Accredited Gemologists Association
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September 28, 2012

Donald S. Clarke
Secretary
Federal Trade Commission
Office of the Secretary
Room H-113 (Annex O)
600 Pennsylvania Avenue, NW
Washington, DC 20580

RE: Jewelry Guides, 16 CFR, Part 23, Project No. G711001

Dear Secretary Clarke:

This submission by the Accredited Gemologists Association (AGA) is in response to your request for comments regarding your comprehensive review of the Commission's Guides for the Jewelry, Precious Metals, and Pewter Industries, and your specific request for comments pertaining to lead-glass-filled rubies.

The AGA was founded in 1974 to provide continuing gemological education on new gemstone discoveries, new occurrences of known gemstones, treatments, synthetic materials, and imitations. We are currently the only gemological organization in the United States that is wholly independent of any trade group or organization, and focuses its efforts on establishing and maintaining high professional standards for the trade with regard to diamonds, colored gemstones, and pearls. We are a proactive organization that focuses on issues of importance to the public—and trade—and our membership has spearheaded consumer-oriented alerts on such serious situations as the telemarketing schemes of the 1980s. AGA members are all experienced gemologists, with highly respected credentials and many years experience.

Congress has declared that "unfair and deceptive acts or practices" shall not be allowed in U.S. interstate commerce, and it has empowered the FTC with authority to enforce that prohibition. Additionally, Congress authorized the FTC to adopt industry-wide trade regulation rules, and it has done so with respect to the jewelry industry with The Jewelry Guides. The Guides provide a roadmap for fair dealing by outlining when disclosures should be made to avoid unfair or deceptive trade practices as jewelry products are sold between wholesalers all the way down to retail consumers.

The current jewelry marketplace has changed considerably since The Guides underwent their last comprehensive review in 1996. Greater emphasis was placed on disclosure of treatments to diamonds and other gemstones to prevent deception and unfair dealing. Those revised guidelines have not worked as well as anticipated. Furthermore, as a result of the current loopholes present in the Guides pertaining to disclosure of treatments, there are now many more (and more extensive) treatments being used on many more gemstones, and many of these are being sold with no disclosure or inaccurate disclosure.

Current Gemstone Marketplace: A Triad Leading to Confusion and Deception

There are three general types of gemstones encountered in today's increasingly global marketplace. First is what we prefer to call "natural" gemstones, which we classify as having been created within the earth and not altered subsequently in *any* way, except for cutting and polishing. Second is what we refer to as "treated" gemstones, classified as having been created within the earth but subsequently altered by some treatment method to improve appearance, beyond cutting and polishing. Finally, there are "synthetic" gemstones, which are created not within the earth but in a factory or laboratory. Synthetic gemstones have essentially the same physical, chemical and optical properties of their natural counterparts, but typically sell for lower prices than earth-created gemstones. Of course, "imitation" gemstones are also manufactured to look like natural gemstones, but they have none of the physical, chemical and optical properties of natural stones.

This triad was not always the case. Prior to the last half of the 20th century, there were really only two categories of gemstones: *natural* and *synthetic*. Before the 1960s, use of treatments was the exception rather than the rule. The word "natural" was originally intended simply to separate "naturally occurring" stones—that is, those formed within the earth—from stones being created in laboratories/factories with the same physical/chemical properties of the naturally occurring stones. At that time, the term "natural" served a valuable purpose, its intent being to help protect the public from "synthetic" gems being misrepresented as "natural" gems.

But today there are essentially two types of "natural" gemstones, when defined as "created within the earth": *natural* (that is, as nature created them, with the exception of cutting and polishing); and *treated* (that is, the color and/or clarity have been improved in some way through human intervention). Man has used a variety of methods to enhance the beauty of gemstones, including heat, oil, dyeing, bleaching, coating, and filling. More recently, irradiation, lasering, and diffusion with chemicals have been added to the assortment of treatments routinely encountered by gemologists examining gemstones. Use of these treatments increases the supply of gemstones, and allows consumers in all income brackets to purchase jewelry to suit their taste and budget.

Treated "naturally occurring" gemstones, however, are less valuable than *natural* "naturally occurring" gemstones. Most consumers are unaware of the value differences because they don't even know there are two categories of "naturally occurring" – natural and treated. The word *natural* has itself become a problem. In light of the quantity of treated gemstones in the market, the word "natural" immediately preceding the name of a gemstone that has been treated is no longer a valid qualifier, but one that is misleading.

Take for example, corundum, the mineral called "ruby" when it is red and "sapphire" when it is blue or any of the many other colors in which it occurs. Red is also the rarest, so it is also the costliest. Throughout most of history, rubies and sapphires underwent very little treatment to enhance their appearance. But as demand for ruby and sapphire increased in the 1960s and 1970s, supplies were being exhausted. Anxious to meet this new demand, enterprising dealers discovered they could heat lesser quality corundum to improve its color and clarity. This new "treatment" went undetected for several years and quickly became routine.

Eventually, virtually all rubies and sapphires sold in jewelry stores worldwide were heat-treated, and seldom was that treatment disclosed to purchasers. Most jewelers were unaware of the new "heat treatment" and, therefore, they were not informing consumers that they were buying stones that they were different from those purchased by their parents and grandparents before them. Even the prices at which the treated material was initially sold did not raise questions because they were comparable to the prices of natural, untreated material. Eventually, however, prices dropped as more and more treated material entered the market and supply outpaced demand.

Once accepted within the trade, albeit, without disclosure, treatments were here to stay. Today there are numerous types of treatments being used on an ever-increasing number of gems. The issue is not that gems are treated—in fact, without the introduction of gemstone treatments, it is possible that only the wealthiest would be wearing lovely jewelry today—but the absence of disclosure that is the issue; *non*-disclosure has resulted in confusion related to what the term "natural" means today in the context of the description of a gemstone, and this has led to consumer deception and exploitation. These issues need to be addressed in the current revisions.

In the absence of explicit information with regard to treatments, it is reasonable for consumers to expect that the word "natural" when used in association with a specific gem or piece of jewelry being considered for purchase, means a *natural* gemstone – that is, not altered or enhanced in any way by except for cutting and polishing.

***All* Gemstone Treatments Must Be Disclosed to *Every* Purchaser**

While trade organizations began to take steps to remedy the disclosure issue in the 1990s, clear and forthright information pertaining to treatments—and the impact of specific treatments on beauty, durability, and value—is still not provided by most jewelers at any stage of transactions with customers. At one extreme, jewelers fail to provide *any* information on treatments. At the other extreme, some jewelers insist that gemstones have *always* been routinely treated, and that *all* gemstones are treated in some manner. This type of distorted information is not accurate and does not serve the interests of the public. To say that *all* gemstones are treated is as misleading as saying that *none* are. [See Attachments 15-17]

Complicating matters further and adding to the confusion is that while most gems sold today are treated, and consumers are buying them unknowingly, there are also an increasing number of *natural* gems entering the market. Natural, untreated gems are still being mined, and natural gems also re-enter the market through estate dealers, auctions, and other sources.

Furthermore, natural gemstones (that is, those not treated in any way) are now receiving unprecedented publicity following major auctions at which they are reaching new record-setting prices, reinforcing the public's perception that natural gemstones are rare and valuable. This, combined with the use of the word "natural" as currently permitted in the FTC guides, creates opportunities for deception and misrepresentation.

In today's market—with so many stones now being "routinely" treated in some way—the FTC faces a new and daunting challenge: not only must the agency address ways to help ensure that consumers are informed about whether or not a stone was created within the earth rather than in a laboratory or factory, but now the FTC must do whatever possible to help ensure consumers are informed as to whether a gemstone is a "naturally occurring gemstone" (that is, not "treated" in any way) or whether its appearance is the result of its having been "treated" after being unearthed.

The AGA has long believed that disclosure of *any* treatment to a gemstone should be the norm, not the exception. Disclosure of gemstone treatments must become an essential statement of fact, and although mandated by the current FTC Jewelry Guides. Section 23.22 (Disclosure of Treatments to Gemstones), it should no longer be "qualified" as it now exists.

> It is unfair or deceptive to fail to disclose that a gemstone has been treated if:
>
> (a) the treatment is not permanent. The seller should disclose that the gemstone has been treated and that the treatment is or may not be permanent;
> (b) the treatment creates special care requirements for the gemstone. The seller should disclose that the gemstone has been treated and has special care requirements. It is also recommended that the seller disclose the special care requirements to the purchaser;
> (c) the treatment has a significant effect on the stone's value. The seller should disclose that the gemstone has been treated.

Gemologists, bench jewelers, and many gemstone dealers can attest to the fact that *all* treated gems—regardless of the type of treatment—are covered by at least one of the sections above. Many are not permanent, but even in cases where they are, they usually need special care. Even "heating" alone can cause increased brittleness that will result in more damage in the course of normal wear. Finally, *all* treated gems in today's market sell for less—often much less—than treated stones, no matter how minimal the treatment.

The AGA believes the time has come to revise the Jewelry Guides to mandate disclosure of *all* treatments to gemstones beyond cutting and polishing. The "shoulds" in Section 23.22 ought to be revised to "musts." Sellers *must* disclose each and every treatment they know, or have reason to believe, has been applied to a gemstone offered for sale to another seller or retail customer.

We can appreciate the issues inherent in modifying the Guides in this direction. But the public desperately needs clarity, and the Guides need to ensure that the public is receiving the information necessary to make informed choices and to understand what they are buying.

Lead Glass-Filled Ruby: A Case Study in Misrepresentation and Deception

Although heat treatment of ruby and sapphire has become the norm over the past half century, a few years ago, our members began seeing a new ruby product at gem shows offered for a few dollars per carat. Most of these "rubies" were represented as being "treated by heat only." It wasn't long before we discovered this was not the case. Our members began receiving calls from bench jewelers who were finding that these "rubies" were not behaving like any ruby they'd ever handled, and that routine jewelry repair and manufacturing techniques were causing extensive and irreparable damage (for which they, the bench jewelers, suffered damage to reputation—and thus future business—as well as having been held financially responsible by retailers and/or consumers).

Gemological examination of the stones revealed unprecedented quantities of glass – a highly refractive *lead*-glass in particular – combined with some unknown quantity of corundum (the mineral known as ruby only when it occurs in a red color with good transparency, or "sapphire" when it is blue or any other color in which nature creates it). In short, a "blend" of two materials altogether different in terms of physical properties.

Subsequent research by AGA members, in association with several of the world's leading gem-testing laboratories, revealed that the lead-glass became an integral part of the blended product and cannot be removed without destroying the entire "gem." Furthermore, the properties associated with "ruby" are no longer the same since the properties associated with lead-glass are also present and inseparable. These are two critical differences between this product and treated rubies. [See Attachments 24-30]

Without the lead glass, there is no "ruby" in terms of color and transparency, but *with* the lead-glass, the physical properties are so altered that the resulting "ruby" lacks the characteristics that make "ruby" a ruby. The fusion of these two very different materials creates something that is neither ruby nor glass, but a new type of imitation that combines properties of both, each of which is inseparable from the other—in short, a new type of "composite" (an imitation created from two or more materials being joined together in some way, to imitate a rarer, and more costly gem). Composites can be formed from two or more parts of a genuine stone, or two or more parts of an imitation or synthetic, or from a combination of genuine and artificial.

This new product now being sold as "treated ruby," at inflated prices, poses a serious threat to consumers that was unknown at the time of the last FTC review more than 10 years ago.

The AGA has numerous real-life examples—some of which are provided in documents submitted along with these comments—of the problems created as a result of selling this product as ruby when the most important physical characteristics associated with ruby—its toughness, hardness, and overall durability, ranking it next to diamond in terms of these characteristics—is not present in this new product. These composites are not only *less* durable, they are *very* fragile. [See Attachments 1-14]

In addition, the lead-glass component has other adverse effects on the ability of anyone selling this product to be in compliance with current FTC guidelines related to a) identity of the stone; b) carat weight; c) quality; d) disclosure related to care requirements, and e) value.

The lead-glass products now in the market are being misrepresented specifically as to their "type," "kind," "quality," "weight," "durability," and "value."

- **Kind**: The lead-glass products are being misrepresented as to the "kind" of product; they are being represented as "treated ruby" when the altered material no longer has the properties of ruby. This lead-glass product is neither ruby nor glass, but a new type of imitation that combines properties of both glass and corundum, each of which is inseparable from the other.
    - They have been clearly identified by the two most highly respected gem-testing laboratories in the USA—the Gemological Institute of America (GIA) and American Gemological Laboratories (AGL) as products that are not genuine ruby. [See Attachment 30]
    - GIA identifies them as *"manufactured products,"* and AGL identifies them as *"composite ruby."* [See Attachments 18-23 and 33]
    - Both labs include comments pertaining to presence of significant amounts of lead-glass, and the need for unusual care. The AGL laboratory states: *"the product has been heavily treated using a high refractive index lead-glass to fill fractures and cavities, vastly improving the apparent clarity and adding weight. The glass may be damaged by a variety of solvents."* [See Attachment 22]

- There are devastating consequences resulting from using traditional techniques on these lead-glass "rubies" at the bench—extreme and irreparable damage—a further indication that the product may look like ruby, but that it is a product that lacks the durability of ruby, a very important characteristic long associated with ruby.

- **Quality**: Because of the composition of the product, and the extensive amounts of lead-glass, no one can know the true quality of the product because it is impossible to conduct accurate color and clarity grading—the two most critical factors involved in determining the quality and value of any gemstone. Lead-glass products cannot be accurately be graded for 3 primary reasons:

  - The high refractive index (RI) of the lead-glass conceals the fissures/fractures, making it impossible to determine how many there are, how deeply they penetrate into the stone, and thus, how great a risk they pose with regard to breakage in the course of normal wear.

    What Is "RI" and How Does It Affect Quality Grading?
    The refractive index of a stone relates to how the light moves through, and between, different media—in this case, ruby and glass. The greater the difference between the RI of each substance, the more easily one can see important internal characteristics; the closer the RI, the more difficult it is to see them. If the RI is essentially the same for both substances, one cannot distinguish where one ends and the other begins. This is why other types of glasses sometimes seen in ruby (usually silica glass) are different; they have lower RIs so one can actually see where the fracture is and properly grade the stone.

    The RI of lead-glass is almost a perfect match to that of ruby. This means that as light moves through the stone, one cannot see where one substance ends and the other begins. This is why, in lead-glass products, one can't see the fractures, and thus can't evaluate the stone's clarity. It is virtually impossible to determine how deep or wide—how dangerous—any fractures or fissures might be. Even a single fracture can be extremely dangerous and severely affect the clarity rating, depending on where it is located and how far it penetrates into the stone, and thus its longevity and value.

    Below one can see how the quantity of lead present affects the RI—the more lead, the higher the RI. It is clear that the percentage of lead present in the glass used on these rubies is very high.

RI's For Various Glasses:

Glass, Fused Silica	RI 1.459
Glass, Pyrex	RI 1.474
Glass, Flint, 29% lead	RI 1.569
Glass, Flint, 55% lead	RI 1.669
Glass, Flint, 71% lead	RI 1.805

The RI of corundum (ruby/sapphire) is 1.76-1.77; form the list above one can see that in order to have the same RI, the lead content in the glass must be in the range of 68-69%. The amount of lead in the glass also accounts for it weighing so much more than ruby, or other glasses used in "treated" material.

- The filler cannot be removed. Another important distinction between lead-glass fillers and other fillers used routinely to treat ruby/sapphire to improve appearance—and which can rightly be sold as "treated ruby"—is seen in whether or not the filler can be removed for any reason. Other fillers, including common silica glass, oil, or epoxy resins, can be removed in cases where this might be necessary to determine whether or not a coloring agent has been added to the filler, or to ascertain how much filler—how heavily filled—the stone is (as with epoxy resins used in emerald). In the case of the lead-glass filler used in these stones, the lead-glass used to create the product cannot be removed from the stone without destroying the stone's structural cohesiveness; attempts to remove the lead-glass result in the destruction of the stone (it crumbles or falls apart).

- The Lead-Glass Filler is Not Colorless. The lead-glass is usually tinted. When analyzed, the lead-glass used has been tinted in order to improve the color seen in the finished product, so one cannot know what the actual color was.

- **Weight**: Ruby weight is indeterminable with these products. We know that lead-glass weighs much more than ruby, but since the lead-glass cannot be removed, and its high RI makes it impossible without expensive, sophisticated instrumentation to ascertain exactly how much glass versus ruby is in a particular stone, it is not possible to accurately determine the weight of the ruby component. Therefore, one cannot calculate the actual ruby weight. The only thing certain about the ruby weight is that it is less than the weight indicated for the entire stone, and in many cases, much less.

This has been noted by respected laboratories around the world, and is indicated on the AGL reports on lead-glass products. One can only estimate the percentage of ruby versus glass in the stone based on the presence of characteristics found only in glass (bubbles, blue-flash, surface crazing), or only in ruby, but a precise weight cannot be known.

- **Durability**: Lead-glass products lack the durability of ruby:
    - Lead-glass is much softer_than ruby (and other glasses used in treatments) and wears more quickly than ruby.
    - Lead-glass is much more vulnerable to scratching, chipping and breaking with normal wear than ruby.
    - Lead-glass is vulnerable to acid-etching by many commonly encountered substances, including lemon juice.
    - Lead-glass composites are quickly and irreparably damaged by techniques that have been routinely used for centuries on ruby or treated ruby; these techniques include the use of heat, and chemicals and acids used routinely in the course of making or repairing jewelry containing such products.
    - The "joins"—the planes—between the lead-glass and ruby also weaken the overall structure of the product, making them more susceptible to damage from an accidental knock or blow.
- **Value**: Lead-glass rubies are being sold to consumers for hundreds to thousands of dollars per carat, when the cost should be 5-10 times less than what they are paying. Within the trade, lead-glass rubies under 5 carats each originally entered the market at prices between $1.00-5.00 per carat. Today, trade acceptance of these as "just another type of treated ruby" has resulted in sharply higher prices for the same sizes/qualities, now costing $10.00-20.00 per carat. Jewelry containing these stones is being sold by some vendors to the trade at highly inflated prices, which are then even more highly inflated when sold to consumers.
    - Retailers purchasing jewelry pieces containing these stones are told they are rubies and are themselves paying very inflated prices for the pieces they buy, and then passing on their mistake to their customers at even higher prices. While they are easy to distinguish from rubies or treated rubies, most jewelry retailers have not taken the time to learn what the distinguishing characteristics are, but describe and price what they sell based on what they are being told by vendors, who often are doing the same thing with regard to their own sources.

- The unscrupulous at all market levels are misrepresenting them knowingly, and selling them at huge profits.

It is for the foregoing reasons that the AGA believes it is essential that the FTC understand how these lead glass-filled ruby products differ from other products in the market that are accurately described as "treated ruby" (or sapphire, or other gemstone name), and how selling them as "ruby" or "treated ruby" violates current FTC guides.

It should be noted that while we discuss our research and experiences related specifically to ruby, we are also now seeing blue, green and yellow sapphires that are the same type of product, with the same issues for public and trade alike. These are also being treated with a high RI glass, resulting in different physical characteristics, a much lower value, and the need for special care to avoid breakage or severe and irreparable damage. [See Attachments 32-34]

The AGA cannot ignore what occurred with rubies and sapphires, when "treated" material first entered the market, and the potential for such a scenario to occur again, unless the current FTC Jewelry Guides are revised to help prevent it. There is already growing concern about just this sort of thing occurring with another gemstone family—the spinel family. The similarities are clear: demand for this beautiful, rare, natural gemstone is increasing dramatically, supply is decreasing, and prices are strengthening. Spinel is highly sought after not only because it is beautiful and rare, but also because connoisseurs are looking for *natural and untreated* gems, and the spinel family is one of the few gemstone families known to be "natural" and "untreated." Until now, that is.

As we saw with sapphires and rubies, treatments to improve the quality of less desirable spinels are beginning to appear in order to meet rapidly increasing demand, and to take advantage of the rising demand in order to sell "treated" spinels, without disclosure, at much higher prices. But the difference between now and the 1960s is that we know about treated material entering the market; we know that treated and untreated spinels are not "the same thing;" and we know how to separate one from the other. Natural spinel is more rare and more expensive than treated spinel. However, if the FTC Jewelry Guides permit treated *and* untreated material to be sold as *natural*, it will lead again to confusion, misrepresentation, and exploitation, just as it did in the 1960s and 1970s. [See Attachment 31]

After considering all of the information provided above, including the historical and current market realities, the AGA strongly recommends that the FTC restrict the use of the qualifier "natural" so that it can precede the word "ruby," "sapphire," "emerald," "topaz," "spinel," or the name of any other precious or semi-precious stone, to *describe **only** stones formed within the earth and which have not been artificially altered in any way.*

Furthermore, in order to ensure clarity and eliminate confusion, the AGA strongly recommends that the FTC revise the *guides to require use of the word "treated," or other similar word, to immediately precede the word "ruby," "sapphire," "emerald," "topaz," "spinel" or the name of any other stone* that formed within the earth *and subsequently was altered to improve appearance, in any way, apart from cutting and polishing*.

A Few Comments About Pearls

The Commission has questioned whether it should amend the Guides to recommend any specific disclosures relating to freshwater pearls, and whether the Guides should advise the disclosure of treatments to pearl products, such as dyeing techniques that artificially color the final product.

The AGA believes a prudent course when using the term "cultured" to describe various types of pearls is to follow recommendations of the The World Jewelley Confederation (CIBJO). For CIBJO, the term "cultured" refers not just to the finished product but, more importantly, to the human intervention responsible for facilitating the growth of the pearl. Cultured pearls are, therefore, products that form as a direct result of the human intervention. The term "cultured" should precede any pearl product that is not either *natural* or an *imitation*. Use of the term "cultured" is appropriate for both seawater and freshwater pearl products whose formation and growth has been initiated and/or controlled by human intervention.

The term "cultured freshwater pearl" should be used to describe any freshwater pearl product that is not either *natural* or *imitation* in origin. Section 23.20 of the Jewelry Guides seems to imply that freshwater pearls in shapes other than round, or that are not bead nucleated, may not require disclosure as "cultured." This was once a position advocated by the pearl industry. However, today this position is considered arcane.

With respect to disclosure of treatments to pearls, the AGA acknowledges that pearls, in general, and cultured pearls specifically, are routinely modified for use in the marketplace. These modifications have been commonly referred to as "processing," and can include drilling, polishing, buffing, peeling and cleaning. The foregoing practices are used extensively enough to be considered common practices and, therefore, no specific disclosure is necessary.

However, more recent pearl treatments, such as bleaching, coating, cutting, dyeing, tinting, filling, heating, irradiation, oiling, waxing, and working (*e.g.*, removing blemishes) are quite another matter. These practices are less traditional and, therefore, should be disclosed in every transaction because they can have a significant influence on the apparent quality, and thus value, of the pearl.

Regarding permanence of these more recent pearl treatments, little is known about the long-term stability of color treatments in pearls as there are no major scientific studies published on the issue. However, dyeing, coating and waxing are not considered permanent and, therefore, should always be disclosed. These treatments are all assumed to require special care instructions.

The extent to which many pearls are modified through treatments is only recently becoming better understood. However, it is widely observed that there is a difference in value between a treated and untreated pearl. An untreated pearl is considered rarer than its treated counterpart. The relationship of a product's rarity to it value is understood to directly influence value in virtually all other gem related categories. There is no reason to believe that pearl products would be different.

The AGA believes it is appropriate to require disclosure of treatments, even those that are permanent, at the time of sale. Such disclosure allows consumers to make informed choices when considering the purchase of pearls. Additionally, such disclose protects the natural pearl market, which has experienced diminished demand as cultured and treated pearls have altered consumer expectations about what pearls should look like to an extent that nature can no longer compete. We believe complete disclosure of pearl treatments, except drilling, polishing, buffing, peeling and cleaning, will ultimately lead to higher consumer confidence in pearl products.

Conclusion

The AGA is committed to working with the FTC to develop industry guidelines that will serve all stakeholders. Consumers want to purchase jewelry to suit all socioeconomic levels. Vendors want to meet this demand with traditional gemstone products alongside treated gemstone products. Consumers can only make informed choices about such purchases if they know the truth about the products under consideration. Are the gemstones natural? Have they been treated in ways that affect their stability or value? Are there significant gaps in consumer understanding of these questions? As experienced gemologists, we know the answer to that final question is an unqualified "Yes!" The FTC can serve consumers by mandating gemstone treatment disclosure at all levels of trade, and use its public relations tools to educate consumers so they can make more informed and intelligent buying decisions.

On Behalf of the Accredited Gemologists Association

Respectfully Submitted by the AGA's "FTC Review Committee"

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Attachments to Accredited Gemologists Association Comments

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30. Scarrett, Kenneth. "A Discussion on Ruby-Glass Composites & Their Potential Impact on the Nomenclature in use for Fracture-Filled or Clarity Enhanced stones in General." GIA Laboratory, Bangkok. Update; 3 Feb 2012.

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33. Heebner, Jennifer. "The Ruby Ruse: How Jewelers Can Avoid the Lead Glass-Filled Gems." JCK Magazine, May 2012.

34. Roskin, Gary. "Weighing in on the $6 Ruby." The Roskin Gem News Report. 2011.

35. Lynch, Craig A. Is That Really A Ruby? Phoenix, Arizona: Ouellet & Lynch, 2010.

From:
Subject: Contact Antoinette Matlins
Date: December 28, 2010 11:11:13 PM EST
To:

Below is the result of your feedback form. It was submitted by
on Tuesday, December 28, 2010 at 20:11:13

---

name: Stacey Laster

REASON FOR CONTACT: Rubies and Lead Glass

referred_by: Rio Grande Blog

message: I am interested on your in depth piece on the unfortunate ruby problem. I have been burned, and have had to replace one of these stones with one of a much higher price. I am hoping that I can avoid such problems in the future.

Thank you in advance.

AGA Attachment 2

From: J
Subject: Join my network on LinkedIn
Date: February 25, 2012 10:21:00 AM EST
To:
Reply-To: J

Hello Antoinette, It was so nice to meet you in Tucson at the Southwest WJA dinner. Thank you for coming and joining us! BTW- I found Macy's in Austin selling glass filled rubies last week & the sales women said she had never heard of such a thing. All Effy goods. Best to you - Jayne Schultz

AGA Attachment 3

From:

Subject: Contact Antoinette Matlins
Date: February 10, 2011 12:06:05 PM EST
To:

Below is the result of your feedback form. It was submitted by
on Thursday, February 10, 2011 at 09:06:05

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name: Julie Swanson
REASON FOR CONTACT: ruby composite article
referred_by: mid-america jewelry news
message: I'm in the process of sending a 2.98 ct (I'll bet money it's a ruby composite) for evaluation because it came out of the pickle all crazed top and bottom !!!!! Thanks for your article and I look forward to more info on ruby composite

----

From:
Subject: Re: Contact Antoinette Matlins
Date: February 21, 2011 10:10:24 AM EST
To: .

This was something that the customer's husband acquired through one of those "mining" outfits in the southern US, I believe she said it was in Georgia. They provide you with the opportunity to "find a rock" then they charge you to cut it for you..... you go home and six weeks later your cut rock arrives in the mail. I think in this case they also sold him the setting. My customer brought it to me to be sized. After the stone showed crazing, my customer called them to inquire about treatments. They claim that the rock is cut right in their facility and that no treatments are done. They also had sent an appraisal along with it stating it was a ruby and worth $$$$, significantly more that what you pay for the "cutting" My customer fortunately allowed me to have the stone sent to a gem evaluation laboratory who concluded that it's a ruby composite. I don't think I'm on the hook to replace it with a real ruby, fortunately. I feel so bad for my customer, though. : (
Thanks so much for your research, I photocopied your article and gave it to her to read. Julie.

On Thu, Feb 10, 2011, Antoinette Matlins · › wrote:
Sounds to me like that's exactly what you had -- a composite ruby -- and I hope you can get your money back! Was this something you bought, set and then "damaged" or was it for a customer? I'd love to know more because we're trying to gauge where the risks are....to the trade and public alike! In any event, I've attached a more in-depth piece. I confess that after reading it again, I think it would benefit from a good editing job, but I think you'll find it helpful.
In addition, did you visit the AGA site? If not, go to www.accreditedgemologists.org and click on the links to the articles on composite rubies posted there (there are several, a couple of which I've written or co-written with Craig Lynch). There are some excellent photos of tell-tale indicators, provided by Craig, and he's also written an excellent booklet on them with extensive photos -- it's available for $25, and was being sold in several places in Tucson. I'm sure you can get it on the AGA site, as well, but if not, you could email him directly if you'd be interested in having a copy --

From: ,
Subject: "Ruby" -Composition or Glass
Date: August 23, 2012 2:28:07 PM EDT
To:

Dear Antoinette Matlins,

My name is Jo-Ann Maggiora Donivan and I am a jeweler in San Francisco Bay Area. with my husband, John Donivan. We both have worked at the commercial level for over 35 years and have had some experiences with the ruby material that is lead-glass filled. Although the stone appears to be a ruby of normal quality I have learned first hand that it cannot be treated at the work bench as a "normal ruby". Besides protecting the stone from general torch work, we now have to make sure that it is not placed inside any pickle pots or even heated ultrasonics. The material is so unstable that I even warn customers not to expose it to some household cleaning solutions or even acid based food, including salad dressings and lemon based foods.

The very fact that it is NOT stable leads me to treat this as if it were glass in all bench procedures.

While some consider this stone to be a "composite" I believe that it should not be considered in any form to be of natural origin. If anything, this stone is a manufactured item--man made. And there should be many disclaimers attached to it upon sale--whether within our industry or to the public consumer.

This is a product that will not nor cannot stand the test of time. And at our workshop, we produce jewelry that is meant to be passed on as heirlooms. This means that it should last through many generations. With this stone material, the metal will survive under normal wear and tear but the stone will not.

Sincerely,

Jo-Ann Maggiora Donivan
John T. Donivan
http://www.donivanandmaggiora.com

August 11, 2010

C. L. Gardner
General Counsel
Jewelers Vigilance Committee

Dear Ms. Gardner:

My name is Bryn Huxoll and I spoke to Ms. Flamm about my desire to lodge a complaint against Macy's jewelry department. She advised me to send you the documentation I have, and a letter describing what happened, along with the ring so that you could get independent verification about the ruby from a respected gem-testing laboratory. So here it is.

I recently went to a Macy's at the Spotsylvania Mall in Spotsylvania, Virginia, in search of a gift for my mother and fell in love with a gorgeous ruby and diamond ring. The ring was originally $1,600 but there was a 40% off sale that made the purchase more attractive, and it was the last day of the sale so I had to make a quick decision.

I was mere seconds away from purchasing the ring when I saw a sign in the jewelry case stating that many gemstones have been treated and may require special care and telling me to "ask associate for details." I asked the woman who was helping me (Shirley Gross – business card enclosed) if the ruby and diamond ring had been treated. She EXPLICITLY told me that it had most CERTAINLY NOT BEEN TREATED and required NO special care. I double-checked that this went for the diamonds and the ruby (she mentioned something about the sign in the showcase being there primarily to let customers know that a stone's weight may vary by as much as .02 carat, but that nothing on the sign applied to the ruby ring I was buying). I asked her if she was a gemologist and she told me she was not, but that Macy's created profiles for each piece of jewelry and the sales associates were privy to the information.

Feeling increasingly confident about the purchase, but recalling some consumer information I had read, I decided to buy the ring only if the sales person was willing to put in writing, on the sales receipt, what she had told me regarding the ruby and diamonds not having had any treatment and that no special care was required. She was happy to do so (receipt enclosed—note Ms. Gross' handwritten comment on the back side of the receipt stating "this ring has not been treated, no special care" along with her initials, "SG").

HOWEVER, when I was making a copy of the receipt to send to you, I noticed that a small purple sticker had been put on the back of the receipt AFTER she had written her note re: not treated/no special care. This little sticker on the back of the receipt states that "special care instructions could be found at Macys.com"! This was not there when she wrote on the receipt, and when she gave me bag with the ring, and handed me the receipt, it was folded in such a way that it was not visible. I'm furious about this, too, because it was done in an underhanded way.

After I left the store, I was comparing ruby jewelry online, and found an article regarding Macy's once selling rubies that were heavily treated and needed lots of special care, and was referred to a website where I could find the names of experts in my area who could tell me, for free, whether or not the ruby in the ring was one of those that Macy's had been selling. I assumed that they wouldn't be selling such rubies any more given the publicity, but decided to check out the ruby anyway—so I could just be 250% positive.

I made an appointment and went in with the ring, with my mind already set that I was being a silly, overly cautious shopper. The appraiser took the ring and examined it. After a few minutes I left the appraiser's office, ring in hand and FURIOUS! The appraiser said that based on all the "bubbles" inside the stone, the ring was AT LEAST 40% GLASS! If it were to be re-sized to fit my mother's finger, my "perfect ruby" ring could fall apart or become very ugly, very quickly, and there would be no way to fix it.

At first I was going to drive straight back to Macy's to return the ring and get a refund, but then it seemed to me that if I did this they would just continue to sell this kind of stuff to others without telling the truth. Furthermore, it seems to me that if Macy's had people doing profiles on each piece of jewelry, then they must know. A reputable company bamboozled me, and I'm sure that other customer's have been too. I've lost all of my confidence in Macy's as a store where I get a good product at a fair price.

This is why I decided to bring this to your attention instead, and appreciate your interest in helping to resolve this and bring it to the attention of Macy's management.

Please note that the tags cannot be removed from the ring or they will not permit me to return it.

If you have any further questions or need additional information, you can reach me on my cell phone at

Thank you.

Bryn C. Huxoll

August 14, 2012

The following is my experience with the composite ruby issue:

I was part of the quality control group in 2007 that discovered Macys was receiving composite rubies from a specific vendor. I also participated in conversations with Macy's buyers and legal department in 2008 up to May 2009 when the quality control group was eliminated. We advised them of their responsibility to disclose the rubies were treated with lead glass if they should decide to keep them to sell to the public. Macys was told they could sell these items at whatever retail price they want. However, it was emphasized they needed to disclose the treatment as the value of the stones were substantially lower than rubies not treated with lead glass.

I purchased a ruby ring November 2009 from Macys as a Christmas gift. The ticket on the piece said the stone was a ruby with diamonds and did not disclose any treatment. I did question the sales associate if the ruby was treated and was told Macys did not sell treated rubies. She even wrote on my sales check "based on the ticket stone is natural". After giving the ring as a gift, I was looking at the stone and it did not look right. The piece was sent to the American Gemological Laboratories for evaluation and the report came back that it was a lead glass filled ruby.

Mimi Lowe

July 29, 2012

Cortney Balzan

My professional background in gemology, jewelry arts, valuation sciences (graduate school) and leadership positions in different International Gemological Associations allowed me to work with large corporations, trade organizations and government agencies and commissions including the Federal Trade Commission in the late 1980's and early 1990's where I had a direct line to legal.

During the 1980's through the 2012 we have experienced treatments from countries specializing in the composite process. At a conference In 2005 a presentation updating attendees on current technology on treatments, there was a one day session on high refractive index lead glass ruby composites presenting problems in Asia, with a warning that may spread throughout the supply chain worldwide.

During this time my clients were large corporations with hundreds of stores. The buying departments were told to inform the supply chain of the potential of a new problem product of high refractive index glass that was being used with corundum, *imitating* ruby. This product imitating ruby eventually found its way into our large quality control facility and was becoming increasingly noticeable. One of the companies with which I was working had an established set of 'Standards and Guides," according to which, this product should have been identified as unacceptable and returned to the vendor or RTV. These Standards and Guides were followed for a short period of time but eventually the RTV stopped because they *needed* the merchandise to get into the stores to be "competitive." They sent them out into the stores without disclosing the treatment, and without any mention of the *unusual* care needed — all of which affected their "value"—even though they were advised to do so.

The results were damaging to any consumer that purchased this high refractive index glass product imitating ruby. Many salespeople in fact were damaged because they were not told about this product. When some of the salespeople found out about this situation and had taken in returns of damaged merchandise due to treatment, many felt deceived for giving false and misleading statements to their customers. So it was not just the customer who purchased the composite ruby that was damaged but others involved with the corporation right down to the store salesperson. This included quality control personnel who felt deceived and defrauded when they found this out. In many cases the damages were lasting.

The larger problem is that these high refractive lead index glass composites are now being sold throughout the marketplace *without disclosure*. This continues because of the lack of proper enforcement. Worse, the sellers know that even if fined, the profits are still so high — and they get away with it because they say they didn't know, and place the blame on the vendor in the supply chain side.

May 15, 2011

Tracy Dumlao

This problem extends offshore to the military and their contractors who purchased these pieces. This is a buyer beware situation because the return policy does not exist. The gift from husband (who was a contractor for the military) to his wife who collected gems for pleasure and resale sometimes had a different story. She found her collection was not ruby but composite imitating ruby that had low value. The product did not fall into the category of gem ruby. She was amazed to find how stores merchandised this imitation in the display case. She went to many stores mall stores and amazed how salespersons were negligent and disclosing this stone as natural with all the characteristics of gem ruby. Her comment was people who buy this jewelry do so for sentimental and loving reasons which can be destroyed in an instant. My collection of composite rubies have been placed in a safe and will not be used for adornment or any other purposes presently.

FROM: JUDY KENNEDY
Email:
DATE: May 24, 2010
Telephone: .
RE: television alert about con operation selling fake rubies as real

I'm hoping you'll agree that the story below is worth telling, hopefully this weekend, on one of your consumer news segments. It might save many Hawaiians from costly mistakes and heartbreak such as I suffered.

The con involves a fraudulent auction scheme—operating as "Roberto Galleries" (and this is probably only one of the names they use)—that is bilking Hawaiians out of thousands of dollars. I was one of the victims, but only recently learned I'd been cheated—out of almost $10,000 — by people who are clearly professional "cons."

They are having another auction on May 30-31 here on Maui and I'm hoping you can do a feature story in time to prevent others from being victimized.

Since discovering how I was deceived and led into purchasing a "ruby" and diamond pendant (which did NOT contain a genuine ruby at all, but an imitation known as a "composite" - an amalgam of tinted glass and low-grade "corundum"), I've learned that everything connected to this auction firm is suspect—the address they show on their letterhead is a strip mall, and the suite # provided is a UPS store, and no one in the area has ever heard of them; the phone number provided is never answered by a person, but a machine; the gemological "laboratory" report and valuation totally misrepresent the identity and value of the pieces being sold, and the laboratory seems to have no clients except Roberto Galleries and other unheard-of auction houses (operating under different names, but possibly the same people). I could go on an on.

I discovered my mistake when I took a gem and jewelry course on the mainland a few weeks ago, with expert Antoinette Matlins (she has done exposes on NBC's Today Show, ABC's Good Morning America, MSNBC, CNBC, CNN, and others, and most recently on the artificial rubies being sold as genuine rubies). She was talking about these ruby-glass compositions - which cost only a few DOLLARS per carat, and showed all the students how to spot them. I pulled out my pendant and was shocked to see the tell-tale indicators of these new ruby-glass compositions, and thought I must be doing something wrong. I wasn't doing anything wrong and Ms. Matlins confirmed my horrible discovery. She then submitted the piece to one of the most respected gem-testing laboratories in the world, where it was further identified as a "composite;" she had initially thought the auction firm had simply made a mistake, and assumed that when presented with irrefutable documentation, that they would take back the piece and refund my money. But they refused and insist they are not responsible and that if I'm unhappy with the purchase my only recourse is to go to arbitration in California.

This is where I think you would have a great story - my telling what happened to me and then exposing the devious way in which they deter/prevent consumer recourse. I can show you papers I signed, without really understanding this wasn't "normal" in the auction arena, and so on. My phone number is: ; cell . Ms Matlins would also be happy to speak with you:)r

June 20, 2012

Hi Antoinette,

My name is Joon Choi and I own and run Good Neighbor Gems, a gem cutting shop in San Francisco. I'm writing you to share my experiences with lead-glass filled rubies.

I've seen dozens of these pass through my store. Mostly from people who wanted a better polish, have chipped or damaged them, or even some completely destroyed by dipping in the pickle.

I've tried everything possible to try to recut and polish these stones. But no matter what I do, I cannot polish them without the fine hairlines re-appearing on the surface. And for the most part, it ends up worse than when I started.

And for stones that are put into the pickle by bench jewelers, they are completely destroyed and irrepairable. I've seen many from jewelers because it is a common practice to put finished jewelry into the pickle after doing any work. And according to them, it only takes minutes for the stones to get damaged.

If you have any questions, please let me know.

Sincerely,

Joon Choi
Good Neighbor Gems

AGA Attachment 12

JEWELRY APPRAISAL

Gennaro Jewelers

"Honest Reputable Jewelers...since 1923, where your diamond NEVER leaves your sight"
Diamonds Re-Set, Appraisals, Ring Sizing...While-U-Wait and Watch!

August 14, 2012

To whom it may concern,

A customer come into our store a couple months ago with a 14k yellow gold oval ruby and diamond cluster style ring that was purchased on vacation. The ring was purchased at a big discount. According to the customer it had a suggested retail price in the show case of around $3,000.00 and the customer purchased it closer to $1000.00. (Later in the transaction the customer produced the receipt to back up the dollar figure for us.) The ring was too big and the customer brought it in for sizing and the process was explained to her.

First her finger was measured with standard ring sizing instruments. Then the current size of the ring was determined by putting it on a mandrel which is a tapered metal "rod" with finger size increments on it. The amount the ring needed to be sized down was explained to the customer as well as the risks involved in doing this type of procedure. Since we don't know anything about the ring in reality, manufacturing style, metals used, repairs or solders used as well as any treatments to stones. The customer agreed to understanding the risks involved in doing the repair. In addition she said she knew of no treatments and the ring was brand new and no previous repairs were done.

When the ring was given to the jeweler with the sizing instructions he began the work while the customer watched behind the glass. After cutting the shank of the ring and making it the correct size the jeweler put a heat sink or heat shield on the top of the ring around the ruby for protection. The ring was fluxed and the shank was soldered where the small piece of gold was removed. Flux is a material used to help solder flow evenly in the seam similar to pipe soldering. Next the jeweler removed the heat shield and put the ring in the "pickle" which is a heated liquid cleaning step to remove fire scale and other contaminates after soldering; then into the ultrasonic for additional cleaning followed by a final steam cleaning of the ring. The steam blows out any residual residue. This is fairly standard procedure for this type of repair. The last steps would be buffing or polishing the ring to remove any scratches or tool marks and to put on a high shiny polish like the ring was right out of the showcase, followed by an ultrasonic cleaning and steaming again.

JEWELRY APPRAISAL

Gennaro Jewelers

"Honest Reputable Jewelers...since 1923, where your diamond NEVER leaves your sight"
Diamonds Re-Set, Appraisals, Ring Sizing...While-U-Wait and Watch!

After this process a final inspection is done and this is when the jeweler noticed that the ruby was damaged. It has horribly included with white vein like lines and voids running throughout the surface of the "Ruby". The "ruby" was glass filled which was not disclosed to the customer at the time of the sale or to us during the questioning part of the take in process where discovery should be discussed, before any work is done to the item.

