

## EDITORS

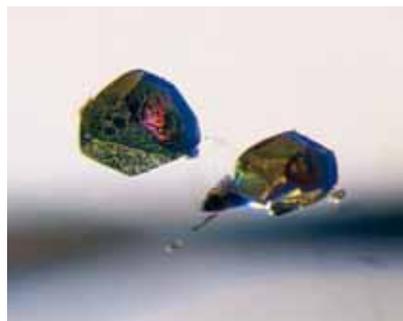
Thomas M. Moses and  
Shane F. McClure  
GIA Laboratory

### DIAMOND With Bimineralic Inclusions

In the GIA Laboratory, diamond graders and staff gemologists examine thousands of diamonds each year to determine their grade, possible treatments, and their natural or synthetic origin. During this process, they often encounter mineral inclusions, the colors of which can cover the entire visible-light spectrum from violet to red as well as near colorless, with diaphaneity ranging from transparent to completely opaque.

Occasionally, these mineral inclusions may warrant further study. When they are close enough to the host dia-

*Figure 1. A hint of underlying red color can be seen emanating from the largest of these otherwise opaque-looking inclusions. The visual appearance suggests an opaque sulfide coating over transparent color-change garnet. Magnified 25 $\times$ .*



mond's surface to be fully identified (for instance, by Raman microanalysis), the results may be surprising, as was the case with the blue sapphire inclusions we reported on recently (Summer 2006 Lab Notes, pp. 165–166). More often, though, interesting solid inclusions are too deep inside their host to be conclusively “identified” by other than visual means.

This was the situation we encountered with the two crystals shown in figure 1, which were observed in a light yellow 1.20 ct round brilliant-cut diamond. These inclusions were interesting because at first they appeared to be opaque, displaying a brassy metallic luster in reflected light as if they were sulfides such as pyrite or pyrrotite, both of which are known inclusions in diamond. Closer examination, however, revealed that the interiors of these inclusions were actually deep purplish red when viewed with incandescent light, and that the color shifted toward blue-green in fluorescent light. Using polarized light, and examining the crystals from several different viewing angles, we did not detect pleochroism in either inclusion, which suggests that they were optically isotropic.

The interior color of the inclusions was well masked by the sulfide-like coatings. Only a few gaps in the coatings allowed the bodycolor of the inclusions to be observed from certain viewing directions (again, see figure 1). As a result of this microscopic examination, we concluded that these inclusions were likely color-change garnets that were coated by an overgrowth of a sulfide or

sulfides at some point before they were completely sealed in the diamond.

While we have encountered change-of-color garnets in diamonds on rare occasions (see, e.g., Fall 1982 Lab Notes, p. 169; Winter 1989 Lab Notes, pp. 237–238), and have often observed sulfides as crusts (sometimes mixed with graphite) filling cracks around inclusions, this is the first time we have noticed what appeared to be opaque sulfides as thin coatings on otherwise transparent inclusions. Similar inclusions may have been overlooked in the past as more common sulfides, but we will now watch for them during future examinations.

*John I. Koivula and Laura Dale*

### HPHT-Treated Type Ia Diamond With a Green Component Caused by the H2 Defect

High-pressure, high temperature (HPHT) treated type Ia diamonds are often yellow with a secondary green hue of varying saturation, which primarily results from fluorescence caused by

*Editors' note: All items are written by staff members of the GIA Laboratory, East Coast (New York City) and West Coast (Carlsbad, California).*

GEMS & GEMOLOGY, Vol. 43, No. 2, pp. 153–161  
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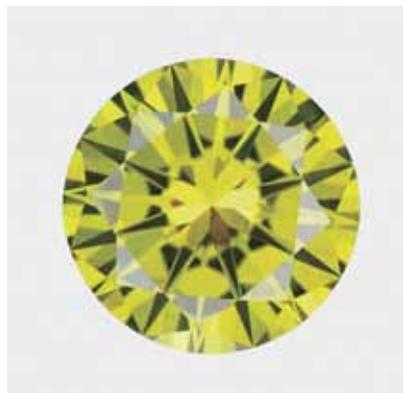


Figure 2. The strong green color component of this 5.82 ct Fancy Deep green-yellow HPHT-treated diamond is unusual due to a high concentration of H2 defects.

the H3 defect (503.2 nm; see, e.g., I. Reinitz et al., "Identification of HPHT-treated yellow to green diamonds," Summer 2000 *Gems & Gemology*, pp. 128–137). While the H2 defect (zero-phonon line at 986.3 nm) is also very common in HPHT-treated type Ia diamonds, its contribution to bodycolor, if any, is usually quite limited. However, in the East Coast laboratory, we recently examined an unusual diamond in which H2 absorption was the primary cause of the green color.

This known-HPHT-treated round-cut 5.82 ct diamond was color graded Fancy Deep green-yellow (figure 2). The color was evenly distributed except for an area of very weak brown that followed internal graining. Very small cloud-like features were seen at the center of the diamond, but it was otherwise free of inclusions. When exposed to long-wave ultraviolet (UV) radiation, it displayed a moderately strong greenish yellow fluorescence; to short-wave UV, it fluoresced a very weak greenish yellow. No phosphorescence was observed. In the DiamondView, moderate blue and greenish yellow fluorescent growth zones were seen, in addition to several nearly inert regions with a triangle shape (figure 3); these latter features are rarely observed on polished facets of untreated natural diamonds.

