NEW SYNTHETIC RUBIES MADE BY PROFESSOR P. O. KNISCHKA

By E. J. Gübelin

A new synthetic ruby, developed by Professor P. O. Knischka using a method of gradient technique (not yet disclosed) through supercooling and saturation, has distinct crystallographic and gemological characteristics. Particularly notable are the great number of faces on the finished crystals and the identifying inclusions.

Professor Paul Otto Knischka, an Austrian engineer, has been successfully producing synthetic rubies by a new method that he invented. This material is distinctive from other synthetic rubies in various features such as crystal forms, optical properties, and inclusions.

Although it is known that these new synthetic rubies are grown from a melt, Professor Knischka thus far has revealed only that they are crystallized synthetically by an as yet undisclosed method of gradient technique through supercooling and supersaturation. The finished crystals (figure 1) display flat brilliant growth faces with mineralogically significant indices. The great number of faces has heretofore not been observed. In addition, the elementary nuclei can be grown to macroscopic mono-crystals, twins, or multiple complexes, as well as clusters.

The crystallographic and gemological characteristics discussed below were determined by careful study by the author in his private laboratory, and through consultation with Professor Knischka. The reader is referred to a prior publication (Knischka and Gübelin, 1980) for information on the other properties of this material. The product, which is not yet commercially available, will eventually be marketed under the trademark ꟼK (Paul Knischka's initials with the "P" inverted).

Figure 1. "Knischka" synthetic ruby crystal cluster, 10 mm.

CRYSTALLOGRAPHY

One of the most interesting features of these new synthetic rubies is the pseudocubic habit that some of the crystals adopt, although not all exhibit an isometric habit. Those that do normally show six forms: c (0001), r $(10\bar{1}1)$, • $(10\bar{1}9)$, d $(01\bar{1}2)$, γ $(01\bar{1}5)$, and n $(22\bar{4}3)$, repeated several times.

These are forms that also occur in natural corundum, yet natural ruby seldom possesses more than 20 faces, whereas these new rubies by Professor Knischka develop a great number of crystal faces, some of which are extremely rare. In more recent productions the number of faces reached 38 (figure 2) and even 42 on one mono-crystal.

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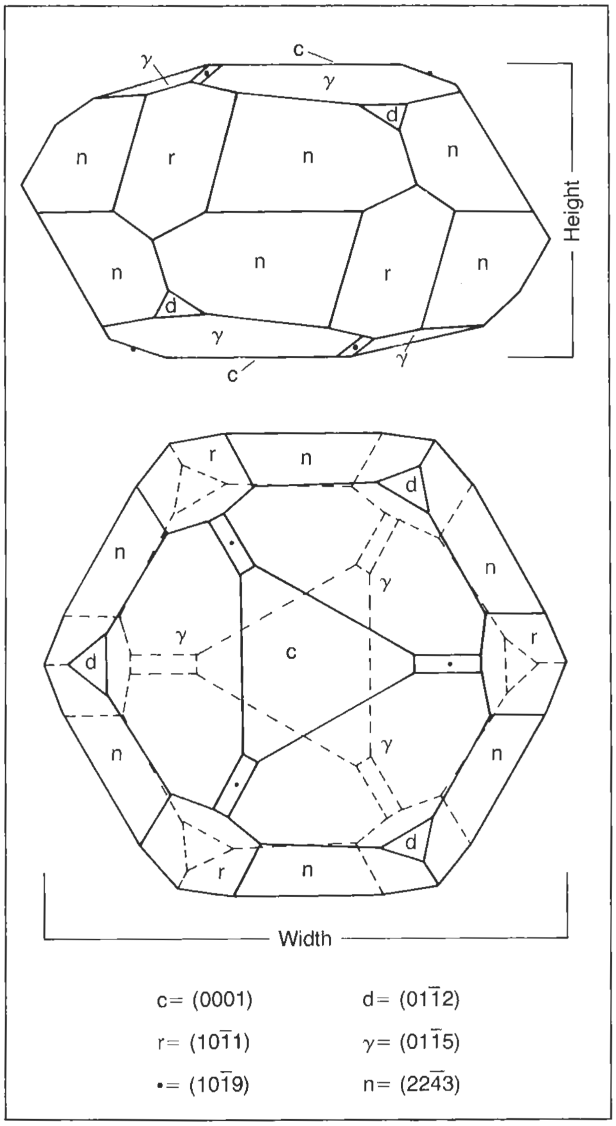