The customer was upset to say the least and any explanation at that moment was not going to help or make her feel any better. She didn't know who to believe or what to do next. She wondered why she wasn't informed at the time she purchased the ring and what could she do now? Finding out this way was upsetting and embarrassing. The stone was showed to me and I explained that the stone was probably lead glass filled. It was the first example I had ever seen live, not from a picture. There are many articles written on this subject and fortunately I follow the latest industry news regularly. The store's owner was notified immediately and he got involved. The owner took the stone to another appraiser for confirmation of lead glass filled. Suspicions were confirmed that the stone was in fact very heavily lead glass filled. Due to hallmarks inside the ring the I was able to track down the manufacturer of the ring where the ruby was in fact said to be lead glass filled and very inexpensive for an eye cleanish 2.50ct very red ruby, it was less than $300 compared to $20,000+ she could spend on a natural Ruby of similar quality. After a bit of a discussion about the entire situation the manufacturer agreed to sell us a single replacement stone. Have explained

In the end, we explained everything to her that the original jeweler should have explained. The customer felt cheated and mislead. Changes in the disclosure laws need to be made to prevent these types of situations from repeating themselves.

Todd Zweifel

Graduate Gemologist

In a message dated 4/29/2010 9:14:48 P.M. Eastern Daylight Time, writes:

> Hello Antoinette,
> If I remember correctly you asked people at the AGA seminar to let you know if they find any military people who have been sold composite rubies. I just identified two composite rubies and three synthetic sapphires that were sold to a serviceman in Afghanistan. Are you still collecting names of these service people?
> Best Regards,
> Joseph Bloyd, GG

Here is the gentleman's information: Jason J. Stewart, First Lieutenant in the Army Reserves - Intelligence.

My understanding is that he is in Afghanistan and purchased the gems there. The gem package consisted of:

-- Two composite rubies in parcel
-- One 5.5ct. composite ruby (awful quality)
-- One 3.5ct composite ruby (visually appealing)

If I can help in any way, please let me know.
Joseph Bloyd, GG, AJP, RMV
Independent Gemologist Appraiser
JNB Jewelry & Gem Appraisal

You're In Afghanistan, Sparkling Gems Abound.... But Beware!

by Dan Hildebrandt, from Sharana, Afghanistan, November 2, 2010

You're in Afghanistan and you've been to the bazaar on any of our numerous U.S. military installations. They are selling local textiles, cast trinkets, antiques, and gems; diamonds, rubies, sapphires, emeralds, tourmaline, the whole spectrum of colorful, exotic gemstones. Wow, how beautiful, and how tempting to buy some at such bargain prices while you're so close to the mining areas...

Stop right there! What you're likely to find is that the quality and value is NOT what it appears to be. One of the biggest disappointments many of us are experiencing is learning when we get home that the beautiful stones we bought aren't what we thought they were. How were we to know, for example, that those lovely rubies we bought at bargain prices -- and which we were assured were worth much more -- are really extremely low-quality stones filled with glass and worth a fraction of what we paid!

This is the reality in Afghanistan, Pakistan, and throughout many of the countries where we have bases. And while it may not be a big deal to some, for others like myself, it *is* a big deal because we have dreams of building our retirement accounts, or bringing home a monster emerald or ruby to surprise and delight our wife or loved one. I hate to be the one to burst the bubble, but this just isn't going to happen if you put yourselves in the hands of the concessionaires, and others selling gems on base. More on this follows. Even those that may be honest often don't even know what they have. If you trust a concessioner at one of these bazaars, you'll probably be taken for a costly ride.

I've now examined over 4,000 carats of rubies being sold by the locals at our bazaars. In the beginning I thought I could tell what I was looking at, and make a wise investment; I assumed if I made my purchase on base, I was "safe." I wasn't. I was a victim.

How could I have ever imagined the many things that are done to imitate, duplicate, and improve the appearance of gemstones? What I ended up with **was** 600 carats of "ruby" that was actually something made by using an extreme type of treatment whereby very high heat is used to melt lead-glass and infuse it into a very porous, low-quality ruby. Many gem-testing laboratories around the world call these stones "glass-ruby *composites*" and there is a question as to whether or not it is even legal to call them real rubies at all. Unlike real rubies (which are tougher than all natural gemstones except diamond), glass-ruby composites can break very easily, and even worse, if you take one to a jeweler to set into a pretty piece of jewelry and the jeweler doesn't know it's not a normal ruby, it can end up as a molten glob on the poor jewelers work table... and there is no way to fix or repair it!

Whatever gemstone you're purchasing, there's a high risk that it isn't what it appears to be. Many synthetics and fakes are being sold, and inexpensive stones such as garnet (worth almost nothing) are being misrepresented and sold as something else, something you're led to believe is much more valuable. To find out more, go to www.accreditedgemologists.org or www.AntoinetteMatlins.com.

Now, don't get me wrong. There is some fine quality merchandise available in Afghanistan, but if you don't know what you're doing, you'll be easily taken. Without the tools that gemologists use to determine a stone's true identity, it's impossible to know what you're buying and what it's worth, so you're taking a big gamble. I've learned, the hard way, one irrefutable fact: *most of the people in Afghanistan selling gemstones to soldiers and civilian contractors* ***are not dealing with us honestly.*** This includes not only the concessionaires but others, living and working on base, representing themselves as gem "experts" and assuring you they can get the "real thing" at "the best price (and by the way, if people living on base try to sell you stones--those not authorized to do so--let your base Mayor know ASAP and have the stones checked out so action can be takes to remove dishonest people from base).

I've taken the time to get some books and learn much more about gemstones being sold here. I've even purchased some tools so I can now identify the stones I see and spot most of the fakes (and NO, you canNOT tell just by looking). In short, my misfortune led me to a new hobby, and I've become passionate about the science of it all. And so I'm still looking at gemstones, for friends as well as myself. This is why I hope you'll trust me when I tell you how great the risk is for *anyone* buying gemstones, on our bases as well as off. I see bad stuff all the time, and too many soldiers are being ripped off by people making a huge amount of money, at our expense.

This is not to say that what I've bought is worth nothing, but the gems I thought were worth hundreds of dollars per carat can be purchased on TV shopping networks and from retailers at home in the USA at prices ranging from $5.00-25.00 per carat on average! And the quality of some of the gems I purchased, while they may have some value, don't have a market--in other words, you won't be able to find anyone at home interested in buying them! Yes, I've learned the hard way -- such is life -- but you don't have to!

- **First, be aware: the only thing "REAL" about the gemstones being sold in Afghanistan is the RISK!**
- **See if you can find a "gemologist" on base; there are some on some bases; they can help you.**
- **If no gemologist is available, invest in some simple tools and a good book or two and learn what to look for and what to look OUT for (you'll be surprised how quickly you can learn how to separate real from fake). I purchased two books: *Gem Identification Made Easy* and *Jewelry & Gems: The Buying Guide*, both by A. Matlins and A.C. Bonanno, (www.GemStonePress.com.) and some simple gem testing tools.**
- **If none of the above is possible, just say "NO"!**
- **If you can't resist the temptation, put a limit on what you spend so you don't get yourself into a bad financial situation. Just take this as a friendly warning--this is a fact: *what you see at the bazaars is probably not even close to what you may think it is.***

The deception isn't just where gems are concerned. I started with gems because they are perhaps the most tempting, and they're easy to carry home! I now do what I can to help others here in Afghanistan avoid being ripped off on the gemstones they are buying -- to find out what they have while there's still time to do something about it, *before* returning home.

To summarize, you're not going to get rich buying a few rubies on a gamble; your hard-earned money will probably do better in almost any other type of investment; $1,000 just does not buy $10,000 anywhere in the world. Now having said all of this, whatever happens, keep this one thing in mind that I've learned in my own life: the true gems are the people in my life that I care about ... and the pride I take in my work.

Important Note: Gem expert and author Antoinette Matlins, a Board Member of the AGA (Accredited Gemologists Association), has advised me that because of growing concern among members about increasing exploitation of soldiers abroad, the AGA has announced that AGA members will identify composite rubies and imitations purchased by soldiers abroad ***at no charge.*** This free service does not include a *written* report, but in some cases findings will be documented in writing if the soldier plans to seek recourse. Go to **www.accreditedgemologists.org**

Information Sheet #1

Standardised Gemmological Report Wording

Corundum

- **with residues from the heating process present in healed fissures**
- **with residues from the heating process present in filled cavities**

Members of the Laboratory Manual Harmonisation Committee (LMHC) have standardised the nomenclature that they use to describe heat treatment in corundum and the degree to which fissure "healing" has occurred, and the residues that remain within the healed fissures and cavities, following the heating of corundum.

Healed fissures[1]:

Any corundum that shows indications of having undergone heat treatment and a degree of healing along (previous) fractures - see Figure 1 - which also contain a residue(s) from the heating process, shall be described as

Identification

- Species: **(Natural)[2] corundum**
- Variety: **Ruby or Sapphire**

Further information

Indications of heating' (to modify the colour and/or transparency of the stone), plus the appropriate residue quantification terminology – **alpha numeric and/or text description[3]**. See table 1 and examples in figures 2, 3 and 4.

Note 1: As an option, e.g., for "simplified reporting" situations, the quantification of residues in healed fissures may be replaced by the statement **'residues in healed fissures'**.

Note 2: Wording in parenthesis is optional.

Note 3: This clause may include the presence of **small** filled cavities.

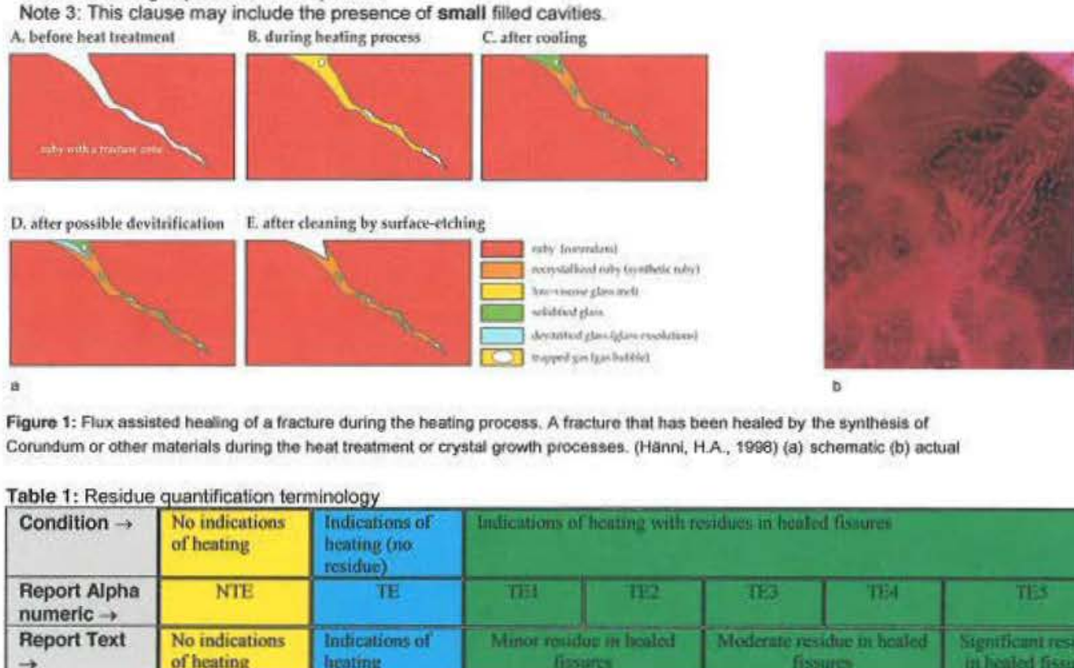

Figure 1: Flux assisted healing of a fracture during the heating process. A fracture that has been healed by the synthesis of Corundum or other materials during the heat treatment or crystal growth processes. (Hänni, H.A., 1998) (a) schematic (b) actual

Table 1: Residue quantification terminology

Condition →	No indications of heating	Indications of heating (no residue)	Indications of heating with residues in healed fissures				
Report Alpha numeric →	NTE	TE	TE1	TE2	TE3	TE4	TE5
Report Text →	No indications of heating	Indications of heating	Minor residue in healed fissures		Moderate residue in healed fissures		Significant residue in healed fissures

Condition →	Indications of heating with residues in cavities		
Report Alpha numeric→	C1	C2	C3
Report Text→	Minor Residue in cavities	Moderate Residue in cavities	Significant Residue in cavities

[1] (see Information Sheet #3 for "corundum with glass filled fissures" and subsequent "corundum with/and glass")

[2] Wording in parenthesis is optional.

[3] In the cases of TE1 and TE2 (minor) or TE3 and TE4 (moderate), when the text version is selected a reference to the specific alpha-numeric shall be indicated either by combining the two or placing an « x » in the appropriate point of the comparative scale.

Members of the LMHC determine which of the residue quantification terminology to use (see table 1) taking into account the size and position of each healed feather and the nature of the residue that remains. This residue may be comprised of structures ranging from a fine bubble-like network with very little 'thickness' to numerous lake-like structures that may have a considerable thickness (see examples in figures 2, 3 and 4).

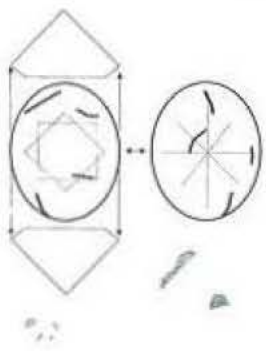

Figure 2: Minor residue (TE1) in this example consisting of fine bubble-like structures

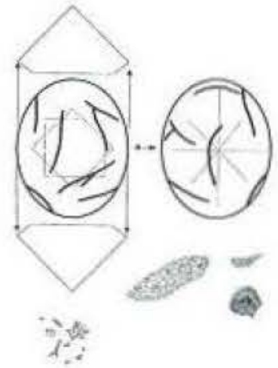

Figure 3: Moderate residue (TE3) in this example consisting of coarse bubble-like structures and films

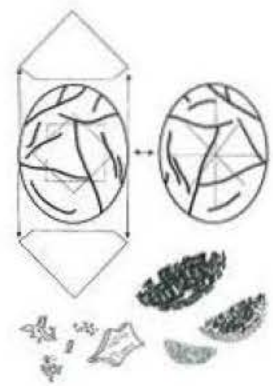

Figure 4: Significant residue (TE5) in this example consisting of coarse and thick film-like structures

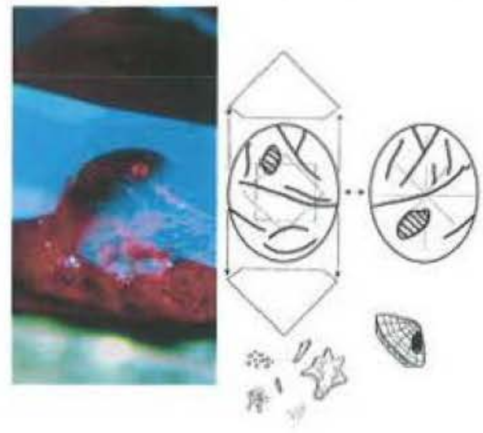

Figure 5: Significant residue (TE5) in this example consisting of coarse and thick film-like structures together with a large glass-filled cavity (C3) (example image left)

Filled cavities:

Any corundum that shows indications of having undergone heat treatment and the presence of a vitreous residue in a cavity(ies), shall be described as

Identification

- Species: **(Natural)[1] corundum**
- Variety: **Ruby or Sapphire**

Further information

Indications of heating' (to modify the colour and/or transparency of the stone), plus the appropriate quantification terminology - **alpha numeric** and/or **text description**. Table1 outlines the use of the designated alpha numeric or text descriptions and figure 5 gives an example of a typical situation.

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Swiss Gemmological Institute - SSEF (Switzerland)

[1] Wording in parenthesis is optional.

Information Sheet #3

Standardised Gemmological Report Wording

Corundum with glass filled fissures and/or cavities and Corundum-Composite Material

Members of the Laboratory Manual Harmonisation Committee (LMHC) have standardised the nomenclature that they use to describe glass filled fissures and/or cavities in corundum and corundum-composite material. This nomenclature is used for all situations that (i) involve the filling of fissures and/or cavities with glass, where there are indications that the clarity of the corundum has been enhanced/modified by this process with the exception of those covered in Information Sheet #1 and (ii) form a corundum-glass composite material.

Glass filled fissures in corundum:

(see Information Sheet #1 for "healed fissures" and subsequent "residues in fissures")

Any corundum that shows indications of having undergone clarity enhancement/modification usually assisted by heating, through the filling of fissures with glass shall be described as,

- Species: **Natural corundum**
- Variety: **Ruby** or **Sapphire**[1]
- Comments: **(Indications of) Clarity enhancement/modification by a glass filler in fissures** *or* **Glass filled fissures** *or* **Glass in fissures,** plus (the appropriate filler quantification terminology - 'alpha numeric and/or text description' - see table 1), (the identification of the glass material – e.g., lead glass, silica glass, etc.) and/or the statement (introduction of glass into fissures involves heating)[2]
  (This treatment usually applies to low quality stones.)
  (Glass filled corundum is unstable to elevated temperatures and to certain chemical agents.)

Table 1: Quantification table for colourless to near-colourless glass in fissure(s) in corundum

Status:	**No indications of clarity modification**	Clarity enhancement/modification / glass in fissures		
Report Alpha numeric:		F1	F2	F3
Report Text:	"No declaration"	Minor clarity enhancement/modification by a glass[3] filler in fissures / Glass[3] filled fissures, Extent: minor[2]	Moderate clarity enhancement/modification by a glass[3] filler in fissures / Glass[3] filled fissures, Extent: moderate	Significant clarity enhancement/modification by a glass[3] filler in fissures / Glass[3] filled fissures, Extent: significant
Further optional report comments:		a lead glass / a silica glass, etc., has been identified as the filler and/or the introduction of glass into fissures involves heating		

Special Notices

1. Whether using the alpha numeric or text description the report shall also illustrate the equivalent by appending the above chart.
2. The process producing 'glass filled fissures' might also induce healing of fissures and/or fractures (see Information Sheet #1).

Glass filled cavities in corundum:

[1] 'Sapphire' for the blue variety of corundum. For other colours, 'Sapphire' preceded by its colour (e.g., yellow sapphire, pink sapphire, etc.). See Information Sheet #4 for 'padparadscha sapphire'.

[2] Text in parenthesis is optional.

[3] In case of coloured glass, the report text shall mention the presence of a coloured glass.

It is possible that during the glass filling process in addition to fissures, cavities may also become filled with glass. When such glass filled cavities are found in addition to the applicable report text and/or alpha numeric (as above) these shall be described as,

- Comments: **(Indications of) 'Glass filled cavity(ies)** plus (the appropriate filler quantification terminology - 'alpha numeric and/or text description' - see table 2), (the identification of the glass material – e.g., lead glass, silica glass, etc.) and/or the statement (introduction of glass into cavities involves heating).
  (This treatment usually applies on low quality stones.)
  (Glass filled corundum is unstable to elevated temperatures and to chemical agents.)

Table 2: Quantification table for colourless to near-colourless glass in cavities in corundum

Status:	Glass in cavities		
Report Alpha numeric:	C1	C2	C3
Report text:	"Minor Glass filled cavity(ies)"	"Moderate glass filled cavities"	"Significant glass filled cavities"
Further optional report comments:	a lead glass / a silica glass, etc., has been identified as the filler and/or the introduction of glass into fissures involves heating		

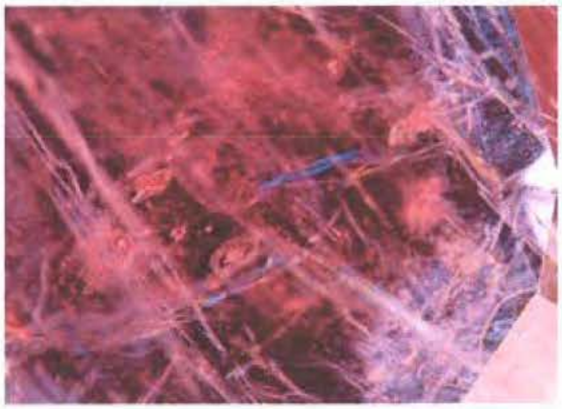

Figure 1a: Colour flashes seen in the area of lead glass filled fractures in ruby

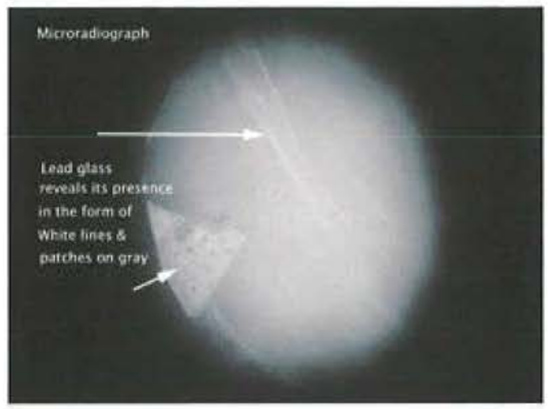

Figure 1b: A microradiograph that reveals the presence of lead glass in fractures

Members of the LMHC determine which quantification terminology to use (see tables 1 and 2) taking into account the size and position of each glass filled fissure and/or cavity. This filling may be of various extents (see examples in figures 2a, b and c.).

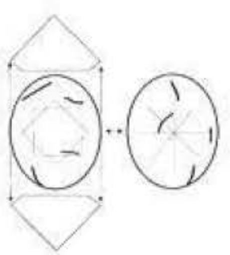

Figure 2a: Glass filled fissures; Extent: minor (F1)

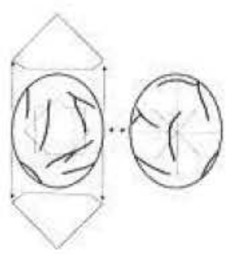

Figure 2b: Glass filled fissures; Extent: moderate (F2)

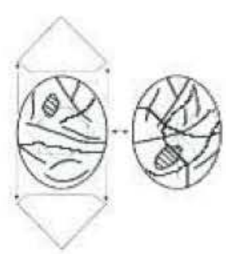

Figure 2c: Glass filled fissures; Extent: significant (F3), and significant glass filled cavities (C3)

Special note:

Durability/stability: Glass filler may be unstable to elevated temperatures and to chemical agents. Special care shall be taken when repairing jewellery items set with glass filled corundum. During jewellery repair the unmounting of such stones is recommended.

Ruby or sapphire with glass:

It is possible to take a heavily fractured, friable, single piece of rough corundum, infuse the fractures with glass and then facet a stone from the treated material. Following the faceting process wide fractures filled with glass may be found to encircle the stone. If the glass were removed the stone would fall into at least two parts.

- species: **'Natural corundum with glass'**
- variety: **'Ruby** or **Sapphire with glass'**
- comments: **This stone is being held together with glass.**
  (If removed the stone would fall into at least two parts.)
  Fracture filling materials such as glass may be unstable to elevated temperature and to chemical agents. (Special care should be taken when cleaning or repairing jewellery items set with fracture filled stones.)

Illustration of the effect of HF acid on corundum with glass:

Figure 3a: A faceted corundum-glass material

Figure 3b: Remaining ruby pieces of the faceted corundum-glass material shown in figure 3a after acid disintegration

Ruby/Sapphire-Glass Composite Material:

It is possible to assemble and/ or to bind a multitude of unrelated tiny pieces of ruby/sapphire into one cutting material with glass. When such material is found, it shall be described as,

- species: **'Corundum-glass composite'**
- variety: **'Ruby/Sapphire-glass composite', an artificial product**
- comments: **This item is a combination of glass and ruby/sapphire.**
  This binding material may be unstable to elevated temperature and to chemical agents. (Special care should be taken when cleaning or repairing composite materials)

Illustration of the effect of HF acid on corundum-glass composite material:

Figure 4a: A faceted corundum-glass composite material

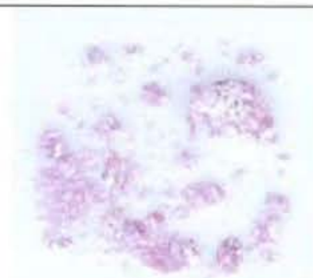

Figure 4b: Remaining ruby pieces of the faceted corundum-glass composite material shown in figure 4a after acid disintegration (107 hours in HF)

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Information Sheet #7
Standardised Gemmological Report Wording

Corundum

- **no indications of heating**
- **indications of heating**

Members of the Laboratory Manual Harmonisation Committee (LMHC) have standardised the nomenclature that they use to describe any corundum that shows no indications of heating or any corundum that shows indications of heating. See also information sheets #1 to #4.

No indications of heating

Any corundum that shows no indications of having undergone heat treatment shall be described as,

Identification
- Species: **(Natural)[1] corundum**
- Variety: **(Natural)[1] ruby / (Natural)[1] sapphire[2] / (Natural)[1] 'padparadscha (sapphire)[1]'**

Further information

No indications of heating (NTE)

This clause may include the presence of an insignificant amount of coloured material within a fissure, but not any amount of iron oxide and/or an orange dye in a 'padparadscha (sapphire)'.

Indications of heating

Any corundum that shows indications of having undergone heat treatment shall be described as,

Identification
- Species: **(Natural)[1] corundum**
- Variety: **Ruby / Sapphire[2] / Padparadscha (sapphire)[1]**

Further information

Indications of heating (to modify the colour or transparency of the stone) (TE)

Note A: Certain heating conditions may not modify some characteristic inclusions/internal features (e.g., intact rutile needles, unaltered zircon) while at the same time changing others (e.g., carbonates, negative crystals, apatite). If any heat-altered inclusions are observed, the comment shall be 'indications of (low temperature) heating'. This may not apply for magmatic hosted corundum.

Note B: Certain heating conditions may not modify some internal characteristics (e.g., blue zoning) while at the same time changing other features (e.g., infrared spectra). In such circumstances, if spectral data indicate heating has taken place, the comment shall be 'indications of (low temperature) heating'. This may not apply for magmatic hosted corundum.

[1] Wording in parentheses is optional.

[2] 'Sapphire' for the blue variety of corundum. For other colours, 'sapphire' preceded by its colour (e.g., yellow sapphire, pink sapphire, etc.) or preceded/replaced by padparadscha.
For the definition of a 'padparadscha (sapphire)', see information sheet #4.

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AMERICAN GEMOLOGICAL LABORATORIES
QUALITY DEFINED

AGA Attachment 18

FOR IMMEDIATE RELEASE

AGL MODIFIES ITS DISCLOSURE POLICY ON LEAD-GLASS FILLED RUBIES.

NEW YORK, NY — 13 November 2007 — After several months of discussions with many sectors of the gemstone and jewelry trade in the U.S., Europe and Asia over concern that exists regarding the proper and adequate disclosure of the lead-glass treated rubies that are entering the market in large numbers, the American Gemological Laboratories (AGL) has decided to modify its disclosure policy regarding stones treated in this manner.

The gemstone industry was stunned in 2005 when the market began to be virtually flooded with large amounts of the lead-glass filled rubies for sale at very low prices, often as low as $2-$15 per carat (figure 1). "Those who have developed this treatment found a highly effective means of taking very low quality ruby that was available in massive quantities and turning it into more transparent, facet-grade ruby via a multiple-step process that involves stages of heating, acid cleaning, as well as injecting a high-refractive index glass," explained C.R. "Cap" Beesley, President of AGL.

"These stones are often so heavily treated that it is not always possible to determine how much of the stone is actually ruby and how much is glass," added Christopher P. Smith, Vice President and Chief Gemologist of AGL (figure 2).

A tremendous amount of concern has erupted as a result of the large volume of material that is available and the impact it may have when a consumer purchases such stones thinking that they are getting a higher quality ruby than they actually are. Smith further stated "In their natural state, these stones are translucent to opaque, with extensive cavities, channels and fractures," (figure 3).

According to Smith, "I previously completed and published, along with several colleagues, an extensive study on the durability and methods of detection for these lead-glass filled rubies" (see Smith et al., 2005 and McClure et al., 2006). In this study our research indicated that the lead-glass was susceptible to many types of solvents, including standard household products. "Once the glass became etched, the apparent clarity of the stones was severely affected and it became readily evident how low quality the stones actually were," Smith stated (figure 4).

Beesley further indicated "Typically the glass is yellow to orange in color and can artificially augment the red color of these stones (figure 5). In light of our long-standing consumer protection initiatives, we feel strongly that it is important to protect the end consumer and the trade by continuing our leadership role in the proper disclosure of these stones."

In a final statement, Smith summarized AGL's policy "We wanted to develop a new category for this material that would allow for easy reference and allude to their condition, then provide further information for clarification under the comments section of our documents."

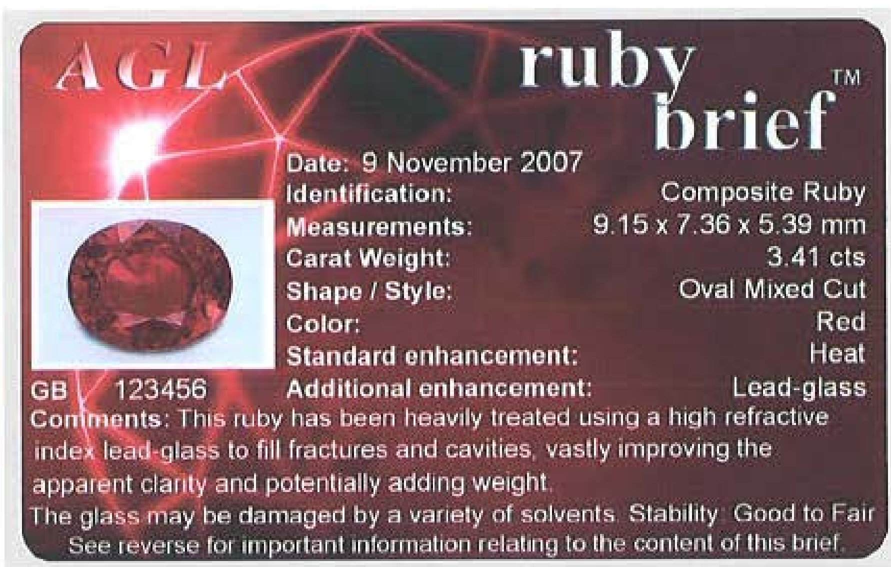
Effective immediately, AGL will disclose this material as follows:

Identification: Composite Ruby
Standard enhancement: Heat
Additional enhancement: Lead-glass
Comments: This ruby has been 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. Stability: Good to Fair

(See an example of a sample GemBrief below)

References:
Smith C.P., McClure S.F., Wang W., Hall M. (2005) Some characteristics of lead-glass-filled corundum. *Jewellery News Asia*, November, No. 255, pp. 79-84.

McClure S.F., Smith C.P., Wang W., Hall M. (2006) Identification and durability of lead glass-filled rubies. *Gems & Gemology*, Vol. 42, No. 1, pp. 22-34.



Sample AGL GemBrief

Figure 1: Lead-glass filled rubies took the gemstone industry by storm in 2005. With wholesale prices ranging from as low as $2-$15 per carat, several sectors of the industry took pre-emptive action asking labs to have stones treated in this manner clearly disclosed. Due to the extreme extent of this treatment and concerns over durability, the AGL identifies such stones as: Composite Ruby, with an additional comment stating: This ruby has been 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. Stability: Good to Fair. Photograph by Jessica Arditi and Sun Joo Chung.

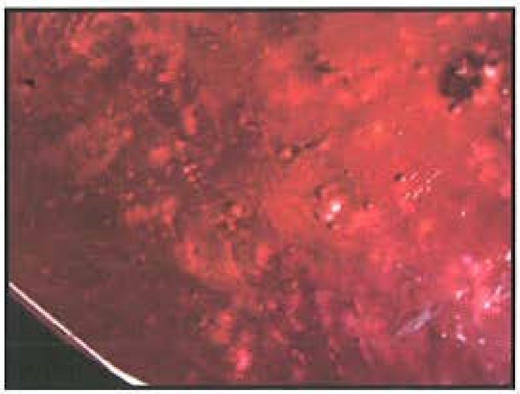


Figure 2: The lead-glass filling is so pervasive and there is such a close match between the refractive index of the glass and the ruby, that it is often difficult to fully recognize the extent of this treatment. This image illustrates one of the most distinctive features of the composite rubies, consisting of large numbers of gas bubbles occurring within the lead-glass. Photomicrograph by Christopher P. Smith.

Figure 3: Low-quality rough ruby, commonly from Madagascar, is the starting material for the lead-glass treatment. After the multi-step treatment process, the transparency and color of stones such as these becomes dramatically improved. Photographs by Fred Kahn and Sun Joo Chung.

Figure 4: When the lead-glass starts to become damaged, the true extent of the fracturing starts to become evident. Photomicrographs by Christopher P. Smith.

Figure 5: A large piece of the yellow to orange colored lead-glass used in this treatment process can be seen still attached to this large piece of ruby rough after the treatment has been completed. The inherent color of the glass helps to artificially augment the red color of the ruby. Photograph by Fred Kahn and Sun Joo Chung.

# # #

About American Gemological Laboratories
Founded in 1977 by C. R. "Cap" Beesley, American Gemological Laboratories (AGL), a subsidiary of the publicly traded Collector's Universe (NASDAQ: CLCT), pioneered the development of the world's first comprehensive Colored Stone Grading System (www.aglgemlab.com) AGL has also provided detailed country of origin and enhancement reports for some of the most prestigious retailers and auction houses in the world for the past three decades. AGL has been designated the official North American laboratory of the International Colored Gemstone Association (ICA). In addition, the laboratory is the official colored gemstone laboratory of the 2007 Fine Jewelry CEO Summit and the JCK Las Vegas Shows, as well as the 2007 Platinum Sponsor of the ICA World Congress in Dubai.

About Collectors Universe
Collectors Universe, Inc. is a leading provider of value added services to the high-value collectibles, diamond and colored gemstone markets, with the Company's common stock traded on the NASDAQ Global Market under the symbol CLCT. For the most recent fiscal year, CLCT authenticated and graded over 3 million items valued at just less than $2 billion.

Contacts:

Cap Beesley

Christopher P. Smith

FOR IMMEDIATE RELEASE

AMERICAN GEMOLOGICAL LABORATORIES
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American Gemological Laboratories (AGL) modifies its disclosure wording on heated rubies

12 June 2009: Over the past year, I have been having extended discussions with AGL clients in the wholesale and retail sectors of the trade, as well as industry organizations to evaluate the services of our laboratory. Some of these discussions have led to refinements in our reporting procedures (already implemented) and contributed to the complete redesign of our Prestige report, which was launched this past February during the Tucson Gem & Mineral Show.

With the recent independence and re-privatization of AGL, this process has continued and resulted in the publication of our first official price list. In it, we have refined and simplified our pricing structure to offer highly competitive rates for top-quality gemological reporting. We are also maintaining the innovative and very popular FastTrack services of GemBriefs, our lower cost alternative in a convenient credit card sized format.

Origin report, including ID and Enhancement: All materials

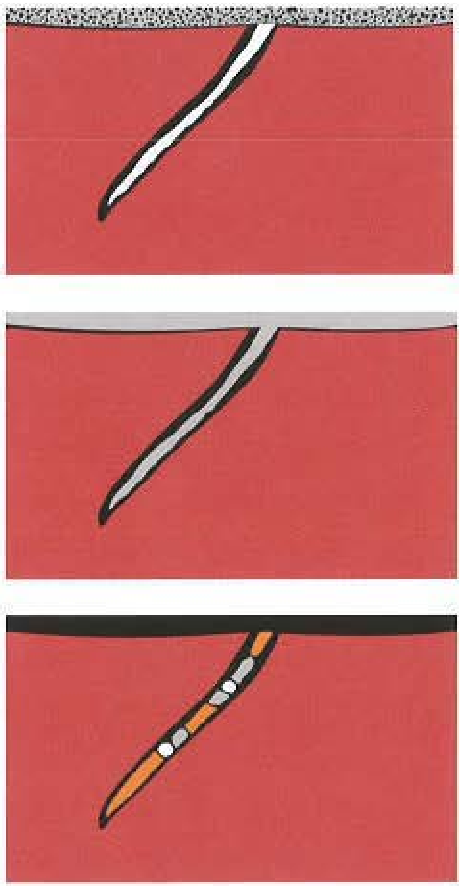
Carat sizes	Foundation Members	Non-Members
Up to 2.99 cts	150 USD	180 USD
3.00 to 9.99 cts	250 USD	300 USD
10 cts and up	350 USD	420 USD

These various discussions have also involved the manner in which we report our findings. Continuing discussions with our clients have helped me gain a better perspective on those reporting policies that are very effective and clearly communicate the proper information to describe a gemstone. However, it has also come to my attention that certain policies have been the cause of greater confusion and therefore are not effectively describing or conveying information. As a result, we have already implemented several changes to our policies on the disclosure for geographic or country of origin determinations, modifying or doing away completely with nomenclature that was confusing or ineffective.

Heated Rubies

Another topic that came to light was the manner or description in which the healing of fissures during the heating process of rubies was being handled. This topic has been a contentious one for more than a decade. As part of the heating process for rubies, it is common practice to coat the stones in a variety of fluxing agents. As the temperature increases, these fluxing agents melt, partially dissolve the ruby's surface and facilitate in the healing of fissures, effectively sealing and reducing the appearance of the fissures and improving the general durability of the stone. AGL has traditionally used the following terminology to describe this enhancement: "Clarity: Inorganic (flux-type)", with additional terminology that addressed the relative quantity of material that remained (e.g. faint, moderate, etc.).

In actuality, the use of fluxing agents during the heating process results in a combination of features or materials being deposited and remaining along the newly healed fissures. The previously open fissures are replaced by planes consisting of re-grown ruby (synthetic), solidified vitreous melt (glass) and voids (empty bubbles). The relative amount of these three parts depends on many factors. To better try and communicate the multiple and complex nature of these remaining bi-products, many labs around the world starting using the term "heating residues" with terms describing the relative quantity (such as: minor residues in fissures).



Prior to heating rubies are coated with fluxing agents.

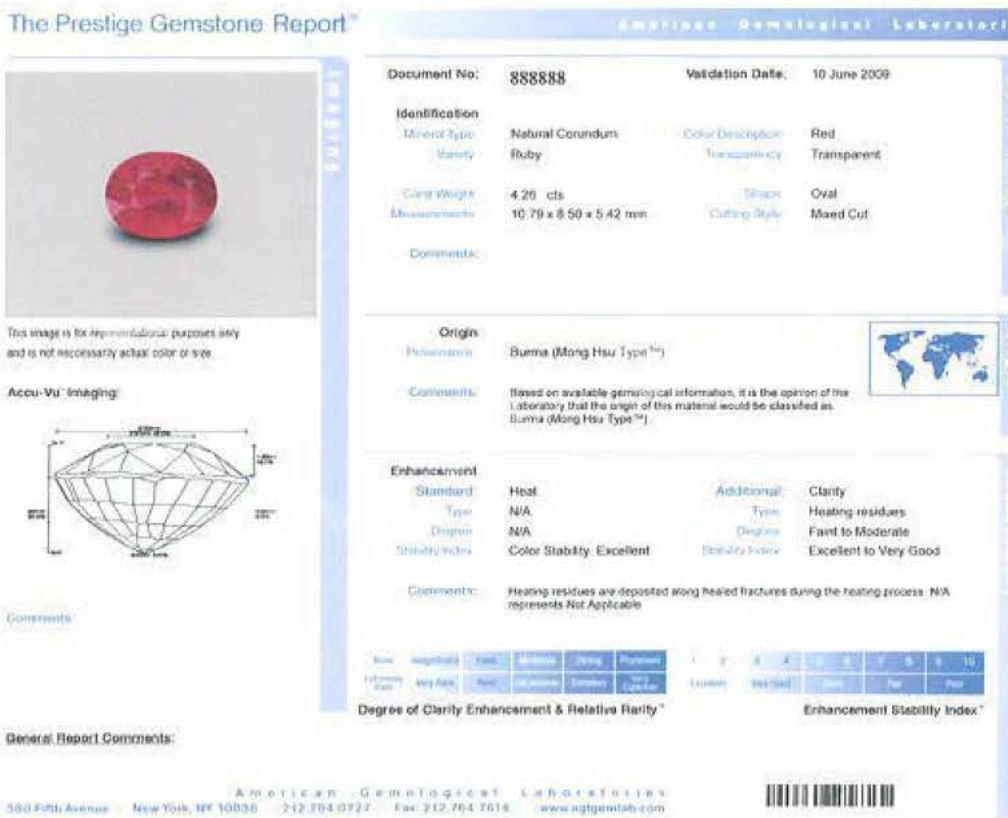
As temperatures rise during the heating process these fluxing agents melt and enter surface reaching fissures.

As the ruby cools at the end of the heating process, tiny amounts of ruby (corundum) is re-grown healing and bonding the fissures. Also remaining confined to the newly healed fissures are solid vitreous melts and tiny voids.

Ruby Fluxing Agent Vitreous Melt (Glass) Re-grown Ruby (Synthetic) Void (Empty Bubble)

Roughly over the past 10 years, multiple labs have been using the term "heating residues" to describe this combination of re-grown ruby, glass and empty bubbles along the healed fissures. As a result, the industry and users of these reports have come to understand the intended meaning of this term and the relative quantification that accompanies it. Meanwhile, the AGL's use of the term "Clarity enhancement: Inorganic (flux-type)" has not provided any greater clarity of this issue or understanding to wholesalers, retailers and consumers.

As a result, effective immediately AGL is modifying its disclosure terminology used for heated rubies, by exchanging the term "Inorganic (flux-type)" with "Heating residues". As well as including an additional description under the comments section of all Prestige and FastTrack reports, stating: "Heating residues are deposited along healed fractures during the heating process."



The Prestige Gemstone Report™

American Gemological Laboratories

Document No: 888888 | Validation Date: 10 June 2009

Identification

Mineral Type	Natural Corundum	Color Description	Red
Variety	Ruby	Transparency	Transparent
Carat Weight	4.26 cts	Shape	Oval
Measurements	10.79 x 8.50 x 5.42 mm	Cutting Style	Mixed Cut

Comments:

This image is for representational purposes only and is not necessarily actual color or size.

Accu-Vu™ Imaging:

Origin

Provenance: Burma (Mong Hsu Type™)

Comments: Based on available gemological information, it is the opinion of the Laboratory that the origin of this material would be classified as Burma (Mong Hsu Type™)

Enhancement

Standard	Heat	Additional	Clarity
Type	N/A	Type	Heating residues
Degree	N/A	Degree	Faint to Moderate
Stability Index	Color Stability: Excellent	Stability Index	Excellent to Very Good

Comments: Heating residues are deposited along healed fractures during the heating process. N/A represents Not Applicable

Comments:

Degree of Clarity Enhancement & Relative Rarity™

Enhancement Stability Index™

General Report Comments:

American Gemological Laboratories

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We at AGL are committed to providing our clients with the best service and high-quality reporting. As we further refine and improve our services, we will keep you informed. We thank all of you for your patronage, feedback and support.

Sincerely,

Christopher P. Smith, President
American Gemological Laboratories LLC

American Gemological Laboratories™
Defining Quality for Over 30 Years

FOR IMMEDIATE RELEASE

AGL Will Not Be Classifying New Ruby Treatment As Composite Ruby

3 May 2010: NEW YORK – American Gemological Laboratories (AGL) has concluded its initial investigations into a new ruby treatment which has been entering the market. Over the past year, another "new" ruby treatment has been coming out of Thailand and is offering a lowcost alternative to more traditionally heated ruby (figure 1). "The conundrum for the trade has been how to deal with these new stones and what kinds of disclosures need to be made." indicated Christopher P. Smith, President of AGL.

