

# A Discussion on Ruby-Glass Composites & Their Potential Impact on the Nomenclature in use for Fracture-Filled or Clarity Enhanced stones in General

Kenneth Scarratt

GIA Laboratory, Bangkok

(First limited LMHC distribution February 2008)

---

---

## Introduction

The association of ruby with treatments that result in an addition of glass to the final product began in 1984 with the appearance on the market of Thai origin rubies in which cavities had been filled with glass (Kane, 1984, Scarratt, et al., 1984) a treatment that had evolved into glass crack filling by 1987 (Hughes, 1987, Scarratt, 1987). In 1992 with the discovery of corundum deposits in the area of Mong Hsu, Burma (Myanmar) that required high temperature-flux heating regimes to bring the material to market the association of ruby treatments and glass was dramatically expanded (Hlaing, 1993, Kremkow, 1993, Laughter, 1993, Peretti, 1993, Smith, et al., 1994). Twenty years after the first association a new ruby-glass association a new form of glass fracture filling in ruby appeared on the market (GAAJ, 2004, Pardieu, 2005, Smith C.P., 2005, McClure, 2006).

Pardieu (Pardieu, 2005) noted that *“some terminology problems may occur about this treatment regarding to the “Lead Glass” definition as many different formulas can be used: Pure lead oxide, lead oxides mixed with silica or fluxes like borax can be encountered... Temperatures, parameters and result can be very different. Some specific studies will probably be done in the future regarding to this issue”*.

Pardieu (Pardieu, 2005) also witnessed the treatment procedure as performed in Chantaburi, Thailand by Master Burner Mahiton Thondisuk and reported that *“the most suitable rubies for repair are stones with color potential and that are rich in fissures”*. He stated further that *“this new treatment is performed currently mostly*

*on Andilamena rubies (Madagascar) on which Mr. Thondisuk has had extensive experience but any ruby material with fissures could be “repaired”. It is a multi step treatment involving simple heating and the use of different lead rich compounds to fill the fissures and cavities of the stones. If most of the “repaired” stones seen were large size stones, stones less than 1 carat have also been treated this way”.*

While Pardieu did allude to wide tracts of glass crossing the surface of examples he examined in 2004 – 5 until recently (early 2008) the material observed in laboratories<sup>1</sup> had an equivalence to treatments applied to “clarity enhance” emeralds (with the use of resins and oils) and diamonds (glass) and therefore the terminology used was adapted from these, i.e., minor, moderate or significant clarity enhancement. In reality the vast majority fell into the significant clarity enhancement category although as McClure (McClure, 2006) points out “ *the efficiency of the treatment is such that a single large fracture in an otherwise clean ruby could be made to “disappear” to the unaided eye exactly as filled fractures can be made to “disappear” in emeralds and diamonds. In fact, we have already seen several stones that fall into this category.* Further and following stability tests laboratories within the Laboratory Manual Harmonization Committee (LMHC)<sup>2</sup> added “*Glass filler may be unstable to elevated temperatures and to chemical agents. Special care shall be taken when repairing jewelry items set with glass filled corundum. During jewelry repair the unmounting of such stones is recommended*” to reports on these stones.

During a meeting of the LMHC held October 18<sup>th</sup> -20<sup>th</sup> 2007 in New York City, Dr. Pornsawat Wathanakul (Scientific Advisor to the GIT member) reopened discussions on glass fracture filling in ruby. Several members had noted myriads of large gas bubbles within the newer material being submitted to their laboratories and that in many cases the glass was filling wide seams crossing facets and seemed to be accounting for an ever increasing volume of the finished product. Further, it was surmised from observation that the material was being held together by the glass, i.e. the glass acting in similar manner to an adhesive. Following discussions and an agreement that this treatment went beyond what might be regarded as a “fracture filling or clarity enhancement process”, the group decided to describe this (heavily treated) material as “*ruby-glass composites*”<sup>i</sup> on all future identification reports.

Further on November 13<sup>th</sup> 2007 American Gem Laboratories (AGL) announced that they were changing their reporting policies with regards these stones (AGL, 2007) and indicated that their report wording henceforth would be Identification: *Composite Ruby*, Standard enhancement: *Heat*, and Additional enhancement: *Lead-glass*. They also indicated a further comment would be added - *This ruby has been*

---

<sup>1</sup> Compared with the prevalence in the market relatively few of these stones have been submitted to laboratories for reports.

<sup>2</sup> The members of the LMHC are; AGTA-Gemological Testing Center (USA), CISGEM (Italy), GAAJ Laboratory (Japan), GIA-Gem Trade Laboratory (USA), GIT Gem Testing Laboratory (Thailand), Gübelin Gem Lab (Switzerland), SSEF Swiss Gemmological Institute (Switzerland)

*heavily treated using a high refractive index lead-glass to fill fractures and cavities, vastly improving the apparent clarity and potentially adding weight. The glass may be damaged by a variety of solvents.*

This paper describes several “rubies” treated with glass and experiments carried out at GIA Laboratory (Bangkok) and at GIA New York that demonstrate the LMHC assumption – that the stones are being ‘bonded together’ by glass. As an implication of these experiments and given that several gemstones (ruby, emerald and diamond being the most often cited but others including tourmaline and quartz being not uncommon) are “clarity enhanced” through the infusion of fractures with oils, resins and glass, the paper also introduces new (February 2008) nomenclature for describing stones that have been *clarity enhanced* and those that are clearly *composites*.

## **Materials and Methods**

Samples (Figure 1) were sourced on the Bangkok market between November 12<sup>th</sup> and 23<sup>rd</sup> 2007. They totaled 40 rough untreated, 70<sup>3</sup> rough treated, and 116 faceted. From this sample group 15 faceted stones were selected for acid disintegration tests, these ranged in size from 0.97ct to 23.86ct (Table 1). The vast majority of the rough material was opaque heavily twinned and considerably fractured to the extent that it would have been difficult if not impossible to cut into faceted material. The surfaces of the treated rough (this treatment is normally applied to the rough material) was covered in a smooth, often thick coating of glass. The faceted samples appeared reasonably translucent to transparent and varied in color from pink, pinkish red through red and orangish red.

---

<sup>3</sup> More rough was obtained as treated samples but was later cut and these stones are included in the cut specimen list.



Figure 1: Some of the specimens used for this report. The rough specimens on the left represent the starting material, the specimens top and right represent the treated rough, and the specimens at center are cut from the treated rough.

The material was examined using *Gemolite* microscopes in the magnifications ranging from 10 to 60x and photomicrographs recorded digitally using Nikon system SMZ1500 with a Nikon Digital Sight Capture System and a variety of magnifications. Fluorescence images were recorded using the *DiamondView*™ (The Diamond Trading Company). The chemistry of the glass was determined with Thermo X Series II LA-ICP-MS system with an attached New Wave Research UP-213 laser. Acid disintegration tests were carried out using conc. 50% hydrofluoric acid (HF = 20) at room temperature and with no or little agitation, in an isolated environment under an appropriate fume hood.

