"OPALITE": PLASTIC IMITATION OPAL WITH TRUE PLAY-OF-COLOR

By John I. Koivula and Robert C. Kammerling

A plastic imitation opal that shows true play-of-color was advertised as "new" and offered for sale under the trade name "Opalite" at the Gem and Lapidary Dealers Association (GLDA) Tucson show in February 1988. Subsequent gemological testing proved that this material was virtually identical to the plastic imitation opal previously described in the literature that was known to be manufactured in Japan. It is now being marketed worldwide under a new name.

Plastic imitations of natural opal have been known to gemologists for over a decade. These imitations, of Japanese manufacture, show true play-of-color. This effect is produced by the close-packed structure assumed by the minute (150–300 nm) polystyrene spheres during the slow sedimentation process by which the material is formed in the laboratory (Horiuchi, 1978).

Because of the realistic play-of-color, these imitations cannot be separated conclusively from either natural or synthetic opals on the basis of unaided visual observation alone, something that is possible with other forms of imitation opal such as the glass known as "Slocum Stone" (Dunn, 1976). With loose stones, it is a simple matter to separate a plastic imitation solely on the basis of heft. The specific gravity of the plastic counterfeit is so radically different from that of either natural or synthetic opal that the plastic is immediately apparent and no further testing is required. However, most jewelers seldom are asked to identify loose stones, and when these opal imitations are in jewelry, the "heft test" is useless. In this respect, it is interesting to note that the earlier Japanese-produced material reported in the literature was only sold mounted in jewelry. In the majority of cases, then, identification of these plastic imitations requires additional gemological testing.

A series of professional papers (Horiuchi, 1978, 1982; Gunawardene and Mertens, 1983; Gunawardene, 1983) have accurately reported the important identifying properties of plastic imitation opals. Over the past 10 years, this knowledge has helped jewelers and gemologists in the identification of the Japanese product. At the February 1988 GLDA Tucson Gem and Mineral Show, however, a plastic imitation opal "advertised as new" was being offered for sale under the trade name "Opalite." It reportedly was being manufactured in the United States by a company calling itself "Excalibur." In view of our ongoing effort to keep up with new developments in the area of synthetics, enhancements, and imitations, and because of the advertised newness of this material, a closer investigation was warranted.

VISUAL APPEARANCE

Emerald Age Trading Company, which marketed the material at Tucson, provided two polished cabochons that represent, in visual appearance, the two types of this material offered (figure 1). The two cabochons are well polished with flat, polished bases. The larger sample, a 2.63-ct oval that measures 18.26 × 13.20 × 3.37 mm, shows what is commonly referred to as a "pinfire" play-of-color. Across its base, an orange "flash effect" similar to that seen on the flat, polished backs of Gilson synthetic opals was noted. The smaller of the two imitations, a 1.39-ct pear shape that measures 13.08 × 10.22 × 3.42 mm, displays a combination of broad flashes of color and a mosaic pattern as well as a yellowish green "flash effect" across the back.

Both samples are a translucent milky bluish white when viewed in either fluorescent or incan-

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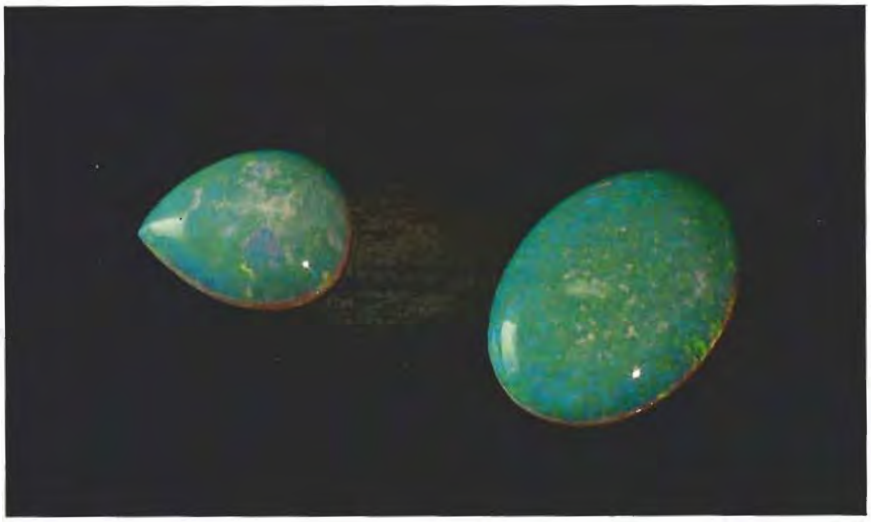

Figure 1. These two cabochons of "Opalite" plastic imitation opal, a 1.39-ct pear-shape and a 2.63-ct oval, were the subjects of this study. Photo by Robert Weldon.

descent surface incident illumination (figure 1). In transmitted light, they appear a translucent pink-orange (figure 2). Similar reactions to transmitted and incident light are also common in natural and synthetic translucent white opals.