This new ruby treatment has been developed in Thailand and is reportedly a modification of the leadglass or Composite Ruby treatment (see AGL modifies its disclosure policy on leadglass filled rubies: November 2007). For this treatment, AGL has been informed that a selection of the rough material suitable for the Composite Ruby treatment is made and treated using various chemicals or fluxing agents, similar to the more traditional heating of ruby that results in fissure healing and heating residues (see American Gemological Laboratories (AGL) modifies its disclosure wording on heated rubies: June 2009).

"With the introduction of this new treatment, it was unclear as to whether these stones would fall under the classification of Composite Ruby by AGL, the more traditional format of fissure healing involving the quantification of heating residues, or yet another new form of disclosure." Smith explained.

During AGL's investigations, it became evident that in some samples fissure healing was taking place, whereas in others there was less healing taking place but open fissures were still being in-filled with a glasslike material however no lead or bismuth was detected as would be expected of a typical Composite Ruby.

It is the decision of AGL not to classify this new treatment as Composite Ruby, nor to develop another new classification for disclosure of this treatment as a consideration of several factors (see frequently asked questions). In the lab's opinion this treatment is more similar to the "glassfilled" rubies that were prevalent during the early to mid 1990's than the more recent Composite Ruby. "At that time, the discussions of glassfilled rubies revolved primarily around rough of Mong Hsu ruby that was being treated, with significant amounts of glasslike heating residues that were remaining." Smith indicated "Today, the material we are discussing is coming mainly from Mozambique, but the issues involved are quite similar."

AGL will expand the disclosure information for those stones that possess a combination of fissure healing and infilling, to better represent the dual nature of what is taking place as a result of this treatment process. For those stones where the majority of what is taking place involves the healing of fissures, the traditional disclosure nomenclature addressing the quantity of heating residues will be applied (figure 2). For those stones where a significant extent of what is taking place involves the infilling of fissures in combination with fissure healing, the disclosure wording will address both heating residues and infilling, with an expanded description under the comments section (figure 3).

Initial durability studies were also carried out and these stones were found to have less special care requirements than Composite Ruby. AGL cautions that all gems should be properly cared for however these stones were most similar to the more traditionally heated rubies possessing heating residues when exposed to conditions in a jeweler's workshop or with commercial household products.

"It is our opinion that the wording policy we have put in place for this material provide a practical approach for the industry and labs to address these stones and maintain that adequate disclosures are being made available to consumers." Smith concluded.

Background

In 2003, the leadglass filled ruby treatment began flooding the international gemstone market. This product was later classified as "Composite Ruby" by the AGL (AGL modifies its disclosure policy on leadglass filled rubies: November 2007). "In our opinion, those stones are an amalgam of natural ruby and a high lead content glass, which intrinsically carry a variety of special care considerations." Smith explained. Composite Rubies have been controversial ever since they first began proliferating in the market and proper disclosure nomenclature and practices have received a lot of attention.

American Gemological Laboratories (AGL) is the United States' most widely known and respected colored stone gem identification and quality grading laboratory. It was founded in 1977 and became the first gemological laboratory in the US to provide quality grading as well as countryoforigin determinations for colored stones. AGL has become an iconic brand for uncompromised standards and excellence in gemstone reporting and is regularly featured by the auction houses of Christie's and Sotheby's for important colored stones they are offering for sale.

Contact: Christopher P. Smith 1212704-0727

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FOR IMMEDIATE RELEASE

GRS and AGL COLLABORATE ON RESEARCH AND HARMONIZE THE DESCRIPTION OF LEAD-GLASS TREATED RUBIES.

HONG KONG / NEW YORK: 29 September 2011 — Ever since the lead-glass treatment of ruby/corundum hit the market nearly 10 years ago, there have been issues over how to describe and represent this material for the trade and laboratories alike. GemResearch Swisslab (GRS) and American Gemological Laboratories (AGL) have come together to begin harmonizing the description of these stones on their respective gemological reports. "We wanted to let the gemstone and jewelry industries know that GRS and AGL have begun working in a spirit of collaboration between our labs and we believe that the controversies surrounding how these stones are described on our reports is a perfect venue to demonstrate this," indicated Dr. Adolf Peretti, President of GRS Laboratories.

"Increasingly over the past several years issues surrounding the clear representation and disclosure of this material have come to the forefront around the world", stated Christopher P. Smith, President of American Gemological Laboratories. "Both GRS and AGL believe that this treatment needs to be clearly distinguished on our reports from the more traditionally heated rubies that are available in the marketplace in order to avoid confusion between these two products."

Christopher P. Smith (left) and Adolf Peretti (right) at the GRS office in Hong Kong, 2011.

Since the lead-glass treatment of low-grade ruby/corundum began entering the market in 2003, literally hundreds of thousands of stones have been sold globally. Gemologists, gemological and trade associations, as well as laboratories around the world have extensively published, lectured and generally communicated how to recognize these stones and the inherent issues of durability that surround this treatment, as well as the need for proper disclosure.

In November 2007, AGL took a high-profile position by coining the name *Composite Ruby* to describe all lead-glass treated ruby/corundum, while in 2010 GRS started using the name *Hybrid Ruby* for the same purpose.

Several features make these stones readily recognizable by anyone with little training and a loupe or microscope. Internal characteristics such as contraction bubbles in the glass, a distinct bluish and orangey color flash and the golden to red body color of the lead-glass make these stones easy to identify without the use of a gemological laboratory or advanced analytical testing. In addition these stones are not durable. Lead-glass treated ruby/corundum may be strongly damaged by some ordinary household products and routine repair by a bench jeweler.

However, the interwoven nature of ruby and glass-filler in addition to the very close refractive index of the high lead-content glass to that of the corundum makes it difficult to determine exactly how much glass versus ruby/corundum is present in each piece. "In our opinion, it does not make sense to create different levels of how to describe these stones, as a lay person will be unlikely to make some of these distinctions on their own". Peretti indicated. "Most of these stones are so heavily in-fused with lead-glass that many believe they should not even be associated with the name of ruby." Peretti commented.

"Regardless of the extent of the lead-glass treatment, these stones are readily recognizable by anyone with little training and simple observations, meanwhile all carry the same essential issues of durability and special care requirements." Smith further added.

As a closing statement, both Peretti and Smith emphasized: "We believe that developing a collaboration between GRS and AGL will be a benefit to our individual companies and the industry in general. In our view the association of the names *Composite Ruby* and *Hybrid Ruby* as a means to represent these lead-glass (bismuth-glass) treated stones will provide our clients with the means to easily recognize and distinguish them from the more traditionally heated ruby on our reports."

As of 3 October 2011, all GRS and AGL reports for lead-glass treated ruby/corundum will read as follows:

GRS
Identification: Synthetic Glass/Treated Ruby (GRS-type "Hybrid Ruby")*

*Comments: Heat-treated and filled with a colored foreign solid substance (including lead). Special care required when handling. Also known as Composite Ruby.

AGL
Identification: Composite Ruby

Comments: This stone is a composite of natural ruby and a high lead content glass. Also known as Hybrid Ruby.*

*See Enhancements section of the AGL report for additional comments related to the durability and special care of this product.

# # #

About GRS GemResearch Swisslab Laboratories
GRS Laboratories is a group of gem testing laboratories first founded in 1994 in Switzerland with additional GRS gem testing laboratories subsequently opened in Thailand, Sri Lanka and Hong Kong. GRS is specialized and has become renowned world-wide for its origin and quality reports on rubies, sapphires and emeralds. Its laboratories are positioned very closely to the worlds most important gem markets. GRS publishes its independent gemological research in its own journal: *Contributions to Gemology* and produces unique documentary video content on topics related to expeditions and research on the source of colored gemstones (www.gemresearch.ch).

About American Gemological Laboratories
American Gemological Laboratories (AGL) is the United States' most widely known and respected colored stone gem identification and quality grading laboratory. It was founded in 1977 and became the first gemological laboratory in the US to provide quality grading as well as country-of-origin determinations for colored stones. AGL has become an iconic brand for uncompromised standards and excellence in gemstone reporting (www.aglgemlab.com).

Contacts:

Dr. Adolf Peretti
President
GRS

Christopher P. Smith
President
AGL

The R.I. match of the high lead-content glass makes it often very difficult to determine the true extent of the treatment without etching the glass.

Contraction bubbles and a strong flash effect are the most readily available means to identify a Composite Ruby.

Identification

Mineral Type:

Variety:	Composite Ruby	Color Description:	Red
Carat Weight:	5.44 cts	Shape:	Oval
Measurements:	11.65 x 9.02 x 5.53 mm	Cutting Style:	Mixed Cut

Comments: This stone represents a composite of natural corundum and glass.

The Prestige Gemstone Report

American Gemological Laboratories

AGL

Document No: CS Sample 14 Validation Date: 03 May 2010

Identification

Variety: Composite Ruby Color Description: Red

Carat Weight: 5.44 cts Shape: Oval

Measurements: 11.65 x 9.02 x 5.53 mm Cutting Style: Mixed Cut

Comments: This stone represents a composite of natural corundum and glass.

Origin

Provenance: Not applicable

Comments:

Enhancement

Standard: Heat Additional: Clarity

Degree: N/A Degree: Prominent

Type: N/A Type: Lead-glass

Stability Index: N/A Stability Index: Good to Fair

Degree of Clarity Enhancement & Relative Rarity

Enhancement Stability Index

Accu-Vu Imaging

General Report Comments:

American Gemological Laboratories

Enhancement

Standard:	Heat	Additional:	Clarity
Degree:	N/A	Degree:	Prominent
Type:	N/A	Type:	Lead-glass
Stability Index:	N/A	Stability Index:	Good to Fair

Comments: This ruby has been heavily treated using a high refractive index lead-glass to fill fractures and cavities, vastly improving the apparent clarity and adding weight. The glass may be damaged by a variety of solvents. N/A represents Not Applicable

Press Release – Consumer Alert

Industry groups have detected an increased supply of highly treated "Ruby" products in the marketplace. According to information gathered by various industry members, these lead glass filled red stones are being sold throughout the supply chain including in U.S. department stores, venues in the Caribbean and elsewhere. These treated red stones have significant fissures filled with relatively large quantities of Lead Glass. They are often being sold as "Natural Rubies" without proper disclosure and most importantly with NO information on the required special care to maintain the appearance of the product.

Be Advised: This product is unstable and requires special care to avoid major and irreversible damage

To protect the consumer and the integrity of our industry we call upon the all sellers of this Composite Lead Glass "Ruby" Product - loose or in jewelry - to make the proper disclosures with the utmost clarity.

Failure to do so can directly lead to loss of consumer confidence not just for the Ruby market, but for all gemstones, including diamonds and jewelry. Additionally, it can result in potential legal action against merchants who fail to make the required FTC disclosures. Certain actions (heat or acid) that take place during repair or even normal wear can, and probably will, alter the appearance of these products, and render the jewelry unusable. Certain every day, common exposures to heat, acids and polishing can and probably will significantly alter the appearance and quality of these stones from their point of purchase. This could lead to potential legal action against sellers.

Disclosure of Treatment:

The treatment to these "rubies" filled with lead glass has a significant impact on their durability and value when compared with conventional enhanced rubies of the same size and color. If the heavily treated products are sold at prices near to the market prices attained by an untreated or conventional treated ruby of the same size and color, buyers may have cause for a legal action against the seller based on deceptive trade practices and economic harm.

When compared with natural ruby, both untreated or with conventional treatments and synthetic/lab created rubies, these heavily treated products are not stable. They can and will change their appearance under the most common tradesman processes and normal wear. FTC GUIDES REQUIRE that ALL sellers disclose at the point of sale, throughout the trade and to consumers any special care required to maintain the appearance of an industry product.

While the FTC Guides do not specify the exact wording to be used to identify these products or to disclose treatments, here are descriptions and classifications of this product employed by some leading international gemological laboratories and trade associations:

American Gem Trade Association: "Glass Filled Composite Ruby – Special Care Required." See Gemstone Information Manual (http://www.agta.org/gemstones/agta-gim/index.html)

American Gemological Laboratories: "Composite Ruby" – With comments "This stone represents a composite of natural corundum and glass, also known as Hybrid Ruby." Additional comments – the material is heavily treated…vastly improving the apparent clarity and adding weight. With special care warnings.

Gemological Institute of America: For a vast majority of this material (LMHC Info Sheet 3 Levels 2 & 3) GIA will not issue Ruby reports but will issue identification reports and the description "A Manufactured Product" with comments – "A manufactured product consisting of glass and ruby" and this product is known to be unstable…with special care comments.

Gemological Research Swisslab: "Synthetic Glass/Treated Ruby" (GRS – type "Hybrid Ruby") with comments Heat treated and filled with a colored foreign solid substance (including lead). Special care required when handling. Also known as Composite Ruby.

It should be noted that, depending on the level of treatment and lead glass filling to which this material has been subject, and based on the definition of the "gemstone" contained in the FTC Guides, it may be improper to use the name "Ruby" alone, without one of the above mentioned descriptors, to describe these products.

The undersigned associations and laboratories urge the trade at all levels to honor their responsibility to the consumer and the marketplace by fulfilling the requirements of the FTC Guides for disclosure of treatment and special care requirements for this material.

American Gemological Laboratories - agl@aglgemlab.com

American Gem Trade Association – info@agta.org

Gem Research Swisslab - adolf@peretti.ch

Jewelers Vigilance Committee - clg@jvclegal.org

Manufacturing Jewelers and Suppliers of America - info@mjsa.org

New York Gemstone Association - info@nygagroup.com

Gem Market News

Glass Filled Rubies-Part I
July/August 2006
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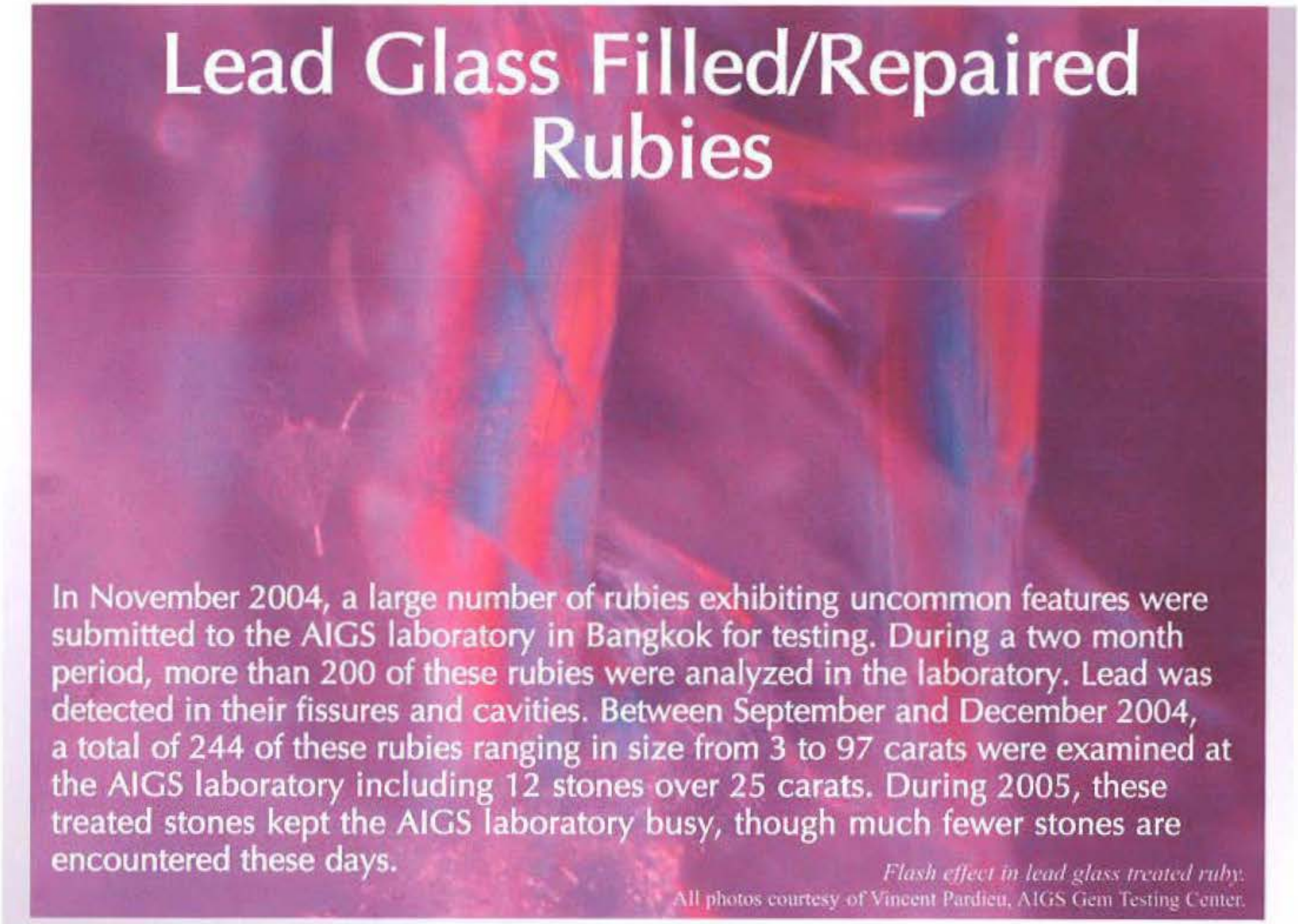
Supplement to ***The Guide***



Lead Glass Filled/Repaired Rubies

In November 2004, a large number of rubies exhibiting uncommon features were submitted to the AIGS laboratory in Bangkok for testing. During a two month period, more than 200 of these rubies were analyzed in the laboratory. Lead was detected in their fissures and cavities. Between September and December 2004, a total of 244 of these rubies ranging in size from 3 to 97 carats were examined at the AIGS laboratory including 12 stones over 25 carats. During 2005, these treated stones kept the AIGS laboratory busy, though much fewer stones are encountered these days.

Flash effect in lead glass treated ruby.
All photos courtesy of Vincent Pardieu, AIGS Gem Testing Center.

By Vincent Pardieu, GGA, GG
Asian Institute of Gemological Sciences
Gem Testing Laboratory

Surprised by the large number of stones suddenly appearing on the Bangkok market, the AIGS laboratory has decided to give priority to the study of these stones and began to research this new product.

Following several weeks of enquiry, we found that the treatment was being performed in three different cities in Thailand: Chantaburi, Bangkok and Mae Sot. AIGS Gemological laboratory then published an initial study on this treatment available at www.aigslaboratory.com.

After the release of this initial study, several other companies have started their own experiments. The composition of the glass used for the treatment can vary from company to company and has also changed with time. Recently, we saw a large Burmese type ruby with all the visual characteristics of lead glass filled ruby but after chemical analysis, no lead glass was present. Instead the filler was identified as a bismuth rich glass. Treaters are also experimenting with heating lead glass filled rubies at higher temperatures and sometimes with the beryllium atmosphere technique. But so far the results do not look to be very good as lead glass does not appear to be as good a flux as borax. Anyway, the point is that as with other treatments, it is not a single technique. There are variations in the glass composition and also the heating techniques. The parameters vary with the companies involved and also evolve with time.

Currently this treatment is not creating many problems for gemologists as the stones are easy to identify for gem labs and trained gemologists using darkfield or fiberoptic illumination in most cases. On a recent field trip to the Pailin gem market in Cambodia, the AIGS students with me had no problem identifying the lead glass filled rubies present in the market using their darkfield loupes. Nevertheless, this treatment is still subject to controversies among the gem dealers, especially those involved in the trade of rubies that were heated with borax typically from Mong Hsu (Burma). The fact is that the lead glass filled rubies have become a serious competitor for the cheapest of these stones which are locally called in Thailand "Lai Thai rubies" due to the fact that their numerous glassy fluid inclusions looks like a network similar to a woven silk tissue.

Necklace containing lead glass filled rubies. Jewelry such as this is now entering the global market.

The producers offer them as an inexpensive ruby alternative. In contrast to the beryllium sapphire controversy:

- The persons at the origin of the treatment were collaborating well with the labs that contacted them

- The stones were sold at very low prices compared to rubies of the same size, which immediately could raise some suspicion.

- The stones are very easy to identify for any gemological laboratory or even any trained gemologist.

As a result, the case here is very different from the beryllium issue, where the detection of the treatment remains a real gemological challenge. We recommend to all people buying facet cut rubies or star rubies to check their stones carefully. If they feel that they lack the identification skills, we recommend that they submit the suspect stones to a qualified gem laboratory for testing.

Currently, the treatment is mostly performed on Madagascar rubies from Andilamena but we have recently seen several stones of probable Burmese or Indian origin (facet cut and also star rubies) which were filled with lead glass.

Following the publication of the first version of this study in January 2005, AIGS gemologists have found that several other companies located in Bangkok and Mae Sot were also producing variants of lead glass 'repaired' rubies. These different companies are using glass, presenting different compositions, and the technique will probably continue to evolve. The glass composition can be very different from one company to another. Pure lead oxide, lead oxides mixed with bismuth, silica, or fluxes like borax can be encountered. Temperatures, parameters, and results can be very different. At the AIGS laboratory, a large stone that was filled with a bismuth glass recently was observed.

The gemstone material can also be very different. The most suitable rubies for repair are stones with color potential that are rich in fissures. Mr. Thondisuk has had extensive experience with ruby from Andilamena, but any ruby material with fissures could be suitable for this treatment. Several lead glass filled star rubies of Burmese origin have been submitted for examination to the AIGS lab. This treatment is particularly interesting for star rubies since the temperatures used are lower than the temperature at which the rutile needles responsible for the star effect start to be affected.

The present article is an update to a study referenced above. It is the result of four specific visits to

Chantaburi by AIGS laboratory gemologists in December 2004 and January 2005 and two visits to the Orange Sapphire Company in Bangkok. This last company was famous for its production of sapphire heated with beryllium technology. Several rough and also cut samples from these companies were studied along with some stones furnished by Bangkok dealers interested in this study. The stones brought to the AIGS Gemological laboratory by our regular customers were also used as a basis for this study.

Rubies found with lead rich foreign substance filling in fissures and cavities at the AIGS laboratory.

The purpose of this article is to provide to gemologists, gem dealers, jewelers and persons interested in the gemological field around the world relevant information to assist in the identification of glass filled ruby. Mr. Mahiton Thondisuk also wants to demonstrate that Chantaburi burners are not cheaters. He is happy to communicate the Thai technology used to produce this product and contribute to the recognition of Thailand and Chantaburi as a famous gem trading center.

Interview: Mahiton Thondisuk, Chantaburi, Thailand

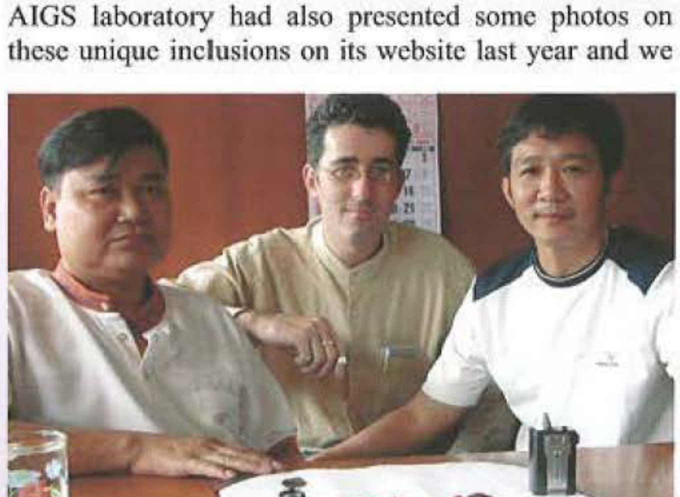
Mr. Thondisuk explained to the AIGS gemologists that this treatment was the result of five years of study in association with several Thai scientists from different universities in Thailand. The idea was to develop a glass compound suitable to "repair" fissures in rubies.

"Beautiful natural stones for which human intervention is limited to cutting and polishing are very rare and extremely expensive", explained Thondisuk. "There are many more lower quality gemstones compared to the tiny amount of real gem quality stones so that if we can find a good way to repair them, we can add them to the trade. In the beginning, I was not thinking that people would actually buy this product...a ruby repaired with glass–it's crazy. So after a few months, I went north to do some farming. But some people began to buy these stones so I came back to Chantaburi two months ago to produce these stones."

"You know," he added, "I love naturally beautiful rubies. In fact I don't really like to do this treatment but the market is looking for nice looking [inexpensive] stones. So I'm doing it…This is quite amazing to see how we can improve the beauty of these stones! "

It was just after Mahiton Thondisuk returned to Chantaburi with Somkuon Plairahan that the lead glass 'repaired' ruby gemstones arrived in large numbers at the AIGS Laboratory.

Several isolated accounts of filled gemstones had been seen on the market a few months before and at that time a warning was published by the GAAJ (Japan) in March 2004 about lead glass found in ruby. Several short articles were also published by the GIA, AGTA, GIT, and other organizations on their websites or in magazines. The AIGS laboratory had also presented some photos on these unique inclusions on its website last year and we



Left to right: Ruby expert Somkuon Plairahan, AIGS laboratory Director, Vincent Pardieu, master burner, Mahiton Thondisuk, glass filled ruby treater.

had a presentation about this subject in March 2005 in Paris.

In fact, this treatment is not really a new development. The process was developed in 1982, by diamond cutter Zvi Yehuda from Ramat Gan (Israel) to produce "Yehuda diamonds." The process used for fracture filling diamonds was quite common in the 1990's. Several companies were producing such stones at that time. Many studies were conducted and many articles about them are found in gemological literature or on the Internet. In the fall 1994 edition of *Gems and Gemology*, an important study of these diamonds was presented. At about this same time, AIGS was developing some special radiographic instruments to detect lead glass filling in diamonds.

Large lead repaired rubies offered for sale.

The fact is that lead glass filling of fissures is back and this treatment is now known in Thailand as "Paw Mai" (which translated from Thia means 'new heat treatment'). A few months ago in Chantaburi this term was used for the beryllium treatment of stones. Most of the stones seen these days are believed to be mainly sent to Asian markets like China and India in which the conjunction of important gemstone traditions and the need for inexpensive gems has created a niche for this product. But these stones are known to have reached the USA and Europe. There, the answer to the product was diverse, as sadly some of these stones were sold without proper disclosure and got damaged after exposure to chemicals.

Lead glass filled rubies in process to be sold on tables in Chantaburi.

Mahiton Thondisuk adds, "It is simple. If I give you the choice between two rubies of equivalent beauty at the same price–one synthetic grown in a factory and one grown in nature but 'repaired' by human technology after being mined–which one will you choose?"

"We are selling these stones at very good prices... Imagine how much a 20 carat heat treated ruby would cost and compare that to one of our stones of equal beauty? We are so [much less expensive]!"

This is an important point and the position of the AIGS is that there is nothing inherently wrong with treatments as long as the customer is provided with the correct information about the stone and the price is related to the real quality of the stone. The important thing is the proper disclosure of the nature of the stone. A very good point with these 'repaired rubies' is that they don't currently present any real identification problems.

Acknowledgments: *A special thanks is extended by AIGS laboratory to Mahiton Thondisuk and Somkuan Plairahan for their open and forthright disclosure of processes used in their fracture filling/repair treatment. Special thanks also to the Orange Sapphire Company for their collaboration regarding this process with the AIGS laboratory.*

Note: The next issue of *GMN* will have the second part of this article on glass filled rubies covering the actual step-by-step process of filling and identification techniques.

Gem Market News

Glass Filled Rubies-Part II
September/October 2006
Volume 25 Issue 5
Supplement to ***The Guide***

The Process and Identification of Filled Rubies with Lead Glass

In the last issue of *GMN*, we explored the prevalence of glass filled rubies on the market. In this issue, we continue with the step-by-step treatment process and the identification techniques.

Yellow lead-rich glass fused two rubies together during the heat treatment process.
All photos courtesy of Vincent Pardieu, AIGS Gem Testing Center.

By Vincent Pardieu, GGA, GG
Asian Institute of Gemological Sciences Gem Testing Laboratory

The following is a presentation of the treatment performed in Chanthaburi, Thailand by Master Burner Mahiton Thondisuk. 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. Most of the "repaired" stones are large but small stones less than 1.0 carat have also been treated this way. In this study, the rough material presented is low quality material from the Andilamena area in Madagascar. In June and September of 2005, the author visited this area to further study its material.

Step-by-Step

Step One: The stones are preformed to eliminate the matrix and other impurities that could disturb the treatment.

Step Two: The stones are heat treated to remove any impurities possibly present in the fissures that could create 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 900°C to 1400°C depending on the ruby type. As 900°C is not hot enough to melt inclusions such as rutile, many stones can still have an unheated aspect. But all stones are heated.

Step Three: The stones are then mixed with oxide powders and heated. The composition of the powder is mainly a mixture of silica and lead, but sodium, potassium, calcium and metallic oxides like vanadium or bismuth also enter in some glass composition. It could be interesting to compare the glasses used here with those used for diamonds, but this would need further investigation. There are two main types of glass compositions used in this process but experimentations about new glasses are in process.

The basic formula is a simple lead rich transparent glass. This formula is used for most of the best quality larger stones. This orange powder will turn into a yellowish to orange glass after heating as you can see in the

Mixing the chemicals before the burn.

Used crucible showing yellowish to orange glass after heating.

accompanying photo of the used crucible. In this case, the heat treatment temperature is believed to be around 900°C in Chanthaburi. But the treatment temperature can be higher or lower for other burners as other components are used in the composition of the glass and this can affect the melting point of the oxides used.

The second formula also incorporates some other metallic oxides to produce glass, optimizing the color and aspect of rubies. This formula was known in the market as the "popular" formula and was used on iron stain rich commercial quality stones. This formula is actually a mix of many oxide powders that turns to a light pink glass, after melting. With this formula, the treatment temperature is believed to be slightly higher than in the basic case, nearing 1000°C.

The powders are added to the stones with care along with some oil to cover them. The stones are then placed in crucibles and brought to the furnace. The powders will fuse during the heating process and turn into glass. A well-balanced glass composition is the key to achieving good transparency and fluidity so the glass will fill the entire fissure. The glass stability is also an important concern to create a durable product. New improved fillers will probably soon be tested and used to get better results.

Rubies covered by colorless lead rich glass after heat treatment in Chanthaburi.

These stones are then heat treated with the glass powder under a controlled atmosphere using electric furnaces. Special precautions have to be used at this step due to the use of lead compounds involving high temperatures. Gas masks, gloves and special compounds are used to clean the clothes and the treatment area. Heat treatment using chemicals of this kind is very technical and requires special knowledge and security precautions as lead vapors are very toxic.

Then, the stones are preformed and heated again using lead glass mixture to get a better result. Some stones can be heated several times with several types of oxides up to the desired result achieved. The stones are finally cut and polished. Sometimes the resulting stones have their surface treated again using several chemicals to improve their surface luster. This last surface treatment may explain why it is easy to detect lead on the stone using EDXRF technology.

Identification and Analysis of the Repaired Rubies

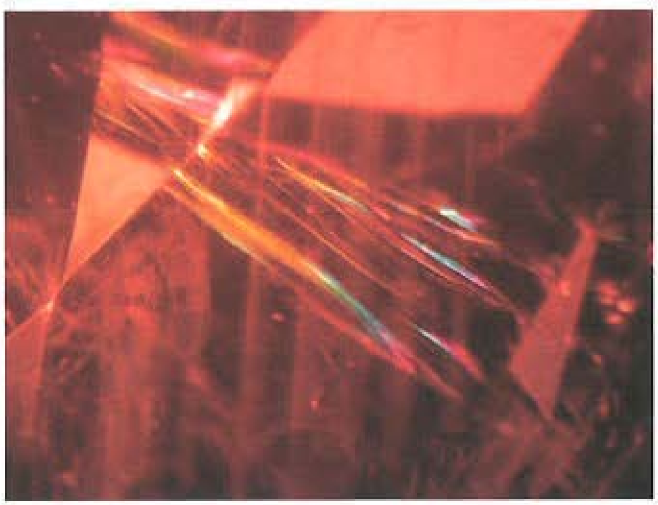
Identification of the lead glass repaired rubies is very easy for any laboratory that owns an EDXRF (Energy Dispersive X-Ray Fluorescence), but microscopic observation is in most cases enough for the experienced gemologist. Using EDXRF the AIGS laboratory found lead and in a few cases, bismuth. It is the ideal instrument to provide a rapid diagnostic result.

EDXRF: This instrument's main use is to provide qualitative and quantitative information on the chemical composition of a given stone. EDXRF can detect any element heavier than fluorine and it is especially efficient for heavy elements such as lead. This instrument provides a very fast and reliable diagnostic analysis. The AIGS laboratory utilizes this instrument on all rubies presented for identification.

Because lead and bismuth are very heavy elements, we are here in the exact opposite situation compared to the beryllium issue. Beryllium is a very light element. Its detection is not possible using EDXRF, which makes their detection more complicated.

Ultra Violet: Examination of the stones using a standard SW and LW (short wave and long wave) fluorescent box did not give any diagnostic result.

Microscope: An experienced gemologist using a microscope and dark field illumination can identify correctly the repaired rubies without any difficulty. Using darkfield illumination, most lead-rich glass filled fissures will display blue/orange flashes as seen in the accompanying photos. This observation can be easier using fiber optic illumination looking near parallel to the fissure. This is a very typical diagnostic feature that is similar to the opticon flash effect in emeralds or in lead glass filled diamonds. However, occasionally a stone may not have this obvious feature.



In darkfield illumination, multiple flashes of color are easy to see.

With careful close-up examination of the fissures, an observer may also find gas bubbles or "platelets." Gas bubbles were found in many rubies filled with the simple lead glass. Some platelets may be found in the repaired rubies using the popular formula from Bangkok. These platelets could be remnants of former iron stains formerly present in many rough stones from alluvial mining areas. Orange or yellowish before heat treatment, they turn whitish or blackish after treatment.

The platelets present in many stones do not present the typical shape of flattened glass bubbles but could be in fact the result of the mixing of the glass with some iron rich natural powders. "The number of such platelets can be reduced with careful temperature control," said master burner Mahiton Thondisuk. Careful observation of these platelets shows that they were transparent when observed from most directions, but they can also act as small mirrors inside the gem. In this case they often appear reddish. Color concentrations in the fissures were not found in any stone from Chanthaburi using the immersion technique, but some platelets did seem to have subtle coloration. In rubies enhanced in Bangkok by the Orange Sapphire Company, some yellow to orange color concentration appears in large fissures and in cavities. The fact that lead glass used in most Chanthaburi treatment is pink explains why it is most of the time not visible inside the gem.

An attempt to explain the reason why the stones repaired using the popular formula present a stronger col-

After heating, the chemicals form a glass coating as seen in this dish of ruby rough.

oration than the stones using the lead-only formula could be in the fact that the transparent platelets could act as mirrors inside the gem. They are normally present in a random orientation inside the gem, following the former fissure planes. They do not block the light path as orientated rutile silk can do. The light passes through some of them and is reflected by others. These reflections could increase the length of the travel of the light inside the gem. As we know, the longer the length of the light passing inside the gem, the more saturated the stone color will be. But this attempt to explain the improvement of the color should be confirmed by more in-depth studies.

Some inexperienced observers could be disturbed by the fact that the heat treatment temperature is not high compared with the temperature at which many stones are heated today using gas furnaces. Many inclusions may still appear as unheated.

Heat treatment temperature can vary from as low as possibly 800°C to more than 1300°C. As rutile needles begin to resorbe at over 1000°C, it is possible to find perfectly shaped needles in lead glass repaired rubies. Burmese star rubies are also known to have been repaired by burners in Mae Sot. It is important to bear in mind that because of the glass composition, the treatment parameters and the ruby material used differs in Chanthaburi, Bangkok, Mae Sot and in the other places this treatment is or will be performed. Therefore, different features are possible.

Origin of Color

The gemstone color improvement seems to result from the fact that the fissures that were formerly filled with air or liquid are then filled with a transparent glass. As lead glass and ruby refractive index are very close, the light can then travel more easily inside the gem, and as a result, the overall color looks dramatically improved. The same phenomenon is encountered with emeralds before and after oiling them. Some questions were raised about the fact that some pink colored glass is used in Chanthaburi, and a more yellow one in Bangkok:

Some question if the stones can be described as dyed. Although we have observed some light color in some wide fissures and cavities in rubies from Bangkok ovens, it was never enough to honestly say that the stone was dyed. Color concentration in fissures was not detected in Chanthaburi stones.

Some red or orange color can be seen in some stones using daylight tubes like those in common use in Chanthaburi's buying offices. But these red looking inclusions described as copper platelets by Mahiton Thondisuk, present similarities with the glassy areas showing similar red coloration found in many Mong Hsu rubies heated with flux under the same illumination.

The lead glass present in this new treatment or the flux residue glass present in Mong Hsu act as a mirror, reflecting the color of the stone to finally give the illusion that the glass is colored. The same phenomenon can also be observed when twinning is present. Twinning planes can appear colored under some orientations. Twinning planes cannot be described as colored.

Dyed rubies exhibit some very clear color concentrations in fissures that are in strong contrast with the light

A wide fissure filled with lead glass from a Bangkok repaired ruby presents a noticeable orange color. Left to right: overhead, transmitted and dark field illumination.

colored to colorless body color regardless of the direction we observe them. The presence of a light pink or yellowish glass visible in wide fissures or cavities in repaired rubies is very different in intensity compared to dyed rubies in which fissures are filled with intensely colored red dying agent. In fact, this light colored glass found in some important fissures can be compared to iron stain in natural stones. The coloration of the glass is not the origin of the color, but massively filling important fissures, it can modify the stone color if the stone color is weak.

Twinning planes seen in Mong Hsu rubies heated with borax presenting some pinkish to reddish coloration.

Durability and Care

To answer the durability question, the AIGS laboratory has performed several tests. Other tests have been performed by the GIA and the results were presented in an article published in *Gems & Gemology,* Spring 2006. Based on the various studies conducted internationally, these stones are durable but should still be handled with care.

However, the study was done during a one year span and none of the treated stones were more than a year old, so time will tell if the durability holds up long-term. If we compare this glass filling method to the glass filling used in diamonds, the treatment looks to be suitable for normal wear.

Compared to emerald oiling or impregnation using resins, this current ruby treatment is probably more durable. Glass is more stable than resin and its presence in a fissure will probably lower the probability that the fissure will expand. The fact that the fissures are closed with a lead rich glass is also probably improving the durability of the repaired gemstone, but not as much as those fissures filled by flux additives. In this case the fissures are closed by the re-crystallization of corundum during the process. Because of this re-crystallization, the fissure is no longer a danger for increasing.

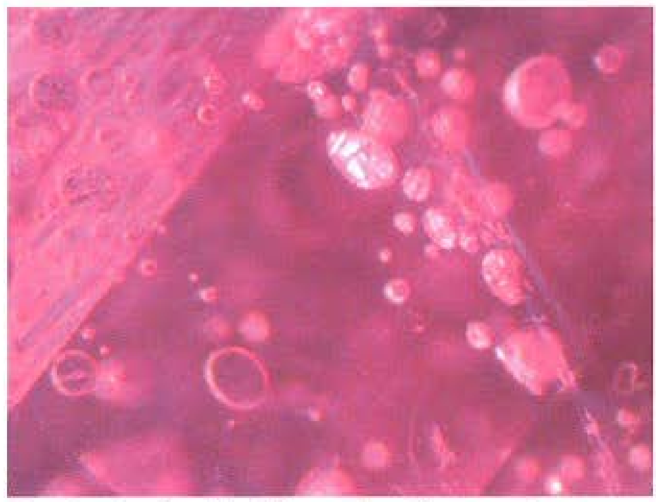
Assuming these stones are more durable than an impregnated emerald, but less than a ruby heated with flux, is a reasonable assumption. However, we must also consider that many companies are trying to perform this treatment. If they succeed, new technical problems may occur. Since the glass composition might vary considerably in the future, some surprises are probably still to come.

In our tests we observed the following.

1. One stone was exposed to a jeweler's torch for a few seconds. Glass began leaving the fissure producing glassy bubbles on the surface. This stone would then need to be polished again at a minimum to enhance its appearance.

2. Some stones were also boiled for several hours, immersed in detergents and exposed for short periods to ultrasonic cleaning without any apparent damage.

3. Several stones were submitted to light and heat fade tests to study the color stability after long exposition to light. No color modification was observed.



Platelets found in Chanthaburi rubies. They are either transparent or acting as mirrors depending on the light orientation.

4. Re-cutting or re-polishing should be performed with care as the glass used is very soft and could be damaged during the process. Many stones studied presented damaged or incomplete fillings.

5. The most important threat to the stone's durability and beauty is contact with powerful acids, such as hydrofluoric acid (also known as HF). AIGS exposed several stones to hydrofluoric acid for 12 hours and 48 hours. In all cases the acid dissolved the glass and the fissures in the stones were much more visible. The color and the clarity of the gemstones were then seriously damaged in three cases out of four. The attractive transparent purplish red stones had lost some saturation after immersion in HF and were then presenting unpleasant shiny whitish fissures.

Sizes Encountered

Large and small stones are heated together in quantity. The most suitable material is corundum exhibiting multiple fissures. But small stones and clean materials are submitted to the treatment in large parcels along with fissured stones. After cutting, these stones will not present filled fissures, so finding diagnostic blue/orange flashes will not be possible. Lead detection using EDXRF can also become a problem. When dealing with small stones, getting diagnostic results is more difficult as we have less material to investigate. Small stone testing presents some identification challenges and several EDXRF tests on different parts of a given stone are recommended. The AIGS laboratory has studied several stones less than 1.0 carat presenting lead reactions using EDXRF only when studied on the pavilion as no filled fissures were reaching the stone surface on the crown.

An assortment of sizes and shapes may be found in the market.

Country of Origin

Although most stones are from Madagascar, we encountered several Burmese rubies presenting lead glass, especially star rubies and recently some Indian star rubies. In fact this treatment is likely to be seen in any stone presenting fissures that can be heated at temperatures up to 1000°C.

Note: This treatment is likely to spread to other corundums and even other gemstones with fissures that can support temperatures around 1000°C.

Conclusions

Different type of lead glass filled rubies are present in the market as several companies and individuals have invested in this process and are using stones from different origins and slightly different techniques and parameters. Lead glass can be found today in some facet cut rubies but also in star rubies.

The detection of these repaired rubies should not be a problem for any experienced gemologist with darkfield illumination microscope or using EDXRF technology. But the fact that the treatment can be performed at low temperature, allowing many inclusions to remain in their unheated appearance, we recommend all ruby buyers check their purchases with care. Most experienced gemological laboratories can provide rapid identification if needed at affordable costs, which is not the case with beryllium treatment.

As long as these stones are properly disclosed and priced, AIGS feels that these stones should find their place in the gem trade where large size and low prices are of prime importance.

The stone durability under normal wear should not be a problem, but it is important to notify that these stones have to be kept away from excess of heat or chemicals. If some repairs are required special attention similar to that used for glass filled diamonds and epoxy filled emeralds, should be observed. Jewelers wishing to use these stones in jewelry should be cautious, but if handled correctly, this product can be used in jewelry without problem. ◆

Acknowledgments: A special thanks is extended by AIGS laboratory to Mr. Mahiton Thondisuk, Mr. Somkuan Plairahan for their open and forthright disclosure of processes used in their fracture filling/ repair treatment. Special thanks also to Orange Sapphire Company for their collaboration regarding this process with the AIGS laboratory.

AIGS Laboratory Reports Comments

For proper disclosure to a customer, the AIGS Gem Testing Laboratory currently uses the following terminology.