Infrared absorption spectra showed

that this diamond contained a high concentration of nitrogen as type Ia with a very low hydrogen content. In addition to a strong H2 absorption, the near-infrared spectra also revealed some unusual features in the 6500–4400  $\text{cm}^{-1}$  region (6456.5, 5765.0, 5395.2, 4931.2, and 4397.8  $\text{cm}^{-1}$ ; figure 4). The assignment of these absorptions is unknown, and to the best of the authors' knowledge they have not been previously reported. The UV-Vis-NIR spectrum also showed very strong N3, H3, and H2 absorptions (figure 5); very weak absorptions were observed at 536.1 and 575.9 nm. The side band of the H2 defect extended out to ~600 nm and efficiently blocked red and orange light. As a result, a transmission window in the 504–600 nm region was created, leading to the apparent green-yellow bodycolor.

Despite the high concentration of H3 defects in this diamond, only weak green luminescence to visible light was observed, which could not entirely explain the strong green component. In addition, the green color was more saturated and clearly darker than that of typical HPHT-treated green-

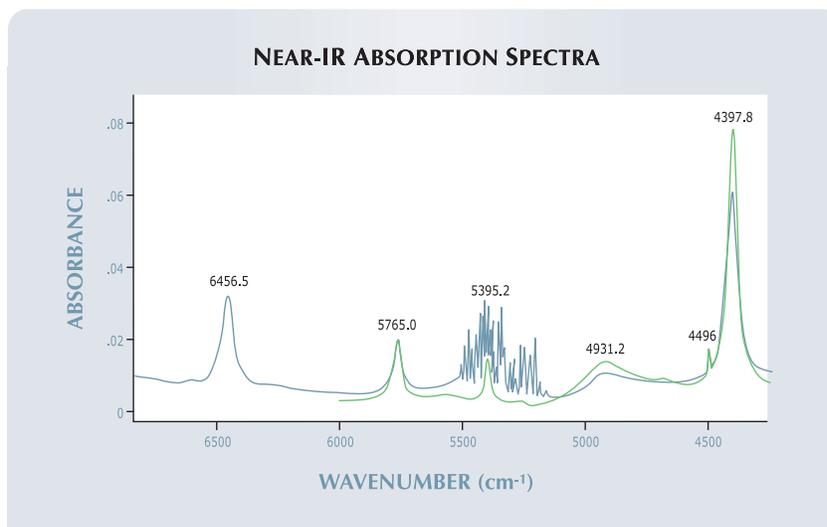


Figure 3. The nearly inert "trigons" in the blue fluorescing regions of this DiamondView image are rarely observed on polished facets of untreated natural diamonds.

yellow diamonds. All these observations strongly indicated that the H2 defect, along with more common defects, caused the attractive green-yellow hue of this rare diamond.

Wuyi Wang and Matthew Hall

Figure 4. The near-infrared absorption spectra of this diamond revealed some unusual features in the 6500–4350  $\text{cm}^{-1}$  region. Assignment of these absorptions is unclear, and they have not been reported in other natural or treated diamonds, except for the sharp peak at 4496  $\text{cm}^{-1}$  due to hydrogen. The two spectra were collected using different sources with different sensitivities.



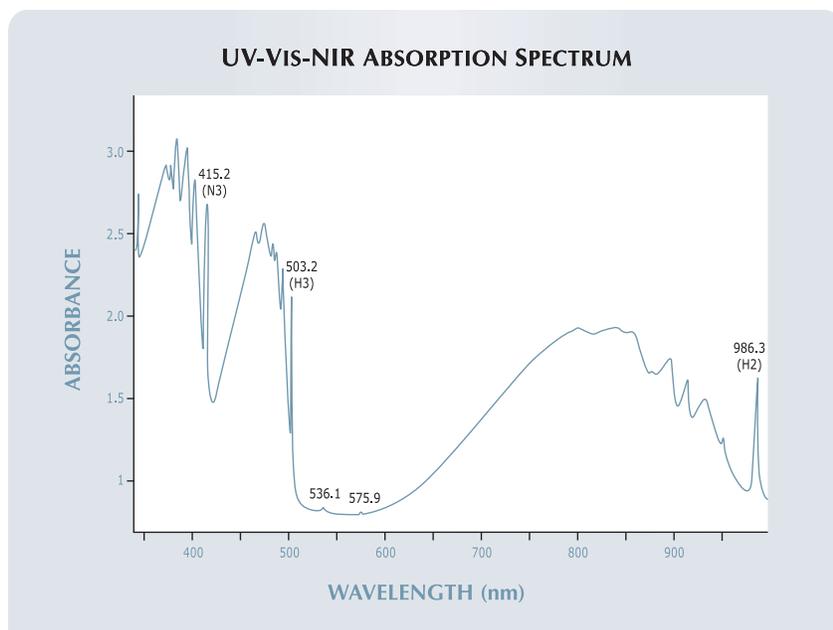


Figure 5. The UV-Vis-NIR absorption spectrum showed very strong absorptions of N3, H3, and H2 centers. The side band of the H2 defect extended well into the visible region, which induced the strong green color component.

