NOTES · AND · NEW TECHNIQUES

A PRELIMINARY REPORT ON THE NEW LECHLEITNER SYNTHETIC RUBY AND SYNTHETIC BLUE SAPPHIRE

By Robert E. Kane

A new synthetic ruby and synthetic blue sapphire have been synthesized by Johann Lechleitner of Innsbruck, Austria. This article reports on the examination of one sample of each of these new synthetics and discusses means of identification. Although most of the gemological properties of these two synthetics overlap with those of their natural counterparts, they can be easily identified from natural corundum and from other synthetics by their distinctive internal characteristics: inclusions that are typical of both the flux-growth and the Verneuil processes.

Very recently, the author examined two new synthetic gem materials (synthetic ruby and synthetic blue sapphire) reported to have been produced by J. Lechleitner of Innsbruck, Austria. Lechleitner is well known for his commercial production (since 1959) of emerald substitutes that consist of a faceted colorless, or very lightly colored, natural beryl "seed" that is completely coated with a thin layer of synthetic emerald (Holmes and Crowningshield, 1960). Lechleitner has also produced emeralds that are completely synthetic.

The material examined in this study included one 0.47-ct round modified brilliant cut synthetic ruby and one 0.69-ct round modified brilliant cut synthetic blue sapphire (see figure 1). Although the two samples examined and discussed here were not obtained directly from J. Lechleitner, he confirmed that he has been growing synthetic ruby and synthetic blue sapphire since late 1983 (J. Lechleitner, pers. comm., 1985). Lechleitner also

Figure 1. Faceted Lechleitner synthetic ruby (0.47 ct) and synthetic blue sapphire (0.69 ct). Photo ©Tino Hammid.

reported that all of the synthetic ruby and synthetic blue sapphire that he has produced to date has been turned over to H. Bank of Idar-Oberstein. Professor Bank (pers. comm., 1985) has stated that Mr. Lechleitner has produced corundum in the following colors: blue, red, "padparadscha," colorless, "alexandrite-color," yellow, green, and pink. According to Professor Bank, the production is "more or less experimental." He did note, however, that a few stones have been sold in Japan, which is where the stones examined by the author were obtained.

The intent of this article is to inform the gemological community of the existence of this new synthetic ruby and synthetic blue sapphire and to provide the gemological properties of these new synthetics, based on the examination of the two above-mentioned samples, as well as indicate means to identify them from their natural counterparts.

GEMOLOGICAL CHARACTERISTICS

The faceted Lechleitner synthetic ruby and synthetic blue sapphire were first examined for color, transparency, and clarity. With regard to color, the Lechleitner synthetic ruby studied is purplish red in hue, with medium tone and strong saturation. The Lechleitner synthetic sapphire examined is blue in hue, with medium tone and moderately strong saturation.

Both synthetics are transparent with areas that appear to be hazy. When judged with the unaided eye, both synthetics also appear to be relatively free of inclusions; when examined with magnification, however, numerous flux inclusions become readily apparent, which accounts for the haziness.

Also examined was the direction of optic axis orientation. In the synthetic ruby, the optic axis is oriented nearly parallel to the table. In the synthetic blue sapphire, the optic axis is oriented about 20°–30° from the plane parallel to the table.

The other gemological characteristics (refractive index, pleochroism, luminescent reactions when exposed to long-wave and short-wave ultraviolet radiation as well as X-rays, absorption spectra as viewed through a hand-held type spectroscope, and specific gravity) of the Lechleitner synthetic ruby and synthetic blue sapphire were obtained using routine gemological methods. These characteristics are summarized in table 1;

TABLE I. The gemological properties of Lechleitner synthetic ruby and synthetic blue sapphire.[a]

Material tested	R.I. and biref.	Pleochroism	Luminescence: Long-wave ultraviolet radiation	Luminescence: Short-wave ultraviolet radiation	Luminescence: X-rays	Absorption spectrum[b] (400 nm–700 nm)	S.G.[c]	Inclusions
Lechleitner synthetic ruby	ϵ = 1.760 ω = 1.768 0.008	Strong purple-red parallel to the c-axis; pale orangy pink perpendicular to the c-axis	Strong red; no phosphorescence	Moderate red, with slightly chalky white overtone; no phosphorescence	Moderate chalky red; no phosphorescence	Absorption lines at 475.0, 476.5, 468.5, 659.2, 668.0, 692.8, and 694.2 nm; broad absorption blocking out all of the violet and some of the blue, all of the green and yellow, and a small area in the orange portion of the visible spectrum	4.00 ±0.03	Flux "fingerprints" and wispy veils that range from nearly transparent to opaque and from near-colorless to white; as well as from thin, minute, tightly arranged patterns to loosely arranged, flat, mesh-like patterns; very low to moderate relief; curved striae
Lechleitner synthetic blue sapphire	ϵ = 1.760 ω = 1.768 0.008	Strong violetish blue parallel to the c-axis; pale greenish gray-blue perpendicular to the c-axis	Inert; no phosphorescence	Very weak chalky whitish blue; no phosphorescence	Very weak, opaque chalky white; no phosphorescence	No visible lines or bands; broad absorption of moderate intensity in a portion of the violet and far red area of the visible spectrum	4.00 ±0.03	Same as for the synthetic ruby but in greater amounts; moderate to high relief; curved color banding