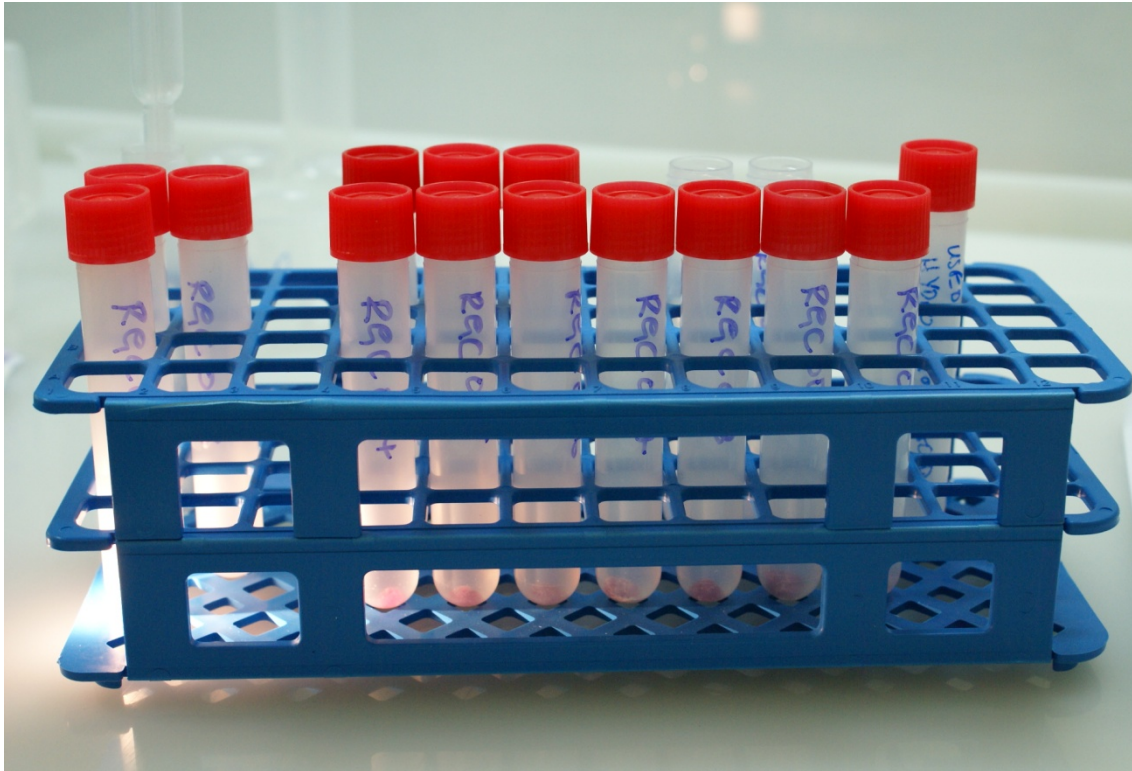


Figure 2: A rack holding individual plastic tubes that held the specimens that underwent acid disintegration. The stones were placed into the tubes and then covered with hydrofluoric acid<sup>4</sup> sealed and left to “soak” for from two to ten days.

## Inclusion observations

Figure 1 through to Figure 9 shows the typical remaining natural inclusions in the faceted treated stones. *Silk* in the form of fine intersecting needles both in isolated clusters and as part of hexagonal zones were often present as were crystals and negative crystals. None of these inclusions revealed any indications that they had been subject to heating, at least above 1300C. Therefore it is surmised that any heat involve in this treatment process should be below 1300C. Thus confirming Pardieu’s observations (Pardieu, 2005) – “... the stones are “warmed”. In fact, this step is a heat treatment. This step is important to remove the impurities possibly present in the fissures that could create some problems when the glass is added. The heat treatment may also by itself improve the stone color. This “warming” can be conducted at different temperatures from 900C to 1400C depending on the ruby type. As 900C is not hot enough to melt some inclusions as rutile, many stones can still have an “unheated” aspect. But all stones are heated.”

The “natural” inclusion scenes were largely indicative of some East African and Madagascar sources.

<sup>4</sup> Note: Hydrofluoric acid is dangerous and should only be used under controlled conditions

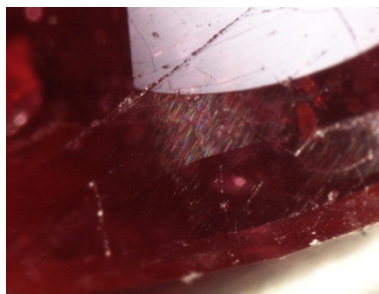


Figure 3: Rutile needles (silk) in a ruby-glass composite; the silk is unaltered by heating

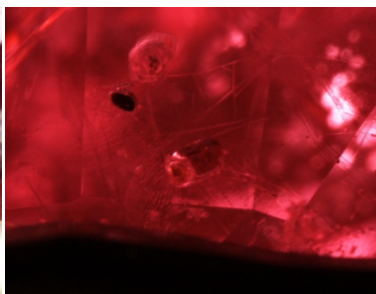


Figure 4: An hexagonal crystal in a ruby-glass composite; the crystal is unaltered by heating

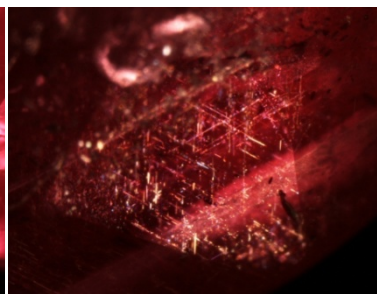


Figure 5: Rutile needles (silk) in a ruby-glass composite; the silk is unaltered by heating

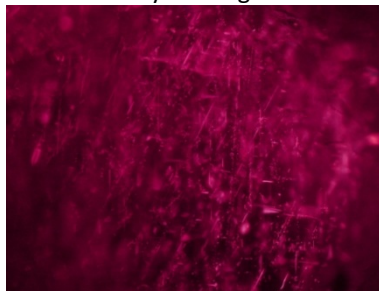


Figure 6: Rutile and other needles in a ruby-glass composite; the needles are unaltered by heating

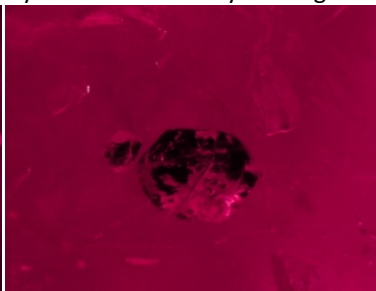


Figure 7: An hexagonal crystal in a ruby-glass composite; the crystal is unaltered by heating



Figure 8: Rutile needles (silk) in an hexagonal formation in a ruby-glass composite; the silk is unaltered by heating

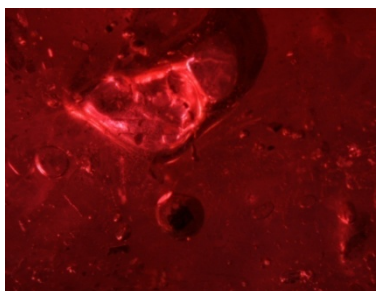


Figure 9 A crystal in a ruby-glass composite; the crystal is unaltered by heating

Also included were copious numbers of both fattened and fully expanded (Figure 10 to Figure 16) gas bubbles within the tracts of glass in each of the treated stones. In many cases the bubbles were so large and/or so prolific that the observer's first thoughts strayed towards a conclusion that the stone was a low quality glass rather than something associated with ruby. The tracts of glass also were responsible for the obvious color flashes (Figure 17 to Figure 19) that were visible even to the unaided eye. These color flashes being in stark contrast to somewhat difficult to see color flashes that have been treated in the same manner but to a lesser degree.

In one case the microscope revealed that the glass being used has an orange color (Figure 20 to Figure 24). Such orange colored glass is described by Pardieu (Pardieu, 2005) where he states "*In rubies enhanced in Bangkok by Orange Sapphire company, some yellow to orange color concentration appears in large fissures and in cavities*". A statement supported by images that compare well with Figure 20 to Figure 24. He

further states *“The fact that lead glass used in most Chantaburi treatment is pink explains why it is most of the time not visible inside the gem”*.

Glass related inclusions observed in some of the ruby-glass composites examined for this report