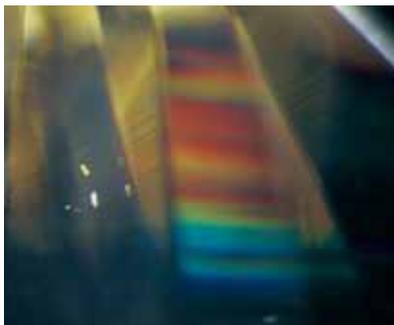
### Diamond with Intense “Rainbow Graining”

Gemologists who grade diamonds are familiar with internal graining and how, in certain manifestations under current diamond grading standards, it can negatively impact the clarity grade of a diamond (see, e.g., J. M. King et al., “The impact of internal whitish and reflective graining on the clarity grading of D-to-Z color diamonds at the GIA Laboratory,” Winter 2006 *Gems & Gemology*, pp. 206–220). One type of internal graining referred to as *phantom* or *colorless graining* is typically just that, colorless and sometimes relatively difficult to see, though it is also the most common. Within this category, however, there is a most unusual type of phantom graining that is both very colorful and extremely rare. On the infrequent occasions that it has been reported, it has been referred to as *rainbow graining* (see, e.g., J. I. Koivula, *The Microworld of Diamonds*, Gemworld International, Northbrook, IL, 2000, p. 94; J. M. King et al.,

“Characterization and grading of natural-color yellow diamonds,” Summer 2005 *Gems & Gemology*, pp. 88–115, and figure 15 therein).

Phantom or colorless internal graining bands are actually contact zones or layers between competing growth planes in the diamond’s crystal structure; these cause a slight-to-heavy

Figure 6. This is the most intense display of “rainbow graining” in a diamond that we have encountered in the GIA Laboratory. Field of view approximately 2.1 mm.



distortion of the surrounding crystal lattice, making the grain area visible. It is also well known that diamonds often undergo plastic deformation, particularly in the {111} octahedral planes, which may result in numerous parallel internal phantom grain lines.

If the layers of phantom graining are sufficiently fine and numerous, then rainbow graining may be observed. However, in addition to possibly being the rarest form of internal graining, rainbow graining is also one of the most elusive and easily overlooked, in that it is highly directional and can thus be viewed only in specific directions in its host. In most directions, it looks like common colorless phantom graining, but a slight tilt of the diamond causes the grain layers to act as a diffraction grating, resulting in a spectral display of colors. This optical effect is essentially the same as that shown by iris agates and some transparent natural glasses that exhibit very fine growth layers (see also T. Hainschwang and F. Notari, “The cause of iridescence in “rainbow” andradite from Nara, Japan,” Winter 2006 *Gems & Gemology*, pp. 222–235, for a general discussion of this effect in gem materials).

Recently, while investigating the color origin of a light yellow round brilliant-cut diamond of over a carat in weight, we encountered the strongest and most vivid display of rainbow graining that we have ever seen (figure 6). It was fortunate that there were also a few small mineral inclusions to focus on while taking this photomicrograph, because rainbow graining does not have any specific focal point; as a result, photos of this type of graining can appear as if the entire image is out of focus.

John I. Koivula and Alethea Inns

### Natural Color Hydrogen-Rich Blue-Gray Diamond

Prior to the 1990s, virtually all natural-color blue diamonds were thought to be type IIb and electrically conductive. Since then, the lab has seen, on rare occasions, nonconductive type Ia gray-

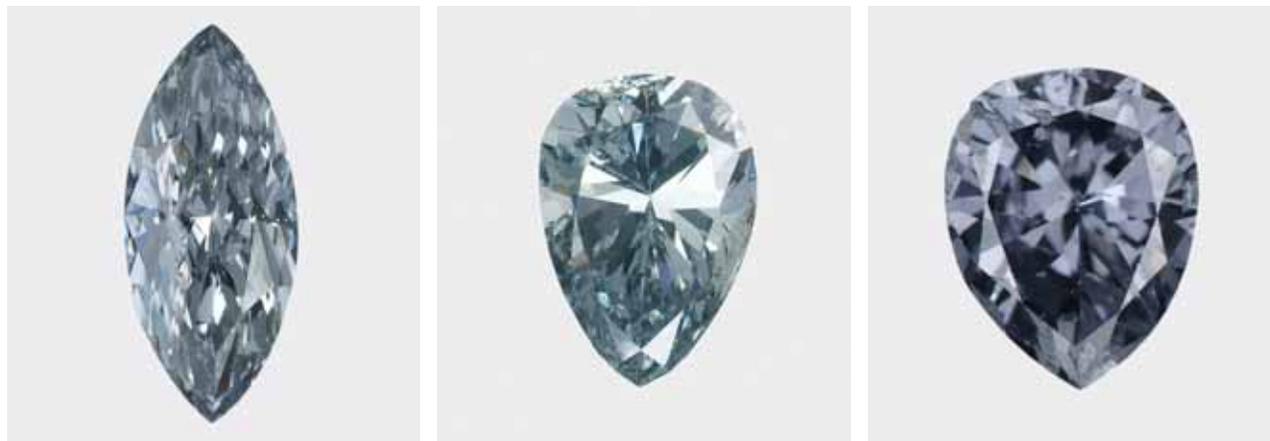


Figure 7. In GIA's color grading system, the 0.24 ct type Ia pear-shaped diamond in the center is described with the same terminology (blue-gray) as the 0.63 ct marquise on the left, but—because it falls at the extreme opposite end of that color range—it has a different appearance. The 0.18 ct pear shape on the right is also a type Ia diamond, but its violet-gray color is more typical of that seen in diamonds with a color related to hydrogen defects.

