THE GEM & JEWELLERY EXPORT PROMOTION COUNCIL
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GEM TESTING LABORATORY

Lab Information Circular

Volume 61, June 2011

Gem Testing Laboratory Jaipur at the GIA Symposium 2011

The Gem Testing Laboratory, Jaipur received an excellent appreciation at the GIA's International Gemological Symposium 2011 held on May 29 and 30, 2011 at their world headquarters in Carlsbad, California. Gagan Choudhary , Deputy Director, GTL represented the laboratory and presented two posters at the symposium. He was also selected as the member of the advisory committee for the symposium where he had to review the submitted papers. The posters presented by Gagan Choudhary were titled as, "Few Remarkable Stones Tested at Gem Testing Laboratory, Jaipur, India" and "Spectroscopic Examination of Commercially Available Quartz Varieties - A Gemmological Perspective". Both, the posters were very well acknowledged by the members of the gemmological community. The former poster was interested more, as it covered a range of gem materials, which even many of the highly experienced gemmologists have not encountered.

This issue briefs on the posters presented at the GIA Symposium 2011, with emphasis on the former one, "Few Remarkable Stones Tested at Gem Testing Laboratory, Jaipur, India".

An overview of the poster titled, "Few Remarkable Stones Tested at Gem Testing Laboratory, Jaipur, India", presented by Gagan Choudhary

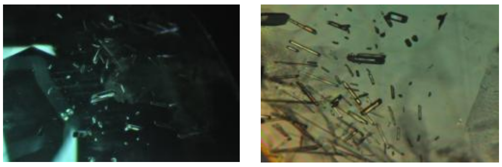
As the regular readers of this newsletter are aware that, at the Gem Testing Laboratory of Jaipur, India we receive for identification various types of gem materials ranging from natural, synthetics, imitations and treated counterparts. All these materials are submitted in rough as well as cut in various forms including bead string necklaces, carvings, etc. Quite often, we also receive gem materials having some interesting and unusual features which we regularly publish in our Lab Information Circular (LIC). This poster basically, covered some of such interesting materials / features, we have encountered in the recent times. Mainly, the visual characteristics were emphasized rather than analytical detailing.

Following are the interesting samples / features covered in the poster.

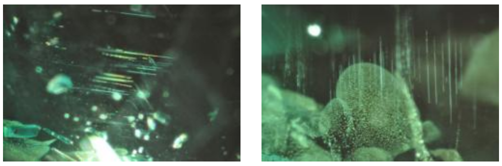
Synthetic emerald with natural-like inclusions

1.a. This 0.60 carat synthetic emerald grown by flux-fusion process was unusual for its inclusions, which closely resembled to those of natural counterparts.

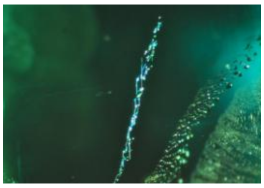
1.b.This synthetic emerald contained numerous transparent colourless crystals, some of which displayed hexagonal profile. These appeared birefringent under crossed polarisers.



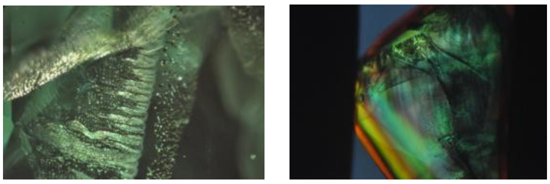
1.c. Fine long tubes/ needles oriented in two directions along the prism faces intersecting each other at 60/120^{o} were the most striking features in this synthetic emerald. Also present were the long tubes oriented along the 'c' axis.



1.d. This synthetic emerald also contained a row of short fine iridescent needles; these were associated with tiny discs / platelets.



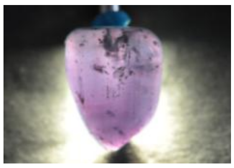
1.e. This emerald also displayed fingerprints in the form of wispy veils with folded appearance which appeared black and opaque in transmitted light, indicting flux. Its synthetic origin was concluded with FTIR spectra, which lacked any water content.



Serpentine with purple transmission

2.a. These dark bluish green tumbled specimen and cabochon of serpentine displayed an unusual purple transmission under fibre-optic light.

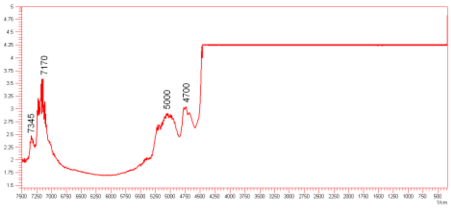
2.b. Strong purple transmission displayed by this serpentine in fibre optic lamp was mistaken for colour change effect by the depositor and misrepresented as alexandrite. This phenomenon can be related to the 'Usambara effect'. Upon enquiry from the depositor, these specimens were mined in Andhra Pradesh in South India and are sold as alexandrite. However, in reflected light, these specimens do not display any colour change effect.



2.c. This rough serpentine also displayed fine cleavage planes, which is not usually observed in this gem variety as this is commonly found as massive aggregates / boulders.

2.d. Minute scattered flaky inclusions were present in planes along the cleavage direction. Exact nature of these inclusions could not be identified.