Figure 2. Isometric synthetic ruby by Professor Knischka, with 38 faces. H/W quotient = 0.47. Top = lateral view; bottom = overhead view.

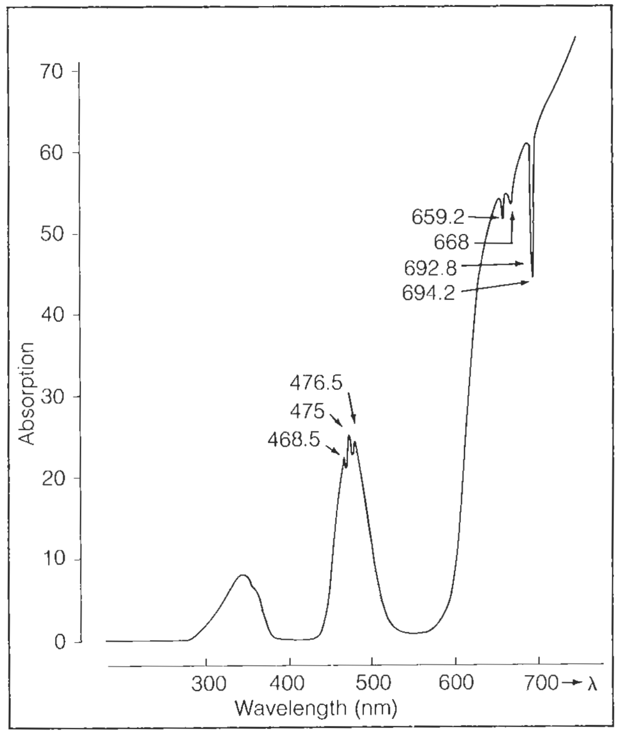

Figure 3. Absorption spectrum (200–800 nm) of a "Knischka" synthetic ruby.

GEMOLOGICAL CHARACTERISTICS

The new synthetic rubies call for increased care on the part of the gemologist. In order to gain a proper account of this significance, a thorough examination was carried out with several cuttable crystals whose smooth crystal faces allowed comprehensive gemological tests, as well as with some cut samples.

Appearance. It is as difficult to see a difference in the appearance of this stone compared to natural ruby from various locations as it is to see a difference compared to synthetic rubies grown by other methods. The difference is greatest at first sight between these and Burma rubies, whose luxurious pigeon-blood red was not duplicated in the "Knischka" synthetic product examined. The red color of Professor Knischka's synthetic ruby shows a clear violet tinge, and the best material varies on the color samples of the DIN color chart 6164 from 10:7:3 for the redder to 10,5:6,5:4 for the violet-tinged samples.

Spectrophotometric Examinations. The spectral curve for this material, illustrated in figure 3, corresponds in all stages with the normal and familiar curve of natural as well as synthetic rubies between 400 and 750 nm. However, the particular character of the maximum transmission between 250 and 400 nm is indicative that the examined ruby was synthetic.

The observed color range also corresponds to the absorption spectrum observed in the optical spectroscope, which embraces all the transmission maxima known for ruby in the blue and red regions, together with accompanying chromium lines at 659.2, 668.0, 692.8, and 694.2 nm as well as the absorption maxima at 550 and 410 and from 270 nm downwards (again, see figure 3).