to-blue diamonds that owe their color to the presence of hydrogen-related defects (see E. Fritsch and K. Scarratt, "Natural-color nonconductive gray-to-blue diamonds," Spring 1992 *Gems & Gemology*, pp. 35–42).

Recently, the East Coast laboratory had an opportunity to examine a nonconductive blue-gray diamond that had other unusual characteristics. The 0.24 ct pear brilliant cut was color graded Fancy blue-gray (figure 7, center). When examined with magnification, it showed a number of moderately sized indented naturals and some feathers breaking the surface. At high magnification using a fiber-optic light, we also saw very fine clouds. The color appeared evenly distributed—unlike type IIb blue diamonds, which commonly show color zoning. Very weak strain, which looked to be associated with some of the surface-reaching inclusions, was visible when the stone was examined with crossed polarizers.

The diamond fluoresced a moderate blue to long-wave UV radiation and a moderate yellow to short-wave UV. In the desk-model spectroscope, absorption bands were present at 415 (N3), 425, and a broad band centered at 550 nm. These features confirmed that the diamond was type Ia. With FTIR

spectroscopy, the diamond showed sharp hydrogen peaks at 4703, 4168, 3236, 3235, 3107, 2811, 2785, 1547, and 1498  $\text{cm}^{-1}$  (again, see Fritsch and Scarratt, 1992). The UV-Vis spectrum showed a similar absorption as that seen in the desk-model spectroscope, with the addition of an increase in absorption from about 600 nm toward the infrared region, which can be associated with hydrogen-rich diamonds (see K. Iakoubovskii and G. J. Adriaenssens, "Optical characterization of natural Argyle diamonds," *Diamond and Related Materials*, Vol. 11, No. 1, 2002, pp. 125–131; E. Fritsch et al., "Thermochromic and photochromic behaviour of 'chameleon' diamonds," *Diamond and Related Materials*, Vol. 16, No. 2, 2007, pp. 401–408).

What was so unusual about this diamond was its color appearance, which was closer to the green side of the blue hue range rather than the more typical appearance closer to the violet boundary. This suggests that these nitrogen- and hydrogen-related defects can give rise to colors other than gray-to-blue or violet.

It is important to note that the color differences described here are quite subtle even when observed with standard color-grading conditions. In the GIA system for color grading col-

ored diamonds, fewer terms are used as the color becomes darker in tone and/or weaker in saturation because the human eye makes fewer distinctions (see J. M. King et al., "Color grading of colored diamonds in the GIA Gem Trade Laboratory," Winter 1994 *Gems & Gemology*, pp. 220–242, figure 23). Therefore, even though this diamond was slightly greener in hue, it was still described as *blue-gray* due to its location in color space. While the subtle color difference noted between this diamond and type IIb blue-gray diamonds under controlled conditions is not considered noticeable enough to warrant a change in terminology, it is sufficient to represent a rare appearance for this color description (see, e.g., J. M. King et al., "Characterizing natural-color type IIb blue diamonds" Winter 1998 *Gems & Gemology*, pp. 246–268).

Jason Darley and John M. King

### Type IIa Diamond with Intense Green Color Introduced by Ni-Related Defects

Nickel-related defects are common in HPHT-grown synthetic diamonds. They have also been documented in some natural diamonds, though they

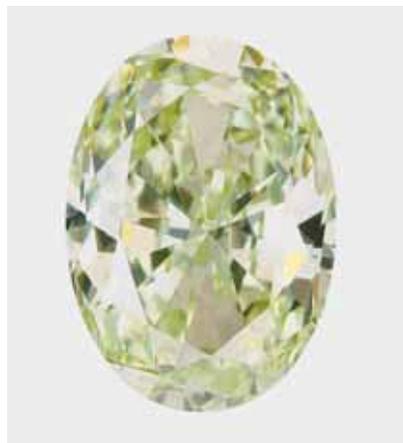


Figure 8. This oval-cut 2.81 ct Fancy Intense yellowish green diamond is colored mainly by Ni-related defects.

are rarely the main contributor to bodycolor in these stones or their function is not clear. However, the East Coast laboratory recently char-

Figure 9. The diamond in figure 8 showed moderately strong green fluorescence in the DiamondView, with narrow dark green bands and a few blue ones. These features ruled out a synthetic origin.