Full Reports:

Result–Found to be a Natural Ruby

Comments–This stone has been clarity enhanced. Lead rich foreign substance found in fissures and cavities.

Mini Reports:

Identification–Natural Ruby. This stone has been clarity enhanced. Lead rich foreign substance found in fissures and cavities.

AGA Attachment 26

Ruby Treatment Continues to Raise Nomenclature Issues

A lead glass treated ruby.
Photo courtesy of AGL.

Stabilized ruby; glass-filled ruby, composite ruby...**what is the correct terminology and what will the industry ultimately accept and use for disclosure? In a follow up to the March/April *GMN*, we examine the issues to find a suitable solution.**

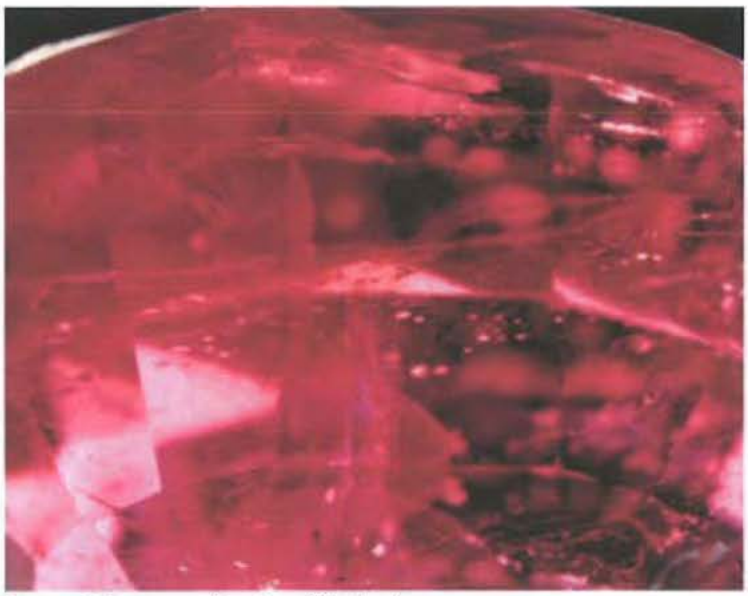
by Stuart M. Robertson, GG

The article, *In Support of the Term Stabilized Ruby*, published in the March/April 2010 issue, elicited mixed response and concern over proper terminology. Gemworld is **not** opposed to the term "glass-filled ruby." However, due to prior use in the industry, the term is incomplete in describing this ruby product unless the amount of filler is quantified. To do this would require expanding the current degrees of enhancement from *minor, moderate* and *significant* to include a designation of *extreme* reserved for "gemstones" altered to an extent that they could not exist absent the treatment.

The point of the article was to address the question of how to classify this treatment. In other words, what function does the treatment serve? Based on my examination of samples of this product from both Mozambique and Madagascar, the apparent affect of the treatment was to "stabilize" the rough for cutting and wear. However, Christopher Smith, President, American Gemological Laboratories, NY, explained the findings of his research regarding this product. His investigation of the material revealed several conditions that are not associated with typical examples of stabilized stones. Smith explained, "The only product that is even somewhat similar [to the lead glass filled ruby] is B-Jade. In that instance, acid is used to leech out material that is ultimately replaced by a polymer. However, when we talk of stabilized opal or turquoise there is a distinction between those products and this ruby material, which I have been describing as "composite-ruby" for three years now."

Smith further explained that treating an intact but porous material like turquoise with a polymer is done to prevent it from being discolored by oil on the skin when worn. The distinction, as he sees it is that in the case of these treated rubies they are often not intact. The glass component represents an appreciable, and in many cases a considerable, amount of the cut stone's weight. "Glass is an integral part of these composite rubies, unlike the polymer associated with stabilized gem materials." Regarding this material, the distinction for Smith is that the "stone" technically is not a ruby after treatment given the substantial glass component.

Yet, dealers familiar with this treated ruby product argue that this characterization is incomplete. Richard Hughes, having seen much of this rough during the past few years, states that the material he has seen is ruby, but very low quality ruby. Others that we spoke with questioned whether the cleaning out process is also attacking the ruby structure, resulting in the appearance that these stones are mostly glass.



Internal features of a glass filled ruby.
Photo courtesy of AGL.

Evolving Language

Initially I hesitated to accept the term composite ruby based on my understanding of how the gem industry uses the term "composite." Traditionally, the term has been associated with products consisting of two or more pieces joined to form the finished "gemstone." However, Smith stated that he had also considered prior use, but concluded that of available terminology, "composite" most closely described the product. "I am not calling these a composite stone. What I have proposed is to name the product 'composite ruby.' Yes, this expands the gemological definition but all the composite ruby I have seen so far consist of two integral components—glass and ruby."

As Smith sees it, there is a relativity factor to be considered that distinguishes these from diamond; a gem that can also be enhanced with glass. "I have heard the clarity enhanced diamond comparison before but it is a completely different matter. When a diamond is clarity enhanced, the filling of cleavages does not alter the weight. That isn't the case with composite ruby."

The amount of glass comprising much of this material is apparently greater than many people realize. The RI of the glass is close to that of ruby. Reportedly, it can be difficult to visually distinguish the percentage of glass versus corundum in much of this material. A more reliable gauge is to etch or remove the glass with solvents. Also, gemologists may recall reference to "glass" healed fractures associated with heating of ruby rough from Burma's Mong Hsu deposit. This is a different matter altogether. To put it in some perspective, Smith notes that the worst healed fissure in Mong Hsu ruby contained far less glass than the best of these stones.

Consistency is Critical

Regardless of what term is ultimately associated with this material, two points must be understood. First, disclosure terminology must be acceptable to both gemological and dealer/retailer entities. Only then will it serve consumers. Terminology that can be perceived as implying a negative attribute will not be used by sellers. Second, terminology should be consistent among trade groups and also labs. If the same product is disclosed by some as "stabilized," others as "composite ruby," and yet others as "treated ruby," confusion will result and consumers may direct their spending elsewhere. Although some of the material we have examined appeared not to contain a significant amount of glass, clearly many others samples do. Smith's case for naming this product as "composite ruby" for commercial purposes is compelling.

Meaningful disclosure cannot exist if the terminology used fails to convey the extent to which a stone has been altered. It is troubling that this material was introduced into the trade as "heated." That is insufficient disclosure for a product containing a significant amount of glass. For those operating within the USA, the Federal Trade Commission regulations require accurate treatment disclosure of this material, as they do other treated gems. Merely stating that the material is "heated" is not enough.

What's in a Label?

In the March article, I consulted with research gemologists, each agreeing at that time that the historical use of "composite" has traditionally differed from the treatment associated with the majority of these "rubies." The term "stabilized" appeared to apply more closely. However, they made those observations based on the samples on hand and that material did not appear to be as heavily treated. We agree that any material not having the properties of ruby before or after the treatment, would have been altered to a greater degree than is implied by the term *stabilized*. Smith indicates that he expects the GILC to adopt the term *composite ruby* to describe the lead-glass treated ruby product.

Consistent use of nomenclature is essential or the industry will have virtually no meaningful disclosure. If consumers are given accurate information, they can make informed choices. Consistent application of nomenclature is the key. This is the point the article endeavored to make. Unless we seek terminology that is both reliable and accurate, the international trade participants will have reason to avoid adopting it. Although still a relatively young discipline, gemology has a useable lexicon that can bring clarity to some of these issues and that should be the starting point when examining purportedly new treatments. The term stabilized ruby seemed to achieve that objective for the samples we had on hand. Whether the term the trade ultimately adopts is composite, stabilized, or something else is not as important as applying a repeatable standard to the nomenclature process. To do anything less invites decisions influenced by the perceived desirability of the final product and not the function of the treatment.

An orangy-yellow lead glass is added through a multiple step treatment process. Photo courtesy of AGL.

Will the Name Work?

Will the term "composite ruby" be widely used by the manufacturers and purveyors of this material? That point is important because the reality is that nearly all this material will be sold without being submitted for laboratory analysis. Even with the efforts of groups like the AGL, GIA and AGA, which have been raising awareness of this product in both public and trade venues, the international gem trade's responsibility to properly describe this material to customers falls ultimately to those who sell it.

The issue facing the international gem trade is not whether to sell this ruby product. That decision has already been made for them by their colleagues who treated the vast quantities of this material. Instead the issue is how best to classify this product so that buyers and jewelers working with these "stones" actually understand what they are, and how to care for them. As is often the case, the problem is not as much the product, as it is the way it is being sold and not accurately disclosed that poses the greatest risk to industry reputation and consumer confidence. Whether or not sales will decline due to accurate disclosure is a matter for the market to determine. It is not the policy of the *GMN* to discuss a product as being good or bad for the trade, except in instances where the product poses a health risk. Instead, we advocate that treatments be properly disclosed and then market participants will have the ability to make informed choices about their purchasing decisions, something that clearly is not possible under the current situation.

In conclusion, we believe that although some of this material is more accurately described as stabilized, a greater population contains a glass constituent in excess of what would be expected in a stabilized stone. Considering Smith's comments and the apparent agreement of the GILC committee to recommend the term "composite-ruby" for this product, the *GMN* encourages use of the term for commercial purposes. With proper education, we believe that term composite ruby can be acceptable to the very segment of the industry that should be encouraged to disclose—treaters and dealers. ◆

Asian Institute of Gemological Sciences Gem Testing Laboratory

"Lead Glass Filled/Repaired Rubies"

By Vincent Pardieu
(Version 04, Updated February, 16th 2005
Original version published on January, 17th 2005)

In November 2004 a large number of rubies having some uncommon features were brought for testing to the AIGS laboratory in Bangkok. For two months more than 200 of these rubies were analyzed in the laboratory. Lead was detected in their fissures and cavities. Between September and December 2004, a total of 244 of these rubies ranging in size from 3 to 97 carats were examined at the AIGS laboratory including 12 stones over 25 carats. In January and February 2005 these stones did not stop to keep AIGS laboratory busy.
Surprised by the large number of stones suddenly appearing on the Bangkok market, AIGS laboratory has decided to give priority to the study of these stones and began to research this new product.

3 rubies found with "lead rich foreign substance filling in fissures and cavities" at AIGS laboratory

Following several weeks of enquiry we found that the treatment was being performed in Chantaburi, Thailand. At the end of December 2004, two gemologists from AIGS visited the company that was applying the treatment. We were very surprised to discover that the treatment expert, Mr. Mahiton Thondisuk, had been a student at the AIGS.
Very friendly contacts were re-established with Mr. Thondisuk, also known as "Kob" and his partner in this enterprise, Mr. Somkuon Plairahan. Mr. Plairahan had formerly been in Mae Sai, the border town with Burma, where he was an expert in Mong Shu Ruby heat treatment.
In the tradition of AIGS philosophy about sharing knowledge in the gemological field, they were very happy to present to AIGS gemologists their treatment methods.

(Left to right: Ruby expert: Mr. Somkuon Plairahan, AIGS laboratory Director: Vincent Pardieu, Master burner: Mr. Mahiton Thondisuk)

Following the publication of the first version of this study in January 2005, AIGS gemologists have found that several other companies located in Bangkok and Mae Sot were also producing some lead glass "repaired" rubies. It is likely that in the future we will see many stones presenting some unusual features as several companies are known to have begun to work on this new treatment. The glass composition could be very different in the future as some people are just mixing lead oxide powders with different fluxes, silica, crushed glass or quartz in order to try to enhance rubies from different origins.
The present article is the result of the four visits to Chantaburi by AIGS laboratory gemologists in December 2004 and January 2005 and two visits to "Orange Sapphire" company in Bangkok. This last company was famous for its production of sapphire heated with beryllium technology. Several rough and also cut samples from these companies were assembled along with some stones furnished by Bangkok buyers interested in the study of these gems. These stones as well as others brought to the laboratory by AIGS regular customers were also used as a basis for this study.

The purpose of this article is to provide to gemologists, gem dealers, jewellers and persons interested in the gemological field around the world some information to assist in the identification of these gemstones. Mr Mahiton Thondisuk want also to show that Chantaburi burners are not cheaters, he is happy to communicate about Thai technology and contribute to make Thailand and Chantaburi a more famous gem trading center.

PART 1: Interview with Mr. Mahiton Thondisuk from Chantaburi, Thailand

Mr. Mahiton Thondisuk explained to the AIGS gemologists that this treatment was the result of five years of study in association with several Thai scientists from different universities in Thailand. The idea was to develop a glass compound suitable to "repair" fissures in rubies.

"Beautiful natural stones for which human intervention is limited to cutting and polishing are very rare and extremely expensive", explained Mr. Mahiton Thondisuk. "There are many more low quality gemstones compared to the tiny amount of real gem quality stones so that if we can find a good way to repair them we can add them to the trade. In the beginning, I was not thinking that people would actually buy this product: A ruby repaired with glass, it's crazy. So after few months, I went north to do some farming. But some people began to buy these stones so I came back to Chantaburi 2 months ago to produce these stones."
"You know," he added, "I love naturally beautiful rubies, in fact I don't really like to do this treatment but the market is looking for nice looking cheap stones. So I'm doing it...
This is quite amazing to see how we can improve the beauty of these stones! "

It was just after Mr. Mahiton Thondisuk returned to Chantaburi with Mr. Somkuon Plairahan that the lead glass "repaired" ruby gemstones arrived in large numbers at the AIGS Laboratory.

Several isolated gemstones had been seen on the market a few months before and at that time a warning was published by GAAJ (Japan) in March 2004 about lead glass found in ruby. Several short articles were also published by GIA, AGTA and other organizations on their website or in magazines. AIGS laboratory had also presented some photos on these unique inclusions on its website last year.
In fact, this treatment is not really a new development. The process was developed in 1982, by diamond cutter Zvi Yehuda from Ramat Gan (Israel) to produce "Yehuda diamonds". The process used for fracture filling diamonds was quite common in the 1990's. Several companies were producing such stones at that time. Many studies were conducted and many articles about them are found in gemological literature or on the internet. In the fall 1994 edition of *Gems and Gemology* an important study of these diamonds was presented. At about this same time AIGS was developing some special radiographic instruments to detect lead glass filling in diamonds.

The fact is that lead glass filling of fissures is back and this treatment is now known in Thailand as "Paw Mai" (new heat treatment in Thai language). A few months ago in Chantaburi this term was used for the beryllium treatment of stones. Most of the stones seen these days are believed to be mainly sent to Asian markets like China and India in which the conjunction of important gemstone traditions and the need for cheap gems has created a niche for this product. But these stones are known to have reached the USA and Europe.
Mr. Mahiton Thondisuk adds: "It is simple, if I give you the choice between two rubies of equivalent beauty at the same price: one synthetic grown in a factory and one grown in nature but "repaired" by human technology after being mined, which one will you choose?"
"We are selling these stones at very good prices... Imagine how much a 20 carat heat treated ruby would cost and compare that to one of our stones of equal beauty? We are so cheaper!"

Large lead repaired Rubies in process to be sold on tables in Chantaburi

This is an important point and in AIGS opinion there is nothing wrong about treatments as long as the customer is provided with the correct information about the stone and the price is related to the real quality of the stone. The important thing is the proper disclosure of the nature of the stone. A very good point with these "repaired rubies" is that they don't currently present any real identification problems, which is a major difference when compared to the beryllium treatment issue.

PART 2: The "lead Glass" treatment, step by step:

Note: 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. Here is now a presentation of the treatment performed in Chantaburi, Thailand by Master Burner Mahiton Thondisuk:

The most suitable rubies for repair are stones with color potential and that are rich in fissures. 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.


(Andilamena rough rubies before treatment)

First step: The stones are preformed to eliminate the matrix and other impurities that could disturb the treatment.

Note: As you can see here, small and large stones are treated together and AIGS gemologists have seen many rubies less than 1 carat treated with lead glass. But many stones treated this way do not present fissures and as a result will not show diagnostic features of the treatment.

Second step: 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.

Third step: The stones are then mixed with some oxide powders and heated. The composition of the powder is mainly a mixture of silica and lead, but sodium, potassium, calcium and metallic oxides like vanadium or bismuth also enter in some glass composition. It could be interesting to compare the glasses used here with those used for diamonds, but this would need further investigation. There are 2 main types of glass compositions used in this process at the moment but experimentations about new glasses are in process.

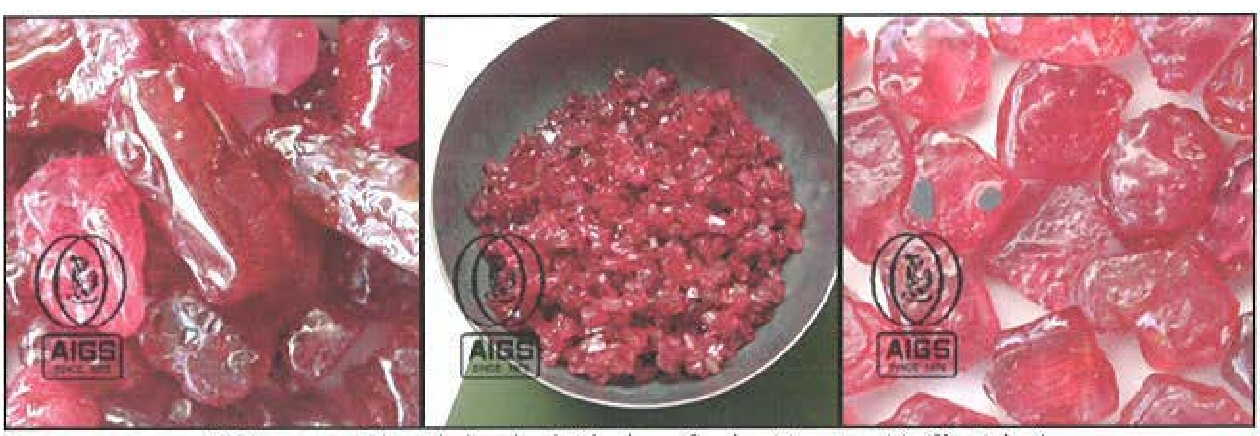
There is currently the "basic" formula which is a simple lead rich transparent glass. This formula is used for most of the best quality larger stones. This orange powder will turn into a yellowish to orange glass after heating as you can see in this used crucible.

In this case, the heat treatment temperature is believed to be around 900 degrees Celsius in Chantaburi. But the treatment temperature can be much higher for other burners as other components are used in the composition of the glass.

The second formula also incorporates some other metallic oxides, in order to produce glass, optimizing the color and aspect of rubies. This formula is known in the market as the "popular" formula and is used on "iron stain" rich commercial quality stones.
This formula is in fact a mix of many oxide powders that turns to a pink glass, after melting.
With this formula, the treatment temperature is slightly higher nearing 1000 degrees Celsius.

The powders are added to the stones with care along with some oil so they will cover them. The stones are then placed in crucibles and are then bring to the furnace. The powders will fuse during the heating process and turn into glass.
Note: A well balanced glass composition is the key to achieving good transparency and fluidity so the glass will fill the entire fissure. The glass stability is also an important concern to create a durable product. New improved fillers will probably soon be tested and used in order to get better results.

These stones are then heat treated with the glass powder under a controlled atmosphere using electric furnaces. Special precautions have to be used at this step due to the use of lead compounds involving high temperatures. Gas masks, gloves and special compounds are used to clean the clothes and the treatment area.
Heat treatment using such kind of chemicals is very technical and requires special knowledge and security precautions as lead vapors are very toxic.



Rubies covered by colorless lead rich glass after heat treatment in Chantaburi.

Rubies covered by yellowish lead rich glass after treatment in Bangkok

Then, the stones are preformed and heated again using lead glass mixture in order to get a better result. Some stone can be heated several times with several types of oxides up to the desired result achieved.

The stones are finally cut and polished. Sometimes the resulting stones have their surface treated again using several chemicals in order to improve their surface luster.

This last surface treatment may explain why it is easy to detect lead on the stone using EDXRF technology.

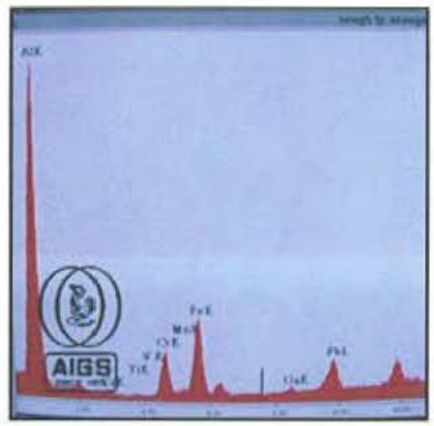
Several rubies heated with lead rich glass in Chantaburi (photo 1) and in Bangkok (photos 2 to 6)

PART 3: Identification and analysis of the "repaired rubies":

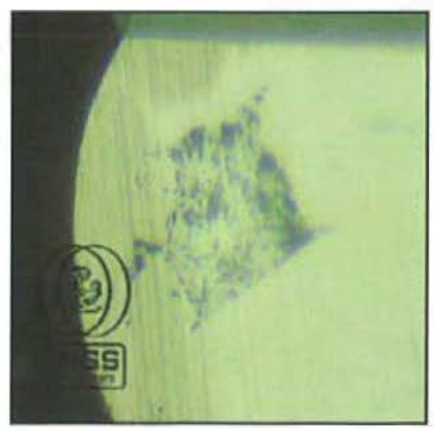
Identification of the lead glass "repaired rubies" is very easy for any laboratory that owns an EDXRF (Energy Dispersive X-Ray Fluorescence), but microscopic observation is in most cases enough for a gemologist that has experience with these stones. Using EDXRF the AIGS laboratory was able to find lead in all the stones studied. It is the ideal instrument to provide a rapid diagnostic result.

EDXRF: This instrument's main use is to provide some quantitative and qualitative information on the chemical composition of a given stone. EDXRF can detect any element heavier than fluorine and it is especially efficient for heavy elements such as lead. This instrument provides a very fast and reliable diagnostic analysis. The AIGS laboratory is using this instrument on all rubies presented for identification.

On the EDXRF spectrum on the right you can clearly see the peaks related to various elements. Ruby is composed of aluminum, oxygen and some trace elements such as chromium and iron that give the stone its color. The presence of lead (PbL on the photo) is diagnostic that the stone has been treated with the lead glass technology because lead is never found in natural corundum. Lead was found in every stone that was tested and copper was also found in 2 stones with very large filled cavities.



This cavity on a "repaired" ruby was carefully placed to be checked using EDXRF, as the cavity luster is very close to the ruby luster showing that the glass has a refractive index very close to the ruby. The cavity surface is visibly damaged, as the glass is very soft. Such damages could have occurred during the cutting or polishing process. Copper was detected while studying this large cavity along with lead but it could be the result of pollution from polishing powder residue filling damaged areas. (The detection of copper was not successful under other conditions)



Because lead is a very heavy element, we are here in the exact opposite situation compared to the Beryllium issue. Beryllium is a very light element. Its detection is not possible using EDXRF, which makes the detection of the stones, treated using beryllium a complicated matter. This relatively new type of treatment involving lead is very easy to detect.

Ultra Violet: Examination of the stones using a standard SW and LW (short wave and long wave) fluorescent box did not give any diagnostic result.

Microscopic observation: An experienced gemologist using a microscope and dark field illumination will be able to identify correctly the "repaired" rubies without any difficulty:

Using dark field illumination, most lead-rich glass filled fissures will display blue/orange flashes as seen on the following photos. This observation can be easier using fiber optic illumination looking near parallel to the fissure. This is a very typical diagnostic feature that is quite similar to "opticon flash effect" in emeralds or in lead glass filled diamonds.
Note: Depending upon the company performing the treatment, the composition of the glass and the parameters used, the "blue/orange flashes" may vary from very obvious to very difficult to observe:

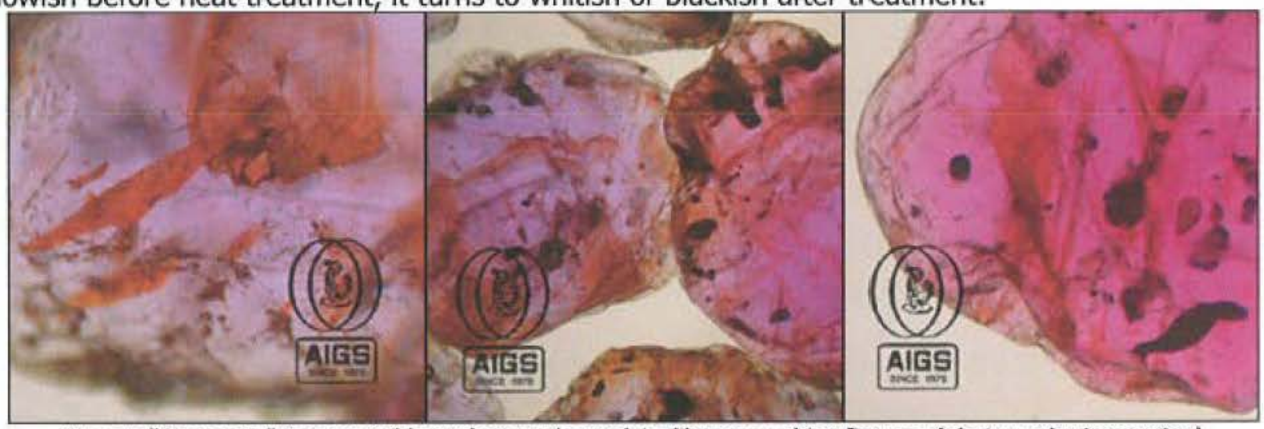
With careful close-up examination of the fissures an observer may also find gas bubbles or "platelets". Gas bubbles were found in many rubies filled with the simple lead glass:

Some "platelets" are present in all the "repaired" rubies that were treated using the so called "popular" formula in Chantaburi and in most stones from Bangkok, these platelets could be remnants of former "iron stains" formerly present in many rough stones from alluvial mining areas.

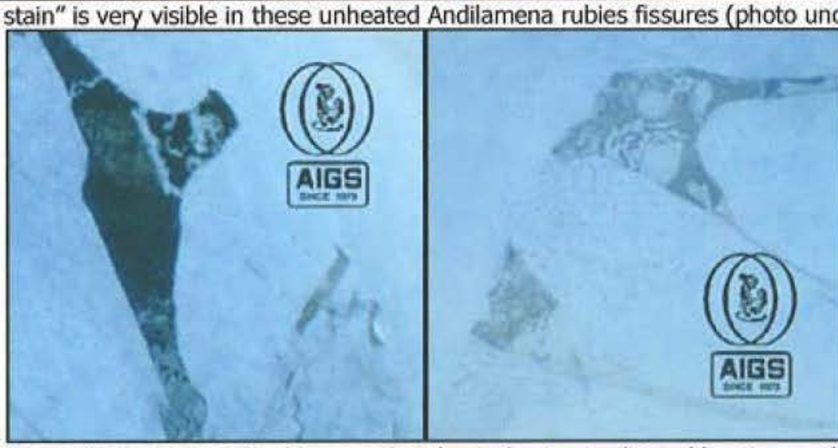
("Platelets" found in Chantaburi rubies: They are transparent or act as mirrors depending the light orientation.)

("Platelets" found in Chantaburi rubies: They are transparent or act as mirrors depending the light orientation.)

Mr. Mahiton Thondisuk told first AIGS gemologists about "copper platelets". It was in fact a language misunderstanding as he was in fact speaking about "iron stain" present in the stone before the treatment: "Iron stain" is present in many stone from alluvial mines like Andilamena. Orange or yellowish before heat treatment, it turns to whitish or blackish after treatment:



Orange "Iron stain" is very visible in these unheated Andilamena rubies fissures (photo under immersion)



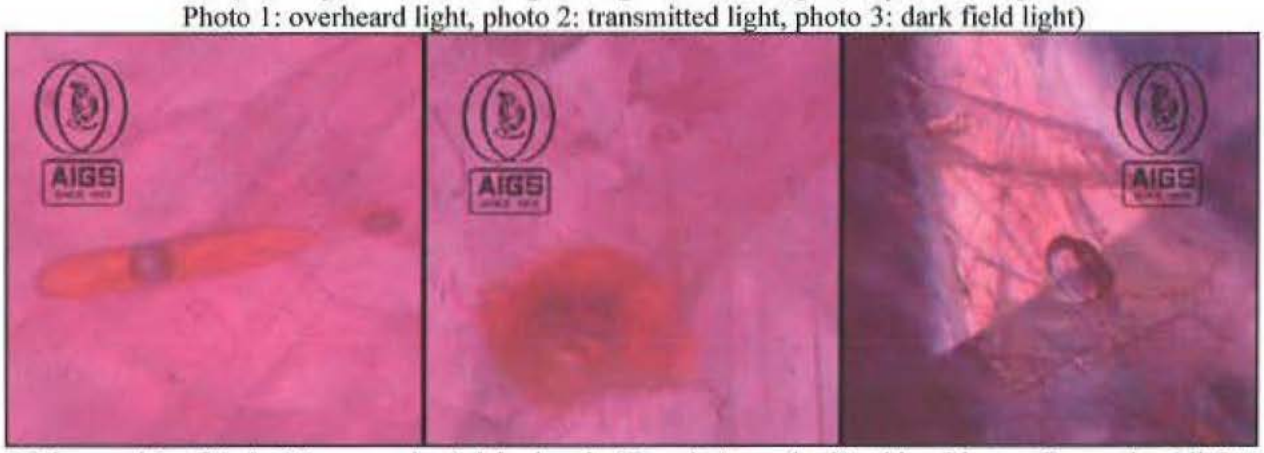
("Iron stain" remains in Pailin blue sapphire heated using traditional heating methods)

The "platelets" present in many stones does not present the typical shape of flattened glass bubbles but could be in fact the result of the mixing of the glass with some iron rich natural powders. "The number of such platelets can be reduced with careful temperature control" said master burner Mahiton Thondisuk. Careful observation of these platelets shows that they were transparent when observed from most directions, but they can also act as small mirrors inside the gem. In this case they are often seen reddish. Color concentrations in the fissures were not found in any stone from Chantaburi using the immersion technique, but some platelets did seem to have subtle coloration. In rubies enhanced in Bangkok by Orange Sapphire company, some yellow to orange color concentration appears is large fissures and in cavities. 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:

(Photo 1 and 2: Bangkok heated rubies presenting some orange color concentration in fissure and cavities
Photo 3: Yellow lead rich glass sticking together two rubies after heat treatment using lead rich glass)

(A wide fissure filled with lead glass from a "Bangkok repaired" ruby present a noticeable orange color:
Left to right: overhead, transmitted and dark field illumination)

(A cavity filled with orange lead glass in a "Bangkok repaired" ruby:
Photo 1: overheard light, photo 2: transmitted light, photo 3: dark field light)

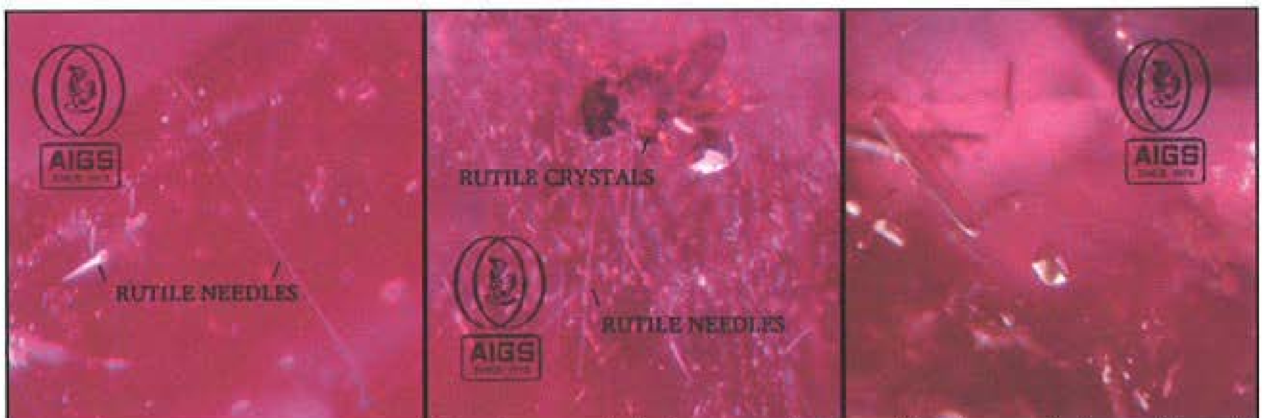


(Other cavities filled with orange lead rich glass in "Bangkok repaired" rubies. Photos: Transmitted light)

An attempt to explain the reason why the stones repaired using the "popular" formula present a stronger coloration than the stones using the "lead only" formula could be in the fact that the transparent platelets could act as mirrors inside the gem. They are normally present in a random orientation inside the gem, following the former fissures planes. They don't block the light path as orientated rutile silk can do. The light passes through some of them and is reflected by others. These reflections could increase the length of the travel of the light inside the gem. As we know, the longer the length of the light passing inside the gem, the more saturated the stone color will be. But this attempt to explain the improvement of the color should be confirmed by more in-depth studies.

Some observers could be disturbed by the fact that the heat treatment temperature is not high compared with the temperature at which many stones are heated nowadays using gas furnaces. Many inclusions may still appear as "unheated" which could disturb an inexperienced observer:
Heat treatment temperature can vary from as low as possibly 800 degrees Celsius to more than 1300 degrees Celsius. As rutile needles begin to resorbe over 1000 degrees Celsius, it is possible to find perfectly shaped needles in lead glass repaired rubies. Burmese star rubies are also known to have been repaired by burners in Mae Sot. As the glass composition, the treatment parameters and the ruby material used are not the same in Chantaburi, Bangkok, Mae Sot and in the other places this treatment is or will be performed, different features are possible.

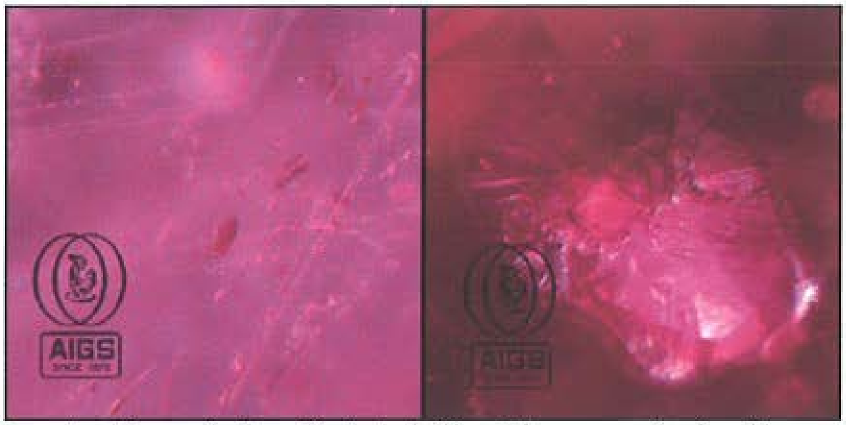
Inclusions in Andilamena rubies repaired in Chantaburi at low temperature (Under 1000 degrees):



(Intact rutile needles, euhedral crystals found in many lead glass treated stones giving them an "unburned" aspect)

Inclusions in Andilamena rubies repaired in Chantaburi over 1000 degrees:

(Melted crystals surrounded by glassy discoids, typical of heated corundum are also found in many "repaired" rubies)



(Melted crystals, glassy discoids, resorbed needles typical of heated gems are also found in many "repaired" rubies)

(High luster rutile crystals reaching the surface should not be mistaken with lower luster lead glass filed areas)

"FUNNY" IDENTIFICATION STORY: A funny identification story happened during this lead glass ruby study: One of AIGS good friends that have provided us some stones did not warn us that the parcel was not only rubies: One stone with a similar aspect as the others was not ruby... Inclusions in this stone were slightly different from the typical ruby heated with lead glass but not that much as you can discover on the following photos: If "blue/orange flashes" were absent numerous "platelet" looking inclusions were present along with needles. When the stone was drop for immersion study in heavy liquid something was really wrong for corundum as the stone was floating! Refractive Index and EDXRF study confirmed its true nature: Pezzottaite...

(The pezzottaite cabochon submitted to AIGS lab and some of its "red platelet" looking inclusions)

"What about the durability of these gems? Should we buy it?"

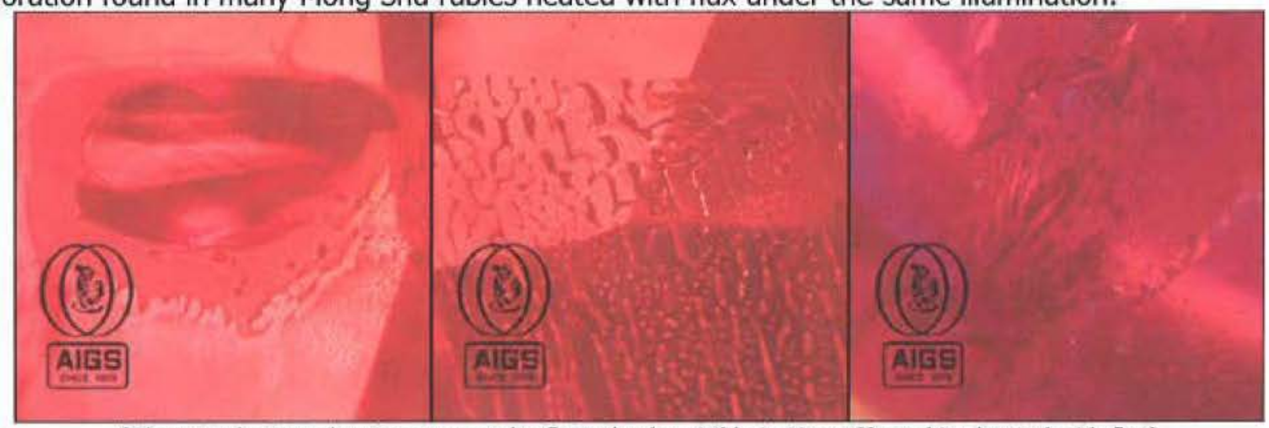
Here are several questions dealers in Bangkok, and from outside Thailand asked AIGS gemologists recently. In order to help them to find the answers, the AIGS laboratory has performed some tests to evaluate the durability of these gems:

- **What is the origin of the color in these stones?** The gemstone color improvement seems to result from the fact that the fissures that were formerly filled with air or liquid are then filled with a transparent glass. As lead glass and ruby refractive index are very close, the light can then travel more easily inside the gem, and as a result, the overall color looks dramatically improved. The same phenomenon is encountered with emeralds before and after oiling them.

Some questions were raised about the fact that some pink colored glass is used in Chantaburi, and a more yellow one in Bangkok:

- **Can we describe these stones as dyed?** Regarding the stones we have seen up to now: No. We have observed some light color in some wide fissures and cavities in rubies from Bangkok ovens but it was never enough to honestly say that the stone was dyed. Color concentration in fissures was not detected in Chantaburi stones.

Some red or orange color can be seen in some stones using "day light" tubes like those in common use in Chantaburi's buying offices. But these red looking inclusions described as "copper platelets" by treatment master Mahiton Thondisuk, present similarities with the glassy areas showing similar red coloration found in many Mong Shu rubies heated with flux under the same illumination:



(Glassy inclusions showing some red reflected color visible in Mong Shu rubies heated with flux)

The glass lead glass present in this new treatment or the "flux residue glass" present in Mong Shu act in fact as a mirror, reflecting the color of the stone to finally give the illusion that the glass is colored. The same phenomenon can also be observed when twinning is present: Twinning planes can appear colored under some orientations. Twinning plane cannot be described as colored:

(Twinning planes seen in Mong Shu rubies heated with borax presenting some pinkish to reddish "coloration")

Dyed rubies present on the other hand some very clear color concentration in fissures which is in strong contrast with the light colored to colorless body color whatever is the direction we observe them. The presence of a light pink or yellowish glass visible in wide fissures or cavities in "repaired rubies" is very different in intensity compared to dyed rubies in which fissures are filled with intensely colored red dying agent. In fact this light colored glass found in some important fissures can be more compared to "iron stain" in natural stones: The coloration of the glass is not the origin of the color, but massively filling important fissures, it can modify the stone color if the stone color is weak.

(Typical dyed rubies presenting strong red colored fissures and a very lightly colored body color)

- **Are these stones durable?** If handled with care: Yes, probably...

As this study was performed over a 2 month period, and regarding to the fact that none of the studied treated stones were more than one year old, we cannot be 100% sure about the durability of the glass inside the gem. Now if we compare this glass filling method to the glass filling used in diamonds, the treatment looks to be suitable for "normal wear".
Compared to emerald oiling or impregnation using resins, this current ruby treatment is probably more durable. Glass is more stable than resin and its presence in a fissure will probably lower the probability that the fissure will expand. The fact that the fissures are closed with a lead rich glass is also probably improving the durability of the "repaired" gemstone, but not as much as those fissures filled by flux additives. It is reasonable to assume that these stones are possibly more durable than an impregnated emerald, but less than a ruby heated with flux.

Now we have also to consider that many companies are now trying to perform this treatment and if some will succeed, some other may encounter technical problems. As the "glass" composition might vary a lot in the future, some surprises are probably still to come.

Note: If this treatment technique is currently performed mostly on Andilamena Madagascar rubies, it is likely to spread on other fractures corundum like star rubies, sapphires and even other gemstones which can support temperatures around 1000 degrees and present fissures.

- **Are only large rubies affected?** No

The stones are heated together in large amounts. The most suitable material is corundum presenting multiple fissures. But small stones and clean material are submitted to the treatment in large parcels along with fissured stones. These stones after cutting will not present filled fissures, so it will not be possible to find diagnostic "blue/orange" flashes. Lead detection using EDXRF can also become a problem: When dealing with small stones, it is more difficult to get diagnostic results as we have less material to investigate. Small stones testing present some identification challenges and several EDXRF tests on different parts of a given stone are recommended: AIGS laboratory has studied several stones under 1 carat presenting lead reaction using EDXRF only when studied on the pavilion as no filled fissures were reaching the stone surface on the crown.

- **What should be avoided with these stones?** AIGS laboratory has performed several durability tests:

    - One of these stones to a jeweler's torch for a few seconds, and we observed some glass leaving the fissure and some glassy bubbles created on the stone's surface. This stone would then need to be polished again at a minimum to enhance its aspect.

    - Some stones were also boiled for several hours, immersed in detergents and exposed for short periods to ultrasonic cleaning without any apparent damage.

    - Several stones were submitted to "light and heat" fade test in order to study the color stability after long exposition to light. No color modification was observed.

    - Recutting or repolishing should be performed with care as the glass used is very soft and could be damaged during the process. Many stones studied presented damaged or incomplete fillings.

    - The most important threat to the stone's durability and beauty is contact with powerful acids, such as hydrofluoric acid (also known as HF). AIGS exposed several stones to hydrofluoric acid for 12 hours and 48 hours. In all cases the acid dissolved the glass and the fissures in the stones were much more visible. The color and the clarity of the gemstones were then seriously damaged in 3 cases out of 4. The attractive transparent purplish red stones had lost some saturation after immersion in HF and were then presenting unpleasant shiny whitish fissures.

Conclusions:

It is likely than in a close future different types of lead glass filled rubies will be present in the market as several companies and individuals are investing in the process.

The detection of these repaired rubies should not be a problem for any experienced gemologist with dark field illumination microscope or using EDXRF technology. But the fact that the treatment can be performed at low temperature and let many inclusions in their "unheated aspect" we recommend all ruby buyers to check their purchases with care.

Experienced gemological laboratories can provide them rapid identification if needed.

As long as these stones are properly disclosed and priced AIGS feels that these stones should find their place in the gem trade where large size and low prices are of prime importance.

