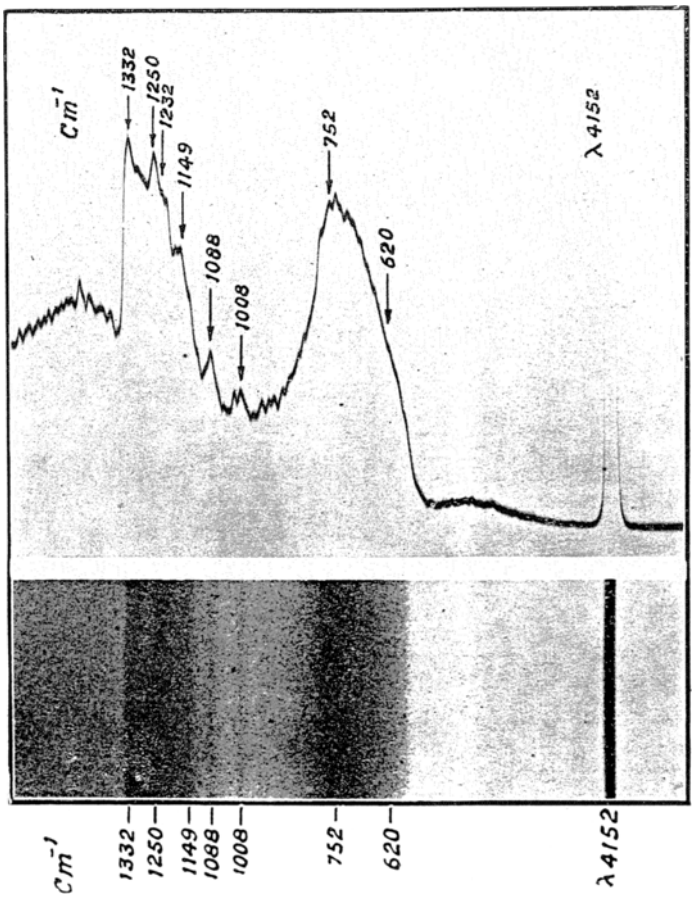

FIG. 1

The Emission Spectrum of Blue-Luminescent Diamond

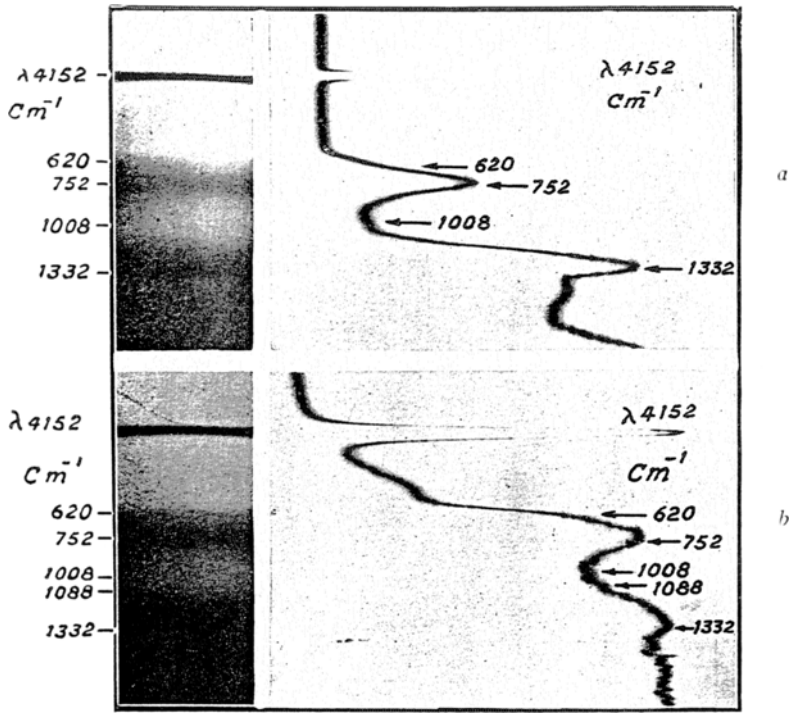

FIG. 2

The Absorption Spectrum of Blue-Luminescent Diamond

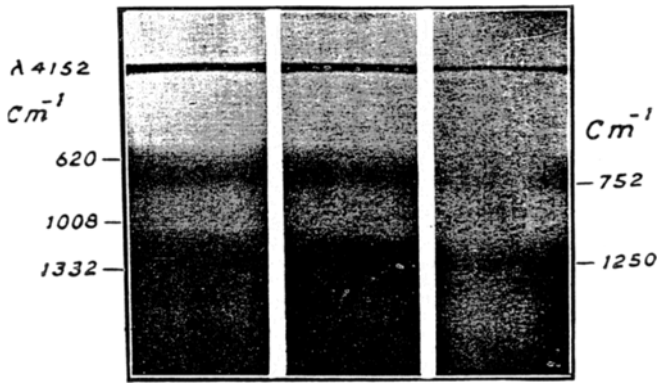

FIG. 3

The Absorption Spectrum of Blue-Luminescent Diamond