Treated Fancy Red Diamond

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Natural-color red diamonds are among the rarest and most prized of gemstones and command some of the highest per-carat prices in the market. The Hancock Red, a 0.95 ct, Fancy purplish red round brilliant diamond, sold at auction in 1987 for over $926,000 per carat, setting a new record at the time (King et al., 1994, 2002). In 2007 at Christie's Geneva, a ring set with a 2.26 ct purplish red diamond sold for $2.6 million (about $1.15 million per carat). Other famous natural red diamonds include the 5.11 ct Moussaieff Red, the largest cut red diamond in the world, and the Rob Red (0.59 ct), "the most saturated and purest red diamond," according to Stephen Hofer, author of *Collecting and Classifying Fancy Color Diamonds*. These famous diamonds exemplify how rare and desirable a natural red color has become in the diamond trade. The value associated with this color has led to many attempts to reproduce it through treatment. Usually, however, treated red diamonds have purplish or brownish color components that are different from the purer hues of natural red diamonds (Wang et al., 2005).

Recently, GIA graded a 2.14 ct oval cut diamond (figure 1) as Fancy red and determined that it had undergone color treatment. It displayed ruby-like color and an even cut. The red color was produced through a combination of high-pressure, high-temperature (HPHT) treatment and irradiation plus annealing. Infrared absorption spectroscopy indicated that the diamond contained both aggregated nitrogen (type IaB) and a very small concentration of isolated nitrogen impurities (created during the HPHT process), as well as a small amount of hydrogen impurity. An absorption peak at 1450 cm^{-1} (H1a) is a result of the irradiation plus annealing treatment (figure 2). Visible absorption spectra indicate very strong nitrogen-vacancy (NV) centers at 575 nm and 637 nm that combine with the 595 nm center to absorb most wavelengths from the blue portion of the visible spectrum up to ~ 640 nm, producing a strong red color (figure 3). All of these defects were produced by the irradiation and annealing stages of treatment. There were several other absorption peaks that we had never seen or reported in natural diamonds. These included peaks at 724, 726, 733.2 and 737.9 nm (figure 3).

This rare treated-color red diamond with a pure hue is the result of several carefully controlled factors, including appropriate concentrations of nitrogen impurities in the starting diamond material and the introduction of precise concentrations of NV^0 and NV^- centers during treatment. This stone indicates that with careful control of treatment conditions and the proper starting material, a diamond with red color rivaling most natural red diamonds can be achieved.

Johnson P. and Breeding C. M. (2009) Treated Fancy red diamond. June 12, 2009. *News from Research,* http://www.gia.edu/research-resources/news-from-research/

Figure 1. This 2.14 ct “Fancy red” oval-cut diamond was produced through a multi-step treatment process.

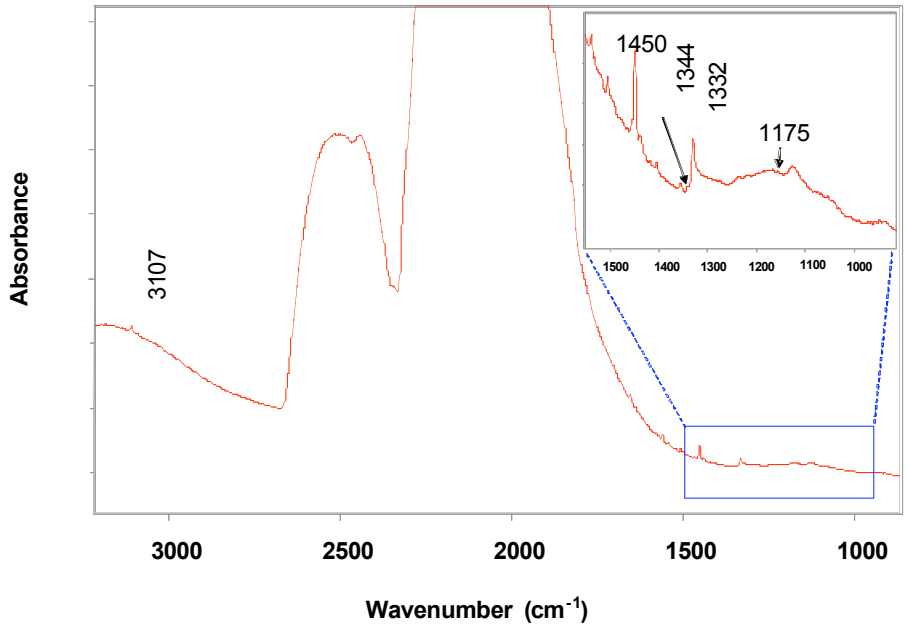

Figure 2. The mid-infrared absorption spectrum showed a type IaB diamond with very low total nitrogen content, including a very small concentration of isolated type Ib nitrogen impurities.

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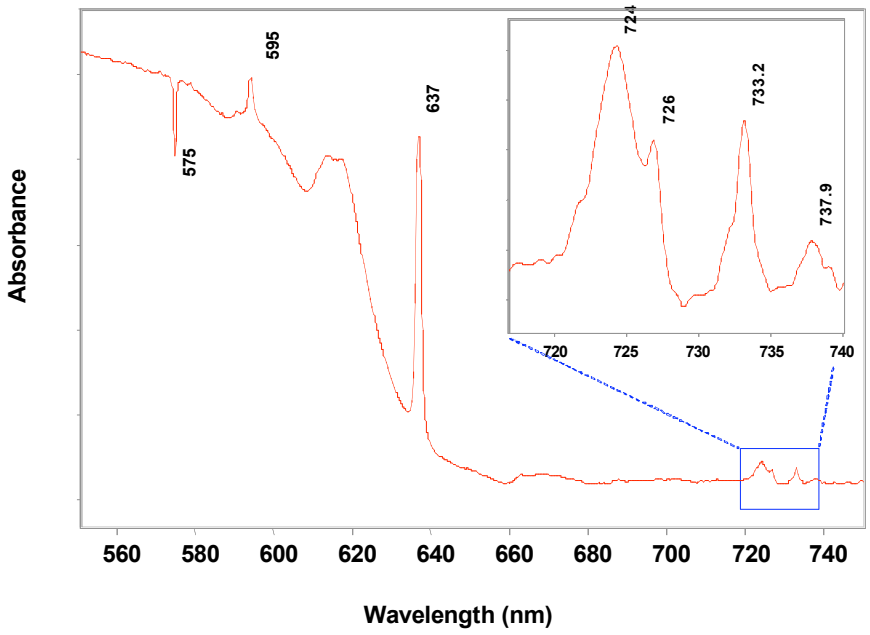

Figure 3. The UV-Visible-NIR absorption spectrum shows a very strong 637 nm (NV^-) center as well as accompanying 575 (NV^0) and 595 nm centers that contribute to strong absorptions from <400 to ~640 nm and the resulting red diamond color. In addition to the 575, 637, and 595 nm peaks, previously undocumented absorptions at 724, 726, 733.2, and 737.9 nm were observed. The apparent negatively shaped appearance of the 575 (NV^0) center in the spectrum is a product of the CCD spectrometer. .

References

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