The stone durability under "normal wear" should not be a problem, but it is important to notify that these stones have to be kept away from excess of heat or powerful acids. If some repairs are required special attention similar to that used for glass filled diamonds and epoxy filled emeralds, should be observed. Jewelers wishing to use these stones in jewelry should be cautious, but if handle correctly this product can be used in jewelry without problem.

AIGS Laboratory Reports Comments:

In order to properly disclose these stones to its customers, AIGS Gem testing Laboratory currently describe them as follows:

- On full reports:

Result: Found to be a Natural Ruby

Comments: This stone has been clarity enhanced.
(Color if noticeable) lead rich foreign substance found in fissures and cavities.

- On mini reports:

Identification: Natural Ruby.
This stone has been clarity enhanced. Lead rich foreign substance found in fissures and cavities.

Learn more about "lead glass filled/repaired" rubies

People interested to study more these stones can contact AIGS Laboratory in Bangkok, Thailand:

Labinfo@aigsthailand.com

More inclusions photos are also available on AIGS laboratory website inclusion gallery:

http://www.aigsthailand.com/LaboInclusion.php

Contacts:

To contact M Mahiton Thondisuk you can send email to:

labinfo@aigsthailand.com

We will be happy to transmit your message to him.

To contact Orange Sapphire:

www.orangesapphire.com

Acknowledgments: A special thanks is extended by AIGS laboratory to Mr Mahiton Thondisuk and Mr Somkuan Plairahan for their open and forthright disclosure of processes used in their fracture filling/ repair treatment. Special thanks also to orange sapphire people to have received and provide some samples for study to AIGS laboratory.

Identification and Durability of Lead Glass–Filled Rubies

Shane F. McClure, Christopher P. Smith, Wuyi Wang, and Matthew Hall

In early 2004, the GAAJ laboratory in Japan issued a lab alert about rubies they had seen that had large numbers of fractures filled with high-lead-content glass, which made them appear very transparent. Since then, large quantities of this material have reached international markets. This dramatic treatment is not difficult to identify with a standard gemological microscope, since it has characteristics similar to clarity-enhanced diamonds (flash effect, gas bubbles, etc.). However, locating filled cavities in reflected light is more challenging, as the surface luster of the filler is close to that of ruby. The filling material appears to be very effective in reducing the appearance of fractures. Durability testing of a few samples by highly skilled jewelers indicated that the filler was fairly resistant to heat exposure during jewelry repair procedures, but it reacted readily with solvents.

Gem corundum has been a mainstay of the jewelry industry for centuries. The demand for rubies and sapphires has usually outdistanced supplies, and for much of history only the very wealthy could afford them. With the discovery of additional deposits during the 20th century, the supply of these gems increased dramatically. However, there continued to be more demand for these beautiful stones than Mother Nature could provide.

Thus enters the art of treatment. We use the term *art* here because many if not most of the treatments were not developed by scientists but rather by experimenters who relied largely on luck or trial and error. Many of those who developed these techniques never fully understood the science or the "why" of what they were doing, but they understood the "what" and the "how" very well.

Corundum, as a very durable material, lends itself to many treatments. And ruby, being the most prized color of corundum, is often a prime focus of these treatments. Over the years, ruby has been subjected to heat treatment to change its color and/or improve its clarity; fracture healing to improve clarity and get a higher yield from naturally fractured rough; glass filling of cavities to improve appearance and add weight; and diffusion, dyeing, coating, and synthetic overgrowth, among others.

The latest venture into ruby treatments involves an improvement in clarity enhancement. In the past, the fractures in rubies have been filled with oils, which do little to improve apparent clarity, and glasses, mostly silica based, which are better than oils but, in our opinion, still not very effective because of their relatively low refractive index.

This newest treatment is based on the same principle that has been applied to emerald and diamond: use of a filling material that closely matches the refractive index of the host material to minimize the appearance of the fractures. In the case of this new treatment, the results are remarkable (figure 1). This article looks at the introduction of this technique, its identification in ruby, and its response to various durability tests.

See end of article for About the Authors and Acknowledgments.
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Figure 1. These stones (2.15–7.42 ct) are typical of the final result achieved with the filling of fractures in rubies with high-lead-content glass. Photo by Elizabeth Schrader.

BACKGROUND

Silica glass has been used extensively to fill cavities and fractures in rubies since the 1980s. Cavity filling was noted first, and it was described as early as 1984 (Kane, 1984). This filling did improve the stones' face-up appearance and could add weight, but it could also readily be detected with magnification.

The early 1990s witnessed the marketing of huge quantities of ruby from Mong Hsu, Myanmar, with multiple cavities and fractures that were filled with, or partially healed by, glassy substances added during high-temperature heat treatment (Peretti et al., 1995; McClure and Smith, 2000). The term *residue* began to be applied to this kind of material, in reference to the glass that was a side effect of the real intent, which was to heal the fractures. The R.I. of this silica glass is significantly lower than that of the host corundum, so even a fracture entirely filled with it can still be easily seen (figure 2). Therefore, even though the appearance of the fractures is improved, silica glass is not the most efficient material for enhancing the clarity of rubies.

The first report of a new type of ruby clarity treatment came in an Internet alert issued by the Gemmological Association of All Japan in early 2004 (GAAJ Research Laboratory, 2004). They described rubies with inordinate amounts of very low-relief fractures that had been filled with a high-lead-content glass. Since the GAAJ report, a large number of these stones have been examined by gemological laboratories around the world, and they have been offered for sale at trade shows in Bangkok, Hong Kong, Switzerland, the United States, and elsewhere. Rubies below 1 ct to over 100 ct have been identified as lead-glass filled (see, e.g., figure 3), with a large number between 5 and 10 ct. In addition to the GAAJ lab alert, several articles have provided observations on this material (see, e.g., AGTA, 2004, 2005, 2006; Rockwell and Breeding, 2004; Li-Jian et al., 2005; Milisenda et al., 2005; Pardieu, 2005; Smith et al., 2005; SSEF, 2005; Sturman, 2005; Themelis, 2005).

Lead-Glass Filling of Rubies. The actual treatment process was described by Vincent Pardieu of the

Figure 2. Silica glass (in the older method) has a significantly lower R.I. than corundum. When it is used to fill fractures in ruby, it improves their appearance, but the fractures are still very visible. Photomicrograph by S. F. McClure; magnified 30×.

Figure 3. Many extremely large lead glass–filled rubies (here, 52.60 and 26.07 ct) have been seen in the market. Rubies courtesy of Golden Stone USA Inc., Los Angeles; photo © Robert Weldon and GIA.

Asian Institute of Gemological Sciences (AIGS; Pardieu, 2005). The following description is summarized from that article. Mr. Pardieu cited as the source of this information the person purported to be doing the treatment at the time, Mahiton Thondisuk of Chantaburi, Thailand.

The first step involves preforming the material to remove any matrix or obvious impurities. The second step is referred to as "warming," that is, heating the stone to moderate temperatures (reportedly 900–1,400°C). Often used as a first step in standard heat treatment, "warming" removes potential impurities from the fractures and may improve the color.

The third step involves mixing the stone with powders that are composed primarily of lead and silica but may also contain sodium, calcium, potassium, and metal oxides such as copper or bismuth. This mixture is then heated again, reportedly to approximately 900°C, fusing the powders into a glass that penetrates the fractures in the stone.

Unlike the process that produces the silica-glass fillings seen previously, the filling of corundum with lead glass initially did not involve the partial healing of fractures. In fact, there was significant evidence to show that these stones had not been exposed to the high temperatures necessary to heal fractures.

According to Pardieu, the original starting material for lead-glass filling was very low grade pink, red, or purplish red corundum from Andilamena in Madagascar that was typically translucent to opaque. For the most part, it is unusable as a gem in its natural state (figure 4). Of course, this treatment can be applied to fractured ruby from any locality. We have now seen lead glass–filled stones that appeared to be from Tanzania and Myanmar. The effectiveness of the treatment is amazing, in that it transforms corundum that is opaque and nearly worthless into material that is transparent enough for use in jewelry.

The Present Study. To characterize this treated material as well as determine its identifying features, we examined dozens of samples by standard gemological methods and other analytical techniques. We also tested the durability of the treatment by subjecting samples to routine jewelry manufacturing and repair procedures, as well as to conditions of standard wear and care. The results of this testing, and procedures for identification, are described here.

Readers should bear in mind that the properties we report below are restricted to those observed in the samples we obtained for this study. Although a broad range of samples were selected from several different vendors over more than 14 months, stones treated in a similar fashion but with glass of a different composition may be in the market, and these may have different properties and different reactions to the durability tests.

MATERIALS AND METHODS

We collected the samples of lead glass–filled rubies and pink sapphires used for this study from late 2004, when large quantities of this treated material first became available on the market, until February 2006. We obtained them in Bangkok and New York City in late 2004, at the June 2005 JCK and AGTA Las Vegas gem shows, and at the 2005 and 2006 Tucson gem shows, all from different sources. We examined a total of 50 faceted samples, ranging from 0.43 to 9.19 ct.

Standard gemological equipment was used to characterize the basic properties of 10 selected samples including: a refractometer, a desk-model spectroscope, long- and short-wave ultraviolet lamps, and a polariscope. All samples were examined with a binocular microscope and fiber-optic illumination.

Qualitative (30 samples) and semiquantitative (2 samples) chemical analyses were performed by energy-dispersive X-ray fluorescence (EDXRF) spectroscopy using a Kevex Omicron spectrometer operated at a voltage of 25kV with no filter, a 50 micron collimator, and a 500 second livetime.

Observations and chemical analyses were also performed on four samples using a JEOL-JXA8800 scanning electron microscope with a wavelength-dispersive spectrometer (SEM-WDS) at the Geophysical Laboratory of the Carnegie Institution of

Washington, in Washington, DC. Operating conditions for both electronic imaging and wavelength-dispersive analyses were 10 μA beam current and 15 kV accelerating potential. The presence of any element with a concentration above 100 ppm (from B to U in the periodic table) will be detected. Even though we used a focused electron beam, which was about 1–2 μm in diameter, due to the limited surface area of the filling material and the poor quality of the polish on most of the samples tested, chemical analysis was performed without calibration against standard materials.

X-radiography was performed on five samples using a Hewlett-Packard Faxitron series X-ray cabinet.

The samples were also tested for their durability in standard conditions of manufacture, wear, and repair. Heating experiments were performed on a total of 10 samples using a Lindberg/Blue box furnace in an ambient atmospheric environment. The temperature of the furnace was raised to the target values first and then the sample (held in an Al_2O_3 ceramic disk) was placed inside. The temperatures were 100, 200, 600, 700, 800, and 1,000°C. Selected samples were exposed to each of these temperatures for periods of 5, 10, and 60 minutes each. In addition, one sample was held at 200°C for an extended period of 16 hours. After a specific heating period, the samples were taken out, cooled in air, and reexamined.

We also exposed eight rubies filled with high-lead-content glass to a series of jewelry repair procedures. These included steam cleaning, ultrasonic cleaning, setting (including mounting, filing and polishing), and retipping of prongs. Details on these tests are given in the section on durability testing below.

A total of eight reagents were used to assess the Pb-glass filler's resistance to chemical attack. Three reagents consisted of caustic soda, aqua regia (nitro-hydrochloric acid), and a standard jeweler's pickling solution (sodium bisulphate). The latter two are frequently used in jewelry manufacturing or repair; caustic soda is a more reactive base than standard pickling solution. We also tested the treatment for its durability to a range of household products: concentrated lemon juice, a typical aerosol oven cleaner, ammonia, a standard drain cleaner, and bleach. For each chemical (with the exception of the pickling solution, for which three samples were used), one ruby with Pb-glass filler was placed in a beaker and covered with the reagent (typically 10–20 ml). In addition to using a fume hood for all experiments, we covered toxic solutions (aqua regia and ammonia) with a baking soda filter over the beaker top to minimize noxious fumes. Each experiment run was conducted at or just below the boiling point to accelerate any reaction; a small laboratory hot plate with variable temperature control was constantly adjusted to keep the reagents at this temperature. Experiment run time was four hours (except for aqua regia, which was one hour long), to mimic the cumulative effect of multiple exposures for shorter periods of time. The beaker was then removed from heat and allowed to cool. Once cooled, the stones were cleaned and examined for alterations to the Pb-glass filler.

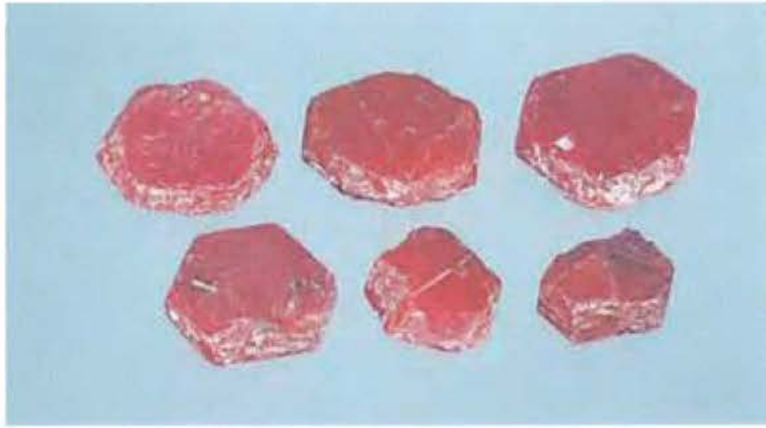


Figure 4. The starting material for this ruby treatment is very low quality and until now was only useful as mineral specimens. The crystals shown here range from 7.28 to 22.08 ct. Photo by Maha Calderon.

RESULTS

Visual Appearance. All the samples collected for this study were transparent to semitransparent and could be considered jewelry quality. The color of many of the specimens was slightly brownish and often of lower saturation—so that some of them would be considered pink sapphire. However, several of the authors saw large parcels of lead glass–filled corundum in early 2006 that could easily be categorized as medium-quality ruby. Two of these rubies were acquired for this study (one is shown in figure 5).

Standard Gemological Properties. The long- and short-wave UV fluorescence, visible-range absorption spectrum, pleochroism, birefringence, optic character, and specific gravity were consistent with ruby/pink sapphire in general. It is interesting to note, however, that the specific gravity of one 1.34 ct stone was slightly higher (4.03) than usual for corundum. This stone had several large, deep, filled cavities. We do not have data on the S.G. of the glass filler, but it is well

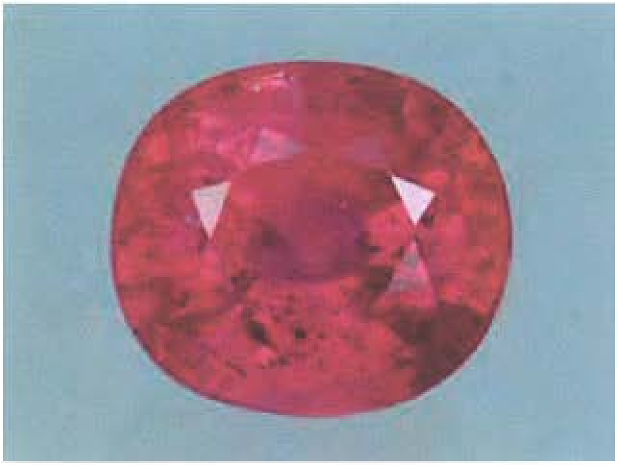


Figure 5. Some of the specimens we acquired for this study, such as this 2.85 ct stone, would be considered medium-quality ruby. Photo by C. D. Mengason.

Figure 6. Dense clouds of fine, unaltered rutile needles following the growth structure prove that this lead glass–filled ruby has not been exposed to extremely high temperatures. Photomicrograph by S. F. McClure; magnified 20×.

known that high-lead-content glass has a high specific gravity, so it is not surprising that it could affect the overall S.G. of the stone. Standard R.I. readings and birefringence were recorded for all of the samples. In addition, we obtained a single approximate R.I. reading of 1.75–1.76 for the lead-glass filler on areas where it filled larger cavities.

Internal Features. All the samples we examined revealed naturally occurring internal features that ranged from extensive twinning and parting planes to various mineral inclusions. Some mineral inclusions showed evidence of thermal alteration, whereas others did not. Most significantly, many of these stones revealed dense clouds of fine, unaltered rutile needles following the hexagonal structure of the ruby (figure 6). This is clear evidence that these stones had not been exposed to temperatures high enough to damage rutile (greater than 1,500°C; Emmett et al., 2003).

When examined with a microscope or a standard jeweler's loupe, virtually all the samples were dominated by numerous large fractures of very low relief. In addition, blue flashes were readily noted as the

Figure 7. One of the most important identification features of this treatment is a blue flash effect similar to that seen in filled diamonds and emeralds. The strength of the flash varied considerably, sometimes being relatively weak, as can be seen in this example. Photomicrograph by S. F. McClure; magnified 15×.

Figure 8. In some of the samples, the flash effect was very strong and an orange flash could also be seen. Here, the blue is quite strong in brightfield illumination, and the orange flash is easily seen in darkfield. Photomicrograph by S. F. McClure; magnified 10×.

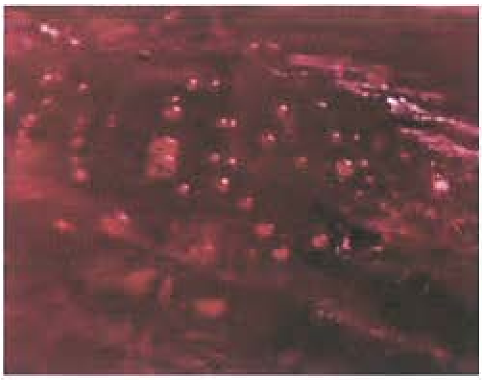


Figure 9. Numerous flattened and rounded gas bubbles were present in almost all the corundum with filled fractures that we examined. Photomicrographs by C. P. Smith (left, 28×) and S. F. McClure (right, 20×).

stones were rotated and repositioned for a complete view of the interior. The strength of the flash effect varied from relatively subtle (figure 7) to quite strong, although usually with the same intensity in samples obtained from the same source. In some stones, an orange flash was visible as well (figure 8). Also seen with magnification in all the samples were numerous flattened and rounded gas bubbles and voids within the glass fillings (figure 9). Where filled cavities were large enough, spherical gas bubbles were sometimes visible. This was reminiscent of the features we first noted in clarity-enhanced diamonds 18 years ago (Koivula et al., 1989). Although the filling material in rubies might be different, the effect of the treatment—to minimize the visibility of fractures and cavities—was almost identical to that achieved with fracture filling in diamonds.

In the majority of the samples, the glass filling did not appear to be colored. However, we did note that along thick seams or cavities of the glass there was a distinct yellow hue in a few samples and a more subtle pink coloration in others. In several of the lower-quality samples we acquired at the Tucson shows in 2006, we observed large filled cavities where the yellow color of the filler was readily apparent, even through the body of the stone (figure 10).

Surface Characteristics. Previously, examining the surface of some heated rubies in reflected light would reveal the presence of cavities or depressions that had become a reservoir for the flux typically used to induce the healing of fractures. These agents often would form a silicon-rich glass that had a significantly lower refractive index than the ruby host, resulting in a lower surface luster. We were somewhat surprised to see how effective this new treatment was at reducing the surface visibility of large cavities and wide fractures, which in some cases extended across the width or length of the sample. In many of the study samples, we noted that lead glass–filled cavities, even very large ones, were difficult to detect. Cavities filled with silica glass or heating residues are typically very visible—even with darkfield illumination (figure 11). Use of the higher-R.I. lead glass, how-

Figure 10. The yellow color of the lead-glass filler is visible here in a very large internal cavity. Photomicrograph by S. F. McClure; magnified 30×.

Figure 11. Cavities filled with silica glass typically remain very visible in the microscope. Photomicrograph by S. F. McClure; magnified 37×.

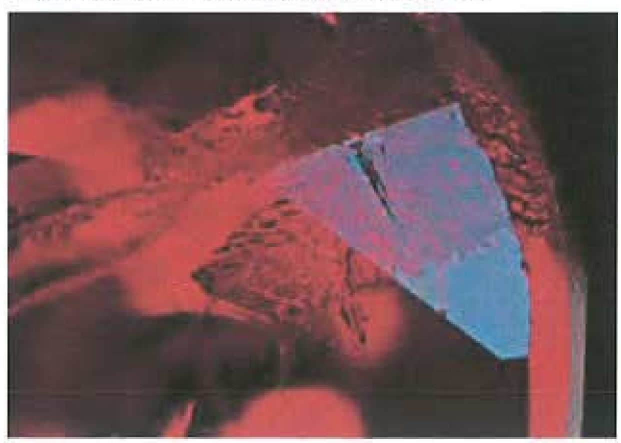


Figure 12. Cavities filled with high-lead glass can be challenging to see. In the image on the left (reflected light), the surface luster of the filler is very close to that of the corundum. On the right, the same filled cavity is not visible at all in darkfield; only the outline of blue flash suggests its presence. Photomicrographs by S. F. McClure; magnified 30×.

ever, makes the cavities virtually disappear (figure 12). Even the traditional reflected-light technique was less reliable, as careful positioning of the stone in figure 12 was necessary to make the subtle difference in surface luster visible. Many examples were seen where the surface luster of the glass was comparable to the luster of the ruby, and only careful examination revealed that the luster was lower than, equal to, or higher than (figure 13) that of the ruby. Many times the only noticeable difference was in the quality of the polish: Glass, particularly high-lead-content glass, is significantly softer than corundum, which makes the polish noticeably inferior to the host (figure 14). In a few samples, we also noted that shrinkage had occurred in the Pb-glass that was filling cavities (figure 15).

It is interesting to note that one lead glass–filled ruby that was submitted to the GIA Laboratory showed evidence of oxidation of the filler at the surface, undoubtedly a consequence of the extreme lead content (figure 16).

Chemical Composition. All 30 of the samples that were analyzed qualitatively with EDXRF showed a significant lead content, as did the two measured semiquantitatively. To obtain a more precise evaluation of the composition of the glass filler alone, we analyzed fillings in four stones by SEM-WDS.

SEM is a very useful technique for analyzing lead glass–filled ruby, because the glass and surrounding ruby show a large difference in brightness in backscattered-electron (BSE) images (figure 17). The filling process is so efficient that the glass can successfully penetrate fractures as thin as 5 μm. BSE images taken at high magnification illustrate that the boundary between the glass and the host ruby is sharp. No precipitation of secondary corundum was observed in any of the samples analyzed. In contrast, in some Si-rich glass-filled rubies we have examined in the lab, we observed that the deposition of secondary corundum formed a zigzag boundary between the glass and the host ruby (figure 18).

SEM-WDS chemical analysis of glass in fractures

Figure 13. Sometimes the surface luster of the lead-glass filling is noticeably higher than the surrounding corundum. Photomicrograph by S. F. McClure; magnified 36×.

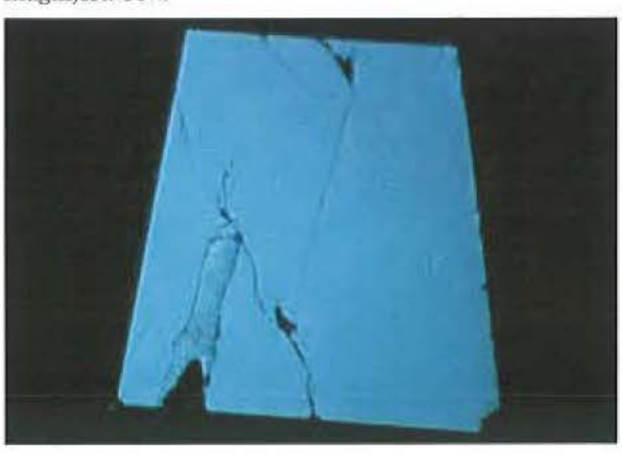


Figure 14. Glass, particularly high-lead-content glass, is significantly softer than corundum, so sometimes the best way to notice a glass-filled cavity in reflected light is by the poor polish on its surface. Photomicrograph by C. P. Smith; magnified 45×.

Figure 15. Shrinkage of the glass in this large cavity (over 1.0 mm in longest dimension) appears to have taken place subsequent to polishing, causing the polished surface of the glass to be lower than that of the surrounding ruby. Photomicrograph by C. P. Smith; magnified 45×.

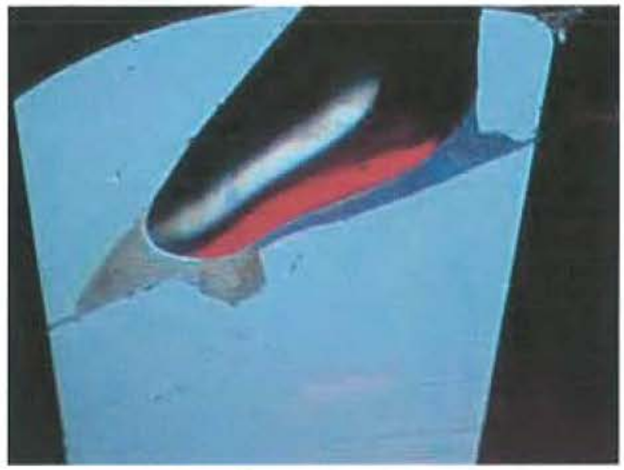
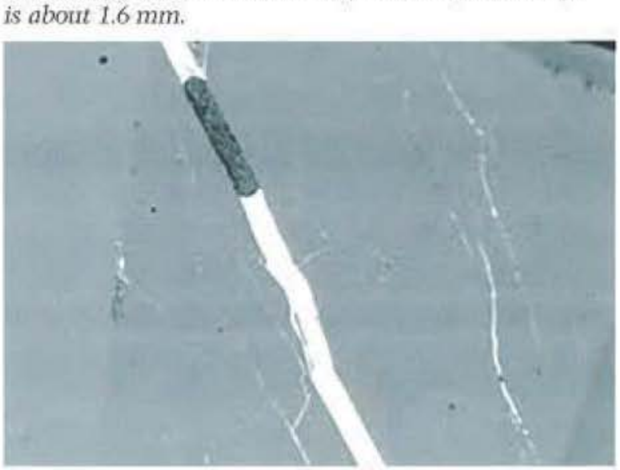


Figure 16. One example recently submitted to the GIA Laboratory showed an obvious oxidization of the glass at the surface. Photomicrograph by S. F. McClure; magnified 40×.

less than 10 μm wide is problematic due to beam overlap with the surrounding ruby. However, consistent results were obtained for glass-filled areas with relatively large surfaces: major components—PbO (71–76 wt.%), Al_2O_3 (12–15 wt.%), and SiO_2 (11–13 wt.%); minor components (<1 wt.%)—Na_2O, K_2O, CaO, FeO; and trace amounts of MgO, P_2O_5, and TiO_2. These results are similar to those that have been described by others (e.g., Li-jian et al., 2005).

Figure 17. This back-scattered-electron image (taken with a scanning electron microscope) shows lead glass–filled fractures of varying widths. Because of the higher average mass of elements in the glass, it is much brighter than the host ruby. Width of the image is about 1.6 mm.



It is interesting to note that semiquantitative EDXRF analyses of the lead glass in two samples acquired in 2006 showed very similar composition to that of rubies acquired in 2004, which suggests that the composition is fairly consistent over time.

X-radiography. This test was shown to be successful in detecting the high-lead-content glass used for filling fractures in diamonds many years ago (Koivula et al., 1989), working on the basis that lead glass strongly absorbs X-rays. As expected, the lead glass–filled fractures in our samples were easily visible in the X-radiograph (figure 19). Others have also reported using this test effectively (Befi and Dutoit, 2005; Kitawaki et al., 2005).

DURABILITY TESTING

Once a method of detection for any given treatment is established, invariably the next question that arises is "Is it durable?" To test this, we set up a series of experiments, focusing mainly on the conditions these stones might encounter in normal situations of wear, care, and manufacture or repair. We first reported the results of some of these tests at the 2005 ICA Congress in Bangkok, Thailand.

Controlled Heating. The first question we wanted to answer was how much heat this lead-glass filler could survive. The melting point of the material is very important, as it determines how well the filler can stand up to jewelry manufacturing techniques. We suspected that the glass might not withstand

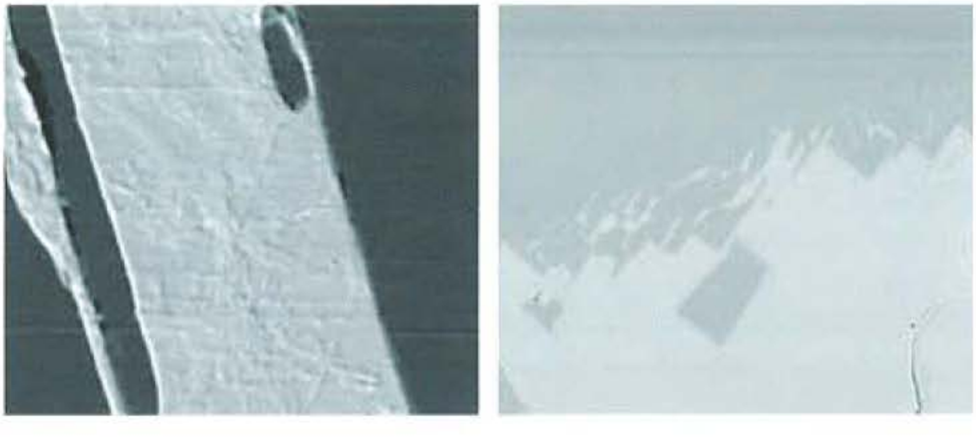
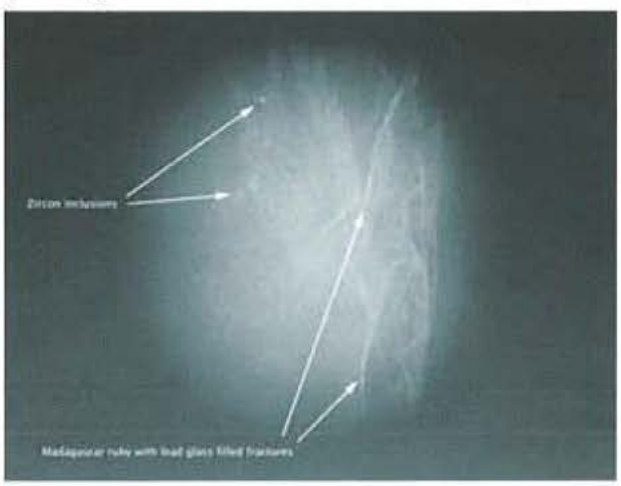


Figure 18. No chemical reaction between the lead glass and the host ruby was detected with the SEM (left, BSE image width ~100 µm); the boundary between the two phases is sharp. In contrast, in the silicon glass–filled ruby (right, BSE image width ~390 µm), deposition of secondary corundum formed a zigzag boundary between the glass and the ruby.

normal jewelry repair techniques such as the retipping of prongs, primarily because of our experiences with the lead glasses used to fill fractures in diamonds (e.g., Koivula et al., 1989).

No change was observed in the samples held at 100°C, at 200°C for 16 hours, or at 600°C. At 700°C, we observed the first sign of a change to the glass: Almost immediately, minor amounts of glass started sweating out of filled fractures and beading on the surface (figure 20). After only a few minutes at this temperature, the glass in larger filled cavities started to melt and flow (figure 21). At 800°C, the glass started bubbling at the surface of the fractures (figure 22). These tests clearly show that the melting point of the lead glass in these samples is between 600° and 700°C. Of course, changes in the composition of the glass from one treater to another or from one time frame to another could result in a change to the melting point.

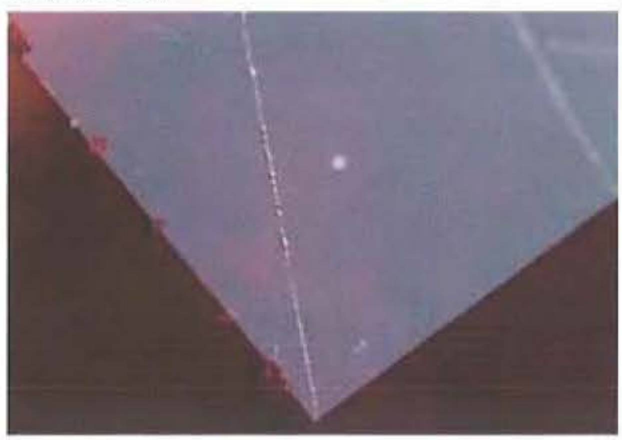
Figure 19. The lead-glass filler is readily seen in an X-radiograph because lead glass strongly absorbs X-rays. Some scattered zircon crystals are also visible in this image.



Jewelry Repair Procedures. No damage to the lead-glass fillings was observed with standard steam cleaning, ultrasonic cleaning, setting, and even retipping of prongs, when these procedures were performed carefully on the limited number of stones tested, as described below. Some damage was seen with immersion in a pickling solution (figure 23) and exposure to other reagents. The specific tests and results are described below.

Steam Cleaning. Two rubies were selected for steam cleaning. A standard steam cleaner was used, maintaining an approximate pressure of 40–50 psi. Each stone was held in a pair of tweezers in the steam at a distance of approximately one inch for 30 seconds, allowed to cool, and examined in the microscope for damage. This procedure was repeated 15 times for each stone. No damage to the filler was detected in either stone.

Figure 20. At 700°C, minor amounts of the lead-glass filler began sweating out of the fractures and beading on the surface. Photomicrograph by C. P. Smith; magnified 50×.



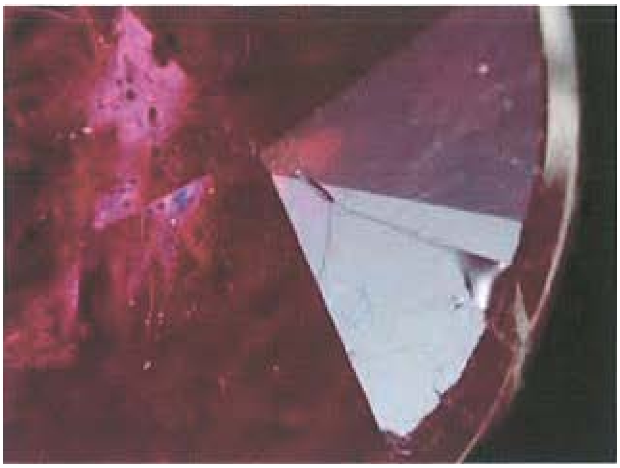


Figure 21. Heating at 700°C for only a few minutes caused the lead-based glass in larger cavities to start to flow. Photomicrograph by C. P. Smith; magnified 24×.

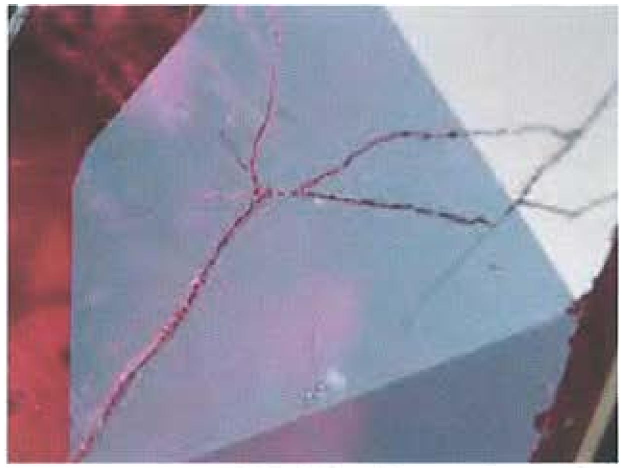


Figure 22. At 800°C, the lead-glass filler actually started to bubble where fractures reached the surface. Photomicrograph by C. P. Smith; magnified 22×.

Ultrasonic Cleaning. Two different rubies were selected for ultrasonic cleaning. The ultrasonic bath was filled with a standard soap solution that was warmed slightly. Both stones were placed in a wire basket and suspended in the solution with the cleaner turned on. The stones were removed after 15 minutes and checked for damage; then they were returned to the ultrasonic for another 15 minutes and checked again. Subsequent additional runs (and rechecks) of 30 minutes, 60 minutes, and another 60 minutes were performed for a cumulative total of three hours in the cleaner. No damage to the filler was observed in either stone.

Setting. Four different rubies were set in standard 14K yellow gold mountings, the process consisting of mounting the stone, filing the prongs, and polishing the setting. Since lead glasses tend to be relatively soft, we examined the stones carefully after these seemingly benign procedures. No damage to the filler was observed in any stone.

Retipping of Prongs. Although jewelers' guidelines typically advise against exposing any ruby or sapphire to the direct heat of a torch during the retipping of prongs, many jewelers routinely perform this procedure with the stone in place. To test the resistance of the filler to standard retipping procedures, we enlisted the aid of two of GIA's Jewelry Manufacturing Arts instructors, Mark Maxwell and Adam Kelley, and began with one of the previously mounted stones. We started with retipping because the temperatures the stones are exposed to during this process are much higher than those for other repair procedures such as sizing. If the filler did not survive the higher-temperature procedure, we would move to one that required lower temperatures to determine the lowest point at which the filler would be damaged.

After some discussion with the instructors, it was decided that they would first perform a retipping procedure that exposed the stone to the lowest temperature possible, assuming the procedure was done correctly. If there was no damage with that

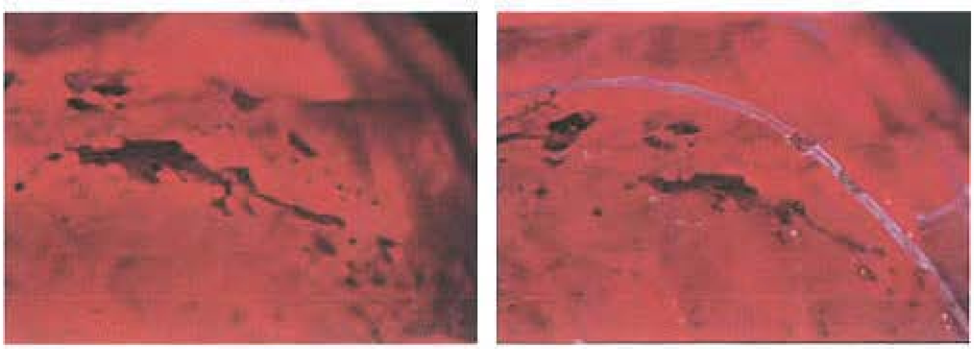


Figure 23. The large fracture in this lead glass–filled ruby is hard to see (left), except for the straight edges on the two flattened gas bubbles in the top center. After immersion in a standard pickling solution for 20 minutes (right), etching of the filler made the edges of the fracture clearly visible. Photomicrographs by S. F. McClure; magnified 30×.

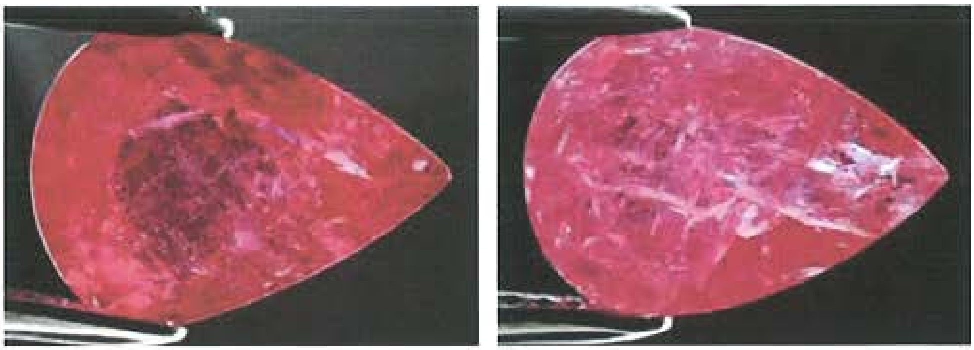


Figure 24. Caustic soda was used to see how much damage a stronger base solution would inflict on the glass. The image on the left shows the 2.08 ct lead glass–filled ruby before the test began; after one hour of exposure (right), the damage to the filler was significant. Photomicrographs by C. P. Smith.

method, we would move to a procedure (on a different stone) that would require the maximum temperature to retip a prong.

The first method involved soldering a piece of 14K wire to the prong to be repaired with a "soft" solder, which would then be filed down to rebuild the prong. After the soldering procedure, the mounted stone was immersed in a warm standard pickling solution for one minute. The stone, which had been carefully examined before heating, was examined again. It now showed thin white lines where the fractures reached the surface.

The thought occurred to us that this near-surface damage of the lead-glass filler could be from the heat or the pickling solution, so we repeated the experiment on a second stone and examined it with the microscope immediately after the soldering procedure without placing it in the pickling solution. This time there was no visible damage to the filler. This indicated that the earlier damage was related to the pickling solution, the testing of which will be outlined below.

Next, a higher-temperature procedure was performed on another sample. This retipping process involved soldering a ball of 14K gold to the prong. This requires heating of the prong, and therefore the ruby, to a much higher temperature than the earlier procedure. Again the stone was examined (without putting it in pickling solution) and was found to have suffered no damage.

Immersion in Pickling Solution. The second lead glass–filled stone that was subjected to the lower-temperature retipping procedure was placed in the warm pickling solution for one minute to duplicate the first incident. Again, on reexamination we noted a thin ribbon-like area of damage at the point where the filled fractures reached the surface.

This result established a connection between the pickling solution and the damaged filler. Two new unmounted stones with lead-glass filler were chosen and then placed in the pickling solution for 5 and 20 minutes respectively. On reinspection, both stones showed near-surface damage (see, e.g., figure 23), with the depth corresponding directly to the duration of immersion. It was now clear that the caustic pickling solution was etching the lead-glass filler, which made the fractures far more visible.

Exposure to Other Corrosive Solutions. The relatively aggressive solutions, caustic soda and aqua regia, had an immediate reaction with the glasses, etching them readily. In fact, the glass was etched/removed from all the cavities and to a relatively shallow depth in all the fractures after only a few minutes of exposure. However, extending this exposure to 4 hours had little further impact on the removal of the filler. After these tests were performed, the stones looked dramatically different from their appearance prior to testing (see, e.g., figure 24). Nevertheless, because the glass was removed only to a limited depth, their overall appearance was still better than what it would have been if the stone was in its untreated state.

Exposure to Household Products. We also decided to test various products that the stones might encounter once they were purchased by an end-consumer. We were very surprised to find that the aerosol oven cleaner had a similar, very aggressive reaction with the glass, readily etching it. In addition, the ammonia, bleach, and even concentrated lemon juice also had an effect, if less dramatic. In these instances, typically the glass was etched at the very surface of the stones, with the traverses of the fractures newly visible as criss-crossing lines (figure 25).

DISCUSSION AND CONCLUSION

The significance of any new treatment typically revolves around two points: (1) how effective it is, and (2) whether it can be detected—especially using routine gem testing equipment. As with any treatment, clarity enhancement by lead-glass filling must be disclosed at all levels of sale to protect consumer confidence.

In the case of lead-glass filling in rubies, the intent is clearly to enhance the apparent clarity of the stone. The treatment is very effective in this regard. Stones that are almost opaque can be improved to the point of being semitransparent to transparent. This makes it possible to market a great deal of previously unusable material.

Fortunately, this treatment is easily detected with magnification. The identifying characteristics are similar to those for diamonds that have been clarity enhanced with a glass filling: very low-relief fractures, gas bubbles and voids (unfilled areas) in fractures, and a blue and orange flash effect. There is also the possibility of a light pink or yellow color to the filler in areas where it is very thick, such as large cavities. However, cavities filled with lead glass are more difficult to detect than those filled with silica glass, so careful observation is required in all cases.