Both plastic opal imitations appear to be assembled: A distinct layer of another plastic substance covers at least part of the base on each. This outer layer is probably an acrylic resin, which is coated over the polystyrene imitation opal to increase durability so that it can be used commercially (Horiuchi, 1982). In some areas, the acrylic layer had been polished away, while in others it was easy to see with some magnification, especially with pinpoint fiber-optic transmitted light when the sample was edge-on against a black background (figure 2).

GEMOLOGICAL PROPERTIES

The properties of "Opalite" as determined by the authors on the basis of these two cabochons are provided in table 1 and discussed below.

Refractive Index. Using the spot method and a fiber-optic white light source, we determined the R.I. on the apex of the dome to be 1.51 for each sample. The polish on the bases of both stones was good enough to get a reasonably clear R.I. reading of 1.500 with sodium vapor light.

The polystyrene that makes up the body mass of plastic imitation opals previously reported in the literature has a refractive index of 1.53, while the acrylic resin coating has an R.I. of 1.48–1.49 (Horiuchi, 1982). The intermediate readings obtained on the two "Opalites" are possibly the result of a combination of the two substances where the polystyrene and the acrylic overlayer intermix in a thin stratum along the contact surface.

Because natural opals have refractive indices in the range of 1.37 to 1.47, R.I. is a useful indicator in the separation of "Opalite" from natural or synthetic opal, provided there is no interference from a mounting.

Reaction to Ultraviolet Radiation. When exposed to long-wave U.V. radiation, the bodies of the two cabochons fluoresced a strong, even bluish white, while their edges seemed to glow a very slight

Figure 2. The thin white acrylic layer at the base of the cabochon and the pink-orange appearance of "Opalite" in transmitted light are both visible in this photomicrograph. Magnified 5×.

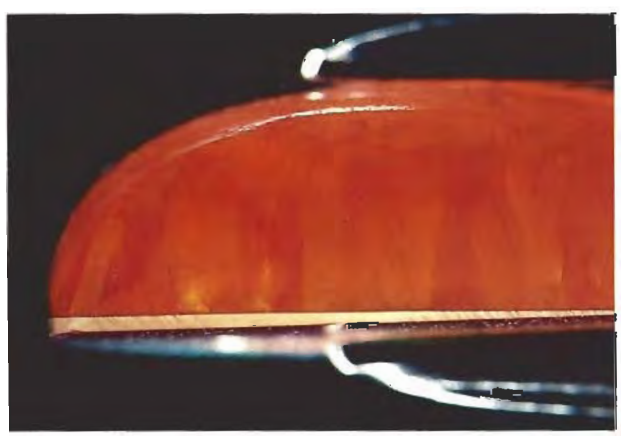

TABLE 1. The gemological properties of "Opalite" plastic imitation opal.

Properties that overlap those of natural opal	
Color	Translucent milky bluish white by surface incident light
Visual appearance	Realistic play-of-color
Polariscope reaction	Moderate anomalous double refraction
Absorption spectrum	General absorption from approximately 537 to 584 nm
Key identifying properties	
Refractive index[a]	Spot reading of 1.51 on apex of the dome; flat facet reading of 1.500 on the base (Na light)
Ultraviolet fluorescence[b]	
Long-wave	Strong, even bluish white; very slight orange at the edges
Short-wave	Weak, superficial chalky blue-white overtone
Specific gravity	1.21 ± 0.01, determined by hydrostatic method
Magnification	May show "honeycomb" or columnar structure.[c] In polarized light, strain knots may also be present. Distinct evidence of assembly is visible.
Hardness	2½

[a]In the promotional literature for "Opalite," a refractive index range of 1.49 to 1.53 is reported.
[b]Testing done in total darkness (darkroom conditions).
[c]Observed using fiber-optic illumination and shadowed transmitted light.

orange. The short-wave reaction was slightly less intense, with a weak, superficial chalky blue-white overtone that was most obvious when the lamp was held very close to the cabochon and the room was in total darkness (darkroom conditions). No phosphorescence was observed in either sample. If fluorescence comparison opals of known origin were used as indicators, this fluorescence could prove useful in separating "Opalite" from natural opal.

Specific Gravity. Both "Opalites" sank fairly rapidly in benzyl benzoate (S.G. of 1.11) but floated slowly to the surface of glycerine (S.G. of 1.26); therefore, specific gravity was estimated at 1.20±0.05. Specific gravity was also determined by the hydrostatic method to be 1.21±0.01 for an average of three runs. This property would easily separate this material from most natural and synthetic opal, which usually has a specific gravity range of 1.99 to 2.25.