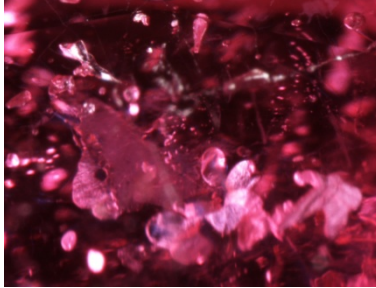


Figure 10: RGC001 flattened bubbles within filled fractures

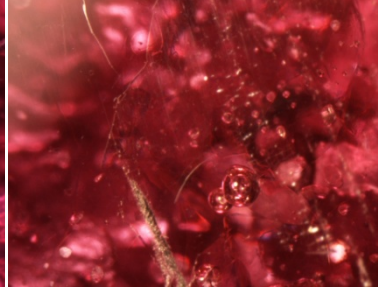


Figure 11:RGC005 expanded bubbles within filled fractures

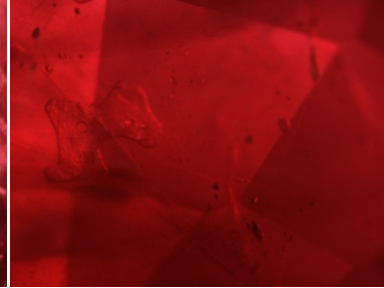


Figure 12:RGC006 flattened bubbled within filled fractures

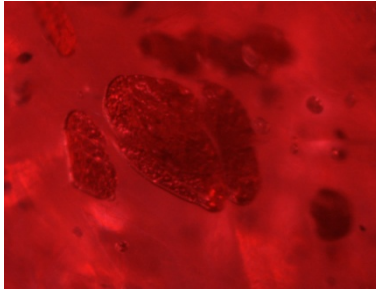


Figure 13: Flattened bubbles within filled fractures

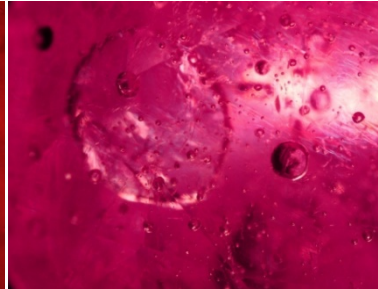


Figure 14:RGC007 flattened and expanded bubbles within filled fractures

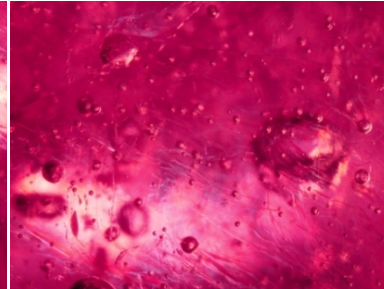


Figure 15:RGC007 flattened and expanded bubbles within filled fractures

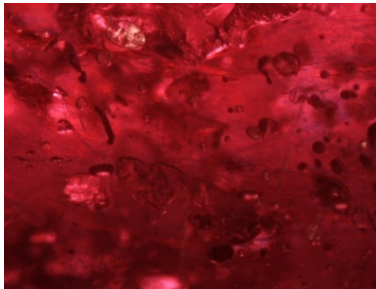


Figure 16: Bubbles within filed fractures

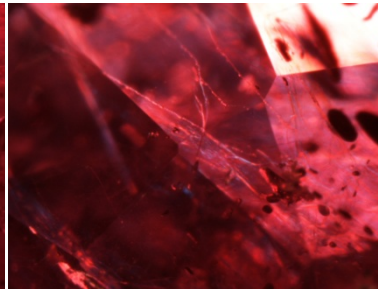


Figure 17:RGC008 color flashed from revealing the glass filled fractures

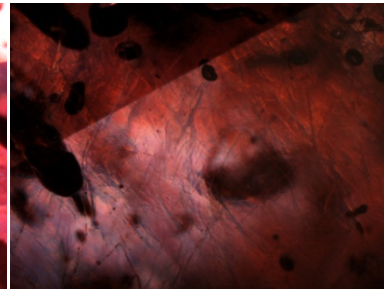


Figure 18:RGC011 color flashed from revealing the glass filled fractures

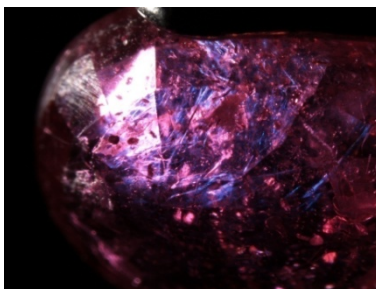


Figure 19:RGC001 color flashed



Figure 20: RGC015 orange glass

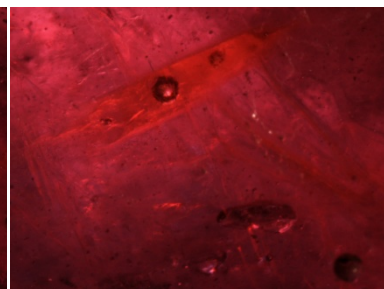


Figure 21: RGC015 orange glass

from revealing the glass filled fractures

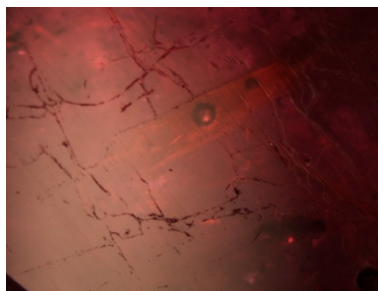


Figure 22: RGC015 orange glass filling a cavity and fracture. Figure 20 to Figure 24 show this in different lighting conditions

filling a cavity and fracture. Figure 21to Figure 24 show this in different lighting conditions

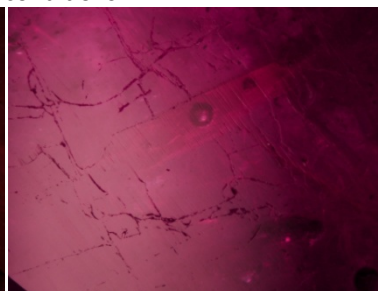


Figure 23: RGC015 orange glass filling a cavity and fracture. Figure 20 to Figure 24 show this in different lighting conditions

filling a cavity and fracture. Figure 20 to Figure 24 show this in different lighting conditions

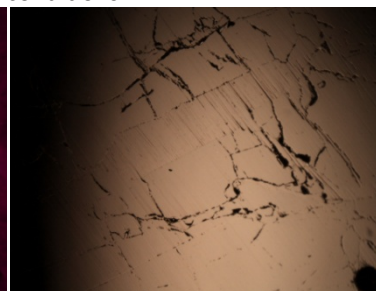


Figure 24: RGC015 orange glass filling a cavity and fracture. Figure 21to Figure 23 show this in different lighting conditions

## Fluorescence observations

In an attempt to further categorize (visually) the volume of glass used in the ruby-glass composites, 15 of the samples were examined and images recorded with the DiamondView™ (Diamond Trading Company). These images are produced here from Figure 25 to Figure 39. This exercise was rewarding in that it quickly recorded images that allowed for a close estimation of the position and volume of glass present in each stone. In particular stones RGC011 and RGC015 revealed copious amounts of glass.

DiamondView™ (Diamond Trading Company) images of specimens RGC001 to RGC015. Glass reveals itself as either black or blue tracts running across each stone. The brighter red areas reflect the positions of gas bubbles. Sample numbers are given for each stone.