A third concern of consumers and the industry alike is the durability of the treatment to jewelry manufacturing and repair procedures, as well as under normal conditions of wear and care. The lead based–glass filler in the stones we tested turned out to be fairly durable to heat exposure during jewelry repair procedures. However, only three stones were tested and the instructors who performed these procedures for us were highly skilled jewelers. As the controlled heating experiments indicated, too much heat with a torch could still damage this filler, so it would be prudent to unmount stones treated in this manner to be safe.

The filler reacted readily with solvents, particularly with a common jeweler's pickling solution, so these stones should not be exposed to such solutions under any circumstances. Not only does this make it more important to remove such stones from their settings before repair procedures, but it also means that consumers should be informed that damage could occur if the stone is exposed to some common household chemicals.

An interesting debate took place among laboratories as a result of this treatment. The type of starting material used frequently will not display conclusive evidence of heating. The inevitable question then arose: Is the presence of lead-glass filler in fractures sufficient proof that the stone has been subjected to enough heat to say it is heat treated? Our experiments showed that, at least in the samples we obtained, temperatures of at least 700°C were necessary to soften the glass. For it to flow into fractures, the temperature would obviously have to be much higher—800° or 900°C at least. We know that these temperatures are high enough to facilitate changes in corundum, particularly in relation to color (Nassau, 1994). It has been hypothesized that formulations of lead glasses could be developed that would have much lower melting points, but as we have not yet observed such glasses ourselves, we maintain that the presence of this glass in fractures is sufficient proof to say the stone also has been heat treated.

Figure 25. Ammonia, bleach, and even concentrated lemon juice damaged the lead-glass filler at the very surface, producing the whitish areas shown here. Photomicrograph by C. P. Smith; magnified 32×.

What is perhaps most remarkable about this treatment is the type of material it brings to the market. High-temperature heat treatment and healing of fractures brought Mong Hsu ruby to the market years ago for what was at the time a very low price. Clarity enhancement with high-lead-content glass has brought ruby and pink sapphire to the market for even lower prices. Of course, the color of the low end of this material is not ideal, but some of the samples acquired for this study were only $2.00 per carat—stones over 1 ct in size that were mostly transparent face up and ranged from purplish red to purplish pink. Inexpensive synthetics cost more than this. We purchased the 2.31 lead glass–filled ruby in figure 5 at the 2006 Tucson shows for $20 per carat. Certainly, better-quality stones—also represented as lead-glass filled, as these were—are being sold for significantly higher prices, but we believe the low end is a new low for treated natural ruby.

From the moment we saw this treatment, we believed it would eventually be used for much higher-quality goods. 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.

With glass being such a versatile material, other formulations may be possible, which could change the properties of the filler, including its melting point. The properties we reported here are only those we observed in our study samples. Last year, two laboratories (AGTA and GAAJ) reported seeing a lead-glass filler in star rubies that did not exhibit a flash effect (Befi and DuToit, 2005; Kitawaki et al., 2005). While no quantitative chemical data was given in either report, it is clear from the lower surface luster of the filler in the images provided that the R.I.—and therefore the composition—of the filler discussed in those reports must be different from the lead-glass fillers we studied. Thus, it is probable there are stones on the market that have been treated in a similar fashion with a glass of different composition. It is imperative that laboratories worldwide continue to monitor the material reaching the market, so that if and when a change occurs that might alter the identifying characteristics of the stones, the greater gemological community can be made aware of it as soon as possible.

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Lead glass filled star rubies reportedly from Madagascar

A preliminary examination and a comparison with star rubies from other deposits.

(February 01st 2010)

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Figure 1: A selection of 34 lead glass filled star rubies showing the color range of the new material from pink to red and to near black. The stones in the photograph weight from approximately 1 to 20 carats. The photograph was taken using a slightly diffused natural sunlight in Bangkok, Thailand. The background used is page 17 of "Gemstone Enhancement" by Kurt Nassau (1984). Photo: V. Pardieu / GIA Laboratory Bangkok

Introduction: Meeting the Thai burner.

In January 2010 the GIA Laboratory Bangkok was contacted by Mr. Mahithon Thongdeesuk (Figure 2), from "Jewel enhancement by Mahiton Co. Ltd" in Bangkok, a Thai burner involved in the development of the lead glass treatment since 2002. He informed the authors that he had finished developing a new product which he will soon release in the Thai market: "Lead glass filled star rubies" (Figure 1, Figure 5 and Figure 6)

Figure 2: Thai gemstone burner Mr. Thongdeesuk at his house in Thailand. Photo: Mahiton Thongdeesuk

Mr. Thongdeesuk informed the GIA gemologists visiting his factory that the material used for this treatment originated from Madagascar. He also told us that he and his partners have now finished treating and polishing about 100 kilos of this new lead glass treated product which will soon be available in the market at a fraction of the price of similar looking untreated gem material.

Mr. Thongdeesuk was interested in collaborating with the GIA Laboratory in order for GIA gemologists to produce an independent study of his new product for publication prior to the product's availability to the trade. Mr. Thongdeesuk main concern is that whilst the Thai gem trade is very aware of treatments, it is not the same in the rest of the world and he is concerned that once his new product, to probably be marketed in Thailand under the name "star ruby paw mai" meaning "star ruby new treatment" or "star ruby lead glass", is released onto the market, it might not be marketed accurately. He expressed particularly concern about the best looking transparent bright pinkish red material that some people may mistake for untreated star rubies from traditional sources like Mogok (Burma).

He felt that the best way to launch his new product is to collaborate with the GIA so that accurate information about the material can rapidly be released to the markets. In this way he hopes that this will set a good example for other gem burners and show them that collaboration with gemological laboratories can not only help to protect the final consumer, Thailand's reputation and those of its Thai gemstone burners, but also promote new products and help them find their place in the global trade without unnecessary controversies.

Mr. Thongdeesuk also mentioned that he is currently building an informative website about lead glass filled rubies with an emphasis on how to identify them and how to take care of them.

Lead glass: An historical background:

Lead glass is a lead rich glass where lead is used to replace calcium and produce high refractive index glass. Men discovered how to make lead glass long time ago as some lead glasses are known from the antiquity. Nevertheless fine transparent qualities started to be produced on an industrial scale at the end of the 17^{th} century in England by Charles Ravencroft and soon factories opened all over Europe and beyond. Today several factories in Europe, Asia and in the USA produce lead glass for its decorative properties. The products are commonly sold as *lead crystal* or even more often simply *crystal* even if technically, the term *crystal* should not be applied to glass, as glass, by definition, lacks a crystalline structure. The use of the term *crystal,* even if it is scientifically very controversial, remains popular for historical and commercial reasons.

The use of lead glass to fill fissures in gemstones is more recent process. Lead (or bismuth) rich glass was first used to fill drill-holes and fissures in diamonds during the 1980's with a process developed by Zvi Yehuda of Ramat Gan, Israel in 1982 (Kammerling, *et al.*, 1994).

The glass filling of fissures and cavities in ruby followed (Scarratt, 1988). Finally lead glass filled rubies became very common in the markets at the end of 2004 when Mr. Thongdeesuk and several other Thai burners applied this method to rubies from the Andilamena ruby mining area in Madagascar (Pardieu, 2005, GAAJ, 2004). Whilst star rubies filled with lead glass are not new, they have been available since the beginning of the treatment (GAAJ, 2004, Hainschwang, 2009, Pardieu, 2006), such stones have remained relatively rare, yet with the arrival of this new treated material from Madagascar the situation could well change and lead glass filled star rubies might be encountered more often in the markets.

Clarity enhancement with lead glass:

The technical interest of glass filling is that it optically hides fissures and fills cavities which occur naturally in most gemstones. This enables the light to pass through the filled areas. Since the fractures don't act like mirrors anymore, the light path becomes longer enabling the color of the stone to appear more saturated (Figure 3). The result of the treatment is often very stunning as heavily fractured, very low grade pink looking material can look like a fine non-fractured red gem after treatment (Figure 3).

Figure 3: Left: Rough ruby material from Andilamena as found at the mines. Center: The same Andilamena material after cleaning fissures with acid and a preliminary heat treatment step without additives in order to clean the fissures to enable the final lead glass treatment. Right: The same Andilamena ruby material after the final heat treatment with lead glass. Photos: V. Pardieu / AIGS, 2005

The binding property of the glass also enables the treated material to be cut and polished more easily. Mr. Thongdeesuk told us that the cutting and polishing of untreated heavily fractured material would not be possible as the stones would probably break in the process. This treatment enables low quality fractured material to find a market in the gem trade as a much cheaper alternative to non-fissured fine quality gemstones.

Nevertheless for filled stones in general and lead glass filled rubies in particular durability remains a serious issue. It is a fact that, in comparison with ruby, lead glass can easily be damaged by chemicals (acids, caustic soda...), has a lower melting point, is very brittle, and can be damaged easily if the lead glass filled stones are not handled with particular care. Thus it is particularly important that the true nature of these lead glass filled stones is disclosed, and furthermore the buyer should be informed about how to take care of this treated material.

For star rubies there is another interesting point to note: Since the lead rich glass used to fill the fissures and cavities inside the stones has a relatively low melting point, most of the inclusions, like the rutile needles responsible for the star effect, are not affected by the treatment (Figure 4). As a result the final product can exhibit a six (or twelve) rayed star very similar to that found in non-fractured, untreated star rubies. But of course, as with most low temperature treatments, this can create some serious identification challenges for the gemologist trying to identify the treatment.

Figure 4: A glass filled cavity in a star ruby studied using overhead lighting. The numerous rutile needles were not affected by the glass filling process as the glass melting point is lower that the temperature necessary to affect them. Photo: V. Pardieu / AIGS, 2006

The result is visually interesting since the stars seen on these lead glass filled star rubies are usually very similar to those seen on untreated material. So for the observer not aware of the existence of such treatment, the identification of the new material in market or field conditions might be more challenging than the identification of diffused or synthetic star stones where the stars produced are typically "too good to be true".

Nevertheless a trained gemologist with the right laboratory equipment will be able to identify the stones properly as a lead glass filled rubies, as we will see later in this study.

Figure 5: Lead glass filled rubies reportedly from Madagascar seen under slightly diffused natural sunlight. About 10% of the material from the mine can reportedly be turned into this transparent red star material after lead glass treatment, with the rest of the production being less transparent or darker. Photo: V. Pardieu, GIA Laboratory Bangkok, 2010.

Gemological description of the "lead glass filled star ruby" material

Description of the stones studied:

The GIA Laboratory in Bangkok selected 34 lead glass filled star rubies at Mr. Thongdeesuk office in Bangkok, on January 18^{th} 2009. The stones weighed from approximately 1 to 20 carats and their color from pink to red and to very dark red. Most of the stones had a slight brownish or purplish aspect, but some stones showed a bright red color (Figure 5, Figure 6). Silk, as white bands was visible in most of the stones reminiscent of the "Kin Bo Tian" type star rubies commonly found in Mogok, Burma. All the stones displayed a six rayed star, and one very dark stone a twelve rayed star.

Figure 6: Several small parcels of lead glass filled rubies showing the different qualities produced by this treatment using as base ruby rough material reportedly from a single (still undisclosed) area in Madagascar. The stars are not visible here as the sky was cloudy; nevertheless the colors are representative of the stones seen at the burner's office. Photo: V. Pardieu, GIA Laboratory Bangkok, January 2010.

UV Fluorescence

The 34 lead glass filled star rubies (Figure 1) were observed under both short wave and long wave ultra violet light using a UVP, UVLS-28 EL series, 8 watt, UV lamp with both 365 and 254nm radiation. Their reactions (Table 1) were found to be more subdued when compared to the strong reaction commonly found in iron poor rubies like those from Burma and quite similar to other iron rich rubies from East Africa and Thailand/Cambodia.

Table 1:

SWUV (253nm)	Inert (dark red stones) to weak red to orangy-red (bright red stones)
LWUV (365nm)	Weak to moderate (dark red stones) to strong red to orangy-red (bright red stones)

Chemistry

The chemistry of the lead glass filled star rubies reportedly from Madagascar was analyzed using an Energy Dispersive X-ray Fluorescence (EDXRF) spectrometer. The instrument employed was the Thermo Fisher Scientific ARL Quant'x, using fundamental parameters (Theoretical) and in-corundum elemental standards.

EDXRF is a very convenient instrument to use for the detection of heavy elements such as lead, bismuth or barium, commonly used in the fabrication of high refractive index glass such as the "lead glass" used to fill fractures gemstones. EDXRF can also provide some semi-quantitative data that is useful for gemologists trying to determine the geographic origin of a given ruby.

Two different analytical methods were used to analyze each stone:

- In the first method the elements Ti, V, Cr, Fe, and Ga were analyzed using a semi-quantitative method useful for origin determination (see table 2 to 6).
- In the second method a thin copper filter was added in order to obtain better results for heavy elements like lead (Pb).

Using both methods the presence of lead was detected in all samples:

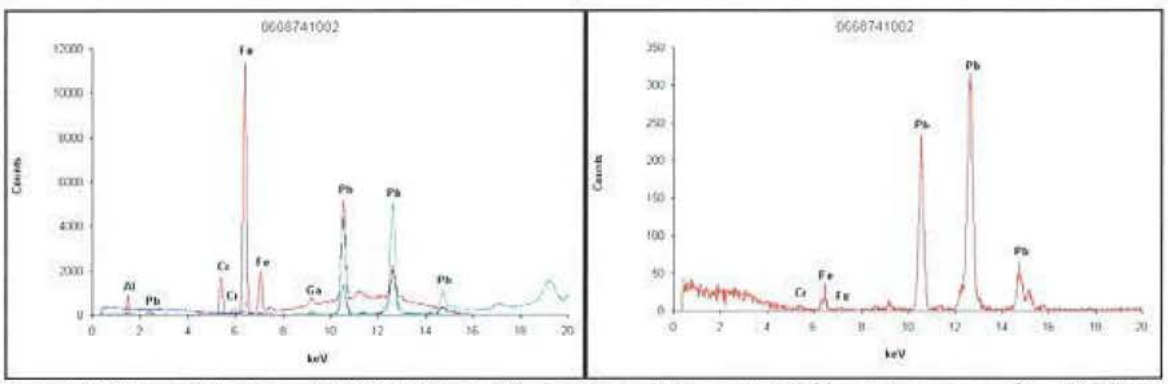

Figure 7: EDXRF analysis of sample 0668741002 using the semi quantitative method (left) or using a copper filter (right). The presence of lead is easily detected in both cases.

The following five stones were selected for study in this preliminary examination:

Table 2: Stone 0668741102: Transparent red lead glass filled star ruby, 1.569cts

Units	Ti	V	Cr	Fe	Ga
oxide wt %	0.034	0.015	0.321	0.701	0.019
elemental ppmw	203.6	86.2	2201	4909	141.9
elemental ppma	86	34	863	1792	41

Table 3 Stone 0668741002: translucent silky pinkish red lead glass filled star ruby, 1.682cts

Units	Ti	V	Cr	Fe	Ga
oxide wt %	0.014	0.004	0.130	0.437	0.021
elemental ppmw	86	26	891	3060	159
elemental ppma	36	10	349	1117	46

Table 4: Stone 0668740802: translucent silky red lead glass filled star ruby, 2.181cts

Units	Ti	V	Cr	Fe	Ga
oxide wt %	0.031	0.009	0.408	0.654	0.020
elemental ppmw	186	54	2794	4691	150
elemental ppma	79	21	1095	1712	43

Table 5 Stone 0668740602: Translucent purplish red lead glass filled star ruby, 17.107 cts

units	Ti	V	Cr	Fe	Ga
oxide wt %	0.059	0.006	0.408	0.667	0.011
elemental ppmw	354	36	2742	4670	84
elemental ppma	150	14	1075	1705	24

Table 6 Stone 0668740702: Very dark purplish red lead glass filled star ruby, 8.611 cts

Units	Ti	V	Cr	Fe	Ga
oxide wt %	0.034	0.012	0.278	0.805	0.023
elemental ppmw	204	67	1903	5606	172
elemental ppma	86	26	746	2046	50

The quantitative data obtained provides some insight into their source type and helps with regards to their origin determination. Their chemistry is characterized by relatively high levels of iron compared to known star rubies from traditional marble type deposits like Mogok (Burma) and Vietnam meaning that these rubies host rock is probably not marble. Thus chemistry seems to be a reliable method to separate these lead glass filled star rubies of reportedly Madagascar origin from star rubies from these traditional Asian deposits.

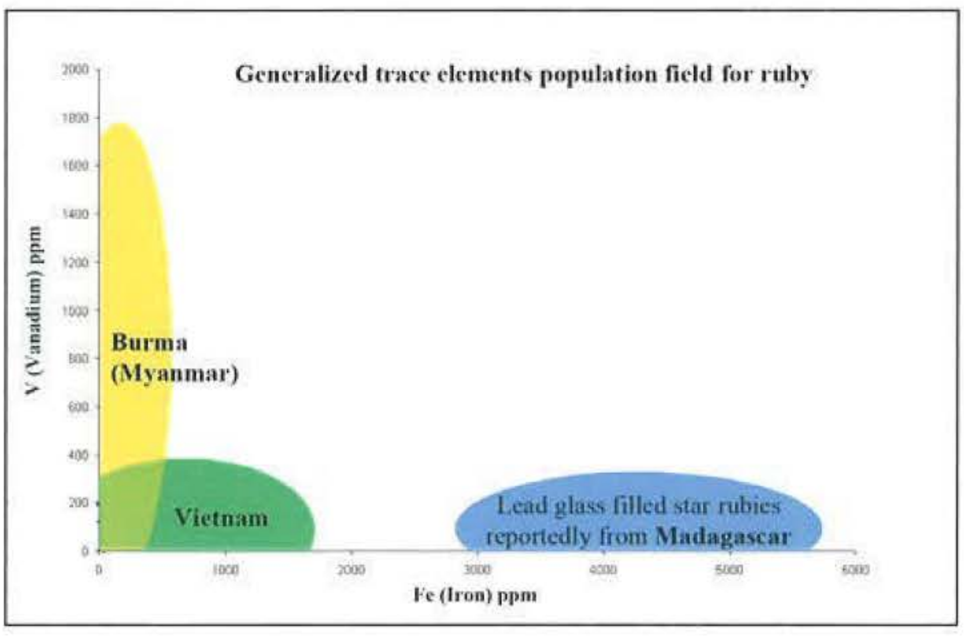

Figure 8: Comparison of the chemistry (V to Fe ratio) between lead glass filled rubies reportedly from Madagascar with untreated rubies from Mogok (Burma) and Vietnam using EDXRF spectrometry.

Infrared spectrometry:

Infrared spectra were collected on the five lead glass filled star rubies selected for this preliminary study using a Thermo Nicolet 6700 FTIR[1] spectrometer and appropriate accessories:

All the samples studied recorded broad bands around 2600 and 3500 cm-1 (Figure 8) reportedly associated with the presence of lead glass in the filled fissures and cavities (GIT, 2007, Panjikar).

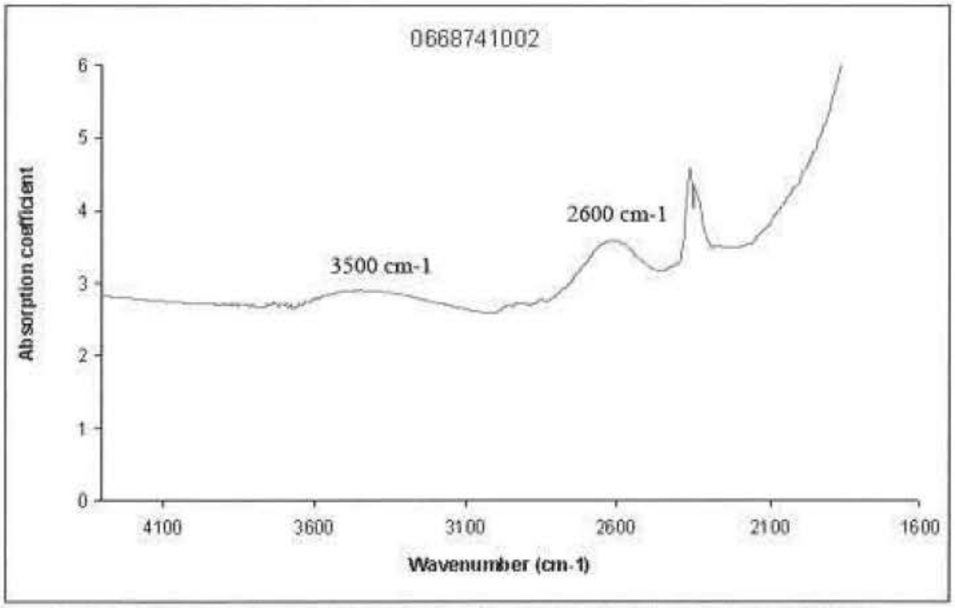

Figure 9: FTIR spectrum of a lead glass filled ruby exhibiting clear broad bands at 3500 cm-1 and 2600 cm-1.

Examination of inclusions in market and laboratory conditions:

The lead glass filled star rubies were studied with the microscope in laboratory conditions and using a 10x triplet loupe in field conditions:

Using the 10 x loupe in field conditions the proper identification of most of the stones studied was often found to be very challenging compared to the faceted lead glass filled rubies seen in the market since 2004:

- First, the lack of transparency of most of the lead glass filled star rubies, due to the presence of dense silk in most of the stones, made the study of the fissures more difficult (Figure 10, Figure 11, Figure 12): Thus finding flattened gas bubbles was harder compared to transparent faceted more traditional lead glass filled material.

[1] FTIR: Fourier Transformed Infra-Red spectrometry

- Furthermore the flash effect commonly seen in many faceted lead glass filled rubies was absent in all the stones studied.

- In the stones studied the filled fissures and cavities were not easy to spot using overhead lighting as the refractive index (RI) of the lead glass used for this treatment seems to be very close to the ruby's own refractive index (Figure 12, Figure 13). This differs to the glass filled fissures and cavities where the glass has a refractive index further away from the ruby host (Figure 4).

Figure 10: The identification of the flattened gas bubbles is challenging due to the presence of dense silk. Photo: V. Pardieu

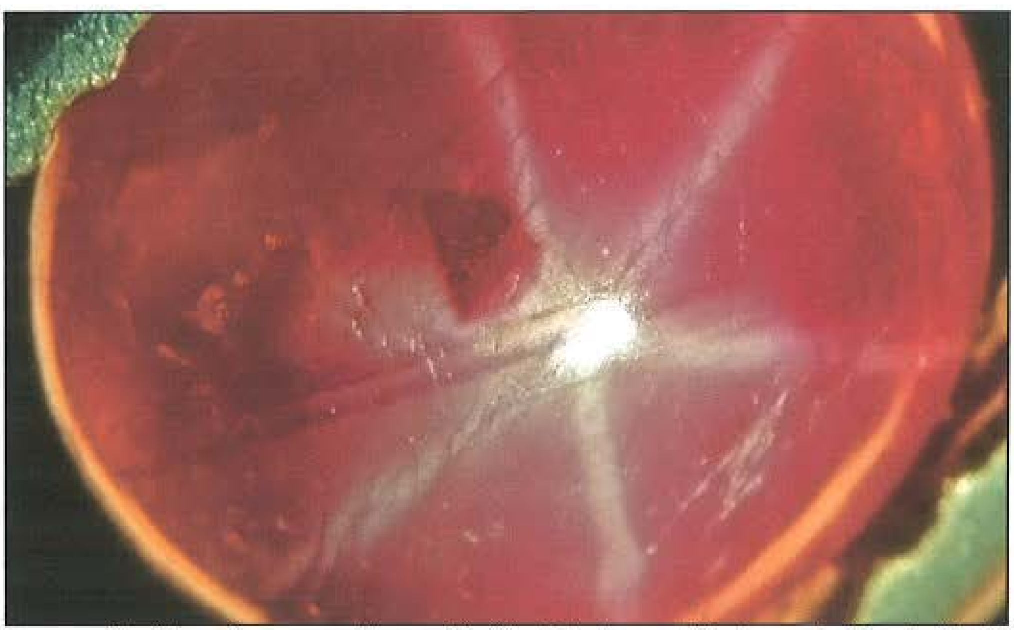

Figure 11: In stones like this one the presence of large cavities filled with glass, containing large spherical gas bubbles (left of the stone) can help to identify the presence of glass filling. Nevertheless the luster difference is not obvious and in such milky stones the examination of the fissures is difficult. Photo: V. Pardieu.

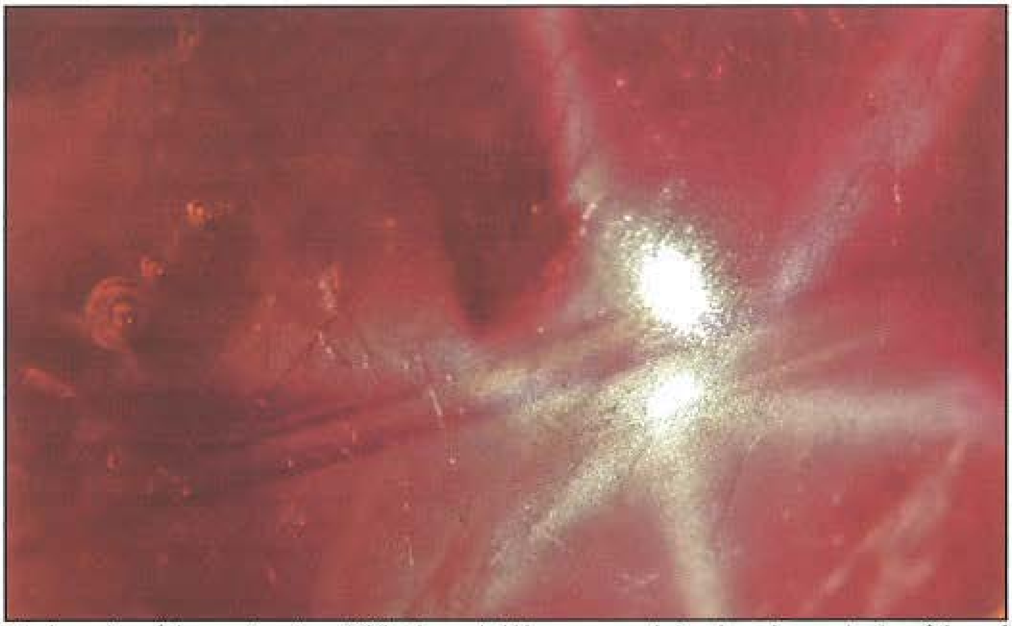

Figure 12: A closer view of the previous stone. Whilst the gas bubbles are more obvious here the examination of the surface does not reveal obvious differences in luster between the ruby and the glass filled fissures and cavities. Photo: V. Pardieu

Figure 13: The identification of large glass filled cavities can also be challenging as the lead glass' refractive index is very close to the host's refractive index and the difference in luster is not obvious as shown here. Nevertheless in this example large gas bubbles are useful evidence to properly identify the presence of the glass filled cavity. However, this sample also shows that polishing has damaged some areas where the glass meets the ruby. Photo: V. Pardieu

Using the microscope, under laboratory conditions with more powerful magnification and better illumination the identification of these stones as lead glass filled rubies was much easier than with the 10x loupe:

The main inclusions were found to be very thin needles arranged in dense (and often white) bands (Figure 15) commonly associated with small particles arranged in a 30 degree orientation to those of the rutile needles (Figure 18). Crystal inclusions were not seen in the stones studied so far with the microscope.

The high density of the needles affect the transparency of stones and thus inclusions were difficult to see. However, when using proper lighting conditions the identification of flattened gas bubbles trapped in the main fractures were quite easy (Figure 14) to detect. Nevertheless, compared to faceted transparent lead glass filled rubies, the lack of flash effect colors associated with the fissures makes the identification of the treatment using the microscope a more challenging operation compared to the transparent faceted lead glass filled rubies more frequently encountered.

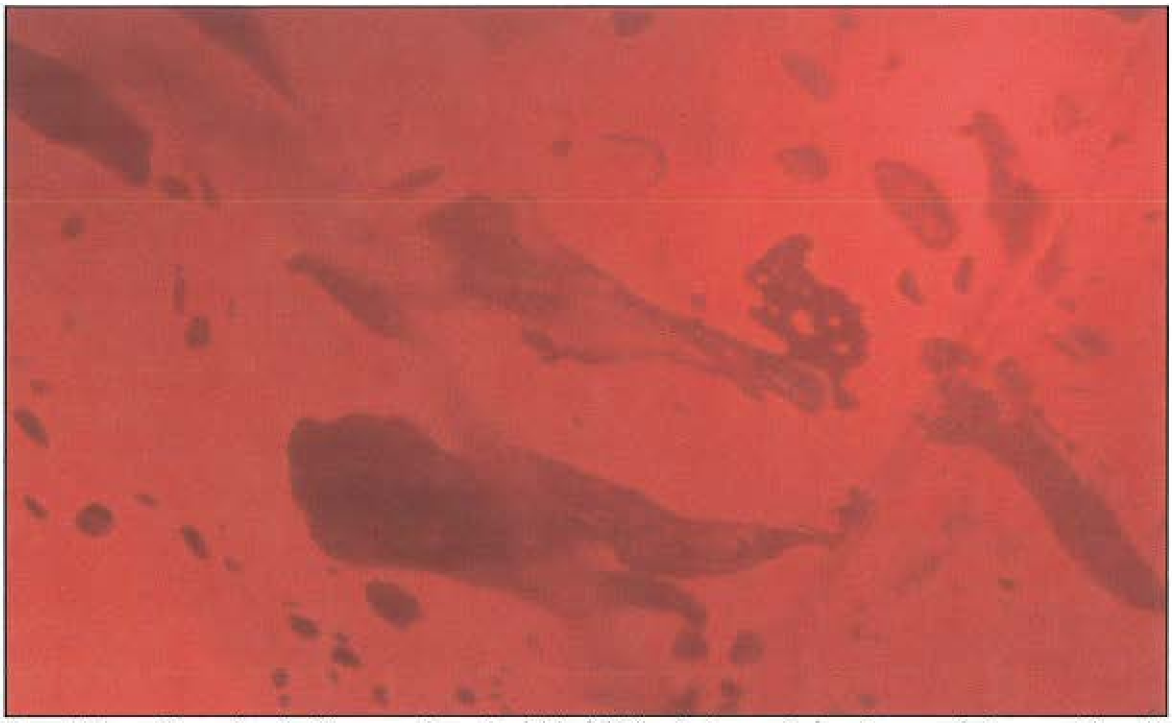

Figure 14: Large flattened gas bubbles seen when using bright field illumination can be found in most of the stones. Photo: V. Pardieu

Figure 15: Using overhead lighting, the dense silk bands can be studied. In the lead glass filled rubies studied they are commonly composed of very tiny and thin needles. In this photo we can also see a large irregularly shaped gas bubble in a surface reaching fissure, but no difference in the surface luster is obvious where the fissure reaches the surface. Photo: V. Pardieu

Figure 16: The same stone as in Figure 14 but using dark field conditions. Owing to the stone's lack of transparency the gas bubbles present are difficult to see. Photo: V. Pardieu

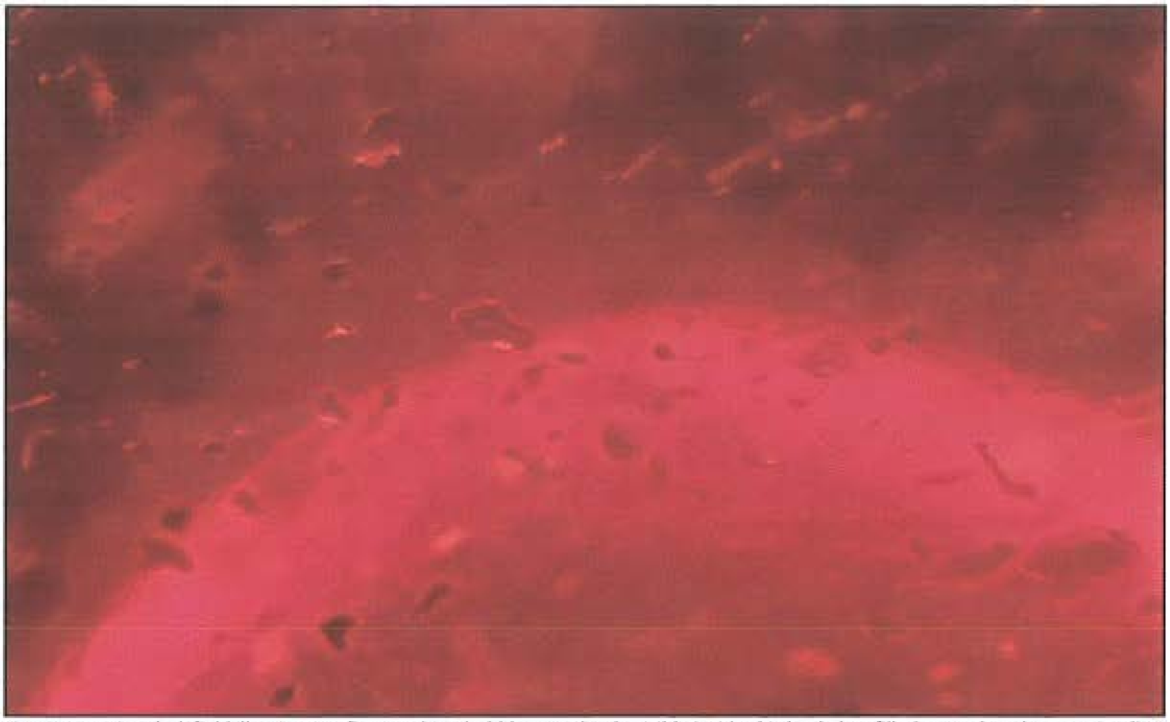

Figure 17: Using dark field illumination flattened gas bubbles are clearly visible inside this lead glass filled star ruby. Photo: V. Pardieu

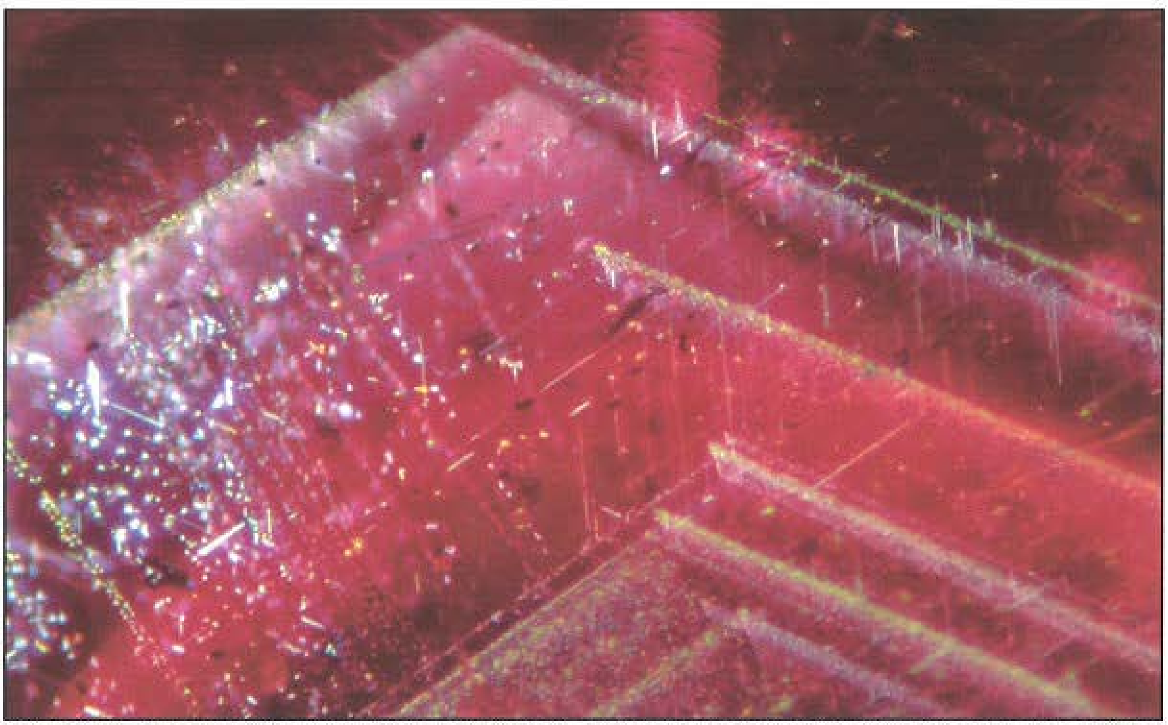

Figure 18: The same stone in the same position as in Figure 16, but here the photo was taken using overhead lighting conditions enabling the reflective and iridescent needles creating the star to be seen. Photo: V. Pardieu

X-Ray Micro-radiography:

Several lead glass filled star rubies were studied at the GIA Laboratory in Bangkok using a Faxitron CS-100's Real-time microradiography unit commonly used in the laboratory for pearl analysis. The unit was originally designed for the inspection of SMT assemblies, semiconductors and PCBs but is excellent for pearl and gemstone microradiography.

Studying lead glass filled stones using x-ray microradiography is an extremely useful method for clearly determining the quantity of lead glass actually present inside the stone. This method enables the examiner to clearly understand whether they are testing a "lead glass filled ruby", a "ruby with glass" or a "ruby-glass composite material" as per the protocols detailed in the nomenclature proposed by the LMHC[2] in the LMHC Information Sheet IS3 (See Annex A).

It shows also how efficiently the lead glass had penetrated the fissures during the heat treatment process (Figure 19, Figure 20, Figure 21 Figure 22). In the microradiographs the lead glass appears as white lines (filled fissures) or white areas (filled cavities).

After studying the microradiographs of the stones studied, it was clear that the samples examined were lead glass filled rubies and not an assembled material resulting from the bonding of several unrelated pieces of ruby material with glass. It appears that the lead glass used has no difficulty in filling very thin fissures and penetrates very deeply into the stones. Large gas bubbles can also clearly be seen within larger fissures.

The observation of the lead glass filled rubies from the top is usually not very revealing except when the stone contains cavities or significant, wide fissures (Figure 20). In such circumstances these filled fissures, along with their gas bubbles, are usually readily apparent. When examined from the side the stones are usually more interesting in that most of the glass filled fissures seems to be confined to oblique planes and other structurally orientated fissures. In this orientation numerous, and very often very thin, lead glass filled fissures became more visible (Figure 22).

Stone 0668741102:

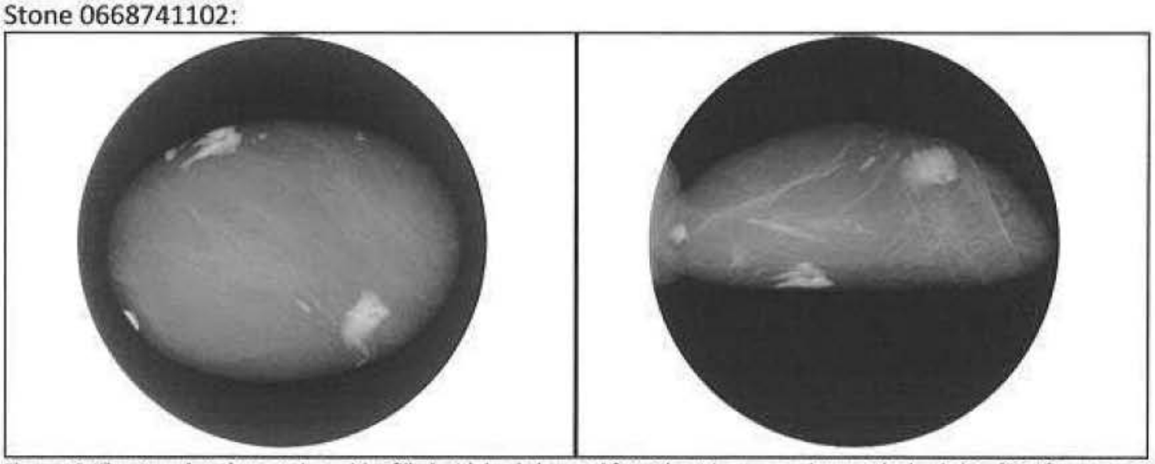

Figure 19: The stone has three main cavities filled with lead glass and from the side we can also see the lead glass filled fissures more clearly.

[2] LMHC: Laboratory Manual Harmonisation Committee

Stone 0668741002:

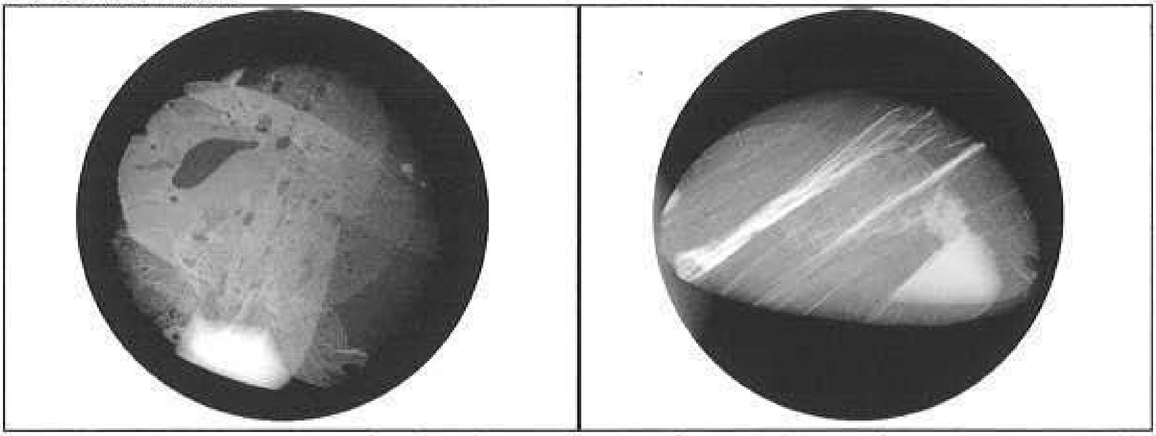

Figure 20: This stone shows several significant filled fissures and one large filled cavity (white area). From the top the gas bubbles contained in these significant fissures are obvious as dark rounded areas, while from the side the wide lead glass filled fissures appear as bright white lines while the thin fissures containing less lead glass are less visible. The dark bubbles being so flat and thin also disappear in the side-on direction.

Stone 0668740702:

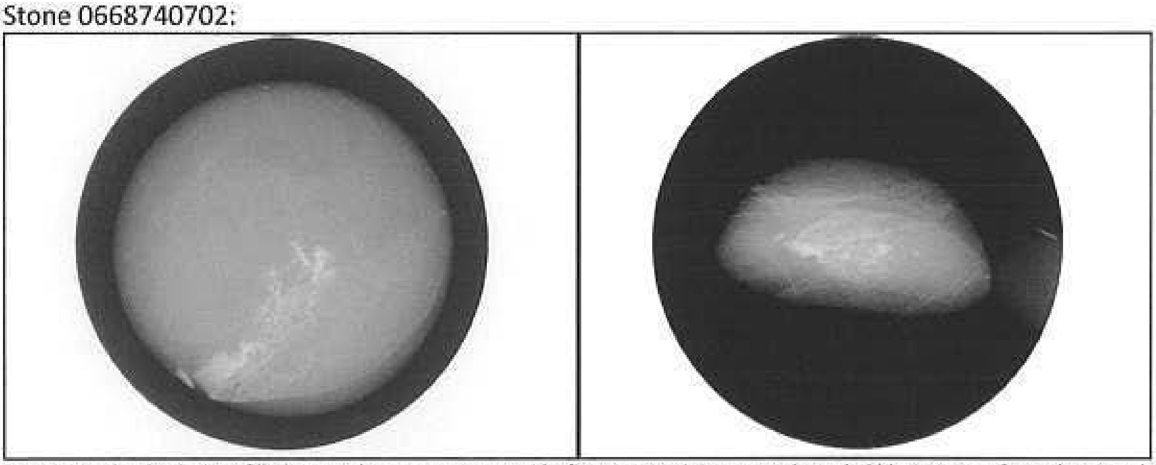

Figure 21: This lead glass filled star ruby presents one wide fissure containing several gas bubbles as seen from the top; the examination of the stone under X-Ray from the side enables to discover many thin lead glass filled fissures.