Polariscope Reaction. As would be expected from an aggregated plastic, both cabochons exhibited moderate anomalous double refraction that was evident when the analyzer of the polariscope was rotated into the extinct position in relation to the polarizer. When the polariscope was in the light position, no such reaction was observed and the cabochons transmitted the typical pink-orange color referred to previously. Because similar effects have been observed in some translucent natural and synthetic opals, polariscope reaction is not diagnostic.

Visible-Light Spectroscopy. Using a Beck prism spectroscope mounted on a GIA GEM Instruments base unit, we obtained a visible-light spectrum for each sample by transmitting white light through the domes of the cabochons. The pear-shaped cabochon had a broad general absorption band that extended from approximately 537 to 584 nm, while the oval cabochon had an absorption band that ranged from 550 to 580 nm. Both natural and synthetic translucent white opals may show similar absorption features, so visible-light spectroscopy does not provide a method for separation of "Opalite" from opal.

Microscopy. In examining any opal or opal-like material, oblique illumination can be used, together with shadowing and transmitted light, to show specific patches of color-play and how they relate to the overall structural appearance of the substance (Gübelin and Koivula, 1986).

When studied in oblique surface incident light with a standard gemological microscope, the 2.63-ct oval showed a "pinfire" play-of-color pattern (figure 3) that could be easily mistaken for the play-of-color shown by some natural opal. In shadowed transmitted light, the "pinfire" structure was transformed into the highly diagnostic so-called honeycomb or lizard-skin pattern (figure 4) that is always associated with laboratory-grown products exhibiting play-of-color. So, on the basis of this structure, a gemologist would at least associate this cabochon with a man-made material generally, if not a plastic imitation specifically.

The pear shape displayed an abstract combination of broad flashes of color and a mosaic play-of-color in the face-up position under surface incident light (again, see figure 1). In shadowed transmitted light, it showed an irregular structure with only a hint of a vague "honeycomb" pattern correspond-

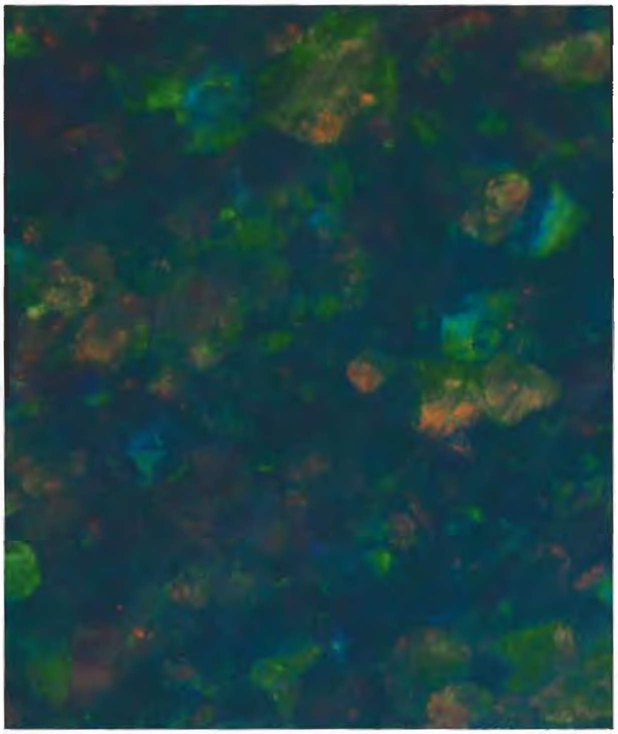

Figure 3. One of the two types of play-of-color known to occur in "Opalite" is shown by this "pinfire" pattern in the oval cabochon. Oblique incident illumination; magnified 15×.

Figure 4. The "honeycomb" structure shown by pinfire "Opalite" when examined with shadowed transmitted light is characteristic of a laboratory-grown material. Magnified 15×.

ing to the play-of-color that, unlike the obvious pattern shown by the oval (figure 4), offers few clues to its identification.

Looking edge-on through each cabochon, using either oblique incident illumination or shadowed transmitted light, we noted a columnar structure in certain directions. Transmitted light reveals this in figure 2. This is similar to the edge-on columnar structure seen in some synthetic opals (Gübelin and Koivula, 1986).

Using polarized light microscopy, we discerned some minor strain knots in both of the cabochons. These are similar to those reported by Gunawardene (1983) in plastic imitation opal, except that they are not as intense in their appearance and are not associated with gas bubbles.

Hardness. The radical difference in hardness between a plastic imitation and a natural or synthetic opal makes hardness testing very useful in this case if it is done carefully (so as not to damage the piece) by a skilled gemologist on an inconspicuous place on the test subject.

