Update on Moissanite Identification

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Introduction

Synthetic moissanite first appeared on the gemmological scene in 1996, but has only been available in a limited way from C3 Inc (Nassau et al, 1997). Because its thermal conductivity overlaps that of diamond, this new diamond simulant cannot be distinguished from diamond with a thermal conductivity probe, a feature of major importance in gem testing. An extended study of synthetic moissanite was presented in 1997 by Nassau et al. Since then, much information has been available on the Internet, mainly at: "www.moissanite.com".

The major gemmological properties of synthetic moissanite are indicated below: It has a specific gravity of 3.21 and a brownish-grey to greenish hue (figure 1). When observed with a gemmological binocular microscope, inclusions consisting of thin parallel tubes (figure 2) can be seen. Its high double refraction of 0.043 (Arem, 1997) in conjunction with a table facet, usually cut perpendicular to the axis, means that one can see a doubling of facet edges when looking obliquely through facets near the girdle.

Nevertheless, the present article describes two properties of synthetic moissanlte not described before: reflecting power and x-ray transparency. In some cases, these properties might help to distinguish synthetic moissanite from diamond.

About Synthetic Moissanite

Moissanite is composed of silicon and carbon (SiC) and exists in several polymorphs (e.g. hexagonal and trigonal-Fleischer, 1995). The isotropic form of transparent synthetic moissanite is always yellow (Nassau, GIA Symposium 1999). Moissanite occurs naturally only as tiny dark crystals in meteorites, in Siberian kimberlite, and in a volcanic breccia from Bohemia (Strunz, 1978).

Before it appeared as a colourless diamond substitute, synthetic moissanite was known as "carborundum" (Fleischer, 1995). Silicon carbide is another name for synthetic moissanite, which usually forms black or green platy crystals. Its high hardness (H = 9 1/4 on the Mohs scale) is useful in powder form as an abrasive material (Arem, 1987).

To commercialise colourless synthetic moissanite as a diamond imitation, C3 Inc has named this synthetic stone: Lab-Created Moissanite Gemstones™. However, in accordance with CIBJO rules (International Confederation of Jewellery, Silverware, Diamonds, Pearls and Stones), applying this gemstone term to synthetic moissanite is prohibited since it is not a natural material (CIBJO, 1999-Gemstone Book Art. 8). The CIBJO book also indicates that it should only be called "Synthetic Moissanite" (CIBJO, 1997-Gemstone Book, Art. 10).

About Reflectivity of Synthetic Moissanite

The reflecting power of a single crystal is measured by the ratio of reflected to incident light intensity (see Read, 1990). When the surrounding medium is air, a transparent gemstone's value (R) is calculated by the simplified Fresnel equation: $R=(n-1)^2/(n+1)^2$.

At 589nm, the moissanite's ordinary refractive index (R.I.) (No) is: 2.65 and its extraordinary R.I. (Ne) is 2.69 (Arem, 1987). Thus at this wavelength, the theoretical reflecting power of synthetic moissanite lies between 0.20 and 0.21.

Most reflectivity meters measure the reflective power of gemstones by means of a near-infrared beam (wavelength around 760nm; Roger Harding, personal communication), thus the previous calculation has to be compensated for by a factor which takes the dispersion of synthetic moissanite into consideration.

Using a reflectivity meter and a beam with a wavelength around 760nm (when the value of the reflecting power of diamond is arbitrarily calibrated at 100), the measured reflectivity of synthetic moissanite lies between 116 and 119. These values are quite different from those of diamond (100) and thus one might consider that when a gemstone is well-polished and big enough to be checked with a reflectivity meter the distinction between synthetic moissanite and diamond will be easily made. This is theoretically true, but since the beginning of 1999, C3 Inc has published warnings and explained that a treatment may change the R.I. and thus the reflecting power of synthetic moissanites. In this case, the reflecting power of synthetic moissanite might overlap that of diamond.

In June 1999, the author had the opportunity to measure the reflecting power of three of the treated synthetic moissanites kindly provided by C3 Inc. The values of the reflecting power of these three samples lay in a very wide range, from 50 to 85 on a reflectivity meter, calibrated at 85 for diamond. The author does not know the wavelength of the reflectivity meter used by C3 Inc but the results show that the treatment has widely modified the reflecting power of synthetic moissanite. Jeff Hunter (President of C3 Inc) claimed that it was not the intention of C3 Inc to modify the reflecting power of synthetic moissanite, but only to show that the treatment affects the tests made by means of reflectivity meters.