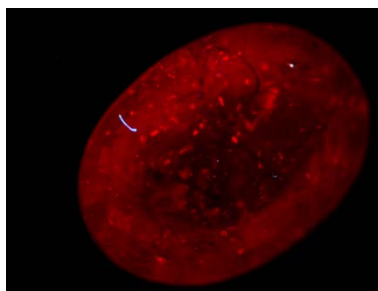


Figure 25: RGC001

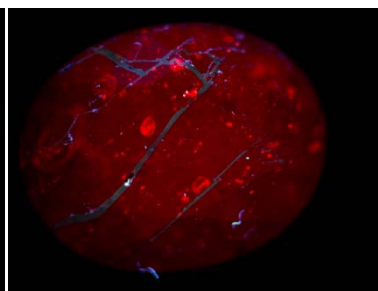


Figure 26: RGC002

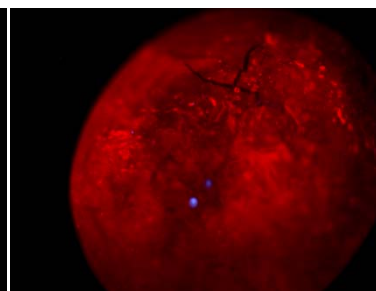


Figure 27: RGC003

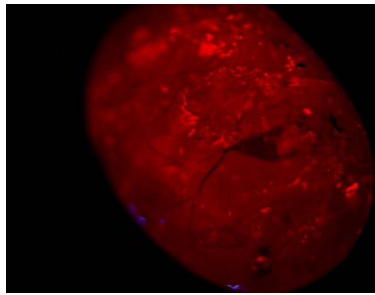


Figure 28: RGC004

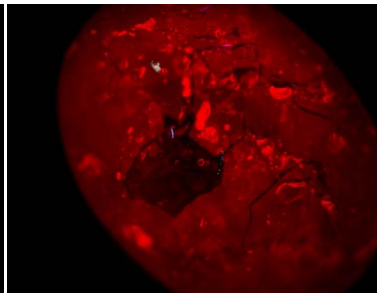


Figure 29: RGC005

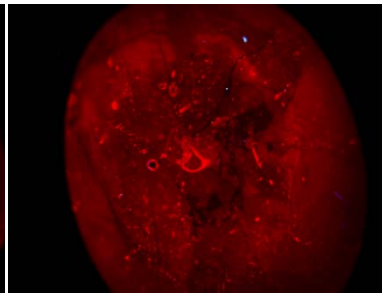


Figure 30: RGC006

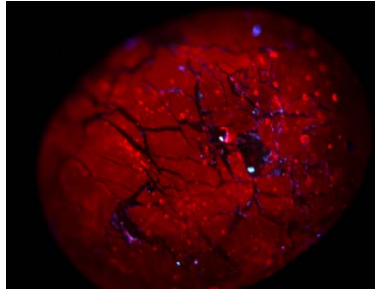


Figure 31: RGC007

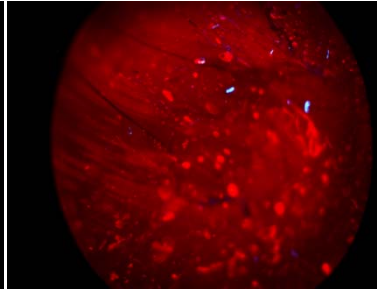


Figure 32: RGC008

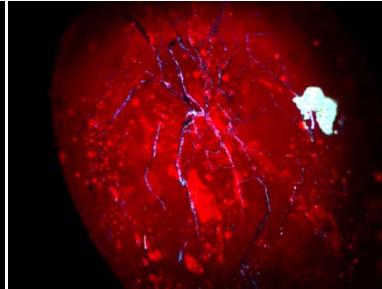


Figure 33: RGC009

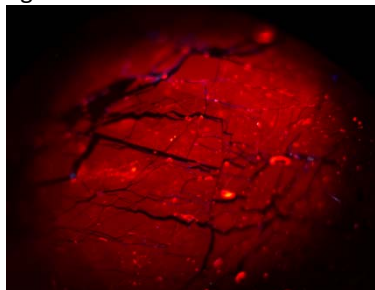


Figure 34: RGC010

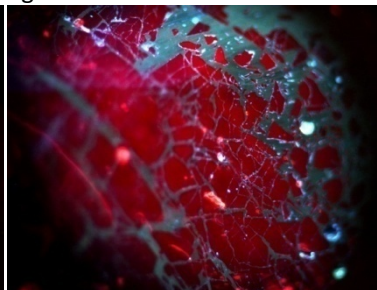


Figure 35: RGC011

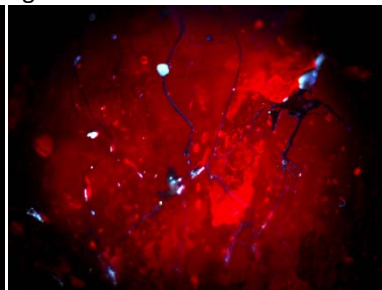


Figure 36: RGC012

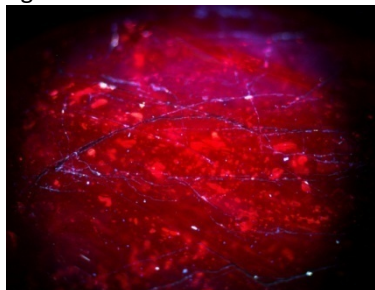


Figure 37: RGC013

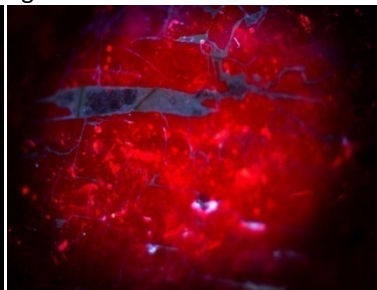


Figure 38: RGC014



Figure 39: RGC015

## Surface reflection related observations

Probably the most convenient method for locating fractures that may (or may not) have been filled with any substance is to position an overhead light and a facet on the sample in a manner that achieves near-total-surface-reflection (NTSR) of the light from the facet under examination. The stone, being examined on a microscope, is then turned to achieve NTSR from each facet. In a position of NTSR any inhomogeneity (whether a change in substance, a cavity or a surface reaching fractures) becomes clearly visible.

Figure 40 to Figure 63 show various facets on the selected 15 test specimens (RGC001-RGC015) in NTSR. All clearly show the presence glass in tracts crossing the stone (Figure 52 to Figure 57), many reveal a veritable jigsaw puzzle of ruby and glass (Figure 40 to Figure 51) while others show facets that have an approximate 50/50 ruby glass composition (Figure 61).

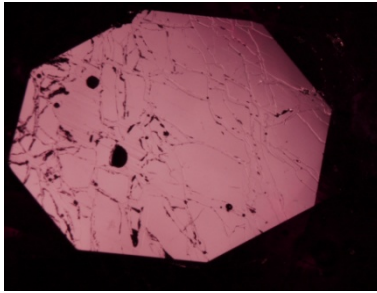


Figure 40: RGC007 this NTSR image of the table facet reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

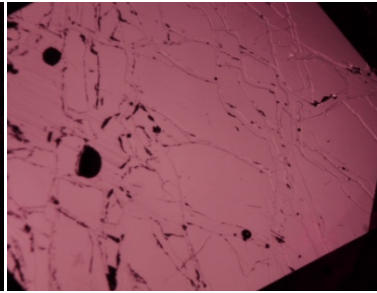


Figure 41: RGC007 (magnified from Figure 40) this NTSR image of the table facet reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

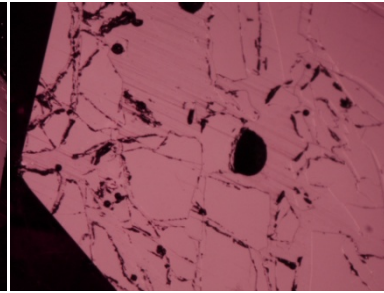


Figure 42: RGC007 (magnified from Figure 41) this NTSR image of the table facet reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

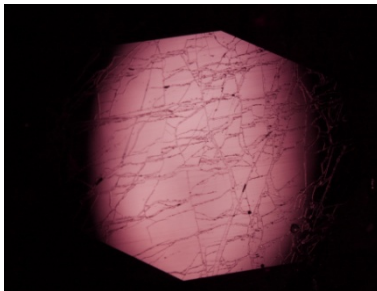


Figure 43: RGC010 as in RGC007 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

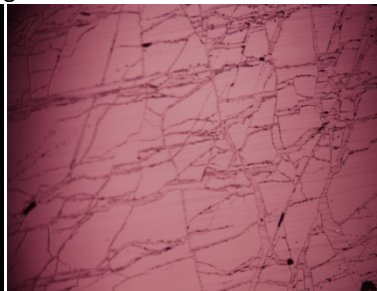


Figure 44: RGC010 (magnified from Figure 43) as in RGC007 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

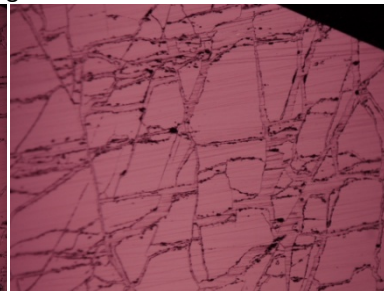


Figure 45: RGC010 (magnified from Figure 44) as in RGC007 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

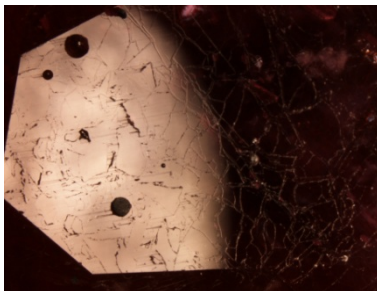


Figure 46: RGC011 as in RGC007 and RGC 010 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

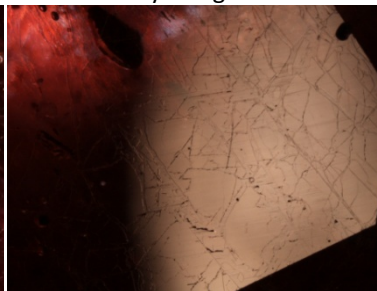


Figure 47: RGC011 (magnified from Figure 46) as in RGC007 and RGC 010 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

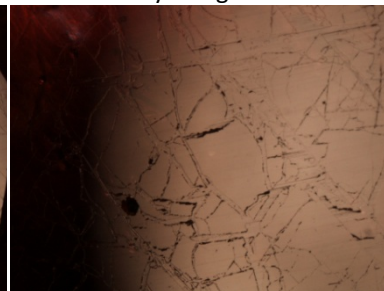


Figure 48: RGC011 (magnified from Figure 47) as in RGC007 and RGC 010 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

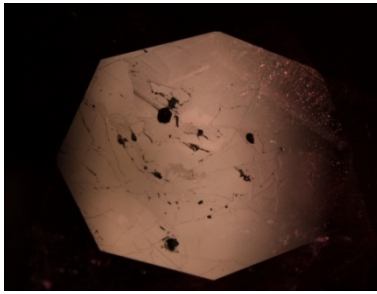


Figure 49: RGC006 as in RGC007, RGC 010 and RGC011 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