[a]*These properties were obtained by testing one faceted sample of each synthetic.*
[b]*The visible-light absorption spectrum as observed through a "hand-held" type of gemological spectroscope unit.*
[c]*Specific gravity was estimated using heavy liquids and indicator stones of known specific gravity.*

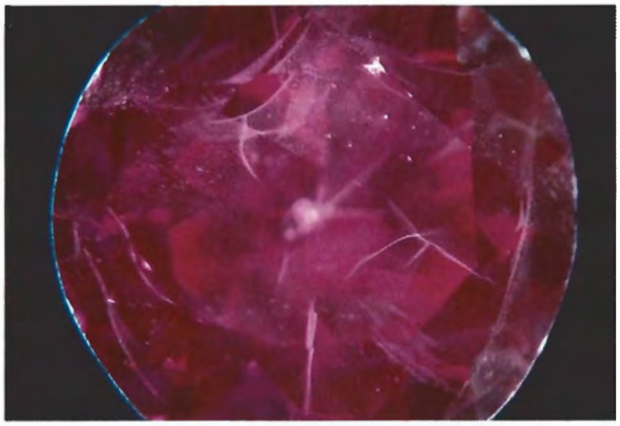

Figure 2. Numerous white, wispy veils, very fine to moderate in texture, reduce the transparency of this Lechleitner synthetic ruby. Dark-field illumination, magnified 20×.

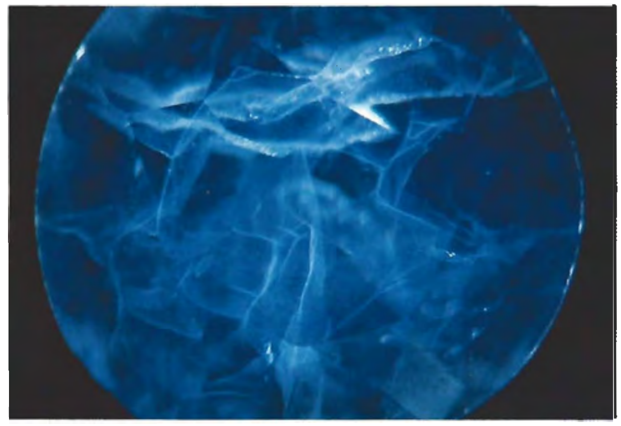

Figure 3. Low magnification is all that is required to reveal the dense concentrations of flux, in the form of wispy veils, that betray the synthetic origin of this Lechleitner synthetic blue sapphire. Dark-field illumination, magnified 15×.

all except the internal characteristics overlap to some extent with their natural counterparts.

IDENTIFICATION

Because of the overlap in most gemological characteristics between the two Lechleitner synthetics and natural corundum, an extensive microscopic examination of the two samples was undertaken. It was determined that the inclusions would provide the most effective means of identification; in fact, there are several easily recognizable inclusions that are diagnostic of synthesis.

Flux. As both the synthetic ruby and the synthetic blue sapphire are examined with low magnification through the table and crown facets, flux in the form of wispy veils and "fingerprints" is readily apparent (figures 2 and 3). In the synthetic ruby, the flux veils range from nearly transparent to opaque and from near-colorless to white in very low to moderate relief. The flux "fingerprints" and veils range from thin, minute, tightly arranged patterns to more loosely arranged mesh-like patterns, both of which frequently intersect (again, see figure 3). At the edges of a few of the flux "fingerprints" or veils are thicker, long channels or voids that are filled or partially filled with flux. This type of inclusion is commonly observed in many flux-grown synthetics and forms when the molten flux is trapped within the rapidly growing crystal and crystallizes or partially crystallizes as the synthetic crystal cools. In the Lechleitner synthetic ruby, a nearly opaque, frosted, white appearance has resulted at the edges of the channels. Some of these small inclusions also exhibit a two-phase-like appearance; however, as with similar-appearing features observed in some Kashan and Ramaura synthetic rubies, these inclusions are probably not truly two-phase but, rather, are completely solid in nature (Kane, 1983).

The Lechleitner synthetic blue sapphire contains flux "fingerprints" and wispy veils that are similar in many respects to those observed in the Lechleitner synthetic ruby. The most notable differences are the larger quantity and higher relief of these flux inclusions (again, see figure 3). As shown in figure 4, one of the "fingerprints" is very similar to those observed in some Chatham flux-grown synthetic blue sapphires (Kane, 1982; Gübelin, 1983).