The treatment is a simple heating process whereby a thin layer of synthetic moissanite (SiC) is transformed into SiO_2, greatly reducing the reflecting power of synthetic moissanite.

How to Quickly Identify Synthetic Moissanite When Mixed with Diamonds

SSEF has set up a test to quickly separate synthetic moissanite from diamonds. The transparency to x-rays of four synthetic moissanites was compared to that of three diamonds. The voltage and the current of the x-ray beam were adjusted to 50 kv and to 5 mA, respectively.

Because of the difference in the atomic weights of their respective chemical elements, diamond and synthetic moissanite show different transparencies to x-rays (figure 3). While diamonds are perfectly transparent and virtually disappear when observed, all synthetic moissanites absorb x-rays and thus during the observation one may see a greyish shadow. Since this test is facilitated by the use of a phosphorescent screen, it is probably the easiest one to perform in a gem laboratory, especially if one needs to ensure that no diamond simulant has been mixed with loose diamonds or on the pavé setting of a piece of jewellery.

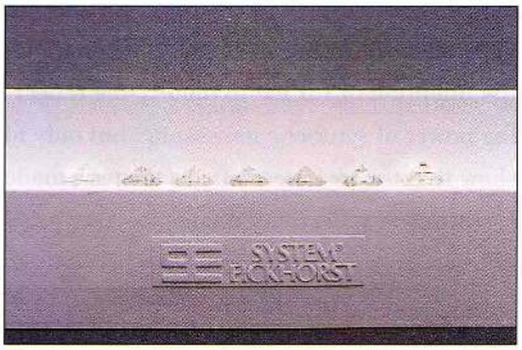

Figure 1. The colours of five synthetic moissanites are compared with two diamond master stones. Transparent synthetic moissanites exhibit either a brownish-grey or a greenish hue. ©SSEF Swiss Gemmological Institute.

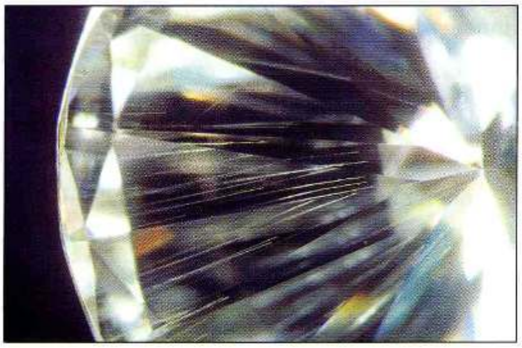

Figure 2. Typical inclusions of synthetic moissanite. These thin parallel tubes are perpendicular to the table because they follow the direction of the optic c-axis and the table of synthetic moissanite is usually cut perpendicular to this axis. ©SSEF Swiss Gemmological Institute

Conclusion

The identification of synthetic moissanite depends on the situation in which the stone is encountered. Whether the stone is set in jewellery or is loose, whether it is well-polished or very small, whether it is by itself or to be sorted out of a lot, the means of identification will change as well as various instruments to be used. From a Leveridge gauge to an x-ray cabinet, each instrument may help in various situations.

Since synthetic moissanite has been on the gem market, two new and different instruments have been offered to gemmologists: Tester Model 590 and Moisketeer. This situation recalls the arrival of the first artificial cubic zirconium oxides (CZ) on the gem market in 1978. CZ was produced by the Ceres Corporation of America and at the time, the same company marketed a new instrument to distinguish CZ from diamond: a thermal conductivity probe (Webster, 1983).

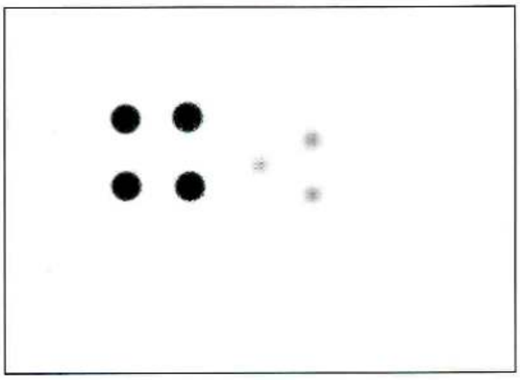

Figure 3. Comparison of the x-ray transparencies of three diamonds and four synthetic moissanites. The x-ray radiographs of three diamonds appear to be grey, indicating some transmission of x-rays, while the four synthetic moissanites are absolutely black, indicating absorption. The transparency to x-rays of synthetic moissanites is an easy test to perform to ensure that synthetic moissanite has not been mixed with diamonds. ©SSEF Swiss Gemmological Institute

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