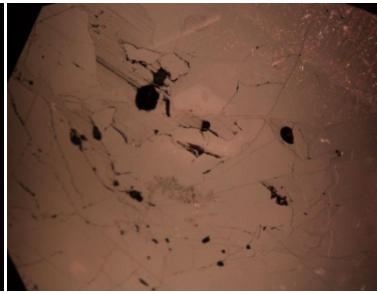


Figure 50: RGC006 (magnified from Figure 49) as in RGC007, RGC 010 and RGC011 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

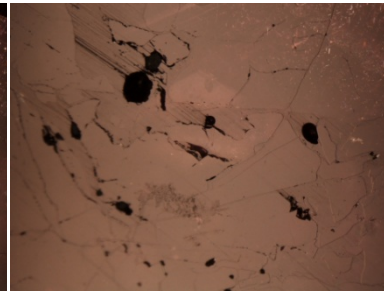


Figure 51: RGC006 (magnified from Figure 50) as in RGC007, RGC 010 and RGC011 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

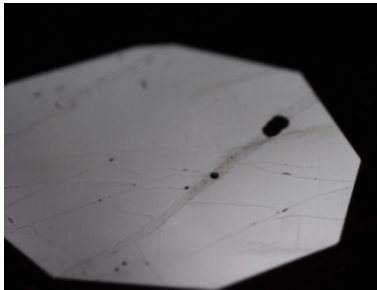


Figure 52: RGC002 showing a wide tract of glass crossing the table facet in NTSR, two bubbles are seen cut through at the surface



Figure 53: RGC002 showing a wide tract of glass crossing the table facet in NTSR, highlighted area on the same facet seen in Figure 52.



Figure 54 RGC002 showing a wide tract of glass crossing the table facet in NTSR, highlighted area on the same facet seen in Figure 52

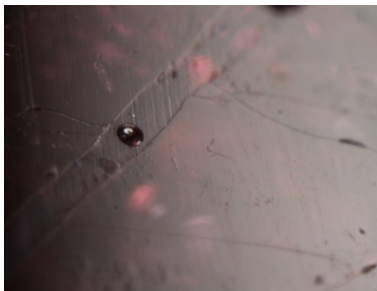


Figure 55: RGC002 showing a wide tract of glass crossing the table facet in NTSR, highlighted area on the same facet seen in Figure 52

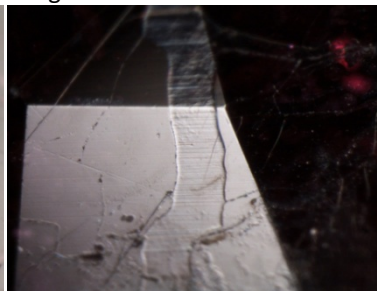


Figure 56: RGC003 showing a wide tract of glass crossing a facet in NTSR

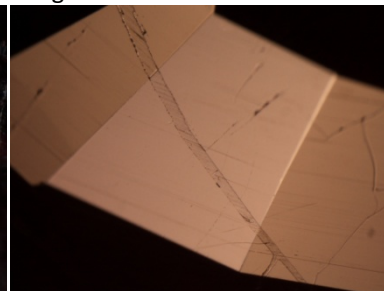


Figure 57: RGC004 showing a wide tract of glass crossing a facet in NTSR

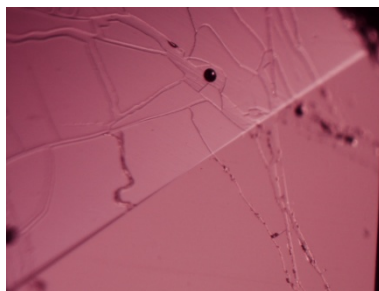


Figure 58:RGC007 showing several wide tracts of glass crossing two facets in NTSR



Figure 59:RGC010 showing wide and narrow tracts of glass crossing a facet in NTSR

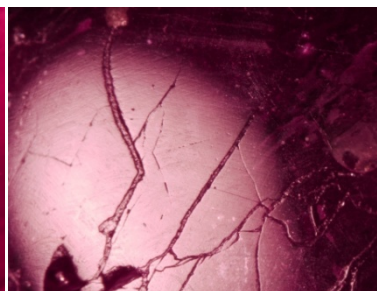


Figure 60:RGC012 showing wide and narrow tracts of glass crossing a facet in NTSR



Figure 61:RGC014 showing wide tracts of glass crossing a facet in NTSR, The proportion of ruby to glass is in the region of 50/50



Figure 62: RGC014 showing wide tracts of glass crossing a facet in NTSR.

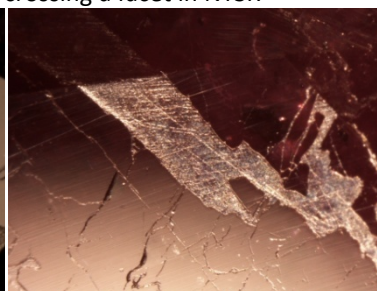


Figure 63:RGC014 showing wide tracts of glass crossing a facet in NTSR.

## Glass composition

The composition of the glass used in the specimens collected for this series of examinations is indicated in Table 2.

## Acid disintegration tests and observations

As seen in Figure 1 and confirmed through industry contacts the start material for the product described here is extremely low quality corundum and further the assumption is that the material cannot be cut and faceted as mined. This assumption is confirmed in part both through industry contacts and our own observations that the material has to be “infused” with glass prior to cutting and faceting (see again Figure 1).

During the October 2007 LMHC meeting a further assumption was made that without the presence of the glass many of these treated stones would not remain in one piece; indicating that the glass was acting much in the same way as a common adhesive. In order to test this assumption 15 stones were selected from a total of 116 faceted stones present on the Bangkok market in November 2007. These 15 stones were immersed in hydrofluoric acid for either 44hrs:45mins or 107hours. These time slots were not chosen through any form of calculation but rather they

were convenient time spans that fitted in with numerous other projects and regular workloads.

The acid began to visually disintegrate the glass within minutes of immersion (Figure 64 and Figure 65). As immersion progressed and the acid disintegrated the glass further so small parts of the stones began to fall off from the main body of each specimen (Figure 66 to Figure 81). Longer immersion resulted in the stones falling into many pieces (Figure 96 to Figure 121) and in one case a total disintegration occurred (Figure 89 to Figure 92).

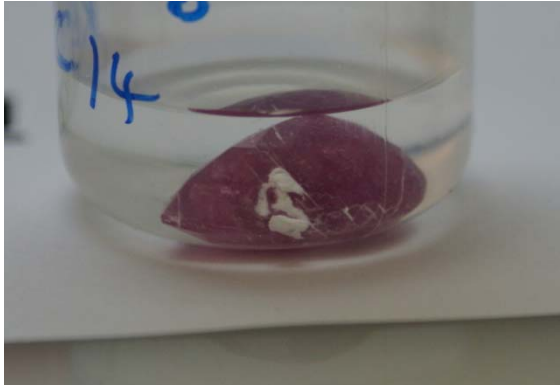


Figure 64: RGC014 seen here immersed in hydrofluoric acid. The white substance is residue from disintegration of the glass by the acid. The disintegration process begins as soon as the stone is placed in the acid. This image is taken within 30 minutes of immersion.



Figure 65: RGC015 seen here immersed in hydrofluoric acid. The white substance is residue from disintegration of the glass by the acid. The disintegration process begins as soon as the stone is placed in the acid. This image is taken within 30 minutes of immersion.

**15 ruby-glass composites subjected to acid disintegration tests (placing in hydrofluoric acid for between 2 and 10 days)**



Figure 66: RGC001 before acid disintegration.



Figure 67: RGC001 after acid disintegration.



Figure 68: RGC001 after acid disintegration.



Figure 69: RGC001 after acid disintegration.



Figure 70: RGC002 before acid disintegration.



Figure 71: RGC002 after acid disintegration.



Figure 72: RGC002 after acid disintegration.

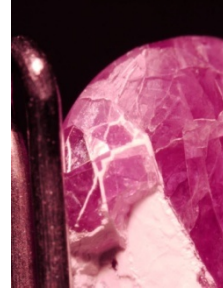


Figure 73: RGC002 after acid disintegration.



Figure 74: RGC003 before acid disintegration.



Figure 75: RGC003 after acid disintegration.

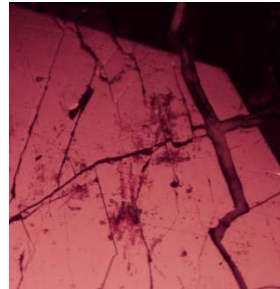


Figure 76: RGC003 after acid disintegration.

