GEM TESTING LABORATORY
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EMERALD - WITH NEW TYPE OF FILLER?

It has been more than two years of the 'emerald debacle', which caused much concern in the Jaipur trade regarding the undisclosed sale of resin-filled emeralds, leading to heavy losses. During those tough times the Gem Testing Laboratory grounded its feet strong enough to address the issue by differentiating between 'oiled' and 'resined' emeralds. However, during these two years, we at GTL have also observed numerous emeralds lying in inventories for many years being thought as oiled were actually 'resined'. This caused another concern for a gem dealer, as it raised question mark on the previous stones sold as 'only oiled'. Since six months or so, we are observing few filled emeralds which show very unusual effects within the fractures, although the filler is being identified as 'resin'.

The fractures typically display reflecting uneven films throughout the fracture, similar to that seen in oiling due to uneven filling. However, when the fracture is rotated and viewed in the vertical direction, it displays strong blue and golden colour flashes, typically associated with resin. Further confirmation or identification of the type of filler is done by infra-red spectroscopy (FTIR) by carefully orienting the fracture in the path of infra red rays. Although, a standard FTIR is usually used to detect oils and resins, but in these cases, we have to use the advanced system equipped with a microscope, which enable us to target the infra red rays on the particular fracture / point with great accuracy, thereby producing the 'spot-on' results.

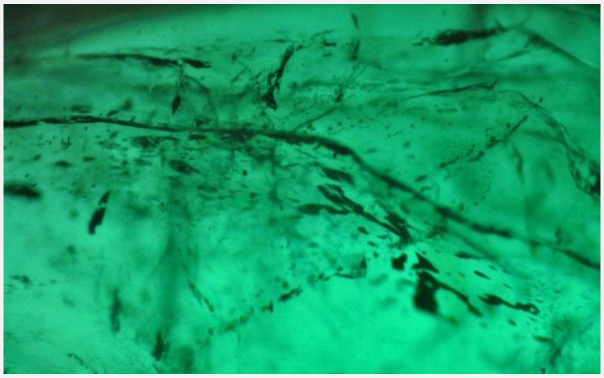

Figure 1: The patchy appearance within fractures is typically associated with uneven filling usually seen in 'oiled' stones, however, the effect is now being observed in 'resined' stones too.

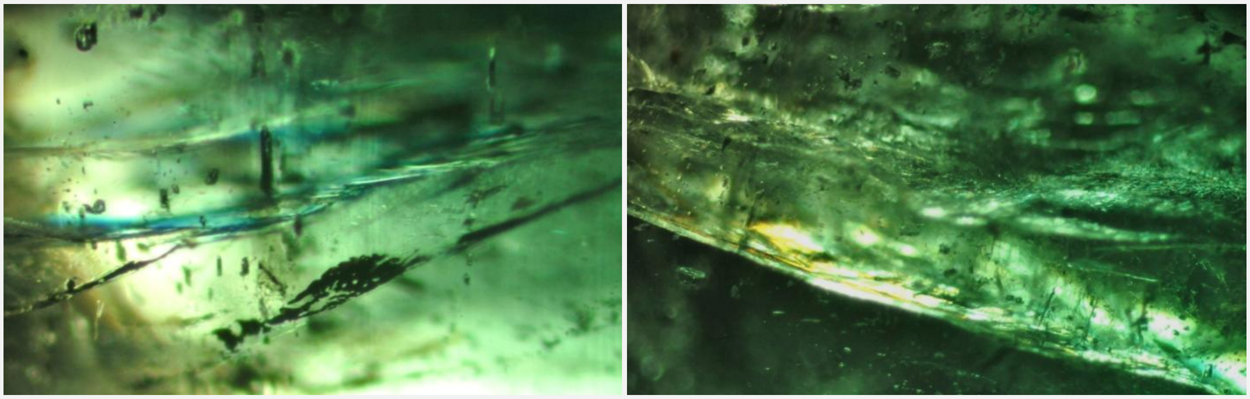

Figure 2: At an angle along the length of the fracture, it displayed blue (left) and golden (right) colour flashes, typically associated with resin.