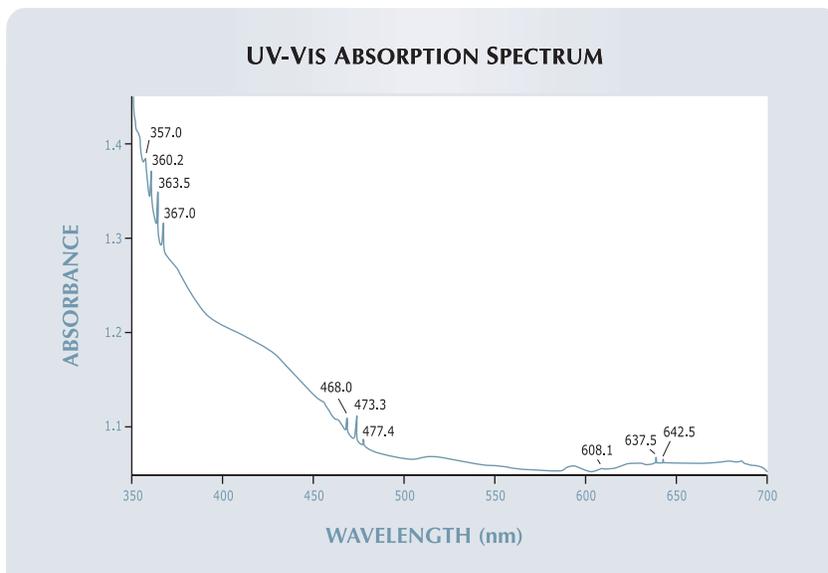


acterized an intensely colored natural yellowish green diamond that proved to be colored by Ni-related defects.

This oval-cut 2.81 ct diamond was color graded Fancy Intense yellowish green (figure 8). Color distribution was even, and the few small pinpoints noted resulted in a clarity grade of VS<sub>1</sub>. A small natural with typical etching features was present near the girdle. The diamond displayed strong yellow fluorescence to long-wave UV radiation and very strong greenish yellow fluorescence to short-wave UV, with no phosphorescence seen at these wavelengths. When examined with the DiamondView, the stone showed moderately strong green fluorescence with narrow dark green bands and a few blue ones (figure 9); a weak yellow phosphorescence was also observed. The evenly distributed fluorescence features and the absence of a typical HPHT-synthetic growth pattern ruled out a synthetic origin for this diamond.

The infrared spectrum did not show any absorption in the one-phonon region, nor any boron-related absorption, and established the stone as a type IIa. Only very weak absorptions at 3107 and 1405 cm<sup>-1</sup> due to hydrogen and a weak peak at 1332 cm<sup>-1</sup> (very likely from N<sup>+</sup>) were observed. The UV-Vis spectrum showed weak but distinct absorptions at 350–370 nm, 460–480 nm, and 600–650 nm (figure 10). All these sharp absorptions, except for the 608.1 and 637.5 nm peaks, are known to originate from Ni-related defects (see, e.g., S. C. Lawson and H. Kanda, "An annealing study of nickel point defects in high-pressure synthetic diamond," *Journal of Applied Physics*, Vol. 73, 1993, pp. 3967–3973). The spectrum also had broad absorption bands with maxima at approximately 310, 520, and 688 nm. The 688 nm band extended to ~600 nm, and limited the transmission of red and orange light. Because of all these selective

Figure 10. Ni-related defects with absorptions at 350–370 nm, 460–480 nm, and 642.5 nm, together with the broad band around 688 nm and additional peaks at 608.1 and 637.5 nm, created a transmission window in the 540–550 nm region, which resulted in the yellowish green bodycolor. The 688 nm band is associated with the 1.40 eV center (zero-phonon line at 883.1 and 884.8 nm), which occurred as predominant emissions in the PL spectra (figure 11).



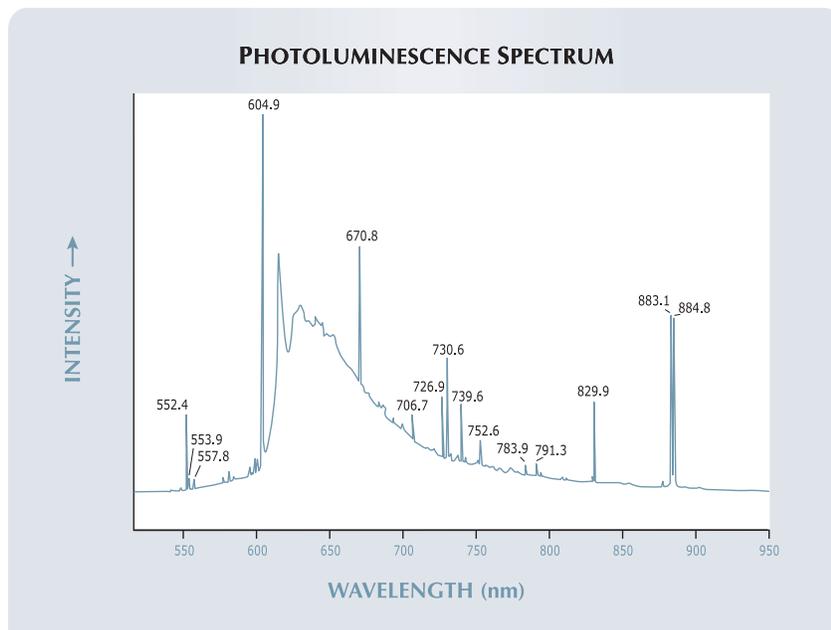


Figure 11. The PL spectra confirm the extremely strong emissions from Ni-related defects (e.g., the 883.1/884.8 nm pair). However, most of these sharp emission peaks remain unclear in assignment.