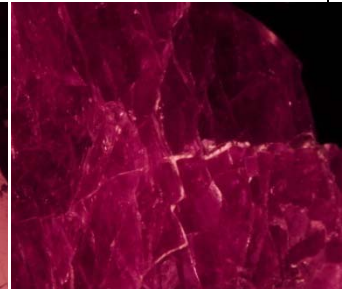


Figure 77: RGC003 after acid disintegration.



Figure 78: RGC004 before acid disintegration.



Figure 79: RGC004 after acid disintegration.



Figure 80: RGC004 after acid disintegration.



Figure 81: RGC004 after acid disintegration.



Figure 82: RGC005 before acid disintegration.



Figure 83: RGC005 after acid disintegration.



Figure 84: RGC005 after acid disintegration.



Figure 85: RGC005 after acid disintegration.



Figure 86: RGC006 before acid disintegration.



Figure 87: RGC006 after acid disintegration.



Figure 88: RGC006 after acid disintegration.



Figure 89: RGC007 before acid disintegration.

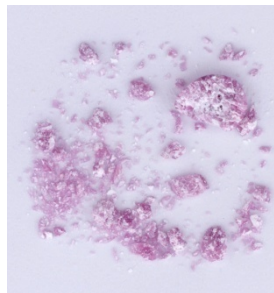


Figure 90: RGC007 after acid disintegration.



Figure 91: RGC007 after acid disintegration.



Figure 92: RGC007 after acid disintegration.



Figure 93: RGC008 before acid disintegration.



Figure 94: RGC008 after acid disintegration.



Figure 95: RGC008 after acid disintegration.



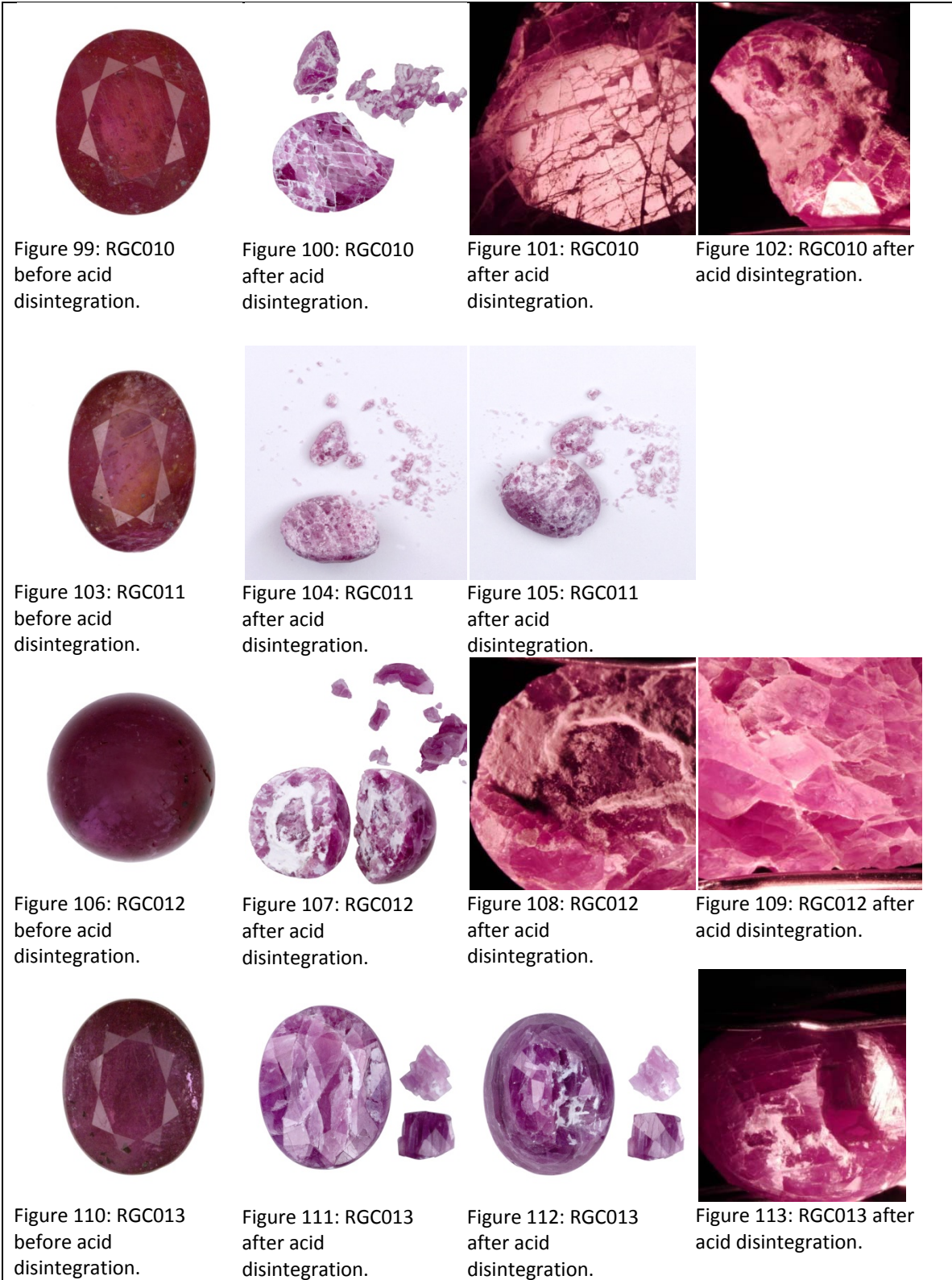
Figure 96: RGC009 before acid disintegration.

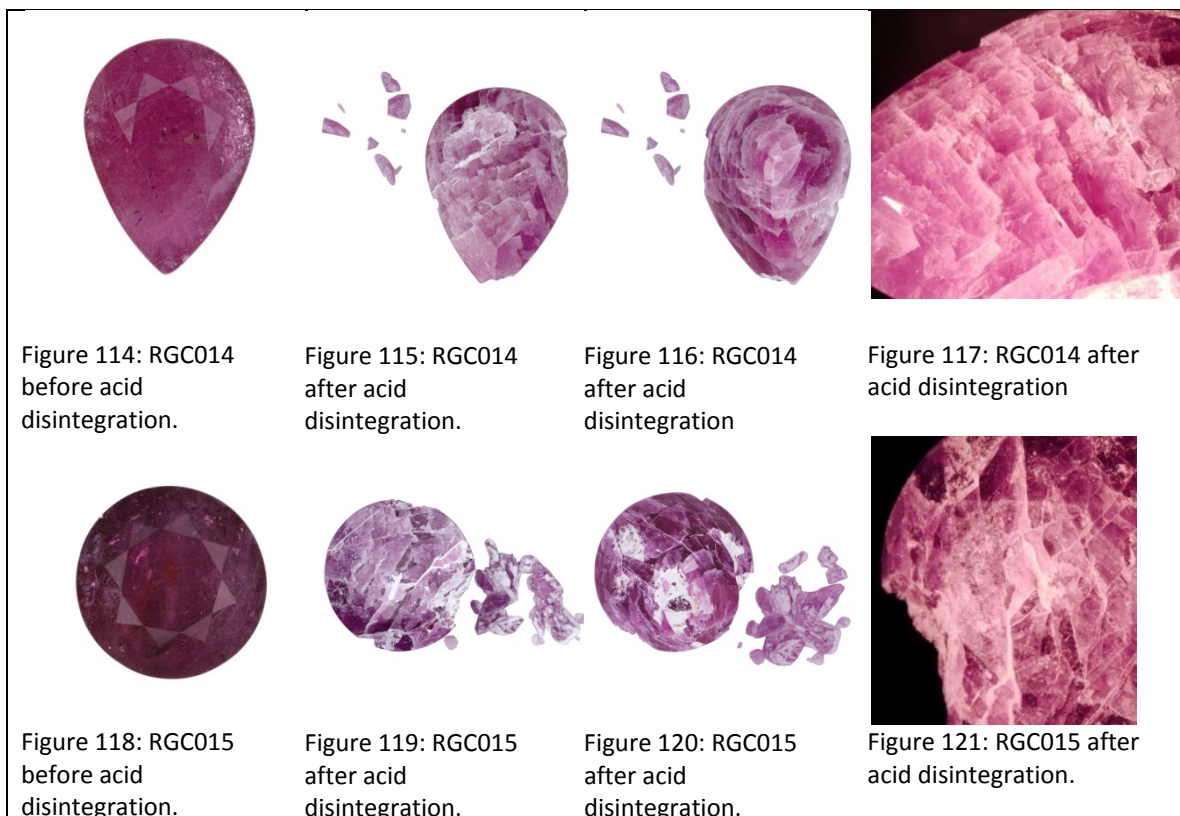


Figure 97: RGC009 after acid disintegration.