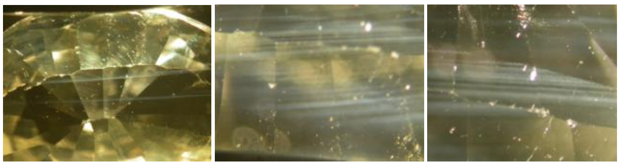
2.e. FTIR spectrum of this serpentine was consistent with those present in our database, dominated by water related features: complete absorption below 4500 cm^{-1} and two broad bands at around 5000 and 4700 cm^{-1}.



Synthetic sapphire with milky zones

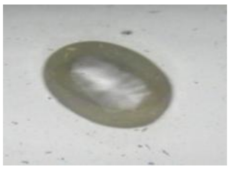
3.a. This 2.14 carat sapphire displaying straight milky zones was proved to be synthetic.

3.b. Milky zones containing fine pinpoints in this synthetic sapphire could have easily misidentify it as natural. These zones appeared to be present along the twinning planes.



3.c. When viewed along the optic axis direction between crossed polarizers, the sample exhibited strong 'Plato lines', confirming the identification as synthetic.

3.d. This sapphire specimen appeared transparent under shortwave Ultraviolet lamp proving its synthetic origin.

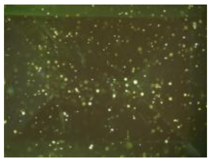


Synthetic quartz with 'lily-pad' like inclusions

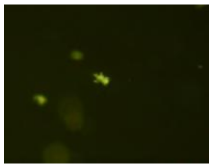
4.a. This synthetic quartz was interesting because of the presence of 'lily-pad' like inclusions. The combination of body colour and inclusions makes this quartz a good representation of peridot. Visually, it was quite difficult to identify this specimen as quartz as the colour is not associated with this gem variety. This was the only specimen we have seen here at the Gem Testing Laboratory with this colour shade and inclusions. Also no reports of such features were found in the literature.

4.b. These 'lily-pads' in the synthetic quartz were basically stress cracks associated with 'bread crumb' like inclusions. This gives indications that they have formed during the heating process to produce green colour.

4.c. Scattered whitish crystallites were present throughout this quartz sample, indicating synthetic origin.



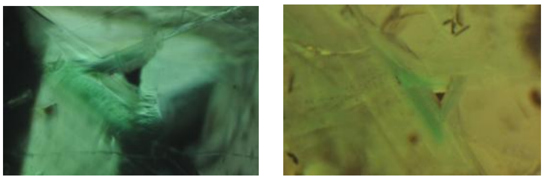
4.d. White crystallites at higher magnifications appeared 'bread crumb' inclusions as seen in synthetic quartz. Its synthetic origin was further confirmed by FTIR.



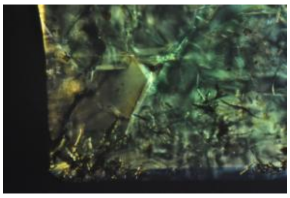
Natural emerald with 'triangular' core

5.a. This natural emerald was unusual for its growth pattern which displayed a triangular core.

5.b. Along the optic axis direction, 'triangular' core / zone was observed, which is unusual in a mineral like emerald, belonging to the hexagonal crystal system. This core was running throughout the stone from front to back.



5.c. Under crossed polarisers, strong strain patters were observed, along with sharp planes forming angles of approximately 60/120°. These planes appeared to be the faces of hexagonal sub-crystals of this emerald. The triangular core formed was in fact the space enclosed by the faces of the three hexagonal crystals and was not directly associated with the atomic structure as usually the case is.

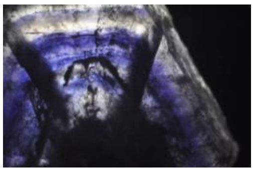


Fluorite crystal with pseudo-hexagonal colour zones

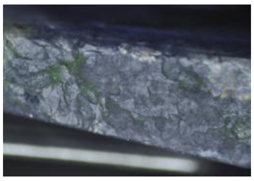
6.a. This fluorite crystal displaying hexagonal zones was initially thought to be a sapphire.

6.b. This fluorite crystal also displayed milky zones, reminiscent of rutile zones in a sapphire.

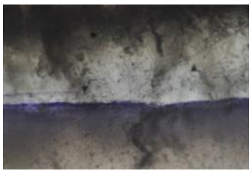
6.c. These colour zones appeared to be patchy, which is commonly associated with fluorite and not sapphire.



6.d. Step-like cleavage plane and dull lustre were typically associated with fluorite, which ruled out the possibility of sapphire.

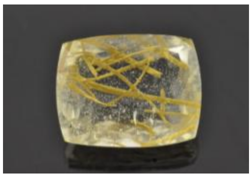


6.e. In addition, the colour appeared to be present in planes along the cleavage direction. Also note tiny triangular inclusions typically associated with fluorite.

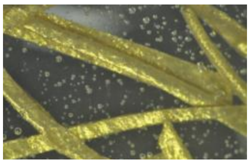


An interesting composite with induced inclusions

7.a. This 18.48 carat specimen imitating 'rutilated' quartz was turned out to be a composite made up of natural rock crystals with induced golden inclusions.