Stone 0668740602:

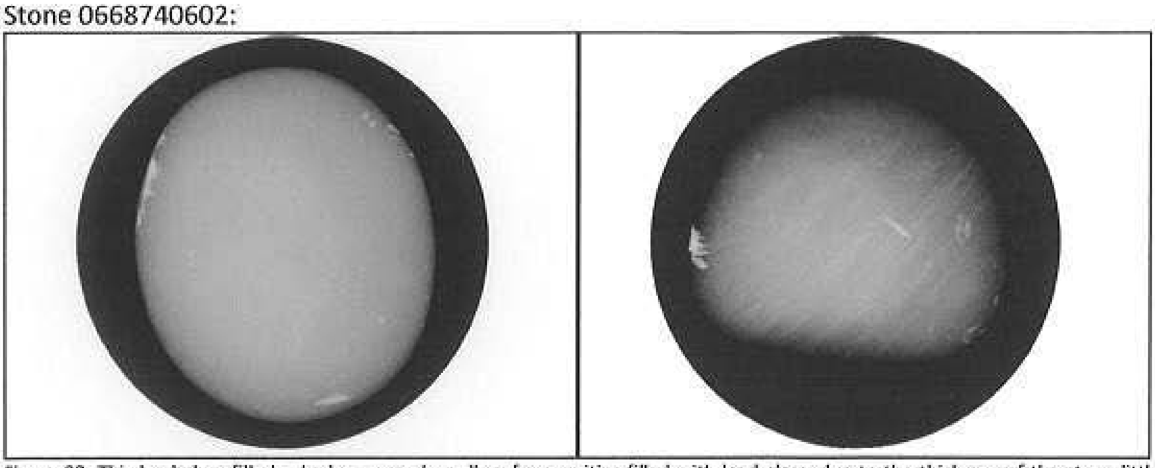

Figure 22: This lead glass filled ruby has several small surface cavities filled with lead glass, due to the thickness of the stone little else can be seen from the top but side-on examination reveals numerous very thin fissures filled with lead glass.

Conclusions and Important Durability Issues:

It was very interesting that a Thai burner contacted laboratory gemologists seeking their assistance in examining his new product and publishing their findings prior to the product's release into the market. Such initiatives and collaborations are very much welcome since they enable people in the market to become aware of new products, understand how to identify them and how to handle them correctly. This is important, since in this case trust in the market should hopefully prevail.

As to the best of our knowledge, the product isn't currently available in the market despite some existing reports on other lead glass filled rubies looking quite similar (GAAJ, 2004, Hainschwang, 2009, Pardieu, 2006), this preliminary study cannot provide information regarding the availability of this new material. Nevertheless it seems that soon large quantities of this material might be available in Thailand.

The reported Madagascar origin of these stones could not be confirmed. Nevertheless the gemological data collected on these stones is very similar to that known for stones from some ruby deposits in East Africa. A visit to the deposit in Madagascar would be necessary to confirm their origin.

The identification of the treatment is not a major technical gemological challenge, at least for knowledgeable gemologists with good instruments. On the other hand in market conditions things might be trickier for people lacking gemological knowledge and training. These stones might therefore be a challenge for the trade, if proper disclosure is not given, particularly because of the durability issues associated with the lead glass filling.

The next step in this study will thus be a more comprehensive study of the material including a specific durability study. The results will be published in an updated version of the present study.

Nevertheless in the case of lead glass filled rubies in general, it is important to keep in mind that the glass used for the process is relatively very soft and has a low melting point. People wearing such stones, and jewelers working with them, should be particularly careful as the glass filled stones can easily be damaged by chemicals (acids, caustic soda, etc...), heat or even scratches and knocks (McClure, 2006).

Thus GIA Laboratory Bangkok gemologists and Mr. Thongdeesuk believe that disclosure about such material at all levels of the supply chain is a vital requirement as it is important for people working with or wearing these treated stones to understand that this material is not as durable and rare as untreated gem material of similar appearance.

For more information on how gemological laboratories like the GIA disclose and describe lead glass filled rubies please consult the LMHC Information Sheet 3 (IS3) included in this study in annex (see Annex A).

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Annex A:

Information Sheet #3
Standardised Gemmological Report Wording

Corundum with glass filled fissures and/or cavities and Corundum-Composite Material

Members of the Laboratory Manual Harmonisation Committee (LMHC) have standardised the nomenclature that they use to describe glass filled fissures and/or cavities in corundum and corundum-composite material. This nomenclature is used for all situations that (i) involve the filling of fissures and/or cavities with glass, where there are indications that the clarity of the corundum has been enhanced/modified by this process with the exception of those covered in Information Sheet #1 and (ii) form a corundum-glass composite material.

Glass filled fissures in corundum:

(see Information Sheet #1 for "healed fissures" and subsequent "residues in fissures")

Any corundum that shows indications of having undergone clarity enhancement/modification usually assisted by heating, through the filling of fissures with glass shall be described as,

- Species: **Natural corundum**
- Variety: **Ruby** or **Sapphire**[3]
- Comments: **(Indications of) Clarity enhancement/modification by a glass filler in fissures** *or* **Glass filled fissures** *or* **Glass in fissures,** plus (the appropriate filler quantification terminology - 'alpha numeric and/or text description' - see table 1), (the identification of the glass material – e.g., lead glass, silica glass, etc.) and/or the statement (introduction of glass into fissures involves heating)[4]
  (This treatment usually applies to low quality stones.)
  (Glass filled corundum is unstable to elevated temperatures and to certain chemical agents.)

Table 1: Quantification table for colourless to near-colourless glass in fissure(s) in corundum

Status:	**No indications of clarity modification**	**Clarity enhancement/modification / glass in fissures**		
Report Alpha numeric:		F1	F2	F3
Report Text:	"No declaration"	*Minor* clarity enhancement/modification by a glass[5] filler in fissures / Glass[5] filled fissures, *Extent: minor*[5]	*Moderate* clarity enhancement/modification by a glass[5] filler in fissures / Glass[5] filled fissures, *Extent: moderate*	*Significant* clarity enhancement/modification by a glass[5] filler in fissures / Glass[5] filled fissures *Extent: significant*
Further optional report comments:		a lead glass / a silica glass, etc., has been identified as the filler and/or the introduction of glass into fissures involves heating.		

Special Notices

1. Whether using the alpha numeric or text description the report shall also illustrate the equivalent by appending the above chart.
2. The process producing 'glass filled fissures' might also induce healing of fissures and/or fractures (see Information Sheet #1).

[3] 'Sapphire' for the blue variety of corundum. For other colours, 'Sapphire' preceded by its colour (e.g., yellow sapphire, pink sapphire, etc.). See Information Sheet #4 for 'padparadscha sapphire'.
[4] Text in parenthesis is optional.
[5] In case of coloured glass, the report text shall mention the presence of a coloured glass.

http://www.gia.edu/research-resources/news-from-research/index.html

Glass filled <u>cavities</u> in corundum:

It is possible that during the glass filling process in addition to fissures, cavities may also become filled with glass. When such glass filled cavities are found in addition to the applicable report text and/or alpha numeric (as above) these shall be described as,

- Comments: **(Indications of) 'Glass filled cavity(ies)** plus (the appropriate filler quantification terminology - 'alpha numeric and/or text description' - see table 2), (the identification of the glass material –
  e.g., lead glass, silica glass, etc.) and/or the statement (introduction of glass into cavities involves heating).
  (This treatment usually applies on low quality stones.)
  (Glass filled corundum is unstable to elevated temperatures and to chemical agents.)

Table 2: Quantification table for colourless to near-colourless glass in cavities in corundum

Status:	Glass in cavities		
Report Alpha numeric:	C1	C2	C3
Report text:	"Minor Glass filled cavity(ies)"	"Moderate glass filled cavities"	"Significant glass filled cavities"
Further optional report comments:	a lead glass / a silica glass, etc., has been identified as the filler and/or the introduction of glass into fissures involves heating.		

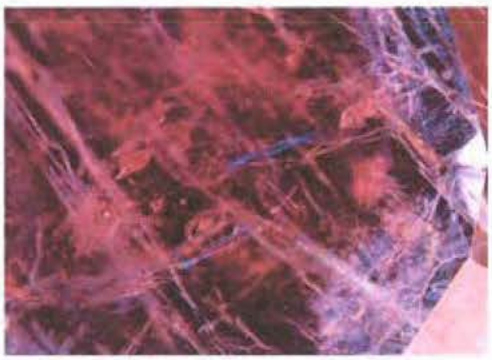

Figure 1a: Colour flashes seen in the area of lead glass filled fractures in ruby

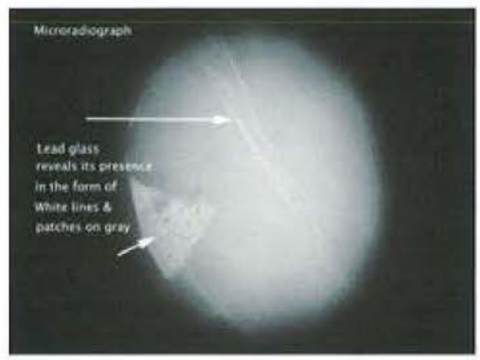

Figure 1b: A microradiograph that reveals the presence of lead glass in fractures

Members of the LMHC determine which quantification terminology to use (see tables 1 and 2) taking into account the size and position of each glass filled fissure and/or cavity. This filling may be of various extents (see examples in figures 2a, b and c.).

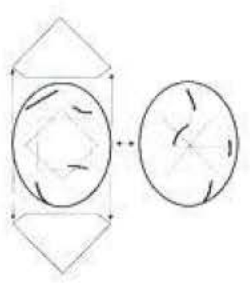

Figure 2a: Glass filled fissures; Extent: minor (F1)

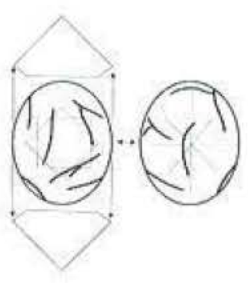

Figure 2b: Glass filled fissures; Extent: moderate (F2)

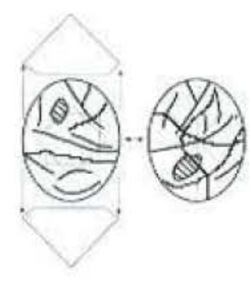

Figure 2c: Glass filled fissures; Extent: significant (F3), and significant glass filled cavities (C3)

Special note:

Durability/stability: Glass filler may be unstable to elevated temperatures and to chemical agents. Special care shall be taken when repairing jewellery items set with glass filled corundum. During jewellery repair the unmounting of such stones is recommended.

Ruby with Glass:

It is possible to assemble and/or to bound several unrelated corundum pieces into one cutting material with glass. When such material is found, it shall be described as,

- species: **'natural corundum with glass'**
- variety: **'ruby with glass'**
- comments: **Fractures filled with glass, which significantly reduces their visibility.**
  Fracture filling materials such as glass may be unstable to elevated temperature and to chemical agents. (Special care should be taken when cleaning or repairing jewellery items set with fracture filled stones.)

Illustration of the effect of HF acid on corundum with glass:

Figure 3a: A faceted corundum-glass material

Figure 3b: Remaining ruby pieces of the faceted corundum-glass material shown in figure 3a after acid disintegration

Ruby-Glass Composite Material:

It is possible to assemble and/ or to bound a multitude of tiny pieces of ruby into one cutting material with glass. When such material is found, it shall be described as,

- species: **'corundum-glass composite'**
- variety: **'ruby-glass composite', an artificial product**
- comments: **This item is a combination of glass and ruby.**
  This binding material may be unstable to elevated temperature and to chemical agents. (Special care should be taken when cleaning or repairing composite materials)

Illustration of the effect of HF acid on corundum-glass composite material:

Figure 4a: A faceted corundum-glass composite material

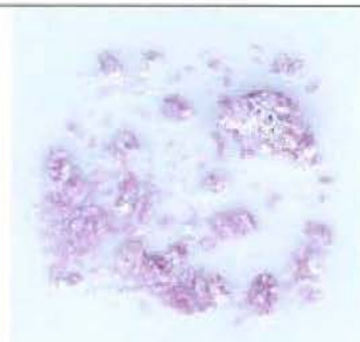

Figure 4b: Remaining ruby pieces of the faceted corundum-glass composite material shown in figure 4a after acid disintegration (107 hours in HF)

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

Update: February 3, 2012

Kenneth Scarratt

GIA Laboratory, Bangkok

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[1] 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)[2] 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 18th -20th 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"* [i] on all future identification reports.

Further on November 13th 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 heavily treated using a high refractive index lead-glass to fill fractures and cavities,*

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[1] Compared with the prevalence in the market relatively few of these stones have been submitted to laboratories for reports.

[2] 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)

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 12th and 23rd 2007. They totaled 40 rough untreated, 70[3] 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 (

). 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.

[3] 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.

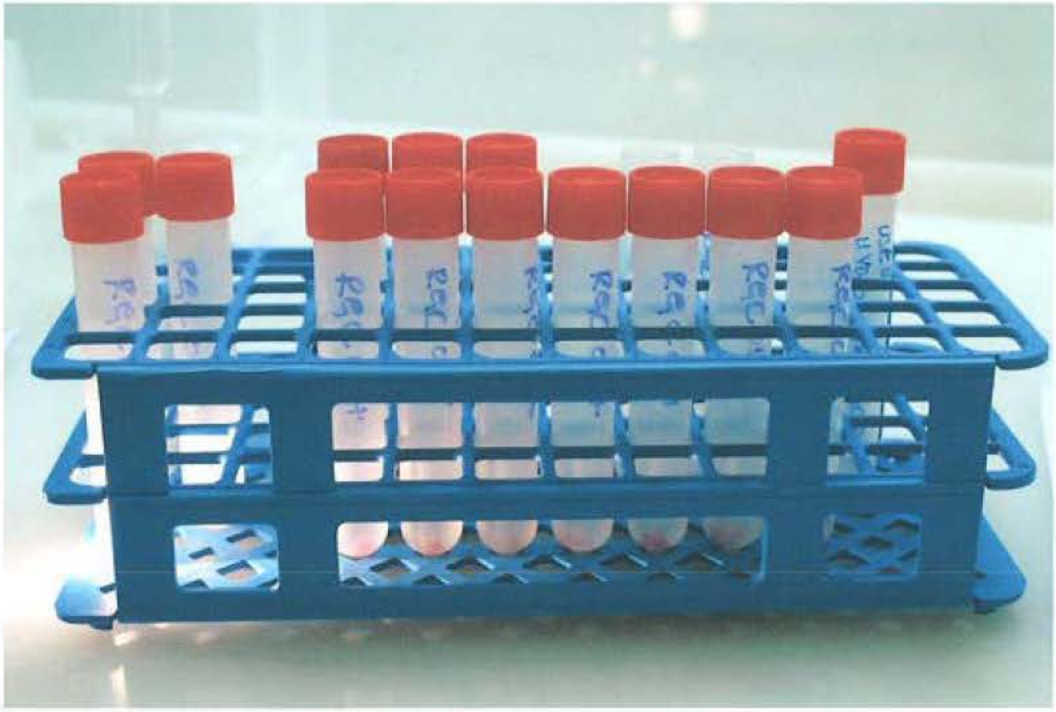

Figure 2: A rack holding individual plastic tubes that held the specimens that underwent acid disintegration. The stones were placed into the tubes and then covered with hydrofluoric acid[4] sealed and left to "soak" for from two to ten days.

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.

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[4] 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

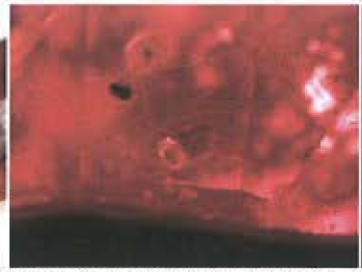


Figure 4: An hexagonal crystal in a ruby-glass composite; the crystal is unaltered by heating

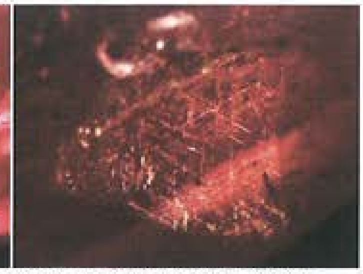


Figure 5: Rutile needles (silk) in a ruby-glass composite: the silk is unaltered by heating

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

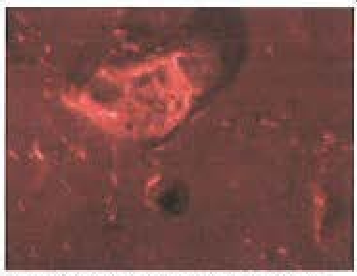


Figure 9 A crystal in a ruby-glass composite: the crystal is unaltered by heating

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) were he states "*In rubies enhanced in Bangkok by Orange Sapphire company, some yellow to orange color concentration appears is 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

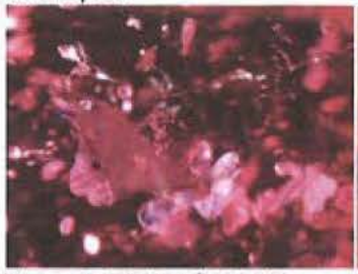


Figure 10: RGC001 flattened bubbles within filled fractures

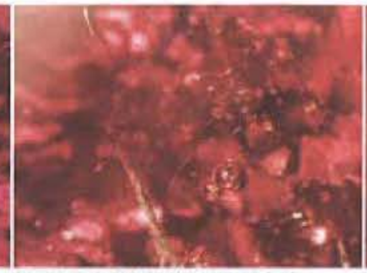


Figure 11:RGC005 expanded bubbles within filled fractures

Figure 12:RGC006 flattened bubbled within filled fractures

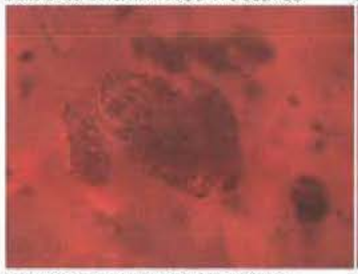


Figure 13: Flattened bubbles within filled fractures

Figure 14:RGC007 flattened and expanded bubbles within filled fractures

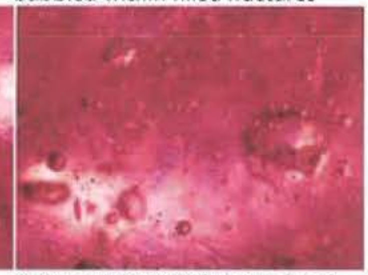


Figure 15:RGC007 flattened and expanded bubbles within filled fractures

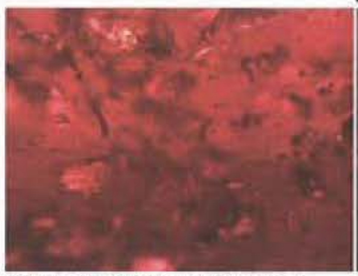


Figure 16: Bubbles within filed fractures

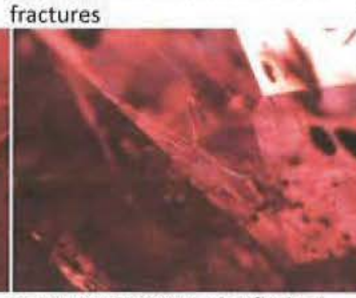


Figure 17:RGC008 color flashed from revealing the glass filled fractures

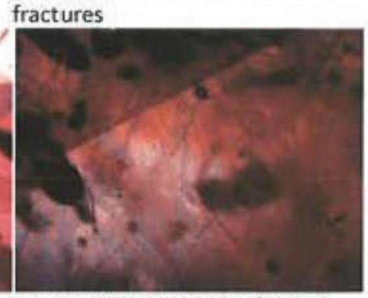


Figure 18:RGC011 color flashed from revealing the glass filled fractures

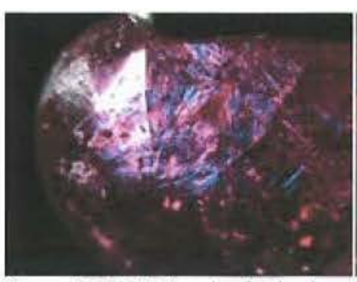


Figure 19:RGC001 color flashed from revealing the glass filled fractures

Figure 20: RGC015 orange glass filling a cavity and fracture. Figure 21to Figure 24 show this in different lighting conditions

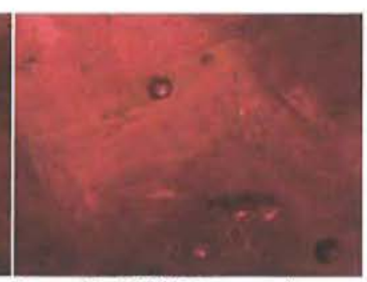


Figure 21: RGC015 orange glass filling a cavity and fracture. Figure 20 to Figure 24 show this in different lighting conditions

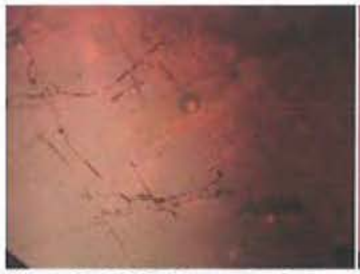


Figure 22: RGC015 orange glass filling a cavity and fracture. Figure 20 to Figure 24 show this in different lighting conditions

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

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

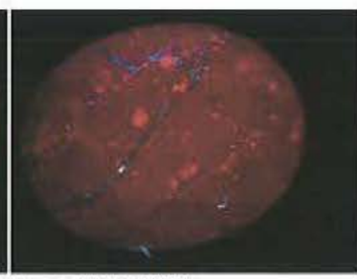


Figure 26: RGC002

Figure 27: RGC003

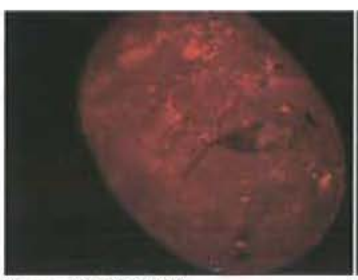


Figure 28: RGC004

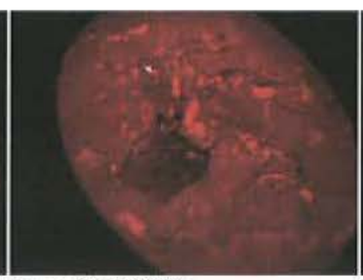


Figure 29: RGC005

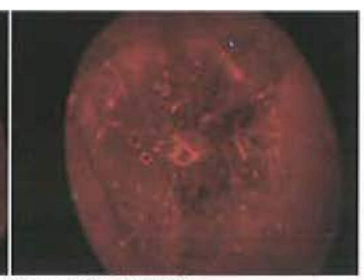


Figure 30: RGC006

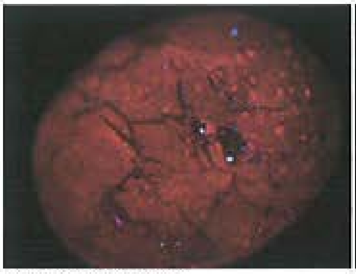


Figure 31: RGC007

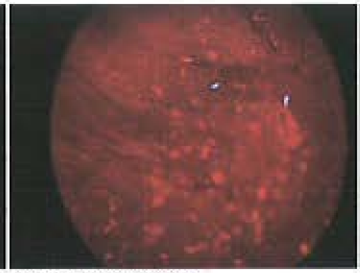


Figure 32: RGC008

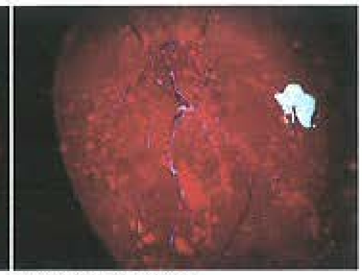


Figure 33: RGC009


Figure 34: RGC010

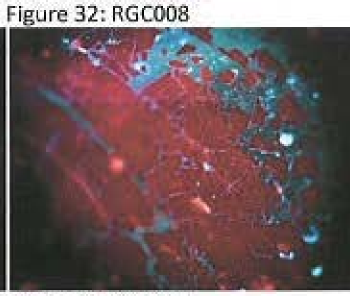


Figure 35: RGC011


Figure 36: RGC012

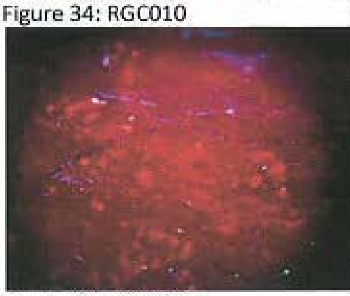


Figure 37: RGC013

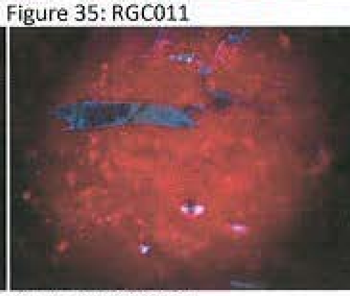


Figure 38: RGC014


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 (NTSF) of the light from the facet under examination. The stone, being examined on a microscope, is then turned to achieve NTSF 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 NTSF. 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).

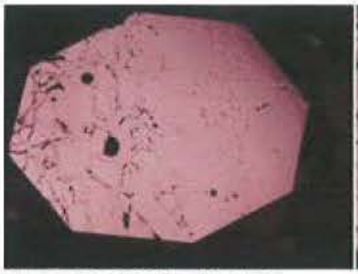


Figure 40: RGC007 this NTSR image of the table facet reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

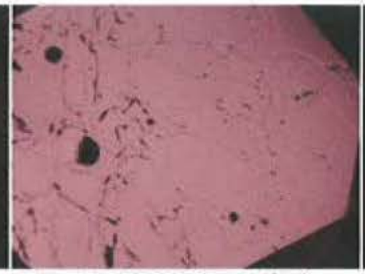


Figure 41: RGC007 (magnified from Figure 40) this NTSR image of the table facet reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

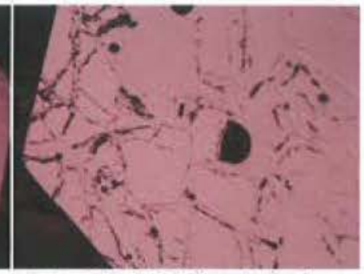


Figure 42: RGC007 (magnified from Figure 41) this NTSR image of the table facet reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

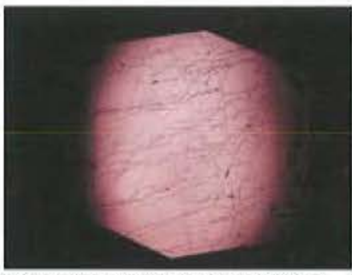


Figure 43: RGC010 as in RGC007 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

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

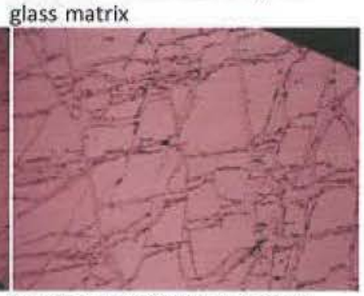


Figure 45: RGC010 (magnified from Figure 44) as in RGC007 this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

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 RGC011this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

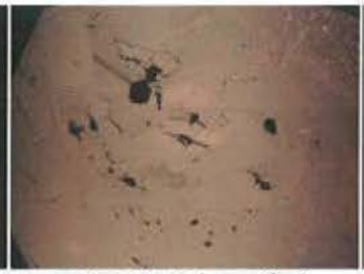


Figure 50: RGC006 (magnified from Figure 49) as in RGC007, RGC 010 and RGC011this NTSR image of the table facet also reveals a virtual jigsaw puzzle of glass and ruby – islands of ruby in a glass matrix

Figure 51: RGC006 (magnified from Figure 50) as in RGC007, RGC 010 and RGC011this 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 NTSF, two bubbles are seen cut through at the surface

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

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

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

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

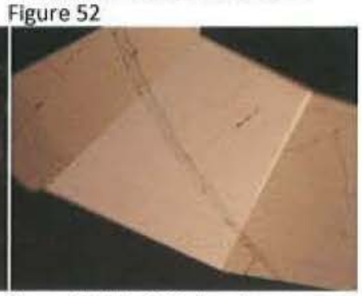


Figure 57:RGC004 showing a wide tract of glass crossing a facet in NTSF

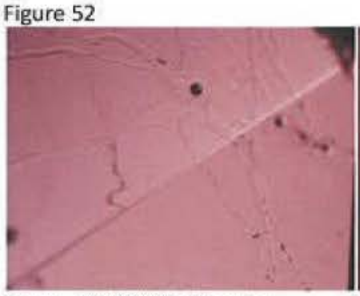


Figure 58:RGC007 showing several wide tracts of glass crossing two facets in NTSF

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

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

Figure 61:RGC014 showing wide tracts of glass crossing a facet in NTSF, 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 NTSF.

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

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 coposites subjected to acid disintigration 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.

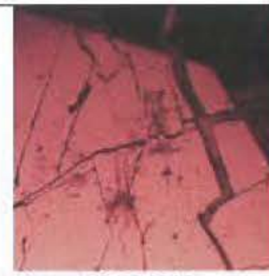


Figure 76: RGC003 after acid disintegration.

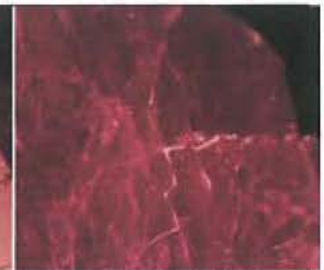


Figure 77: RGC003 after acid disintegration.


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.

Figure 99: RGC010 before acid disintegration.

Figure 100: RGC010 after acid disintegration.

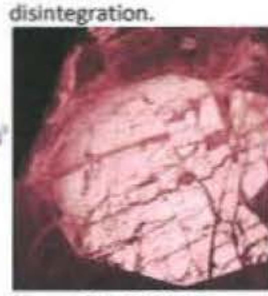


Figure 101: RGC010 after acid disintegration.

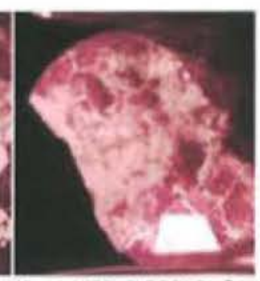


Figure 102: RGC010 after acid disintegration.

Figure 103: RGC011 before acid disintegration.

Figure 104: RGC011 after acid disintegration.

Figure 105: RGC011 after acid disintegration.

Figure 106: RGC012 before acid disintegration.

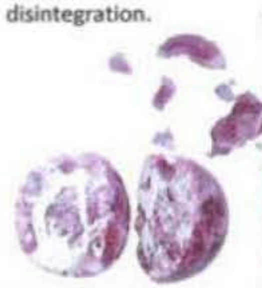


Figure 107: RGC012 after acid disintegration.

Figure 108: RGC012 after acid disintegration.

Figure 109: RGC012 after acid disintegration.

Figure 110: RGC013 before acid disintegration.

Figure 111: RGC013 after acid disintegration.

Figure 112: RGC013 after acid disintegration.

Figure 113: RGC013 after acid disintegration.

Figure 114: RGC014 before acid disintegration.

Figure 115: RGC014 after acid disintegration.

Figure 116: RGC014 after acid disintegration

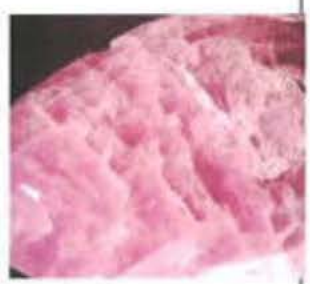


Figure 117: RGC014 after acid disintegration

Figure 118: RGC015 before acid disintegration.

Figure 119: RGC015 after acid disintegration.

Figure 120: RGC015 after acid disintegration.

Figure 121: RGC015 after acid disintegration.

Discussion

From the above observations and results of acid disintegration experiments an adjustment in GIA's reporting policy was made along the lines taken by fellow LMHC members (ruby-glass composite) in early 2008. However, and again in consultation with the LMHC and importantly with the US industry in late 2011 GIA adjusted its reporting policies on glass filled rubies further.

The latest adjustments are to some extent 'landmarks' in that they acknowledge, for what maybe the first time, that a division exists between what might be deemed a 'treatment' (to an otherwise natural stone) and what might be a 'manufactured' product, i.e., if an artificial material (such as a glass) used during a 'treatment' process becomes the dominant component then the end product may not be considered a 'treated stone' but rather it is a 'manufactured product'.

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

The following new reporting policy was introduced for use within GIA Laboratories in November 2011. GIA welcomes your comments.

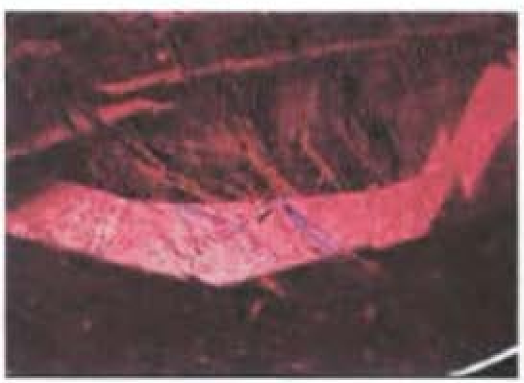
Condition	Presumed Intent / Application	Case A
Fissures present, but obviously intact material	Clarity enhancement; corundum, emeralds, tourmaline, etc	**Species** Natural (Corundum, Beryl or Tourmaline etc) **Variety** (Ruby / Sapphire, Emerald or Tourmaline)

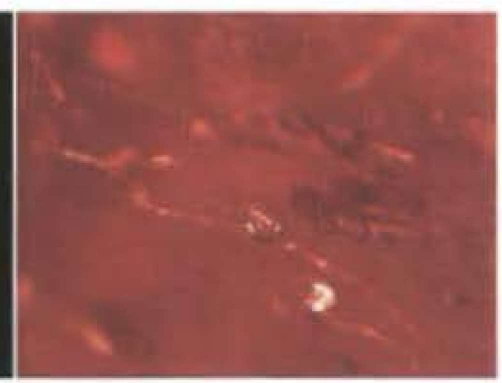
The images of "ruby with glass" here generally reflect the material described in this section and would also reflect the situation with emerald.

Treatment:
A (minor, moderate, significant) amount clarity enhancement, using (a filler, glass, resin, oil) to reduce the visibility of fissures.

Add (indications of heating) if filler is glass.

Comment:
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





Condition	Presumed Intent / Application
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.	To strengthen fractured rough to enable cutting; improve clarity and appearance; currently applies to corundum and beryl

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

Case B

Identification Report Only (not a gemstone specific report, e.g., a ruby report).

Conclusion:
A manufactured product

Comment:
This item is a combination of glass and ruby/sapphire; if the glass is removed or altered the stone may fall apart. 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

Condition	Presumed Intent / Application	Case C
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	**Identification Report Only (not a gemstone specific** report, e.g., a ruby report). **Conclusion:** A manufactured product

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

Comment:

This item is a combination of glass and ruby/sapphire; if the glass is removed or altered the stone may fall apart. 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

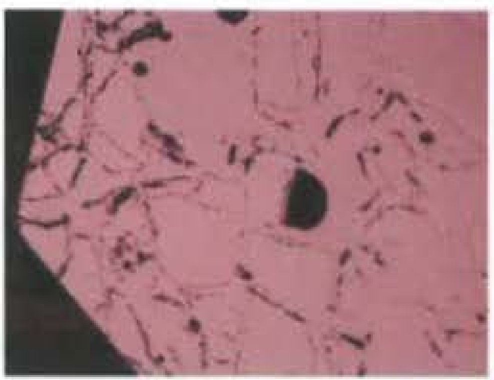


Table 1	Ct Weight pre acid	L	W	D	Acid disintegrated	Ct Weight post acid and after drying
RGC001	0.97330	7.007	5.187	2.782	Into HF 14:15 November 24th 2007 out 11:00 November 26th 2007. **Total 44 hours 45mins**	0.93 major piece alone including residue
RGC002	1.29770	6.973	5.613	3.969	Into HF 15:22 November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

Table 2	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	7Li	**9Be**	**11B**	**24Mg**	**27Al**	**29Si**	**44Ca**	**45Sc**	**47Ti**	**48Ti**	**51V**	**52Cr**	**53Cr**	**55Mn**	**56Fe**
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
Average	**22.06**	**2.27**	**15792.00**	**7522.20**	**195100.00**	**########**	**208.00**	**14.46**	**1182.80**	**1177.60**	**15.20**	**50.12**	**57.32**	**27.55**	**3189.40**
Stdev	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
	59Co	**60Ni**	**65Cu**	**66Zn**	**69Ga**	**71Ga**	**72Ge**	**83Kr**	**85Rb**	**88Sr**	**89Y**	**90Zr**	**93Nb**	**118Sn**	**137Ba**
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
Average	**1.32**	**30.68**	**8.51**	**234.90**	**52.38**	**20.39**	**0.88**	**0.00**	**6.41**	**11.04**	**5.59**	**1956.80**	**2.01**	**4.48**	**156.98**
Stdev	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	
	139La	**140Ce**	**146Nd**	**147Sm**	**153Eu**	**163Dy**	**172Yb**	**175Lu**	**181Ta**	**182W**	**208Pb**	**220Bkg**	**232Th**	**238U**	
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	
Average	**2.27**	**5.24**	**1.95**	**0.43**	**0.08**	**0.63**	**1.24**	**0.24**	**0.46**	**0.21**	**1076200.00**	**0.00**	**1.47**	**1.82**	
Stdev	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	

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[i] **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

AGA Attachment 31

Spinel and its Treatments: A Current Status Report

By Christopher P. Smith, American Gemological Laboratories

Introduction

Spinel has historically been one of the most highly revered gemstones. However, over an extended period of time, its popularity had suffered as a result of many factors, including its classification as "semi-precious" and a general confusion with another dominant red gemstone: ruby. More recently though, spinel has been making a strong comeback and so its popularity is once again on the rise.

Articles of important new sources and even a book devoted to this beautiful and colorfully diverse gemstone have helped to focus attention back onto spinel (see e.g. Smith et.al., 2007; Senoble, 2008; Pardieu et.al., 2009; Krzemnicki, 2010; Yavorskyy and Hughes, 2010). In addition to exhibiting a vibrant array of shades and nuances of color, spinel has also traditionally been spared the controversy of treatments that have encumbered many other gem varieties, such as ruby, sapphire, emerald, quartz, topaz and tanzanite among others.

Fortunately, spinel remains a gemstone that is generally free of treatment considerations. However, today some treatments are starting to be encountered (Robertson, 2012). This article is a review of those treatments and the gemological characteristics that help to distinguish them.

Spinel Treatments

It should be noted that for those stones presently in the marketplace, treated spinel is not commonplace and they are only rarely encountered by the major labs around the world. However, the author has noticed a general increase in the attempts to improve spinel quality and color, utilizing a variety of treatment practices.

Clarity Enhancement

The practice of filling fissures to reduce their visibility and improve the apparent clarity of a gemstone is probably the single most prevalent treatment applied to gemstones. Oils and other

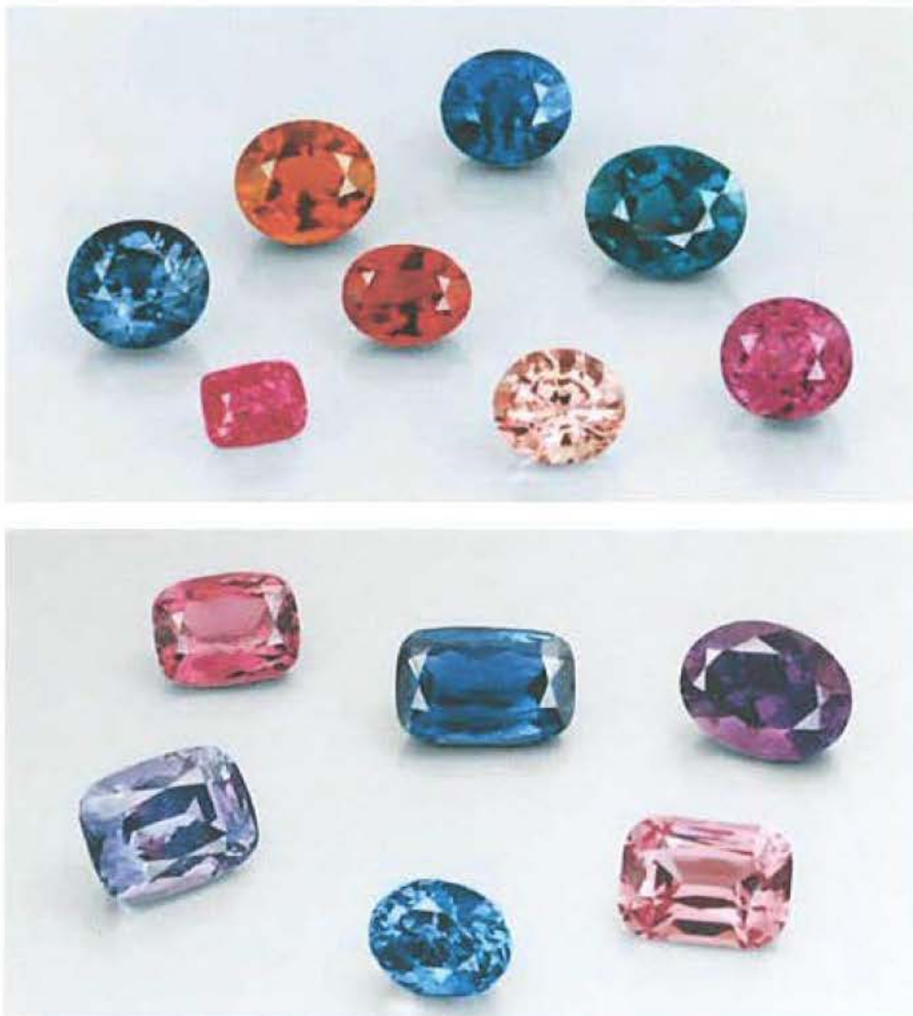

Figure 1: Spinel offers a beautiful array of colors that is matched by a few other gemstones. (Photos: Bilal Mahmood and Kelly Kramer)

materials may be introduced into a fissure, thereby making that fissure less reflective and reducing its visibility.

As a result for all colors of spinel, the filling of fissures is going to be the most common form of treatment or enhancement that one may encounter.

Detection of clarity enhancement is most readily accomplished with magnification, using a microscope or jeweler's loupe. An iridescence is generally visible along a filled fissure. In addition, areas of higher relief may also be evident where the filling of a fissure was incomplete or the filler has been partially removed (Figure 2).