Figure 98: RGC009 after acid disintegration.



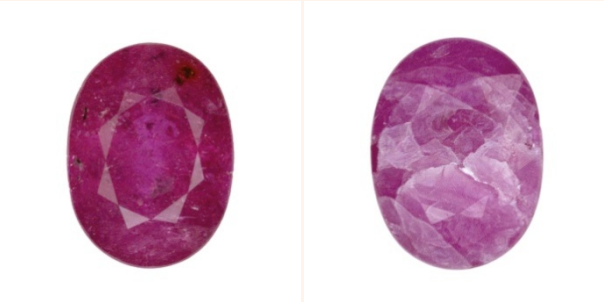



## Discussion

From the above observations and results of acid disintegration experiments it would appear that an adjustment in reporting nomenclature is necessary and that the line taken by LMHC (ruby-glass composite) is integral with this. However, this single (LMHC) change impacts other reporting areas. These other areas are those where presently report language describes “clarity enhancement” (fracture filling) regardless of the stone type and whether this involves glass or some other substance.

The market continues to be watched and assessed for any new developments to this or similar treatment processes and this discussion paper will be periodically updated.

The following new report nomenclature was introduced for use within GIA Laboratories at February 1<sup>st</sup> 2008. Suggestions and further input is welcome.

Condition	Presumed Intent / Application	Case A
Fissures present, but obviously intact material	Clarity enhancement; corundum, emeralds, tourmaline, etc	<p><b>Species</b> Natural (Corundum, Beryl or Tourmaline etc)</p> <p><b>Variety</b> (Ruby / Sapphire, Emerald or Tourmaline)</p>
<p>The images of “ruby with glass” here generally reflect the material described in this section and would also reflect the situation with emerald.</p>		<p><b>Treatment:</b></p> <p>A (minor, moderate, significant) amount clarity enhancement, using (a filler, glass, resin, oil) to reduce the visibility of fissures.</p> <p>Add (indications of heating) if filler is glass.</p> <p><b>Comment:</b></p> <p>Fissure filling materials (glass/oil/resin etc) may be unstable to elevated temperatures and to chemical agents. Special care should be taken when cleaning or repairing jewelry items set with fissure filled stones</p>
		

**Condition**

Highly fractured and/or twinned material with filled voids, channels and fissures. Material was one piece initially but may lose integrity if filling material is removed. An exceptionally large amount of filling material is present.

**Presumed Intent / Application**

To strengthen fractured rough to enable cutting; improve clarity and appearance; currently applies to corundum and beryl

**Case B**

**Species** Natural (Corundum or Beryl) with (filler, glass, resin)

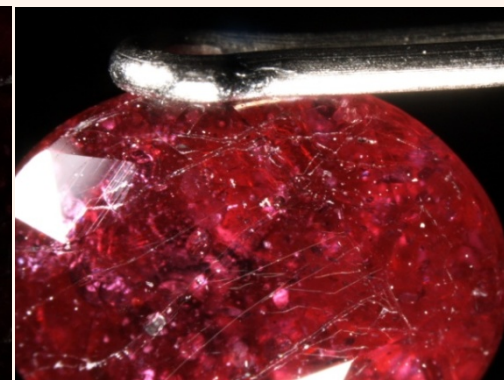
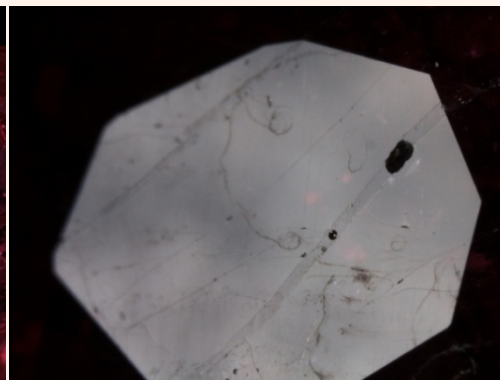
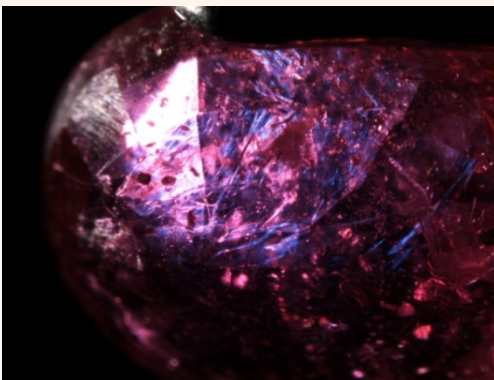
**Variety:** (Ruby / Sapphire or Emerald) with (filler, glass, oil, resin)

The images of “ruby with glass” here generally reflect the material described in this section and would also reflect the situation with emerald.

**Treatment:** Fractures filled with (glass/resin) which significantly reduces their visibility. Add ( indications of heating) if filler is glass

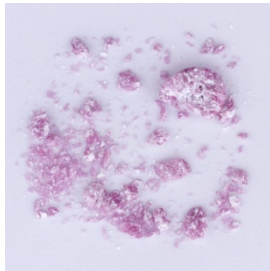
**Comment:**

Significant fractures present in this stone have been hidden from view by the treatment described above. Fracture filling materials (glass/oil/resin etc) may be unstable to elevated temperatures and to chemical agents. Special care should be taken when cleaning or repairing jewelry items set with fracture filled stones



<b>Condition</b>	<b>Presumed Intent / Application</b>	<b>Case C</b>
3. Assemblage or bonding of unrelated gemstone pieces (chunks or powder)	to produce large cutting material from unusable pieces or powders; currently applies to corundum and beryl	<b>Species</b> (Corundum-Glass / Beryl-resin) Composite <b>Variety:</b> (Ruby-Glass / Emerald-resin) Composite

The images of “ruby with glass” here generally reflect the material described in this section and would also reflect the situation with emerald.

**Treatment:**

Nothing stated

**Comment:**

This item is a combination of (ruby / emerald and glass / resin). The binding material may be unstable to elevated temperatures and to chemical agents. Special care should be taken when cleaning or repairing composite materials



<b>Table 1</b>	Ct Weight pre acid	L	W	D	Acid disintegrated	Ct Weight post acid and after drying
<b>RGC001</b>	0.97330	7.007	5.187	2.782	Into HF 14:15 November 24th 2007 out 11:00 November 26th 2007. <b>Total 44 hours 45mins</b>	0.93 major piece alone including residue
<b>RGC002</b>	1.29770	6.973	5.613	3.969	Into HF 15:22 November 24th 2007 out 10:00 November 26th 2007. <b>Total 44 hours 45mins</b>	1.00850 major piece alone including residue
<b>RGC003</b>	1.58270	7.920	6.929	3.012	Into HF 16:00 November 24th 2007 out 12:00 November 26th 2007. <b>Total 44 hours 45mins</b>	1.55 major piece alone including residue
<b>RGC004</b>	1.60520	7.510	5.593	4.245	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	1.58 major piece alone including residue
<b>RGC005</b>	1.83240	8.488	6.381	3.611	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	1.56 major piece alone including residue
<b>RGC006</b>	1.83830	8.390	6.664	3.504	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	1.82 major piece alone including residue
<b>RGC007</b>	2.09230	7.776	6.204	4.919	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	1.67 Only dust left
<b>RGC008</b>	2.47430	8.371	7.279	4.783	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	2.41 major piece alone including residue
<b>RGC009</b>	3.58680	9.491	7.430	5.298	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	3.11 major piece alone including residue
<b>RGC010</b>	5.75550	11.176	9.264	6.267	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	5.05 major piece alone including residue
<b>RGC011</b>	9.84210	14.640	10.280	6.585	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	8.23 major piece alone including residue
<b>RGC012</b>	11.71390	11.733	11.817	7.440	Into HF 12:00 December 7 <sup>th</sup> out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	11.19 major piece alone including residue
<b>RGC013</b>	12.89150	14.109	11.383	8.473	Into HF 12:00 December 7 <sup>th</sup> out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	12.72 major piece alone including residue
<b>RGC014</b>	21.05030	21.063	15.255	8.896	Into HF 12:00 December 7 <sup>th</sup> 2007 out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	20.68 major piece alone including residue
<b>RGC015</b>	23.86110	16.675	16.437	9.721	Into HF 12:00 December 7 <sup>th</sup> out 11:00 December 15 <sup>th</sup> 2007. <b>Total 107 hours</b>	23.00 major piece alone including residue

