A Treated Mixed-Type Synthetic Yellow Diamond

The Gem and Jewelry Institute of Thailand's Gem Testing Laboratory in Bangkok recently examined a 0.70 ct round brilliant (Figure 25) that was submitted to determine whether it was a natural or synthetic diamond and to establish the origin of its yellow colour. The sample was graded Fancy Vivid yellow with a clarity of VS_2. It fluoresced weak green to long-wave UV radiation and moderate green to short-wave UV. With magnification, clouds of pinpoint inclusions were seen under the table facet (Figure 26a) and a small fracture was present near a star facet. No strain was observed with cross-polarised filters. Examination with diffused illumination showed yellow colour zoning (Figure 26b). The DiamondView revealed the distinctive luminescence pattern of cubo-octahedral growth structures associated with high-pressure, high-temperature (HPHT) synthesis (Figure 27). The diamond was therefore identified as synthetic.

Figure 25: This 0.70 ct Fancy Vivid yellow round brilliant proved to be an HPHT-grown synthetic diamond that was apparently treated by low-pressure, high-temperature annealing. Photo by T. Sripoonjan.

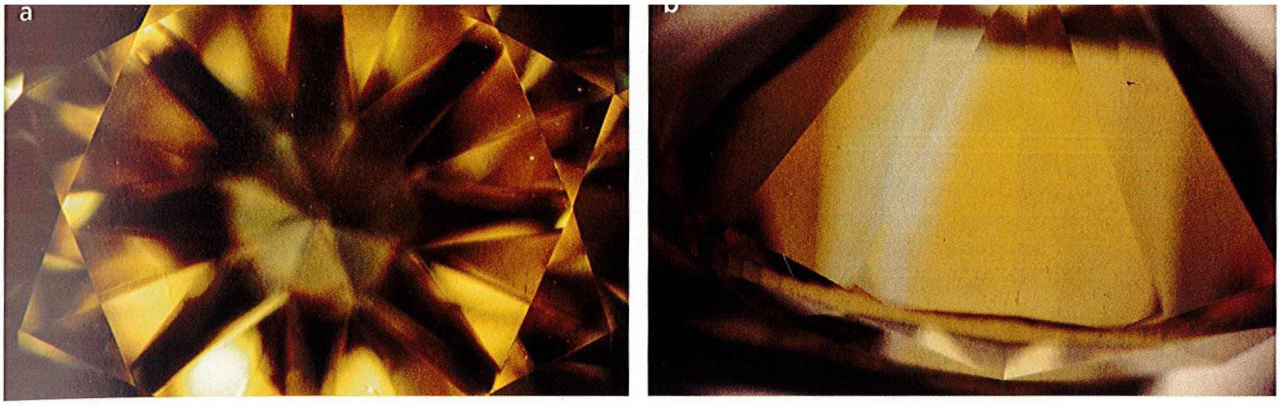

Figure 26: The 0.70 ct sample displays (**a**) clouds of pinpoint inclusions under the table facet and (**b**) yellow colour zoning through the pavilion with diffused illumination. Photomicrographs by M. Maneekrajangsaeng; magnified 50×.

The visible-range spectrum (Figure 28a) revealed features typically attributed to type Ib diamond, with strong absorption at wavelengths below 500 nm; such a pattern, which is due to isolated single nitrogen, has also been observed in as-grown synthetic diamond (Kazuchits et al., 2016). The photoluminescence spectrum (PL) acquired with 532 nm laser excitation at liquid-nitrogen temperature showed a dominant doublet at 692/694 nm, which has been reported in high-nitrogen synthetic diamonds grown in a Ni-containing environment and after annealing at temperatures above 1,700°C (Zaitsev, 2001, p. 189), thus confirming that this was an HPHT-grown synthetic yellow diamond.

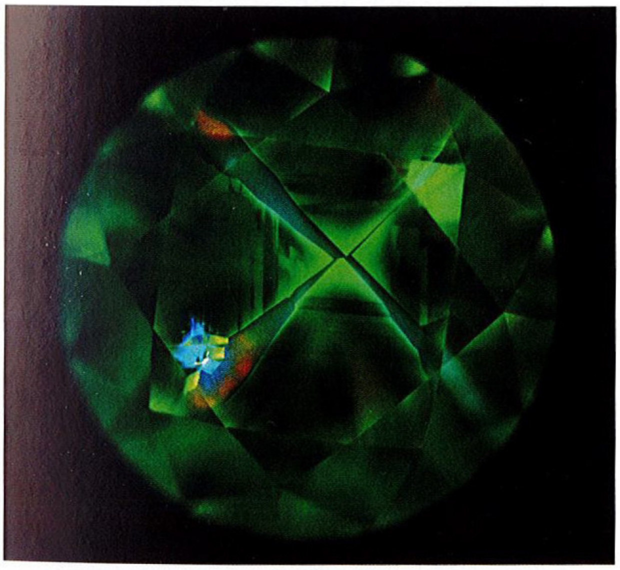

Figure 27: Seen with the DiamondView, a cubo-octahedral growth pattern is evident in the 0.70 ct synthetic diamond. Photo by M. Maneekrajangsaeng.

