



Figure 20. These 17.05 and 1.79 ct specimens, represented as emerald, were identified as glass imitations. Photo by G. Choudhary.

model spectroscope. These properties indicated glass.

Striking features were observed with magnification. Both specimens displayed a series of sharp, straight lines along their lengths (figure 21, left), which were visible with darkfield illumination but were much clearer when the stones were observed under immersion. Such straight lines are often associated with growth lines or zoning in natural gemstones. Viewed from different angles, some of these lines were revealed to be planes with sharp edges (figure 21, right). In addition, a few scattered gas bubbles were present in the 1.79 ct specimen.

These glass imitations were readily identified with classical gem testing instruments, but they may pose a problem for jewelers or field gemologists who attempt to identify them with only a 10× lens.

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“Nanogems”—A new lab-grown gem material. Glass-ceramic is a class of lab-grown materials that consists of glass matrix and nanometer-size crystalline particles

(oxides and silicates) that are grown within the matrix. It has unusual physical properties—such as negative thermal expansion—that make it useful for specialized industrial applications. Glass-ceramic became known to the general public during the 1970s, when it was first used as a surface for cooking ranges. Until now, though, we have not seen glass-ceramic gem materials. One Russian manufacturer, Formica LLC (Moscow, with a factory in Bangkok), has developed a new glass-ceramic gem material that it calls “Nanogems.” According to the company, the material is available in a variety of colors, has a Mohs hardness of 7–7½, and its high thermal shock resistance makes it suitable for a variety of jewelry manufacturing processes.

At the 2010 Tucson show, Formica LLC donated four samples to GIA, consisting of two blue and two green brilliants ranging from 2.59 to 3.15 ct (figure 22). Standard gemological testing yielded the following properties: RI—1.621 (blue) and 1.629 (green); no dispersion evident; hydrostatic SG—3.02–3.07; aggregate reaction in the polariscope; fluorescence—inert to long-wave UV and inert (green samples) or weak white (blue samples) to short-wave UV, with no phosphorescence; spectroscope spectrum—three distinct bands in the green, yellow, and red regions (blue samples) and two distinct bands in the orange and red regions (green samples). Microscopic observation revealed only a few pinpoint inclusions and conchoidal fractures in the green samples. However, all four showed prominent graining, in most cases throughout the entire specimen (figure 23). When illuminated with a fiber-optic light source, all also had a somewhat milky appearance, as would be expected for light scattering from nano-crystals.

Laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS) of all samples indicated a mainly Mg-Ti-Zn-Zr aluminosilicate composition. The blue samples contained ~80 ppm Co and the green samples ~7000 ppm Ni. We believe these two elements are the main coloring agents. UV-Vis spectroscopy showed results equivalent to those seen with the desk-model

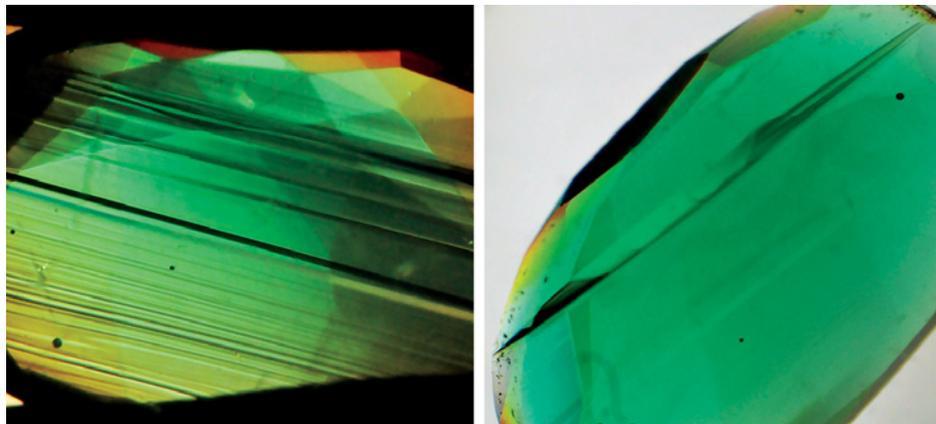


Figure 21. Both specimens in figure 20 displayed sharp, straight lines along the length of the gem, reminiscent of growth lines and zones in natural gemstones (left). Viewed from various angles, some of the lines were actually planes with sharp edges (right). Photomicrographs by G. Choudhary; magnified 45×.