<b>Table 2</b>	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	<b>7Li</b>	<b>9Be</b>	<b>11B</b>	<b>24Mg</b>	<b>27Al</b>	<b>29Si</b>	<b>44Ca</b>	<b>45Sc</b>	<b>47Ti</b>	<b>48Ti</b>	<b>51V</b>	<b>52Cr</b>	<b>53Cr</b>	<b>55Mn</b>	<b>56Fe</b>
glass on ruby composite rough sp1	23.61	2.17	17000	6933	198000	58510	-3410	13.22	1173	1173	15.59	31.72	59.91	20.24	3188
glass on ruby composite rough sp2	21.97	2.24	15510	8177	180100	135600	1050	13.52	1133	1135	14.91	52.73	55.25	32.11	3098
glass on ruby composite rough sp3	21.36	2.08	15330	7815	198200	142100	1110	15.02	1172	1163	15.2	54.66	55.45	29.81	3155
glass on ruby composite rough sp4	21.78	2.55	15560	7583	214100	151900	1140	16.12	1228	1219	15.55	55.63	59.51	28.59	3289
glass on ruby composite rough sp5	21.57	2.32	15560	7103	185100	146500	1150	14.41	1208	1198	14.75	55.85	56.5	27.02	3217
<b>Average</b>	<b>22.06</b>	<b>2.27</b>	<b>15792.00</b>	<b>7522.20</b>	<b>195100.00</b>	<b>#####</b>	<b>208.00</b>	<b>14.46</b>	<b>1182.80</b>	<b>1177.60</b>	<b>15.20</b>	<b>50.12</b>	<b>57.32</b>	<b>27.55</b>	<b>3189.40</b>
<b>Stdev</b>	0.90	0.18	681.89	510.17	13266.69	38707.49	2022.90	1.17	36.64	32.32	0.37	10.36	2.23	4.49	71.10
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	<b>59Co</b>	<b>60Ni</b>	<b>65Cu</b>	<b>66Zn</b>	<b>69Ga</b>	<b>71Ga</b>	<b>72Ge</b>	<b>83Kr</b>	<b>85Rb</b>	<b>88Sr</b>	<b>89Y</b>	<b>90Zr</b>	<b>93Nb</b>	<b>118Sn</b>	<b>137Ba</b>
glass on ruby composite rough sp1	1.30	29.67	8.34	221.80	53.61	20.66	0.87	0.00	6.63	11.18	5.06	1813.00	1.99	4.06	157.40
glass on ruby composite rough sp2	1.45	32.55	8.92	231.80	49.85	21.19	0.98	0.00	6.21	9.76	5.08	1772.00	1.97	3.64	150.50
glass on ruby composite rough sp3	1.38	30.59	8.55	230.60	52.65	19.59	0.83	0.00	6.22	11.40	6.15	2081.00	2.00	3.54	158.40
glass on ruby composite rough sp4	1.21	30.52	8.85	243.70	55.65	20.26	0.86	0.00	6.68	12.25	6.68	2341.00	2.05	7.10	164.10
glass on ruby composite rough sp5	1.26	30.09	7.89	246.60	50.16	20.27	0.86	0.00	6.30	10.63	4.99	1777.00	2.05	4.08	154.50
<b>Average</b>	<b>1.32</b>	<b>30.68</b>	<b>8.51</b>	<b>234.90</b>	<b>52.38</b>	<b>20.39</b>	<b>0.88</b>	<b>0.00</b>	<b>6.41</b>	<b>11.04</b>	<b>5.59</b>	<b>1956.80</b>	<b>2.01</b>	<b>4.48</b>	<b>156.98</b>
<b>Stdev</b>	0.09	1.11	0.42	10.17	2.43	0.59	0.06	0.00	0.23	0.93	0.78	250.10	0.04	1.48	5.03
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	<b>139La</b>	<b>140Ce</b>	<b>146Nd</b>	<b>147Sm</b>	<b>153Eu</b>	<b>163Dy</b>	<b>172Yb</b>	<b>175Lu</b>	<b>181Ta</b>	<b>182W</b>	<b>208Pb</b>	<b>220Bkg</b>	<b>232Th</b>	<b>238U</b>	
glass on ruby composite rough sp1	2.00	4.85	1.96	0.45	0.06	0.65	1.29	0.21	0.43	0.20	1131000	0	1.30	1.76	
glass on ruby composite rough sp2	2.10	5.00	1.66	0.38	0.08	0.55	1.02	0.23	0.42	0.15	1042000	0	1.32	1.82	
glass on ruby composite rough sp3	2.39	5.39	2.14	0.45	0.10	0.63	1.27	0.26	0.46	0.19	1044000	0	1.61	1.75	
glass on ruby composite rough sp4	2.66	5.76	2.35	0.54	0.10	0.79	1.44	0.30	0.49	0.25	1074000	0	1.73	1.85	
glass on ruby composite rough sp5	2.19	5.19	1.66	0.34	0.08	0.54	1.19	0.21	0.50	0.25	1090000	0	1.39	1.94	
<b>Average</b>	<b>2.27</b>	<b>5.24</b>	<b>1.95</b>	<b>0.43</b>	<b>0.08</b>	<b>0.63</b>	<b>1.24</b>	<b>0.24</b>	<b>0.46</b>	<b>0.21</b>	<b>1076200.00</b>	<b>0.00</b>	<b>1.47</b>	<b>1.82</b>	
<b>Stdev</b>	0.26	0.36	0.30	0.08	0.02	0.10	0.16	0.04	0.04	0.04	36758.67	0.00	0.19	0.08	

## References

- Kane, R. E. (1984) Natural rubies with glass-filled cavities. *Gems & Gemology*. 20. 4. 187–199
- Scarratt, K., *et al.* (1984) Glass infilling of cavities in natural ruby. *Journal of Gemmology*. 19. 4. 293–297
- Hughes, R. W. (1987) Glass infilling of cracks in ruby. *ICA Lab Alert*. 4. 1
- Scarratt, K. (1987) Glass infilling of cavities in ruby and sapphire. *Journal of Gemmology*. 20. 7/8. 421
- Hlaing, U. T. (1993) Mong Hsu ruby update. *Australian Gemmologist*. 18. 5. 157-160
- Kremkow, C. (1993) Burma is back: Mong Hsu ruby rush transforms market. *ICA Gazette*. 1, 9
- Laughter, T. (1993) How do you do? I'm from Mong Hsu. *JewelSiam*. 4. 5. 38–41
- Peretti, A. (1993) Foreign substances in Mong Hsu rubies. *JewelSiam*. 4. 5. 42
- Smith, C. P., *et al.* (1994) The Mong Hsu ruby: A new type of Burmese ruby. *JewelSiam*. 4. 6. 82-98
- GAAJ. (2004) GAAJ Lab Alert:- lead glass impregnated ruby. [http://www.gaai-zenhokyo.co.jp/researchroom/kanbetu/2004/gaaj\\_alert-040315en.html](http://www.gaai-zenhokyo.co.jp/researchroom/kanbetu/2004/gaaj_alert-040315en.html)
- Pardieu, V. (2005) Lead Glass Filled/Repaired Rubies, Version 04. <http://www.aigslaboratory.com/Filearticle/55.pdf>
- Smith C.P., M. S. F., Wang W., Hall M. (2005) Some characteristics of lead-glass-filled corundum. *Jewellery News Asia*. November. 255. 79-84.
- McClure, S. F., Smith, C.P., Wang, W., Hall, M. (2006) Identification and Durability of Lead Glass-Filled Rubies. *Gems & Gemology*. 42. 1. 22-34
- AGL. (2007) AGL Modifies its Disclosure Policy on Lead-Glass Filled Rubies <http://www.aglgemlab.com/AGLModifiesDisclosure.html>

---

<sup>i</sup> **Composite materials** (or **composites** for short) are engineered [materials](#) made from two or more constituent materials with significantly different physical or chemical properties and which remain separate and distinct on a macroscopic level within the finished structure. - [http://en.wikipedia.org/wiki/Composite\\_material](http://en.wikipedia.org/wiki/Composite_material)