A third transmission maximum at the shortwave end of this graph, at 345 nm, is rare with

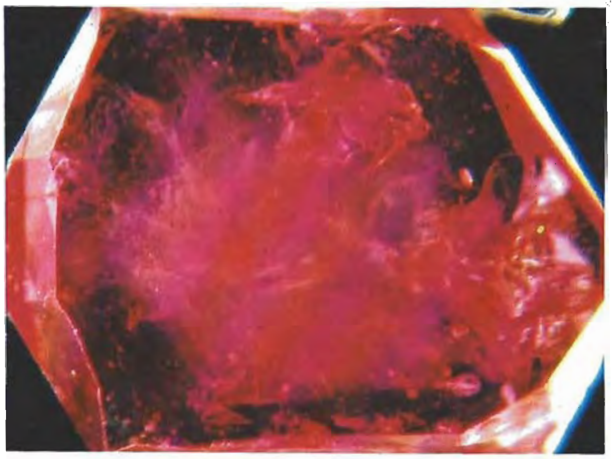

Figure 4. Integral picture of the interior of a cut synthetic K ruby with cloudy veils. Magnified 10×.

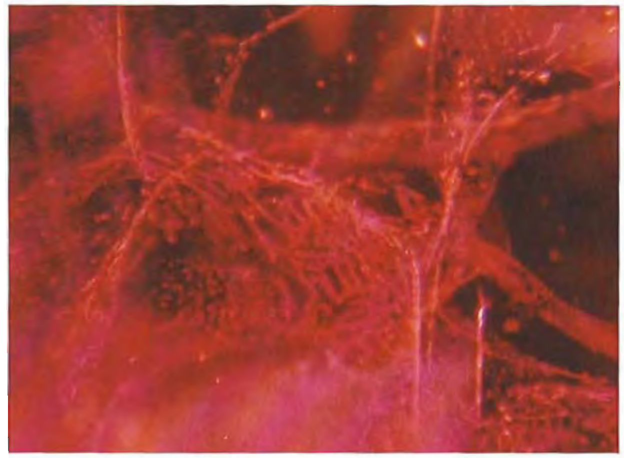

Figure 5. Net-like moisture-banners (healing fissures) which are usually discernible from similar inclusions in natural ruby by their typical pattern. Magnified 25×.

natural rubies but common with synthetic rubies. It would, however, be inadvisable to rely completely on this transmission maximum in the ultraviolet region.

Dichroism. This property is very strongly defined, with the twin colors purple-red and orange-red, but it does not help differentiate this synthetic from natural ruby.

Luminescence. When exposed to short- and long-wave ultraviolet radiation as well as to X-radiation and the "crossed filter" method applied for tests of the property, the "Knischka" synthetic rubies glowed clearly to strongly carmine red. After exposure to X-rays, a weak afterglow of phosphorescence was observed, lasting about seven seconds. This might help differentiate the stone from natural ruby, and is a consequence of the fact that natural ruby contains more iron than its synthetic counterparts.

Refraction and Double-Refraction. Neither the refractive indices nor the birefringence of this synthetic show diagnostically important values or anomalies; that is, they show exactly the same constants as are known for natural ruby: $n_\epsilon = 1.760 - 1.761$, $n_\omega = 1.768 - 1.769$, $n_\epsilon - n_\omega = -0.008$.

Specific Gravity. The synthetic material shows minor variations in density between 3.971 and 3.981, and can be stated as having an average value of 3.976 ± 0.001 g/cm^3.

Inclusions. To the unaided eye, there is nothing to be seen inside the material that might give definite and immediate proof of synthesis. Yet the interiors of several samples showed a broad, phantom-like cloud that varied in size from one sample to the next and was reminiscent of the dust-like clouds in Burmese rubies (figure 4). Viewed with a pocket lens—or, even better, under the microscope—the inclusion scene is revealed in considerable detail, with swirls of color, liquid feathers, negative crystals, black platelets, and two-phase inclusions.