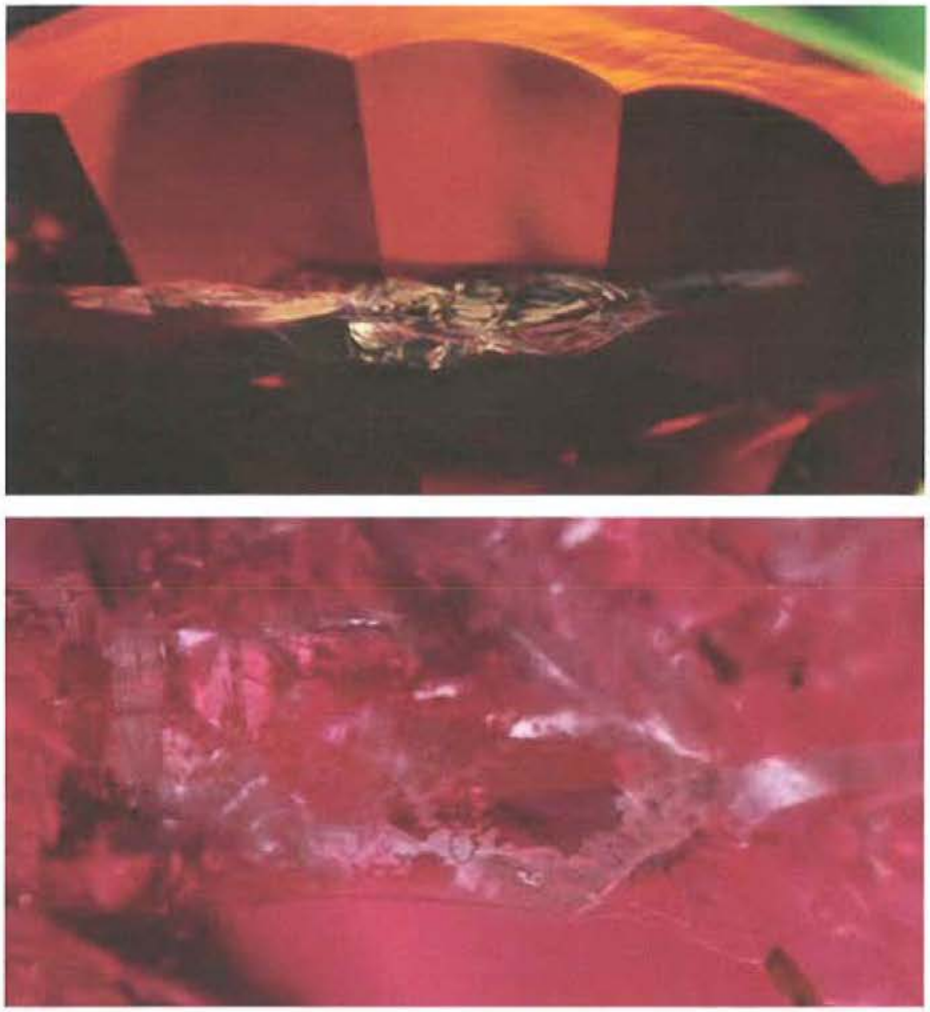

Figure 2: The filling of fissures in spinel using an oil is the most common form of enhancement that is likely to be encountered. Such clarity enhancement can be readily seen where the filling has been incomplete or the filler has been partially removed, leaving behind areas of higher relief that stand out against the lower relief areas where the filler remains. *(Photomicrographs: Christopher P. Smith, 35x)*

Heat Treatment

Throughout most of the history of gemology, it was thought that heating did not improve the quality of spinel. In the author's 25 years of experience, in the very rare occurrence when a red spinel was encountered in the lab that showed evidence of heating, this was thought to be an unintentional treatment where a spinel inadvertently was mixed in with a parcel of rubies that were being heated.

For those stones encountered in the past, this inadvertent treatment is still considered to be the case. However, in 2005 there started to be talk in the industry that heating was being used to improve the quality of some spinels from Tanzania. As a result, research was conducted that demonstrated how indeed heating could be used to alter the quality of some spinels (Saeseaw et.al., 2009).

As described, these researchers concluded that this treatment was not being performed to improve color, since their experiments showed either little to no color modification or a less desirable color resulted from the heating. However, they did find that the transparency of certain spinels could be significantly improved by heating at temperatures between approximately 950°C and 1150°C.

Additionally through this research, it was shown that Raman and photo-luminescence spectroscopy provided a very effective means of identifying this treatment. The researchers demonstrated that the lattice of spinel heated at or above approximately 750°C went from what is classified as an ordered structure to a disordered structure. For more detail, the reader is referred to Saeseaw et.al., 2009. This change in the lattice may be seen in the broadening of the primary Raman band of spinel (from approximately 6.8 – 10.6 wavenumbers in unheated spinel to more than 30 wavenumbers in heated spinel), as well as a significant modification in the band structure of chromium emission (Figure 3). It is important to note that the Raman and photoluminescence spectra of spinel heated above this temperature are consistent with the spectra of synthetic spinel.

Relatively Higher Temperatures

Since the awareness of the potential for heating spinel, most major labs have been routinely testing the spinel submitted using either singly or in combination, photoluminescence and Raman spectroscopy.

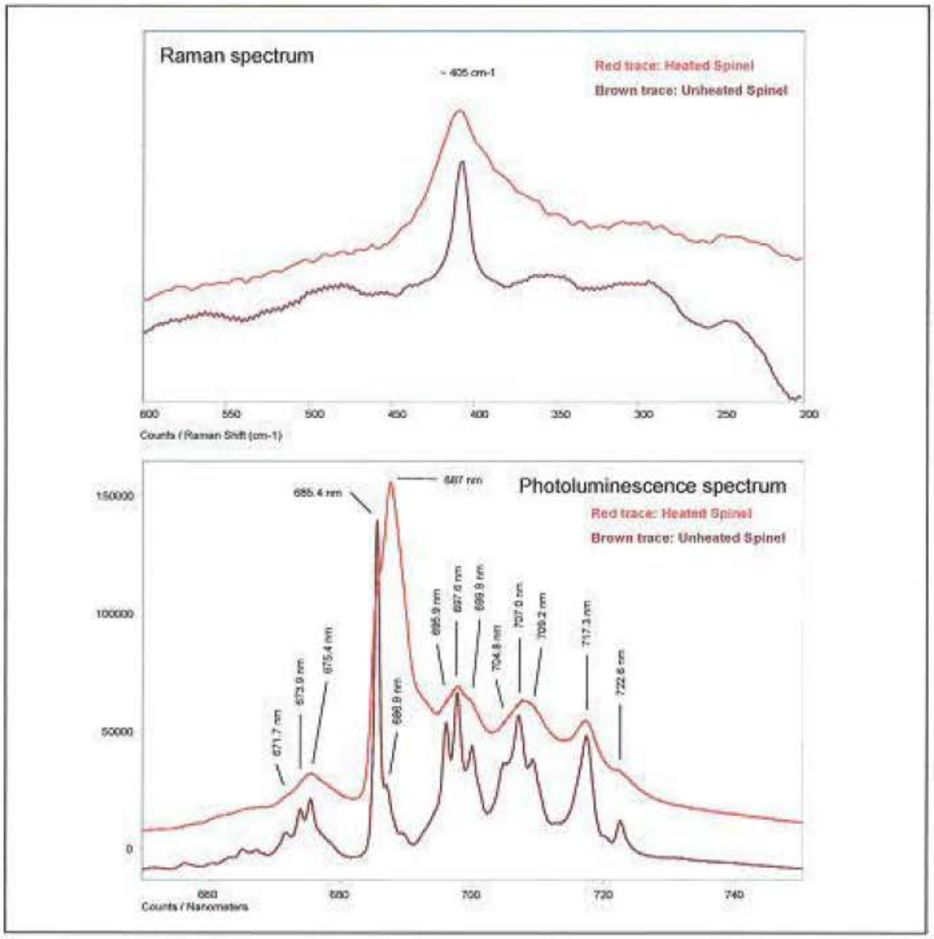

Figure 3: Raman spectroscopy and photoluminescence are very effective methods for distinguishing if a natural spinel has been heated to temperatures of approximately 750°C or more. At approximately this temperature, the lattice of spinel transitions from an ordered to a disordered structure. The traces of this disordered structure may be seen in the broadening of the primary Raman band positioned at approximately 405 cm-1 Raman shift, as well as the chromium (Cr) emission of the photoluminescence spectrum. Shown here are two natural spinels: one unheated and one heated.

To date, only a handful of spinels tested by the AGL have been determined to be heated in this manner. For these stones, not only were the photoluminescence and Raman spectroscopy helpful in determining their heated status (Figure 3), these stones additionally exhibited inclusion features that revealed evidence of being exposed to heat treatment (Figure 4).

A similar limited number of stones have been identified by other major labs, such as the GIA (McClure, 2012). However, other researchers have been in contact with groups that are attempting to increase the usage of this treatment technique (A. Peretti pers. comm., 2012).

Relatively Lower Temperatures

More recently, the AGL has examined parcels of spinel that were not consistent with the type of spinel heating described previously, yet due to various inclusion features, they still appeared to have been heated (Smith, 2011; Robertson 2012). This included most colors of gem-quality, transparent spinel with the exception of "cobalt-blue." As questions were raised to the suppliers of these parcels by the author, they admitted that the spinels had indeed been heated.

The features observed by the author were more consistent with the type of inclusion features that are reminiscent of rubies, pink sapphires and yellow sapphires, etc. which had been heated at relatively low temperatures (see e.g. Smith, 2010). These consisted of atoll-like discoid stress fractures (Figure 5), low-relief secondary fissures extending from healed fissures (Figure 6) and stress fractures surrounding various mineral inclusions (Figure 7), as well as others.

Unexpectedly, the Raman and photoluminescence spectra of these spinels were consistent with an ordered lattice and did not reveal the modifications that so readily had distinguished the heated spinels described previously (Figure 3).

Figure 4: Concentrations of fine stringer-like inclusion features are common to certain sources of spinel. In the heated spinels submitted to the American Gemological Laboratories (AGL) to date, such stringer-type inclusions revealed an atypical or disturbed appearance. (Photomicrograph: Christopher P. Smith, 42x)

Discussion

Spinel is a fascinating and beautiful gem that is once again receiving the attention and admiration that it deserves. The broad array of color and exciting new sources have helped to catapult this gem in popularity over the past decade. As demand have grown and top-quality gems are scarce, it is not surprising that attempts are now being made to improve certain colors and types of spinel.

At the moment it is still safe to assume that the vast majority of spinel in the market is free of treatments. However more recently, attempts to improve the quality and subsequent value of spinel through treatments seems to be increasing. The oiling of fissures is an old treatment procedure that can and is applied to virtually any gemstone with surface reaching fissures. Careful observation using

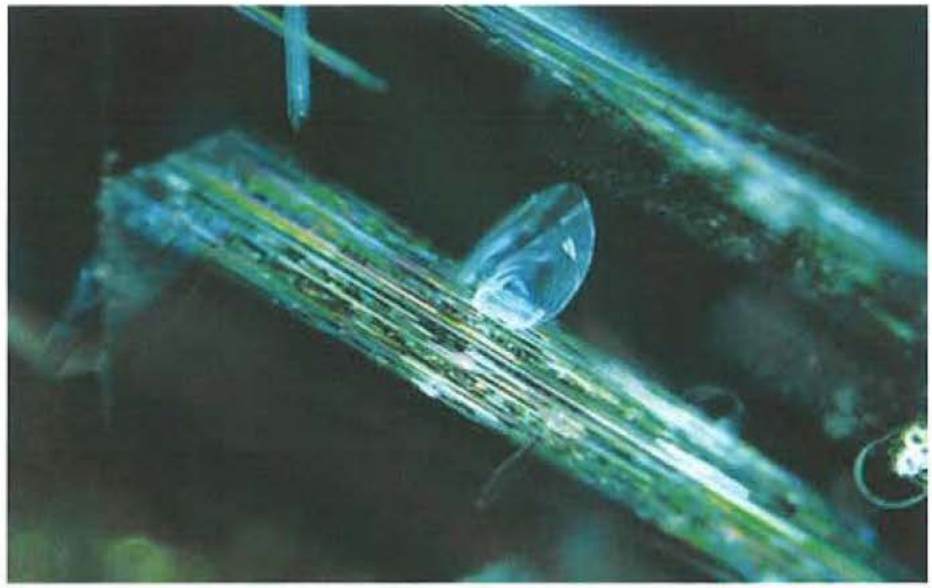

Figure 5: A more recent type of heated spinel encountered by the AGL revealed thermally induced inclusion features more consistent with what may be seen in rubies and sapphires heated to relatively lower temperatures. These included discoid or atoll-like induced stress fractures with a partial healing rim as seen extending from needle-like inclusions. (Photomicrograph: Christopher P. Smith, 75x)

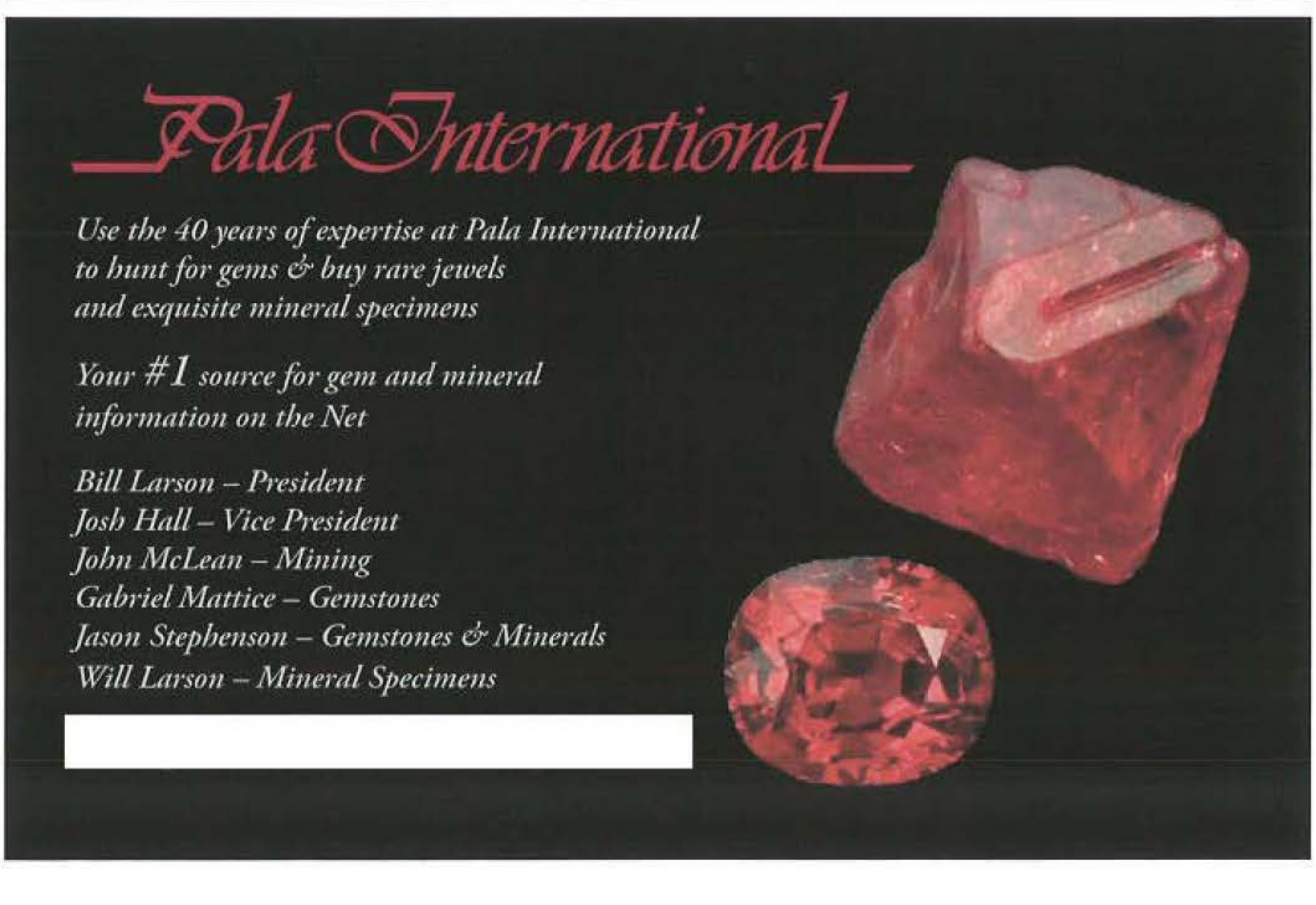

Figure 6: Another feature of the spinels heated at relatively lower temperatures was the occurrence of very transparent, subtle stress fractures extending from the constituents of healed fissures. (Photomicrograph: Christopher P. Smith, 75x)

magnification will permit this treatment to be identified by any jeweler or gemologist with a little training.

The heating of spinel seems to be the most recent trend. Although a few years ago it was shown that spinel heated from approximately 950°C to 1150°C may be improved in transparency, this form of treatment has so far not been widely encountered.

Even more recently, a newer heating procedure has been seen. This new treatment does not exhibit the modified Raman and photoluminescence spectra that permit the relatively higher temperature heating to be readily detected. However, a number of inclusions were observed that can help to identify this treatment. For stones free of inclusions, the detection of this relatively lower temperature heating is significantly more difficult.

In the course of discussions with those performing the treatment, the specific heating conditions were not given. However, based on the fact that the Raman and photoluminescence spectra were not altered, it is presumed that the treatment is either below approximately 750°C and/or shorter in duration than the 6 hours of heating employed by previous researchers (see again Saeseaw et.al., 2009). In further discussion with the treaters, they indicated that the spinels were being heated to improve their color and not their clarity. Although the author witnessed this relatively lower temperature heating in a broad range of colors, the treaters indicated that only some stones improve significantly. Others improved only slightly or not at all. Presently research is continuing with samples before and after heating and the findings will be presented once completed.

Although the author examined a number of parcels consisting of several hundred stones that had been heated in this manner, it is unclear at the moment how prevalent this treatment may be and the author is not suggesting that this form of treatment is widespread.

Figure 7: Mineral inclusions of the spinels heated at relatively lower temperatures also revealed evidence of this treatment. Shown here are inclusions of apatite with thermally induced stress fractures. (Photomicrograph: Christopher P. Smith, 65x)

As an ending note, it is unfortunate that as a gemstone which has traditionally been exempt from controversy involving treatment, spinel must now be added to the long list of gemstones that may be heated. Furthermore, this is another reminder that as gemologists, we can no longer take any gem for granted as being "untreated." IC

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National Jewler

GIA posts educational glass-filled ruby video

By Michelle Graff
FEB 9, 2012

Carlsbad, Calif.--The Gemological Institute of America now is referencing lead glass-filled rubies as "manufactured product" on reports, the institution revealed in a new video designed to educate the trade and the public.

The five-minute clip, which can be seen below, features Kenneth Scarratt, GIA's managing director for Southeast Asia and director of the lab in Thailand, and Shane McClure, the GIA's director of West Coast identification services.

It reviews what lead glass-filled rubies are, how to identify and care for them--the stones can be damaged during jewelry cleaning and repair and even by some everyday household cleaners--and addresses what the GIA is now calling this material.

In an interview with *National Jeweler*, McClure said the GIA decided to start using "manufactured product," with explanation, for lead glass-filled ruby reports to reduce confusion in the marketplace.

"One of the purposes was to try to get away from all these names that are out there," he said. "I don't think the public understands these names."

American Gemological Laboratories (AGL) refers to lead glass-filled rubies as "composite rubies" and, in September, announced it would be cross-referencing its reports with those of GemResearch Swisslab (GRS), which calls lead glass-filled rubies "hybrid rubies."

"This was an attempt to get around giving it another name and just say what it is," McClure said, when asked if he thought using "manufactured product" just added to the confusion by creating yet another term for these stones. "It's something that's been made by man."

Creating the video gave GIA the chance to both introduce the new term and provide information on lead glass-filled rubies, which McClure said are a "big problem" of which the industry needs to be aware.

He said the GIA first started seeing these stones in 2003 and started reporting on it in 2004, but widespread awareness didn't really take hold until about 2009. He said quite a few lead glass-filled rubies come through the GIA lab, mostly submitted by members of the public who have bought the stones online.

McClure said while submitters do not disclose what they pay for the stones, many of them ask if the GIA can determine country of origin because what they bought is supposedly an untreated Burmese ruby. This leads him to believe they are paying too much.

"The public is getting ripped off with this stuff and, of course, they blame the rest of us (in the industry) when that happens," he said.

The Ruby Ruse: How Jewelers Can Avoid the Lead Glass–Filled Gems

What happens when undisclosed lead glass–filled rubies enter the market? Here's how retailers can avoid disastrous results.

By Jennifer Heebner, Senior Editor
This story appears in the May 2012 issue of JCK magazine

Within the past year, Leo Anglo, the general manager of Vincent's Jewelers in St. Louis, has seen so many customers carrying rubies through his doors that a rush on the classic gems appears to be in full swing.

There was the colonel in the Armed Forces who brought in eight oval-shape rubies he'd bought from an Army and Air Force Exchange Service–approved vendor in Afghanistan for about $600 a carat ($5,000 total), and the woman who'd paid $1,700 for a 0.75 ct. ruby in a 14k gold mounting at a national department store.

The problem? Neither client had been told the stones were lead glass–filled and required special care. Anglo had the unenviable task of delivering the bad news: The stones weren't worth anywhere near what the customers had paid for them. In the case of the colonel, the rubies were worth about $1,000 retail—80 percent less than he paid, and far less than what he was promised they were worth.

Meanwhile, the woman with the ring learned her ruby was lead glass–filled when she took the ring to another -jeweler to be resized. It was damaged beyond repair; the department store where she bought the original gem replaced the ring, but it was the replacement stone—another lead glass–filled ruby—that she brought to Anglo for a value assessment.

As he does with all suspect rubies, Anglo placed the woman's stone under a Hanneman filter ($80.95 at Kassoy Jewelry Supply) fitted with a ruby slide that revealed bright blue flashes of color—the telltale signs of a lead glass–filled gem. He sent it to a lab just to be sure.

After all, Anglo had been down this road before. "Since we're buying secondhand merchandise like crazy, we have to have a way to test the stones or else we're not putting them in the case," he says.

BEFORE

© GIA

Rough Mozambique rubies

AFTER

© GIA

The same rubies after being filled with lead glass

Most rubies undergo heat treatment, either in the rough or after polishing, to enhance or improve color and quality. Often the rubies are heated with compounds such as borax to heal open cracks or fissures. These practices are commonplace and widely accepted, and do not affect the day-to-day handling of stones. For example, household products don't harm them, and bench jewelers know how to handle them properly during routine manufacturing and repair.

Although lead glass material is easily identifiable—gas bubbles and flashes of blue are the giveaways—the gems in question, sometimes referred to as "composite rubies," are frequently sold undisclosed. "Identification is not the issue," Shane McClure, GIA's director of West Coast Identification Services, told attendees at the GIA GemFest in Basel in March.

"Disclosure is the real problem."

Gemologist/author Antoinette Matlins has seen that problem firsthand on the jewelry show circuit. In Las Vegas last year, Matlins stopped by a booth packed with customers to peruse the finished jewelry. She inspected trays of ruby-set gold styles with stones that looked Burmese in origin that the dealer described as untreated and natural. Matlins, however, had her suspicions. Loupe in hand, she pointed out the gas bubbles and blue flashes to the vendor, who reluctantly revealed the rocks were lead glass–filled and required special care.

"The designs were very pretty," says Matlins, "but none of the retailers were asking about treatments."

Lead glass–filled rubies have an altered chemical makeup that makes them extremely vulnerable to damage. For example, their surfaces turn white when exposed to substances as common as lemon juice, let alone bench jeweler solvents. When sellers don't disclose the treatment, they're breaking the law, and buyers take the hit.

And because composites are appearing in the market with greater frequency, jewelers need to be extra vigilant about how to identify and handle the material to avoid ruined reputations and economic loss. Christopher Smith, president and chief gemologist of American Gemological Laboratories in New York City, says composite samples come into his lab with regularity today, whereas he saw just a handful annually a few years ago.

In Columbia, Mo., L.C. Betz, the owner of L.C. Betz & Associates, tells customers who bring in commercial-grade ruby jewels that stones must come out of their settings before repairs can begin. "I say that I'm a -jeweler, not a gemologist, and I'm not going to take any risks," Betz says. He also has a gemologist inspect potential buys from the public and avoids buying commercial qualities for stock. "You have to cover your own backside," he says.


GIA

© GIAA GIA report tells all: "A manufactured product consisting of lead glass and ruby...unstable to high temperatures and to chemical agents."

According to AGL's Smith, more and more estate pieces set with composite rubies promoted as unheated Burmese material are surfacing in the market. "It's one of the most disturbing developments we've seen," he says. "Ten-plus carat composite rubies set in antique jewelry are being sold without declaration. Now composites aren't just a low-cost alternative for consumers—this is much more overt; people are taking out the original stones and replacing them with composites on purpose to mislead."

To avoid scenarios like this, Patrick Hopman, co-president of Hopman Jewelers in Elkhart, Ind., sells rubies of only one carat or more in size accompanied by a certification from an accredited lab. "Just because something is old doesn't mean that it's real," he says. Hopman will buy color from the public, but if the stone doesn't have a certificate from a lab, he pays less for it because he'll then have to pay for his own lab cert if he hopes to resell the gem.

At Blue Diamond in Jefferson City, Mo., president Mary Kempker doesn't buy any colored stones from the public. "We don't have the equipment to buy safely, and it costs $70 a pop to have a stone tested by a lab."

Benjamin Hakimi, president of the New York Gemstone Association and president of Colorline, a New York City gem wholesaler, once had to come to the rescue of a high-end Madison Avenue retailer and New York City–

based bench jeweler; the latter had dropped a customer's 15 ct. off-round cushion-cut ruby into the pickle solution for a resizing job from the merchant. The stone developed "lines and cracks" and all but fell apart, Hakimi says.

It turned out the customer—who was not told the ruby was lead glass–filled at the time of purchase—had bought the ring in the Caribbean for nearly $15,000. "The store was relieved that it wasn't their fault," says Hakimi, who issued a letter to the customer stating that if the gem was not purchased as a natural ruby, it should have been disclosed for being lead glass–filled. "I supplied her with all of the lab reports and samples, and got a certificate from AGL saying it was a composite ruby and lead glass–filled."

One surefire way to lessen or eliminate liabilities is to heed Federal Trade Commission regulations, press suppliers for full disclosure, and tell customers exactly what they're buying at the time of purchase. If not, retailers could get sued—by customers, or by competitors under the Lanham Trademark Act, which regulates unfair competition—or make themselves vulnerable to legal action by local and state authorities and the FTC.

"Retailers are completely liable," says Cecilia Gardner, president and CEO of the -Jewelers -Vigilance Committee. In December 2011, JVC was one of six industry groups that jointly published a consumer -advisory warning about undisclosed lead glass–filled rubies in the market.

On its website, JVC told members of the industry that lead glass–filled rubies were "a different species altogether from a 'ruby'" and could contain "more glass than precious stone," making them far less valuable than traditionally heated natural rubies of similar sizes, colors, and shapes. "These highly treated gemstones may not be even considered gems under the current definitions in the FTC Guides," adds Gardner.

Which isn't to suggest that lead glass–filled rubies don't have a place in the market. Because of the shortage caused by the ban on importing Burmese rubies, composites are a valid option when disclosed—and priced—properly. But as with many treatments, buyers beware.

"This material is the most abundant ruby product in the market today—it eclipses everything else out there—and it's not always being represented properly," Smith says of the lead glass–filled rubies. "This could completely change the dynamic for the ruby market and its future."

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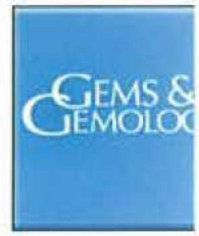
Weighing in on the $6 Ruby

At the most recent Las Vegas Antique Jewelry & Watch Show, located at the MGM Grand Hotel (across town from the JCK Show at the Sands) we saw something we really didn't expect to see - "glass-filled ruby." It was being sold for $6 per carat up to $15 per carat.



We expect to see glass-filled ruby at gem shows, and we did see it at the Tucson gems and minerals shows last February - for as low as $1.50 per carat. But we were surprised to see it at an antique and estate jewelry show.

Not so surprising was a lack of disclosure signage. We were forced to ask the obligatory questions: "Is this ruby?" The answer, "yes." "Is this treated?" The answer, "yes." "Is it glass-filled?" The answer, "yes."

What is glass-filled ruby? And why don't they want you to know about it? The answers to these questions and more right here in our feature: ***"Weighing in on the $6 Ruby."***

Beautiful Rubies and a Beautiful "Ruby Ring." Yes?

This pretty 14-karat yellow gold mounting is set with a 3-carat ruby, and is accented with round brilliant cut diamond melee. The ring could be retail priced anywhere from $800 to $2,000. Normally, for a ruby ring, you would be paying mostly for the ruby, and then the gold and diamonds are additional costs. But here you are paying for the gold and diamonds, and it's the ruby that only adds a little to the overall cost of the ring. Why? Because this particular ruby, in order to make it durable enough to use in jewelry, has been filled with glass, and may have been priced at just $6 per carat!

In this feature:

Part I

"Is This A Real Ruby?"

Q. If the ruby in the ring cost only $6 per carat, then is it really a ruby?

A. The quick answer is, "yes."

Q. But if it's a ruby, shouldn't it cost 100s if not 1,000s of dollars per carat?

A. Again, the quick answer is, "yes." If it were a ruby of such a quality that it required no treatment, or only heat treatment, then it would have cost 100s if not 1,000s of dollars per carat.

Q. So then what's the difference? Why does this ruby and rubies like this cost $6 per carat?

A. This particular ruby started out as very low quality ruby. (See image below) In order for it to be cut and polished, it was necessary to treat it to enhance its durability - to literally glue it all together to keep it from crumbling and falling apart. Now that's low quality!

This is natural untreated very low quality rough ruby. This will be filled with glass, cut and polished to look something like these two stones below.

Part II

"BUYER - BE AWARE!"

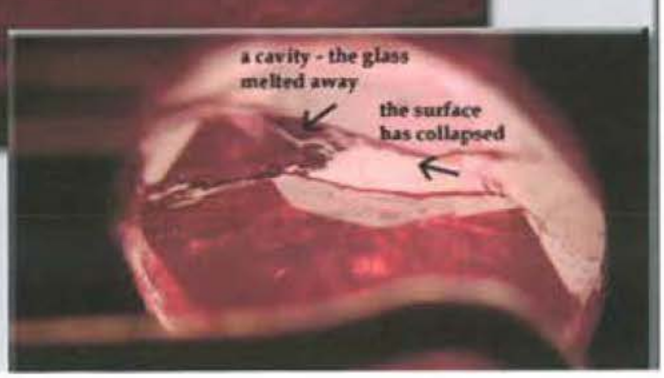
Glass Filled Ruby

It looks nice. But remember, it started out like that very low quality ruby shown above.

This Ruby Has Stability Issues

While this material looks pretty, and is stable enough to cut, polish, and wear in a piece of jewelry, the glass filler has some drawbacks. For one, it cannot withstand any acids, including household acids such as cleaning supplies containing bleach (laundry detergent and dishwasher liquid), or foods such as lemons, limes, vinegars, salad dressings, pickles, salt, or wine. So your ruby should stay away from the laundry room, kitchen, and dining areas - including restaurants. While this may not always be posible, remember to clean your ruby ring as often as you can with mild soap and water. And one should definitely not wear this ruby near any chlorinated swimming pools or hot tubs.

If your ruby jewelry should need repair, the jeweler needs to be aware of the treatment since an overuse of heat applied to the ruby will melt the glass and ruin the treatment. (see the images below.)



Glass filled rubies damaged due to excessive heat during repair.

Part III
"Can You Call This a Gemstone?"

The Major Durability Issue

The material shown here is red corundum, hence the name "ruby" applies. However, it is not durable enough to cut and polished as it is. It will fall apart, crumble on the polishing wheel, and therefore needs to be treated for stability. We need to glue it together with something.

According to Cecilia Gardner, CEO and general counsel for the Jewelers Vigilance Committee (JVC), because it is not durable without this treatment, the ruby fails one of the FTC requirements to be called a "gem" or "gemstone." So while we can call it a ruby, we should not call it a gem ruby.

FTC - § 23.25 Misuse of the word "gem."

(a) It is unfair or deceptive to use the word "gem" to describe, identify, or refer to a ruby, sapphire, emerald, topaz, or other industry product that does not possess the beauty, symmetry, rarity, and value necessary for qualification as a gem.

Both of these rough red corundums (aka Ruby) are completely natural as found in nature. #1 on the left - non gem ruby. #2 on the right - low quality gem ruby. For both, treatments will make these rubies pretty enough to be worn in jewelry. Different starting materials however require different treatments.

#1 will be moderately heated and then, in a vacuum, filled with melted glass. (see images below) The melted glass will fill all of the fissures and cavities throughout the stone, masking those fissures and cavities, and making the stone look transparent - as transparent as #2. The glass also acts like a glue, stabilizing the stone so it will not fall apart when its being cut and polished. The color of the glass is yellow, which will also help enhance the color of the ruby. Yellow and purple make red, so by adding the glass, we are making the color more like what ruby is supposed to look like.

#2 above is already stable and transparent naturally - no treatment necessary. But its clarity and color can be improved. The treatment for this stone will be high temperature heat, with a flux (a flux is an additive that helps lower the heat necessary to dissolve ruby). The high temperature with flux dissolves the walls of the fissures, which, when eventually cooled, will grow back together. This is called "healing." The high temperature not only helps to heal the ruby, it also helps to enhance the color of the ruby. (Color enhancement by heat is considered a traditional treatment.)

Rough #1 cannot be treated in this manner. It cannot take the high temperatures needed to heal fissures. Because the #2 rough material is stable, transparent, and has the potential to be healed, it will cost more than rough #1. The treatment process for rough #2 is also more intensive and will cost more, so the final product will be more expensive than the lead glass filled material.

A Name for the Trade and Consumer

In the jewelry trade, this glass-filled ruby material is called by several names. Obviously, one of the names is "glass-filled ruby." It is also called "lead glass-filled ruby," "treated ruby," "enhanced ruby," "filled ruby," "fissure-filled ruby," "heated ruby," "a hybrid gemstone," and "ruby with glass."

The American Gemological Laboratories in New York calls this material "composite ruby."

"There has been some confusion with gem identification reports, what they mean and what they're describing," notes Chris Smith, president and CEO of the American Gemological Laboratories in New York. "They have not been answering that basic fundamental question, 'Is this lead glass treated ruby or not?' There are a lot of people in the industry who do not want to deal with lead glass-filled ruby," says Smith. "They tell us, 'I don't mind the other types of heating, fissure healing treatments, but I don't want to deal with this lead glass-filled material.' "

In this material, the lead glass is just as intrinsic to the ruby as is the ruby. "After this ruby goes through the process of being cleaned, in an acid bath to clean out foreign material, what's left is very brittle," explains Smith. "You can literally crush it between your thumb and index finger. In the strict sense, it may still be a single piece, but you cannot polish it. So the lead glass is infused into the ruby, stabilizing it in order to be polished. Sometimes there's more ruby than glass, but sometimes there's more glass than ruby. That product is an amalgam of glass and natural red corundum. We call this material 'composite ruby'."

GIA is looking at descriptions for this ruby as well. "We have three different levels of what we will say about this material," says Shane McClure, director of gem identification at the GIA Gem Laboratory in Carlsbad, Calif. "One, if it's coherent material that could have been cut without the treatment, and it was subsequently heat treated to partially heal fissures, then that is just considered clarity enhancement. We don't see much of that by the way.

"The second category is what we mostly see, and that's

material that you can tell was clearly one piece of rough when it started, but it may not have been able to have been cut. They may have tried to cut it and it fell apart. So they had to glass fill it in order to make it useful. Now that material we call 'Ruby with Glass.' "

GIA, as well as AGL, also include care and cleaning comments. In fact, there are many comments on these reports explaining in detail the nature of the material identified in the report.

"And then we have a third comment," says McClure, "a 'ruby glass composite,' which is one we hold for stones where we see pieces of ruby floating in glass. We don't see that very often either."

Fish Tank Gravel?

A few gem suppliers would joke about the low quality of the starting material for Glass-Filled Ruby, calling it "fish tank gravel." The Roskin Gem News Report called to check with the manufacturers of "Aquarium Gravel," and while we agree that this untreated material looks like a great candidate for the fish tank, as it turns out, this material does NOT qualify for fish tank gravel. (No, it's not the lead content.)

"It may have sharp edges that might cut the fish, especially the bottom dwellers such as catfish or other scavengers," says Rick Dunnahoo, vice president of sales and marketing for Estes Aquarium Aggregates, in Totowa, New Jersey. "It also sounds like this material would be too smooth and would not have enough surface area to support bacteria, essential for that bacteriological cycle. The products we sell are actually aggregates. We would never entertain something similar to this." On the positive side, ruby would cost too much, even at the reported \$5/pound for starting material. "Typically, a 5 pound bag of aquarium gravel would retail anywhere from \$2.99 up to \$3.99."

One last gravel point: The actual size for aquarium gravel *ranges from 3 to 6 mm. If we had 3 to 6 mm ruby, we would cut and polish it and set that in jewelry.*

However, the very small pieces of ruby (smaller than 3 mm) might possibly be considered for "aquarium sand" used in live plant tanks, says Dunahoo, but this would be for a very small percentage of the freshwater tank market.

Dunahoo does note that in large chunks, ruby rough could possibly be used as a decorative accent, just to make the tank look pretty. How appropriate! But never as fish tank gravel.


How To Identify Glass-Filled Ruby
See our feature story, "Glass Filled Ruby," in our Trade News archives.

BIG Problem - Price and Name!

Because it did ***not*** start out costing a lot of money, you would naturally think that the savings would be passed on to the consumer - or at least, that's the theory.

In reality, many retail buyers, sales clerks and consumers are unaware of what they have. They see the name "ruby" and think "historically sought after gemstone," and "traditionally color enhanced by heat - an accepted process." But this ruby is neither the quality that is sought after, nor has it been "traditionally" heated. And yet lead glass-filled ruby set in gold and diamond jewelry can be seen in jewelry department stores retail priced for thousands of dollars.

San Francisco Public Press
Log onto this link for a very telling story regarding Macy's department store and Glass-Filled Ruby: http://sfpublicpress.org/news/2010-07/macys-sells-rubies-filled-with-glass

Be Prepared

Ask questions and shop from an educated gem supplier and retail jeweler. Just because the FTC requires disclosure, does retail jeweler. Just because the FTC requires disclosure, does not mean that you will be given proper disclosure information. The person you are relying on may not know what they have or how to identify it. Once again, see our feature story, "Glass Filled Ruby," in our Trade News archives.

FTC - § 23.22 Disclosure of treatments to gemstones.

It is unfair or deceptive to fail to disclose that a gemstone has been treated if:

(a) the treatment is not permanent. The seller should disclose that the gemstone has been treated and that the treatment is or may not be permanent;

(b) the treatment creates special care requirements for the gemstone. The seller should disclose that the gemstone has been treated and has special care requirements. It is also recommended that the seller disclose the special care requirements to the purchaser;

(c) the treatment has a significant effect on the stone's value. The seller should disclose that the gemstone has been treated.

Note to § 23.22: The disclosures outlined in this section are applicable to sellers at every level of trade, as defined in § 23.0(b) of these Guides, and they may be made at the point of sale prior to sale; except that where a jewelry product can be purchased without personally viewing the product, (e.g., direct mail catalogs, online services, televised shopping programs) disclosure should be made in the solicitation for or description of the product.

Proper Disclosure is So Important

Prior to developing a treatment process specifically designed for this quality of corundum, the ruby in the ring above may have been crushed and screened to produce uniform grit and powder and then used for things such as creating sand paper, emery boards, and polishing or grinding wheels (and not fish tank gravel, *see above*). Because of its pretty red color, it could also have been used as an ornamental decorative material - but definitely not as a cut and polished gemstone in a ring - not without treatment.

Glass-filled ruby is the perfect example as to why the disclosure of gemstone treatments is required by the Federal Trade Commission (FTC) here in the United States. Therefore, people need to be told that "the ruby in the ring above has been treated." People also need to be told that "this treated ruby will need special handling when being worn and while ruby will need special handling when being worn and while being cleaned."

Unfortunately, it's not "required" but only "recommended" to tell people any more than "treated, and needs special care." And as we found out at the jewelry show, even with FTC regulations, proper disclosure is not always given freely.

New Ruby Disclosure Standards - GILC

Members of the Gemstone Industry & Laboratory Conference's (GILC) ruby committee reached consensus on accepting a disclosure for lead glass-filled ruby that reads "Composite-Ruby, Glass-Filled, Requires Special Care." The aim of this committee, formed during the recent GILC event held in Tucson, was to recommend disclosure language at the retail level that might not match the disclosure standard language required of gemstone traders. While the phrases "composite ruby" and "glass-filled" are properly utilized in disclosure language, the committee felt the phrase "special care required" should also be included for sales transactions.

A New Category of "Gem Material"

"What I would like to make (and keep) clear, is the use of the term 'Hybrid' as a stone category or classification, such as 'Hybrid Gemstone'," says Bear Williams of Stone Group Labs in Jefferson City, Mo. Gemstone identifctaion categories would include "Natural," "Synthetic," "Imitation," and now "Hybrid." "By creating its own "hybrid" gem category, we can now isolate it, and protect it from being called a "Natural" gemstone. This entire concept also solves the FTC problem."

The Problem With Disclosure is Non-Disclosure!

The discussions/arguments in the trade are not about disclosure, but how to disclose the treatment. Gemstone suppliers want to describe this treated ruby as best they can, without presenting it in a negative manner. We certainly do not want to discourage jewelry purchases. So words like "composite," "composition," "filled," "enhanced," "hybrid," etc... have all been bandied about. And to many, while these words are adequate, we are still questioning whether or not it tells the full story to the consumer. Does the consumer really know that by calling this material "composite ruby," "fissure filled ruby," or "ruby with glass," that it is actually held together by glass, that it is clarity enhanced, and color enhanced, and probably looked like #1 above before it was treated? Not likely.

And even with the additional descriptive paragraphs at the bottom of gemological reports detailing the material and the need for proper care and cleaning, the consumer reads past all of this and just sees the name "ruby." And many retailers do too.

What's worse than all of this? It's not that we are divided as to what to call this material. It's that many people are not disclosing anything!

According to the San Francisco Public Press, described in the feature story noted above, "none [of the Macy's sales staff] mentioned the possibility that the rubies may have had fractures filled with glass (as acknowledged by Macy's gem treatment chart linked from the company's website) or were glass-ruby composites."

"We can argue all night long about what to call it," states McClure. "But that doesn't matter, if people in the trade aren't disclosing it. What difference does it make what we want to call it if they aren't calling it anything?"

Part IV
"Is This A Glass-Filled or Composite Ruby?"

There's more to this story. As we mentioned above, the ruby that IS stable enough to cut and polished, like #2, is being heated to partially heal fissures. Because this proces is not perfect, it creates layers and pockets of silica glass residue. This treated ruby is not the same as the "glass-filled" treated ruby, but in the end, it does contain glass - a silica glass as opposed to a leaded glass.

Remember, the leaded glass enhances the clarity by masking the fissures, enhances the color, by mixing yellow glass with purple corundum, and enhances the durability by gluing everything together. The silica glass is what's left after attempting to heal the fissures in the ruby. The glass in this case only partially masks fissures that did not heal.

... to be continued.

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RGNR

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