Curved Growth Features. Easily visible in several portions of the Lechleitner synthetic ruby are curved growth features, also referred to as curved

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Figure 4. Flux ranging from semitransparent to opaque and from near-colorless to white occurs in wide, mesh-like patterns intersected by thin, tightly arranged white "fingerprints" in a Lechleitner synthetic blue sapphire. Dark-field illumination, magnified 35×.

striae, a commonly encountered inclusion by-product of the Verneuil method of growing synthetic crystals and sometimes observed in rubies grown by the Czochralski pulling method.

The Lechleitner synthetic blue sapphire also contains curved growth features. Although not as readily apparent as in the synthetic ruby, the curved color banding in the synthetic blue sapphire is faintly visible with high magnification (approximately 40×) and diffused illumination.

METHOD OF SYNTHESIS

The characteristic appearance of the flux inclusions in the two Lechleitner synthetics indicates that this material was at least partially manufactured in a flux-growth environment. On the basis of his own investigations and discussions with crystal growers, the author has developed two theories to explain the presence of both curved growth features and various forms of flux-type inclusions in a single stone:

1. A small Verneuil seed crystal could have been placed in the flux growth chamber (crucible), with the intended purpose of starting and/or controlling the size and direction of the flux growth. The curved growth features observed in the two synthetic stones studied could be in the actual Verneuil seed crystal, which was not removed during cutting and thus became part of the faceted synthetic gemstone.
2. A larger Verneuil synthetic corundum (colorless or doped with added impurities to produce ruby or blue sapphire) could have been placed in a flux-growth environment for a sufficient length of time to enable flux-grown corundum to completely encase the Verneuil synthetic, while also inducing flux inclusions within the Verneuil material.

Both of these methods have been applied to synthetic ruby growth in the past, in experiments conducted by Chatham Created Gems of San Francisco, California (Thomas Chatham, pers. comm., 1981). Figure 5 shows examples of synthetic ruby grown by Chatham several years ago using the latter of the above-mentioned growth techniques. A slightly different experiment involving a highly fractured Verneuil synthetic ruby placed in a flux-growth environment for 42 days was recently conducted (Koivula, 1983). Although it was difficult to determine whether or not the curved features extended completely throughout the Lechleitner synthetic sapphire and synthetic ruby (in both stones they were only visible through the pavilion), there was no discernible division between the Verneuil portion and the flux portion of these synthetics; the flux appeared to have been induced into the Verneuil material. Such a division was observed in the experimental Chatham synthetic rubies.

Professor Bank (1983 and pers. comm., 1985) has confirmed that Lechleitner is producing several different combinations of synthetic overgrowth, including synthetic pink corundum over synthetic Verneuil colorless corundum, synthetic ruby over synthetic Verneuil ruby, and synthetic ruby over natural corundum. It is important to note that the process used to manufacture the Lechleitner synthetic corundums examined for this study is completely different from that used by Lechleitner to produce his synthetic emerald overgrowth. Neither the synthetic ruby nor the synthetic blue sapphire showed any of the characteristics that are typically associated with the Lechleitner imitation emerald, such as the "stress" cracks at the interface of the synthetic overgrowth and the natural emerald seed.

CONCLUSION

The Lechleitner synthetic ruby and synthetic blue sapphire appear to represent a new method of syn-

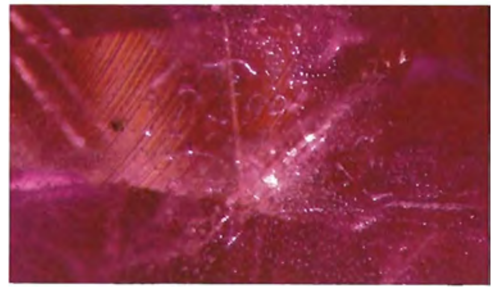

Figure 5. Synthetic ruby crystals grown by Chatham, Inc., using a technique by which Verneuil synthetic rubies are placed in a flux-growth environment. Like the Lechleitner synthetics, these crystals contain both curved striae and flux. Photo on left ©Tino Hammid; photomicrograph, dark-field illumination, magnified 40×.

thesis that thus far has not been widely available commercially. As with essentially all other synthetic corundum, the gemological properties of the Lechleitner synthetic ruby and synthetic blue sapphire examined in this study overlap to some extent with those of their natural counterparts, with the exception of inclusions. Various forms of white flux ("fingerprints" and wispy veils) and curved growth features were observed in the two samples examined, and provide a definitive means of identification.

It is very unlikely that a synthetic grown by this method would be devoid of inclusions. It is possible, however, that a synthetic stone of this manufacture could be cut from the exterior of the synthetic crystal so that it would contain only flux inclusions, and thus be devoid of curved growth features. This report is based only on one Lechleitner synthetic ruby and synthetic blue sapphire; it is probable that when more material is examined in the future, a wider variety of characteristics will be present. However, if the gemologist is aware of these new synthetics and their characteristic inclusions, and uses careful microscopic examination, these materials should be readily identified.

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