absorptions, a transparent “window” centered around 540–550 nm is created, leading to the yellowish green body-color. The 688 nm band is associated with the 1.40 eV center (zero-phonon line at 883.1 and 884.8 nm; again, see Lawson and Kanda, 1993), which occurs as predominant emissions in photoluminescence (PL) spectra collected with various laser excitations (e.g., figure 11, spectrum collected using 514 nm laser excitation). Other strong emission peaks were recorded, most of which remain unclear in assignment. In contrast, some common emissions in natural diamonds (e.g., H3, H4, N-V centers) are absent.

Green in natural diamonds can be introduced by a number of known defects or defect combinations. Selective absorptions from the GRI and some hydrogen-related defects, along with fluorescence of the H3 defect, are considered the main causes. Ni-related defects have long been recognized as color contributors in HPHT synthetic diamonds, depending on the concentration of isolated nitrogen, but they have not been reported as a

major color contributor in natural diamond. The absence of these previously mentioned defects and the almost exclusive occurrence of Ni-related defects (in particular the 1.40 eV center) strongly indicate that the intense green hue of this diamond is caused by Ni-related defects. The size, high clarity, and attractive Ni-related intense green color of this diamond make it very unusual.

This rare diamond reveals another cause of green color in naturally colored diamonds. The 1.40 eV center—which is caused by the interstitial charged ion Ni<sup>+</sup>—has been documented in chameleon diamonds (see, e.g., J. E. Shigley et al., “Photoluminescence features of chameleon diamonds,” *Proceedings of the 55th De Beers Diamond Conference*, Coventry, UK, 2004, pp. 4.1–4.2; T. Hainschwang et al., “A gemological study of a collection of chameleon diamonds,” *Spring 2005 Gems & Gemology*, pp. 20–35), as have other Ni-related defects (e.g., the 1.563 eV center with a zero-phonon line at 793.5 nm).

Wuyi Wang and Tom Moses

## Diamond with Zigzag Cleavage

In addition to its superior scratch and indentation hardness, the other physical property for which diamond is best known is its four directions of perfect {111} octahedral cleavage. This property has been used to help pre-shape diamond rough through the process of cleaving for as long as diamonds have been fashioned as gems. In a gem diamond, however, a cleavage is also the single most damaging internal feature or clarity characteristic that a stone can possess. Sometimes referred to as a “feather,” a prominent cleavage can significantly affect the structural integrity of its host diamond, particularly if it is exposed to the surface where it can absorb water and other unwanted matter that might alter its visibility. That is where glass filling is particularly useful, because it seals surface-reaching cleavage cracks, preventing the introduction of unwanted and unsightly debris, at the same time that it reduces the apparent visibility of those cracks.

During the course of testing to determine the color origin of a round brilliant-cut diamond, we recently encountered a relatively shallow surface-exposed cleavage system that had a most unusual elongated zigzag pattern, much like a zipper. This system extended into the crown and table of its host and, as shown in figure 12, appeared to result from a combination of at least two directions of cleavage. To the best of our knowledge, this is the first time such a well-developed pattern has been encountered in the GIA Laboratory.

Its presence and clear presentation as a cleavage pattern also make it the ideal subject to once again point out that in the fields of crystallography, gemology, and mineralogy there is a distinct and definable difference between *cleavage* and *fracture*. Essentially, a fracture is a break in a mineral *other* than along a cleavage plane. In fact, very few single-crystal gem-quality diamonds ever actually fracture. Diamond is very tough, and



Figure 12. Extending from the edge of the crown into the table facet of this diamond, this most unusual 3.2-mm-long zigzag crack shows at least two directions of the diamond's perfect cleavage.

when it breaks, it almost always breaks along a cleavage plane or a combination of two or more of its four cleavage directions.

John I. Koivula and  
Cheryl Y. Wentzell

### HPHT-Grown SYNTHETIC DIAMOND Crystal with Unusual Morphology and Negative Trigons

Recently, the East Coast laboratory examined a 1.56 ct highly saturated red crystal ( $7.25 \times 5.75 \times 3.42$  mm; figure 13). Gemological and spectroscopic characterization identified it as an HPHT-grown synthetic diamond that apparently was artificially irradiated and annealed. In the past, we have had the opportunity to document similarly color-treated pink to purplish pink synthetic crystals and red synthetic faceted diamonds (T. M. Moses et al., "Two treated-color synthetic red diamonds

seen in the trade," Fall 1993 *Gems & Gemology*, pp. 182–190). However, this specimen differed from samples we had previously seen.