Reflecting films are however, not associated with resin, therefore, such filled-emeralds can easily be misidentified as 'oiled' if careful and thorough observations are not made from all possible angles. Once the flash effect is detected, it is equally important to focus the infra-red laser precisely on the fracture, which sometimes becomes a time consuming process. If one misses the flash effect, correct identification as resin will be difficult to establish. At this stage we are assuming that this filler is probably - (i) a resin based substance filled by traditional methods or by semi-mechanised methods or (ii) a 'multiple' treatment where emeralds, pre-treated with resin are again filled with oil. Although, the former option appears more convincing, we are still trying to find out the exact reason for such filling effects.

NATURAL ROCK CRYSTAL - COATED WITH DIAMOND CHIPS

Recently, we received a rough specimen weighing 12.63 carats, which was fashioned as a cube with curved faces. The specimen gave reminiscence of a cubic diamond crystal, coated with associated natural minerals. However, when the specimen was viewed from all directions, it displayed variation in lustre from the two opposite faces, which raised doubt regarding its origin. Further, the fine chips stuck on the surface was quite uniform, usually not seen in natural specimens.

Figure 3: This 12.63 ct specimen represented as diamond is actually composed of pieces of quartz and diamond and then coated with chips of diamond embedded in a polymer

Raman analysis performed on various parts revealed that the areas with duller lustre were actually quartz, while with brighter lustre were diamonds. In addition, the fine reflecting chips present on the surface of this specimen were also identified as diamond, which were embedded in a polymer.

Detailed analysis revealed that the major exposed areas were rather composed of diamond while the areas covered with chips and polymer was quartz. Although identification of this specimen as a composite was not a problem, awareness and careful observations are necessary.

'BUMBLE-BEE' JASPER - A CARBONATE - SULPHIDE ROCK

'Bumble-Bee' jasper has been known since recently only from 1990s and has derived its name due to the alternating coloured layers of black, orange, yellow and white, resembling a type of bee, known as 'bumble-bee' (*see inset*). This interesting gem variety is usually found only in Indonesia.

Technically, this is not true jasper and does not contain micro-crystalline quartz. This is a sedimentary rock composed of sulphur, manganese oxide, arsenic-sulphide minerals such as realgar and orpiment, and carbonate minerals such as calcite and aragonite, formed in volcanic fumaroles. Its yellow colour is due to sulphur, black due to manganese oxide, and orange due to arsenic- sulphide minerals. Due to the porous nature, these rocks are usually filled with colourless polymer to improve their lustre and durability.

Recently, few specimens submitted to GTL for identification did not show the presence of manganese oxide, but the presence of realgar and calcite-aragonite was established by Raman spectroscopy. Although, these rocks are relatively soft with hardness of only 4, but can provide an interesting option for designers and consumers alike.

Figure 4: This 19.55 ct cabochon, known as 'bumble-bee' jasper due to its appearance similar to that of a 'bumble-bee' (inset), is basically a sedimentary rock composed of carbonate minerals (calcite-aragonite), arsenic-sulphide minerals (realgar - orpiment), sulphur and manganese oxide.

References
http://www.limebrightmedia.com/celestialearthminerals.com/library/mineralpedia/bumble-bee-jasper/bumble-bee-jasper

GTL UPGRADES ITS RAMAN SYSTEM WITH 375 NM UV LASER

From last two years or so, we have been using the Raman spectrometer in solving many challenges of gem testing; the Raman system available at the GTL is equipped with two lasers - 532 nm (green) and 785 nm (red). However, recently we have upgraded the Raman system with one more laser - 375 nm (in the UV range). The UV laser has much higher energy as compared to the green or red laser, and hence is capable of exiting more electrons, which in turn provides better signals in the larger region of the spectra.

Figure 5: This 375 nm diode UV laser was recently procured at GTL, specifically for 'photoluminescence' spectral studies of diamonds and coloured stones

Currently, features at lower wavelengths than green laser (i.e. 532 nm) cannot be recorded, and many features present, especially in diamonds are left out to be measured. There are few important features present in the range of 380 to 530 nm, which assist in identification of irradiated, annealed and HPHT treated (fancy coloured) diamonds; with the 375 nm laser, all these features can be recorded. For example, presence of peak at 496 nm in diamonds suggests irradiation.