With magnification, it can be observed that the fine point of a common sewing needle will readily dent "Opalite" when only the slightest pressure is exerted. Gem-quality natural opals and synthetic opals will not be dented by such a test, although some poor-quality highly porous natural opals may be.

It is interesting to note that the manufacturer's promotional literature, which contains several errors, some quite comical (e.g., "they [opals] also evolve from fossilized aquatic animals and plants such as teeth of sharks, squids and prehistoric creatures which have been deposited in rock seams and hardened for thousands of years"), states that "These Flawless Gem-Quality OPALITES will not scratch or chip easily like their counterpart, the natural opal." While plastics are generally quite tough and resistant to chipping, they are not hard materials. To say that "Opalite," with a Mohs hardness of 2 $^1/_2$ as determined by the authors, will not scratch as easily as natural opal, with a Mohs hardness of 5 $^1/_2$–6 $^1/_2$, is totally untrue.

Thermal Conductivity. Plastics, including "Opalite," feel much warmer to the touch than do

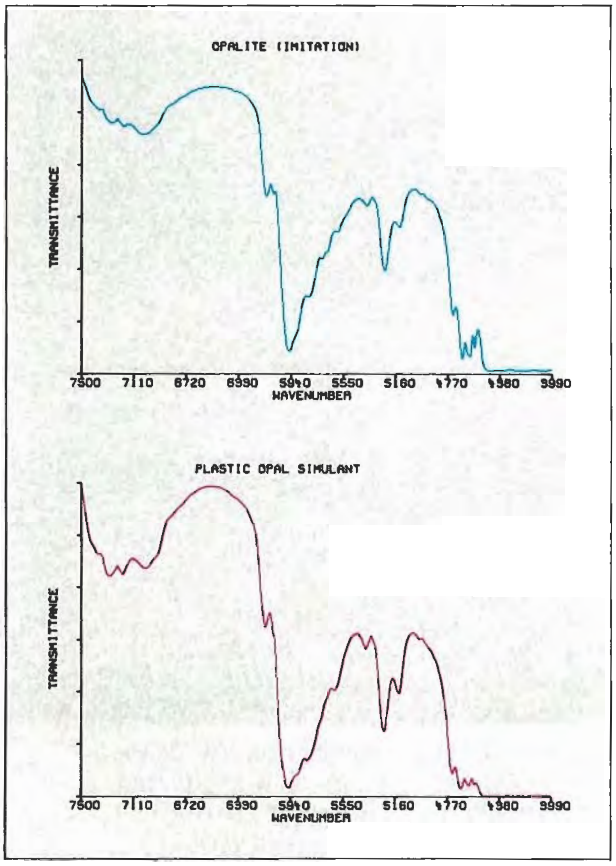

Figure 5. The infrared absorption pattern of "Opalite" (top) is typical of plastic imitation opal and virtually identical to the infrared absorption pattern of a Japanese plastic imitation opal (bottom; GIA collection no. 6873).

natural and synthetic opals. When "Opalite" or any plastic imitation opal is tested with a thermal inertia probe, it usually does not register on the instrument, or it causes the needle to drop slightly lower than its normal "at rest" position. Because natural and synthetic opals do react slightly, in a positive way, thermal conductivity can be useful for spotting plastic imitation opal (Horiuchi, 1982).

Infrared Spectrometry. In the infrared region of the electromagnetic spectrum, plastics, like many organic materials, show unique absorption features that allow them to be recognized and classified (Fritsch and Stockton, 1987). Using a Nicolet 60SX research grade Fourier transform infrared spectrometer, Carol M. Stockton determined the infrared absorption characteristics of the two "Opalite" specimens. Both gave a strong pattern that is typical of plastic imitation opal and that closely matches that of a plastic imitation opal of Japanese manufacture (figure 5) from GIA's reference collection.

Infrared testing, however, is expensive and the equipment is sensitive, but as a last resort an infrared spectrometer will always be able to identify a plastic imitation of opal or of any other gem material.

CONCLUSION

Since we first began this project, we have learned that the "Opalite" plastic imitation opal being sold today is now available throughout the world and is being marketed under the name "Opal Essence." Advertisements for "Opalite" can be found in magazines such as *Accent* (March 1988) and *Jewellery News Asia* (April 1988), and it is being sold in markets such as Korea and Taiwan.

"Opalite" may represent a new production run of imitation opal, but it is not a new manufacturing process. This material is virtually identical to the plastic imitation opals that have been produced in Japan for a decade. A very effective substitute, "Opalite" cannot be identified as an imitation by sight alone. However, numerous optical and physical differences that exist between plastic and opal, such as refractive index, specific gravity, hardness, microscopic appearance, and thermal conductivity, as well as infrared absorption, should serve to make a separation possible even in the most difficult testing situations.

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