Consistent with other HPHT-grown synthetic diamonds, features such as subtle growth sector-related color zoning and remnants of the seed crystal were apparent when the sample was examined with a gemological microscope. The sample fluoresced bright orange in the DiamondView, and a cross-shaped green fluorescence pattern was observed through the {111} faces. The green pattern suggested the possibility of a higher concentration of H3 centers in this area, while the strong orange color is most likely a result of high concentrations of N-V centers.

Many HPHT-grown synthetic diamond crystals have a distinctive cuboctahedral morphology (J. E. Shigley et al., "Lab-grown colored diamonds from Chatham Created Gems," Summer 2004 *Gems & Gemology*, pp. 128–145), typically with both cubic {100} and octahedral {111} faces having equivalent surface area. In contrast (but similar to natural diamond), this synthetic specimen had well-developed octahedral growth but virtually no cubic faces. The highly developed {111} faces suggest that it may have been grown at higher temperatures than most HPHT-grown synthetics, possibly in excess of  $\sim 1800^\circ\text{C}$  (I. Sunagawa, "Morphology of natural and synthetic diamond crystals," in I. Sunagawa, Ed., *Materials Science of the Earth's Interior*, Terra Scientific Publishing Co., Tokyo, 1984, pp. 303–330).

In addition, indented triangular etch regions were present on almost every octahedral surface. Triangular features have been reported on synthetic diamonds in the past (see, e.g., J. E. Shigley et al., "Gemological properties of near-colorless synthetic diamonds," Spring 1997 *Gems & Gemology*, pp. 42–53); however, in those cases, they protruded from the surface, creating small pyramids. On this synthetic diamond, the triangular etch marks were negative (i.e., indented), very similar to trigons observed on natural diamonds.



Figure 13. This deeply saturated 1.56 ct red synthetic diamond crystal displays well-developed octahedral faces and the presence of negative trigons. Magnified 15 $\times$ .

Thus, it appears that the occurrence of negative trigons may not always be a useful criterion for the separation of natural from HPHT-grown synthetic diamonds.

Also with magnification, we observed a few metallic flux particles and graphitized inclusions, both of which are characteristic of HPHT-grown synthetics. A large graphitized fracture was seen breaking the surface on both sides, and both ends of the crystal were heavily etched and pitted, with some deeply pitted areas filled with graphitized material.

The red color of this synthetic diamond was more highly saturated than other color-treated red synthetic diamond crystals submitted to the laboratory, which were more pink. The infrared spectrum showed mostly type Ib nitrogen with some type IaA aggregates, which is consistent with a relatively high growth temperature. The overall nitrogen concentration from the IR absorption spectrum was calculated to be  $\sim 100$  ppm. This absorption in general is higher than that of other pink HPHT-grown synthetic diamonds we have examined (again, see Shigley et al., 2004). Obvious H1a ( $1450\text{ cm}^{-1}$ ) and H1b ( $4935\text{ cm}^{-1}$ ), as well as H2 (986.3 nm), absorptions indicate that this synthetic diamond underwent irradiation and annealing.

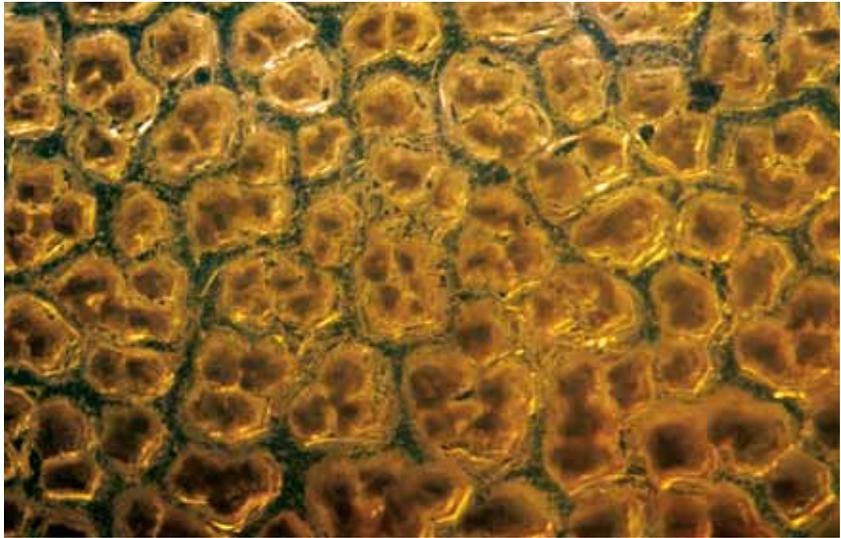
Matthew Hall and Jason Darley

## Idocrase in JADEITE: A Heavenly Home

The GIA Laboratory sees a wide variety of jade items for identification. These examinations are usually routine and generally do not offer any surprises. A recent exception was provided by a mottled translucent green-and-white bangle bracelet. The gemological identification as jadeite and the determination that it had not been treated were both straightforward. The surprise came during the microscopic examination, when we were searching for possible dye concentrations in any surface-reaching cracks.