By contrast, the mid-IR spectrum of this synthetic diamond showed an unusual mixed type of dominant IaA (indicated by the band at 1282 cm^{-1}, due to two adjacent substitutional nitrogen atoms, N-N) and minor Ib (indicated by the bands at 1344 and 1130 cm^{-1}, due to single nitrogen), as seen in Figure 28b. Although such a mixed type is quite common among natural yellow diamonds, HPHT-grown yellow synthetic diamonds typically belong only to type Ib (Shigley et al., 1993).

Recent studies (e.g. Kazuchits et al., 2016; Kitawaki et al., 2017) suggested that the type IaA aggregation of nitrogen could occur during post-growth treatment of HPHT-grown synthetic diamond under a low-pressure, high-temperature (LPHT) annealing process. We infer that the present sample was initially synthesised as a type Ib yellow diamond by the HPHT process, and afterwards some isolated nitrogen was converted to N-N centres during LPHT treatment, as shown by the presence of the 1282 cm^{-1} band in the FTIR spectrum. This conclusion is also supported by the presence of the 692/694 nm doublet in the PL spectrum, which is known to be produced during annealing at temperatures above 1,700°C (Zaitsev, 2001).

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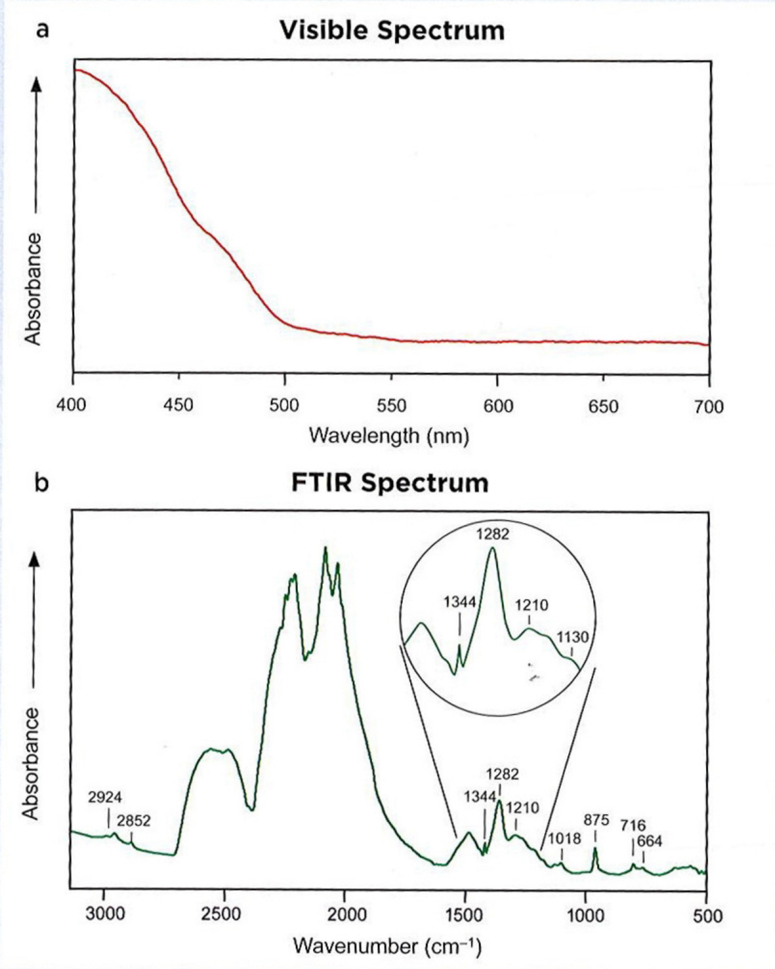

Figure 28: (**a**) The optical spectrum of the synthetic diamond reveals strong absorption at wavelengths below 500 nm. (**b**) The sample's FTIR spectrum shows features associated with mixed diamond types of IaA (1282 cm^{-1}) and Ib (1344 and 1130 cm^{-1}), which is quite unusual for synthetic diamond.

References

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ERRATUM

Petroleum Inclusion in Pink Spinel

In the Gem Notes section of Vol. 35, No. 1, 2016 (pp. 20–21), we described the presence of petroleum in a negative crystal inclusion in a pink spinel. At that time, we were told that this spinel was reportedly of Sri Lankan origin. Upon further inquiry with the original supplier, it has been established that this spinel was of Burmese origin. We thank Richard Hughes for bringing this to our attention.

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