This 375 nm laser will now be more useful in studying the 'photo-luminescence' spectra of diamonds and coloured gemstones, thereby assisting not only in identification of HPHT-treated and irradiated diamonds but also treatments in coloured gemstones, especially spinels and corundum.

We are confident that this 375 nm laser will reveal many exciting and interesting phenomena in diamonds and gemstones, which we will be eager to share.

SYNTHETIC DIFFUSED SAPPHIRES REMAINS A CHALLENGE!

Figure 6: A loose and mounted synthetic diffused sapphire

Since the beginning of this century, diffusion of titanium on synthetic sapphires, turning colourless corundum to blue became very common and today, these diffused synthetic sapphires have very high penetration into the market, and in large sizes. Although, identification of the treatment is quite straightforward, determination of natural or synthetic origin remains a challenge. The starting colourless material used for diffusion is usually inclusion free, which causes the main concern.

When a corundum is heated at high temperatures, as is required for diffusion, the surface breaks are often healed with the heating residue (flux) giving appearance of a 'healed fingerprint'; a casual observation in such cases can easily misidentify these diffused synthetic sapphires, as 'natural'. And we have seen many such cases!

And, when set in a jewellery piece, it becomes even more challenging to correctly differentiate between natural and synthetic. In such cases, a careful and detailed analysis is of utmost importance!

CERAMIC - IMITATION HEMATITE

Figure 7: A string of black and coated golden (right) ceramic-imitation hematite, known as 'Magnetic hematite'

In the past six months, few black metallic beads and faceted stones were submitted to us as hematite, but they turned out to be an artificial material with ceramic-like appearance. Although these specimens are identical to natural hematite, separation is quite straightforward. The most prominent feature for separation of this artificial material and hematite is the magnetism; the ceramic-imitation is strikingly magnetic, the property not typically associated with hematite. In addition to the black metallic samples, similar material was also submitted in golden colour.

The submitted samples displayed granular structure typically seen in ceramic products, while their specific gravity was measured at ~4.50, as against ~5.00 of hematite. Further, qualitative EDXRF analysis revealed the presence of Fe and Sr with traces of Ti (for golden sample only), which suggested it to be coated, along with the microscopic observation.

A magnetic imitation of hematite, known as 'hematine' has been known in the trade for decades, which is claimed to be made from powdered hematite, coloured by iron oxide and bonded with resin. However, as per our analysis, the submitted samples displayed Sr as additional element, which is absent in hematite; further, no signs of resin were seen in these samples. Presence of Sr and granular structure suggested that these samples are man-made products, similar to 'ceramic' or 'ferrite' magnets.

Due to the striking magnetism and hematite-like appearance, this material is also known as 'magnetic hematite' in the trade.

SHELLS GAINING POPULARITY

Mollusc shells have been known and used in jewellery for centuries, which were then started to be coated with coloured substances to produce fancy colours and / or to imitate pearls. In the past few months, we at the laboratory, have seen many samples of coated and/ or dyed shells, in fancy colours such as orange, red, blue, golden, etc; this clearly suggests the growing market for these shells in cheap fashion jewellery. Some of the coated shells closely imitate the appearance of fine quality of golden pearls, as shown in the image on right.

Figure 8: Coated shell beads

Written and Edited by: Gagan Choudhary (*Deputy Director)*

Contact for further details:
Technical Matters: Meenu Brijesh Vyas (*Asst. Director);*
Sandeep Vijay, Vinayndar Sikand, Sonal Meghani (*Executives*)
Front Desk: Radhamani Amma (*Sr. Executive);* Kailash Chand Daurata (*Jr. Executive*)

www.gtljaipur.info | gtl@gjepcindia.com | /gtljaipur | +91-141-2568221, 2573565
RAJASTHAN CHAMBER BHAWAN, 2ND FLOOR, M. I. ROAD, JAIPUR - 302003, INDIA