Fluorescence Cage in Diamonds:
Visual but Unusual observation in Treated Diamond

The "Fluorescence Cage" is a term for the observed enhanced fluorescence on the facet edges and junctions. It is a luminous network which was observed on the surface of diamond subjected to HPHT treatment. This fluorescence pattern is believed to be a result of HPHT-induced optical centres, high concentration of which remained on the facet edges after re-polishing. Fluorescence cage was captured only with the help of fluorescence microscope using 365nm UV excitation source.

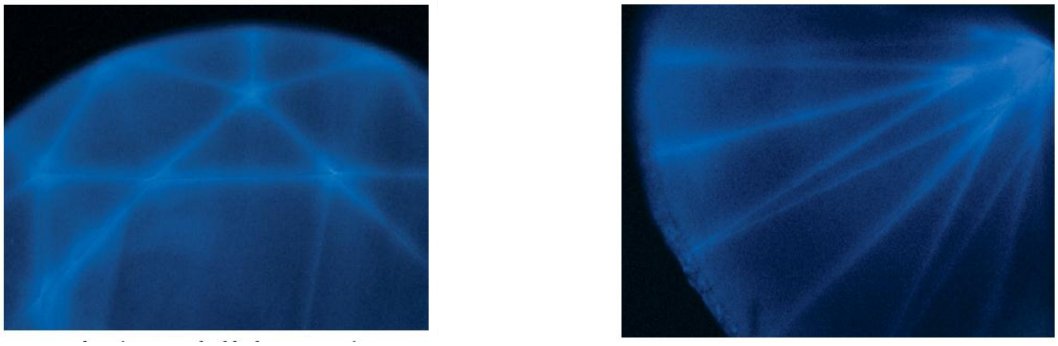

Fig. 1. "Fluorescence Cage" , A cage pattern of intense fluorescence on facet edges of Table and Pavillion of a HPHT-treated type I diamond (from ref.1)

The co-discoverer of the effect, Dr. Inga Dobrinets, EGL USA explained that "The visual observation of a fluorescence cage appears to be the most reliable feature used so far for the reporting of HPHT treatment. A significant advantage of the cage-based identification is its comprehensive fidelity and technical simplicity. While the 'cage effect' may not appear on all HPHT-treated stones, when it is evident, a conclusive identification can be made on that basis alone."

The stone under analysis was a Fancy brownish-orangy yellow coloured I1 clarity grade diamond. From IR observations, it was identified as a mixed type IaA/B+Ib. Further detailed photoluminescence studies showed dominant presence of nitrogen related NV^- centre peaks at 638 nm, 542 nm,564 nm and574nm. These centres are common for HPHT-treated natural diamonds with brown-to yellow-to-orange coloration. HPHT is one of the natural processes of diamond growth in the earth crust. Diamonds that are released from fiery, erupting volcanoes are not fully crystallized ("premature diamonds") and HPHT treatment in the labs will convert such diamonds to its fully "mature" state.

In fluorescence microscopy, the specimen is illuminated with preferably monochromatic light. Compared to source intensity, emitted fluorescence is weak as well of longer wavelength. For natural diamonds shorter wavelength light is used to produce characteristic fluorescence where as for those diamonds with colour centers, longer wave length source is better. In this case, 365 nm light is used for excitation. Source light, therefore, is optically separated from emitted fluorescence using spectral filters. This is a powerful technique to image a fluorescence emitting object like HPHT treated diamond. In this case, a weak, predominantly yellowish green fluorescence was observed.).

Studies on such HPHT Treated Type Ia diamonds, coloured or colourless, had shown the fluorescence cage, it was observed very faint in low-nitrogen near colourless type Ia HPHT-treated diamonds, and but not observed in the colourless type IIa HPHT treated diamonds. This fluorescence cage is formed by superposition of the H3 (green colour emission centre) and NV^-(orange colour emission centers) nitrogen related optical centers.

Reference:

1. Inga A. Dobrinets and Alexander M. Zaitsev, NOTES & NEW TECHNIQUES, GEMS & GEMOLOGY, Fall, (2009), pages 186-190.
2. https://www.caratsdirect2u.com/Articles.asp?ID=268
3. Diamond and Related Materials, 9(2000), Pages 113-122