spectroscope: three obvious bands in the blue samples (545, 583, and 624 nm) and two in the green samples (593 and 633 nm). The infrared spectra of all samples displayed a general absorption edge at 2150 cm^{-1} and two distinct bands at 3641 and 3394 cm^{-1} , probably related to the hydroxyl group. Four additional minor absorption bands were observed, at 4521 , 4252 , 2677 , and 2244 cm^{-1} . Raman spectroscopy indicated a broad hump typical of an amorphous material (i.e., glass), with some sharper bands (most prominently at 656 and 415 cm^{-1}) that matched those of gahnospinel. Therefore, the properties of this material are consistent with a glass-ceramic.

The aggregate polariscope reaction and strong graining should allow separation of this material from glasses typically used as gem simulants. However, it is possible that not all faceted glass-ceramics will exhibit these features, making them more difficult to distinguish from glass—despite their unusual chemical composition. The most definitive separation criteria would be provided by X-ray diffraction, but this technique is not available in most gemological laboratories.

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Serpentine doublets, sold as pietersite, from Arizona. At the 2010 Tucson gem shows, one of these contributors (PH) purchased a few samples represented as pietersite that reportedly came from Globe, Arizona. The sample group contained rough pieces as well as cabochons (doublets) consisting of “pietersite” attached to black resin bases. Pietersite is composed of chatoyant silicified crocidolite (a fibrous asbestos mineral)—in the form of brecciated dark blue hawk’s-eye and/or brownish yellow tiger’s-eye. It was discovered in 1962 in northern Namibia (see Gem News, Summer 1988, pp. 117–118, and Spring 1992, p. 61), and a similar rock was found in 1993 in Xichuan, Henan Province, China. Considering the rarity of pietersite deposits, a U.S. locality for this material would be noteworthy.

The following properties were obtained from five of the Arizona cabochons (9.40–87.85 ct; e.g., figure 24): color—very light yellow to brownish yellow; spot RI—1.54–1.55; and fluorescence—inert to long- and short-wave UV radiation. Specific gravity measurements would not be meaningful because of the resin backing. Microscopic examination revealed that the gem material consisted of parallel fibers oriented perpendicular to the chatoyant bands, and those fibers were thus responsible for the tiger’s-eye effect. The fibers varied from white to light yellow, and some were brownish red as expected for staining by iron oxides/hydroxides.

Three pieces of rough (45.16–420.12 g) also were examined. They were composed of white to light yellow fibers with crosscutting deep green and brown crystalline aggregates. Their structure consisted of asbestiform parallel fibers oriented normal to the surfaces of



Figure 22. These four glass-ceramic samples (2.59–3.15 ct) were manufactured by Formica LLC. Photo by Robert Weldon.

fracture veins that were hosted within a massive brown-black matrix. Hydrostatic SG measurements of the three samples yielded values of 2.43–2.46. Powder X-ray diffraction data identified the major mineral as serpentine, formed by an admixture of chrysotile and lizardite. The samples also contained minor amounts of quartz and calcite.

This Arizona material is quite different from pietersite. Although its refractive index overlaps that expected for pietersite, its SG values are lower (cf., 2.50–2.58 from Namibia and 2.67–2.74 from China), which is consistent with serpentine. In addition, the Namibian and Chinese pietersite consists of fibers that are oriented in an irregular fashion, unlike this serpentine from Arizona.

Figure 23. This green glass-ceramic specimen contains a few pinpoints, as well as prominent graining when viewed in certain orientations. Photomicrograph by A. Shen; field of view 1.8 mm wide.