The nature of the turbid clouds could not be determined even with the strongest magnification. The liquid feathers, with their irregular course and net-like pattern (figure 5) are remarkably similar to those in the synthetic rubies by Chatham and are sometimes difficult to distinguish from the fluid inclusions in natural ruby. The negative crystals (figure 6) unmistakably follow the characteristic crystal habit of rubies grown by this method. They perch, usually alone or in small groups, on the ends of long crystalline tubes, and they can be considered identifying features.

Equally characteristic are the small, distorted, hexagonal platelets of platinum or silver that can be observed now and then in synthetic stones but are never seen in natural gemstones. However, the manufacturer of the "Knischka" product states that he can now repress the formation of such platelets during the growth process.

The comparatively large gas bubbles, already visible under low magnification, prove under higher magnification to be the gaseous part of two-phase inclusions, whose contours within the ruby are astonishingly fine, almost to the point of invisibility (figures 7 and 8). These inclusions,

Figure 6. These negative crystals follow the trigonal-dipyramidal habit of the host crystal, terminating crystalline rods. Magnified 25×.

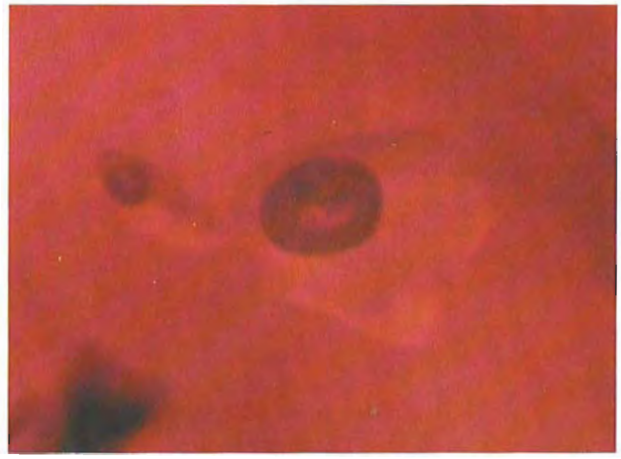

Figure 7. Two-phase inclusion with a large bubble and barely visible form. With a pocket lens or other weak magnification, one would see only the gas bubble. Magnified 64×.

which sometimes appear as negative crystals and sometimes as irregular shapes, must contain a highly refractive substance, the chemical properties of which could only be determined by mass spectroscopy or by the manufacturer's disclosure of the process he has developed. This knowledge, though, is of little importance in the recognition of these synthetic rubies or in their distinction from either natural or other synthetic rubies. However, the distinctive two-phase inclusions in the interior scene of these synthetic rubies are a novelty and can be regarded as an identifying characteristic of Professor Knischka's synthetic rubies.

Although the inclusion assemblage of the synthetic rubies is similar to the internal world of natural rubies, particularly those from Burma, under strong magnification it differs very clearly from that of its natural counterpart. In the same way, these synthetic rubies differ from all other synthetic rubies in the exemplary singularity of their inclusions, and therein lies the challenge to greater care and attention mentioned above.

SUMMARY AND OUTLOOK

These synthetic rubies were grown according to a method as yet undisclosed. Nevertheless, they have characteristics that closely correspond to those of natural rubies as opposed to the curved layers of inclusions seen in synthetic Verneuil rubies influenced by the boule. Only by careful documentation of all the properties and meticulous attention to the detailed characters of the inclusions can one hope to ascertain the synthetic origin of this new product.

Figure 8. Complex underlaying of several two-phase inclusions with large gas bubbles and partly crystalline forms. Magnified 64×.

REFERENCE

Knischka P.O., Gübelin E. (1980) Synthetische Rubine mit Edelsteinqualität, isometrischem Habitus und hoher Zahl unbeschädigter Kristallflächen. *Zeitschrift der Deutschen Gemmologischen Gesellschaft,* Vol. 29, No. 3/4, pp. 155–186.