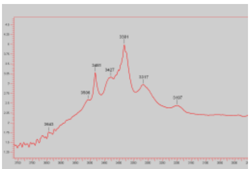


7.b. Golden tubes with a flaky structure were present within a thick layer of polymer sandwiched between two pieces of rock crystals.



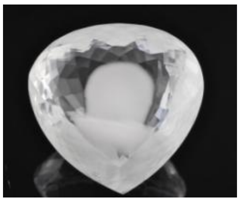
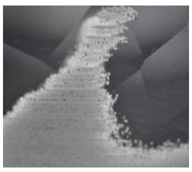
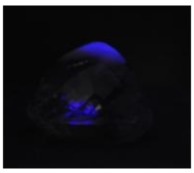
7.c. This composite specimen displayed a strong blue glow under long wave ultraviolet lamp, because of the glue used.

7.d. IR Spectra of this composite showed the peaks that were consistent with natural rock crystal.

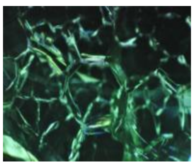
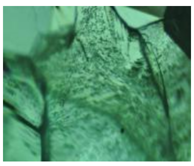


Few interesting glasses

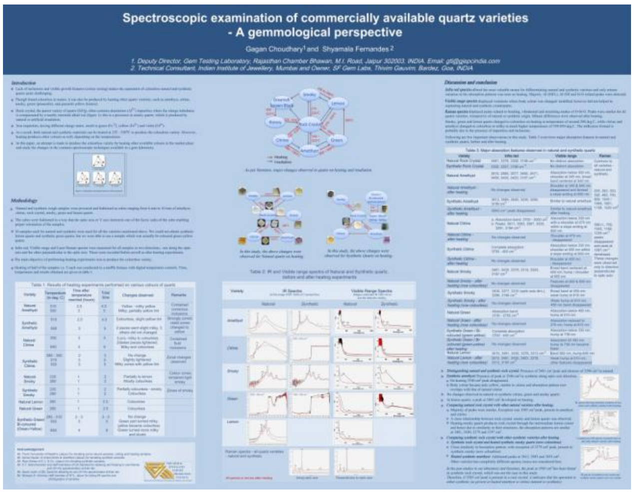
8.a. This glass specimen was unusual for its inclusion pattern, which created an image of 'Shivling' - the symbol representing Lord Shiva in Hindu theology. The pattern was formed by the rows of gas bubbles, which appeared blue under short wave UV.

8.b. This glass sample imitating emerald was interesting due to its pseudo- hexagonal cracks, which were filled with some yellow substance.

The second poster titled, "Spectroscopic Examination of Commercially Available Quartz Varieties - A Gemmological Perspective", was purely a technical paper and was more useful for those associated with laboratories or academics. Therefore, only the abstract is being presented here. For more details, please contact Gagan Choudhary at GTL office.

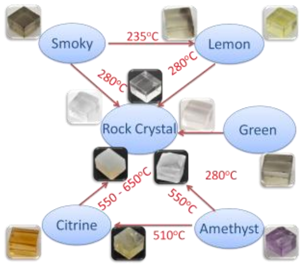


Poster titled, "Spectroscopic Examination of Commercially Available Quartz Varieties - A Gemmological Perspective" co-authored by Mrs. Shyamala Fernandes and presented by Gagan Choudhary

Abstract

The lack of inclusions and visible growth features (colour zoning) makes the separation of colourless natural and synthetic quartz quite challenging. Though found colourless in nature, it can also be produced by heating other quartz varieties, such as amethyst, citrine, smoky, green (praseolite), and greenish yellow (lemon). Rock crystal, the purest variety of quartz, often contains aluminum (Al^{3+}) impurities where the charge imbalance is compensated by a nearby interstitial alkali ion; this is a precursor for smoky quartz, which is produced by natural or artificial irradiation. Iron impurities, having different charge states, result in green (Fe^{2+}), yellow (Fe^{3+}), and violet (Fe^{4+}). As a result, both natural and synthetic materials can be heated to 250-500°C to produce the colourless variety.

Infrared, Raman, and UV-Vis-NIR spectroscopy provide useful data to differentiate between the natural and synthetic crystals, while also identifying the original colour variety. Infrared spectra offer the most valuable means for differentiating between natural and synthetic quartz, and for correlating the features observed in the spectroscopic data with colour varieties of natural and synthetic material. In this study, the OH, Al-OH/Li, Al-OH, Si-O / Al-OH, and Si-O related peaks at around 3593, 3480, 3379, 3305, and 3198 cm^{-1} consistently appeared in natural rock crystal, while the 3584, 3421, 3297, and 3198 cm^{-1} peaks were present in synthetic rock crystal; the most important peak in distinguishing natural from synthetic crystals was at 3480 cm^{-1}. The data also help differentiate between natural and synthetic versions of other coloured varieties and whether the colour is natural or produced by heating.



Various colours of quartz were heated to produce the colourless variety (rock crystal) for this study. Spectroscopic studies were done before as well as after heating.

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