While no dye was observed in the bangle, this inspection did reveal the presence of several small euhedral-to-subhedral translucent white to light brown modified prismatic inclusions (figure 14) that appeared to have crystallized in the tetragonal system. While it is often very difficult to identify inclusions that are completely enclosed in a massive material such as jade, several were exposed on the bracelet's surface, so they made convenient targets for Raman microanalysis. This conclusively identified

*Figure 14. During an otherwise routine gem identification, it was a pleasant surprise to find these relatively well-formed translucent crystals of idocrase included in a jadeite bangle bracelet. Field of view is 5.2 mm.*



*Figure 15. This unusual pattern appears to have been generated when opal was deposited over a surface covered with numerous more-or-less evenly spaced microcrystals of quartz. Field of view is 4.2 mm.*

one inclusion as idocrase, a tetragonal mineral known to mineralogists as vesuvianite.

Since jadeite and idocrase are both minerals formed through metamorphism, and since they have common mineral associations as well, it is not completely surprising to find inclu-

sions of idocrase in jadeite. However, this is the first time we have encountered such idocrase inclusions, and mineralogical texts do not list jadeite and idocrase as mineral associates. This discovery adds a bit of new information to the gemological literature and increases our knowledge of gem-quality jadeite jade.

With its long-standing popularity as a gemstone and carving material, and in view of its rich history, jade is often referred to as the "stone of heaven." Now we know it is also a home to idocrase.

*John I. Koivula, Mike Breeding,  
and Eric Fritz*

## OPAL with Unusual Structure

Opal is one of the most fascinating of the phenomenal gems. Not only is it well known for its myriad play-of-color patterns, but it is also prized as a fossilizing agent and preservative of the structural features of other materials it replaces or envelops. In the past, GIA Laboratory staff members have seen opalized clams and other mollusks, portions of dinosaur bones preserved by opal, and opalized wood and

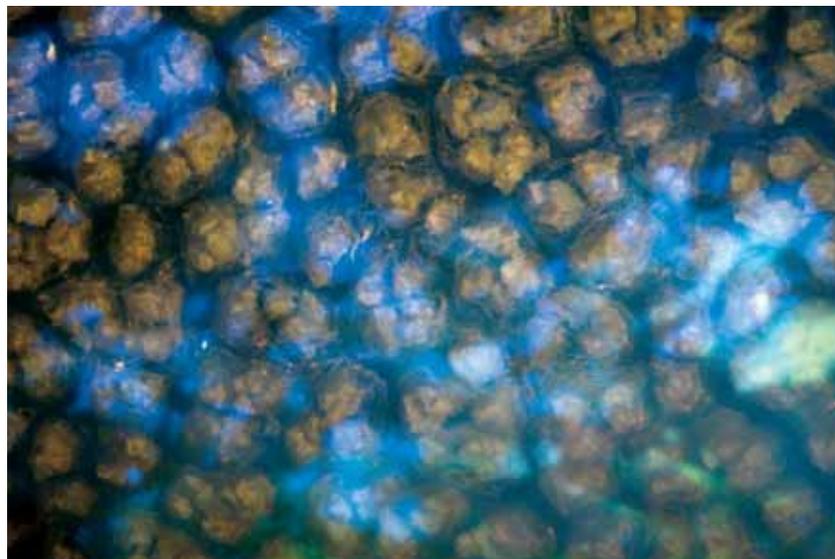


Figure 16. The play-of-color creates a hazy glow over the quartz casts on the base of their opal host. Field of view is 4.2 mm.

bark showing excellent cell detail (see, e.g., Fall 2001 Lab Notes, pp. 218–219).

We recently had the opportunity to examine an opal that appeared to have a columnar structure of relatively evenly spaced cells, so that it resembled synthetic opal without the

aid of magnification. The 1.09 ct translucent light brown cushion-shaped tabular cabochon measured  $10.02 \times 7.72 \times 1.98$  mm. Our client was told that it came from an opal field in Queensland, Australia, but the structure had generated a certain

amount of suspicion about its origin.

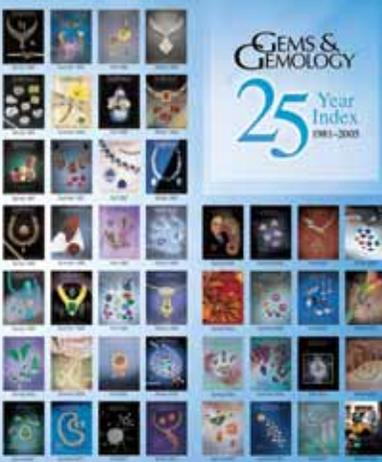
Standard gemological testing easily identified the opal as natural. With magnification, it appeared that the unusual structural pattern was generated when the opalizing solution was deposited over a drusy surface covered with numerous uniformly spaced quartz microcrystals, as shown in figure 15. The blue and green play-of-color displayed by the opal highlighted this structure like a colorful mist, adding a mysterious, alien haziness to the gem (figure 16) that seemed to float over the surface as the stone was moved. Throughout the years in the GIA Laboratory, we have had the opportunity to identify many marvelous opals from a variety of localities worldwide, but this is the first time we have encountered such a structure.

John I. Koivula

#### PHOTO CREDITS

John I. Koivula—1, 6, 12, and 14–16; Jian Xin (Jae) Liao—2 and 8; Wuyi Wang—3 and 9; Jessica Arditi—7; Jason Darley—13.

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