

# What are Synthetic Diamonds? *Kaylan Khourie, FGA*

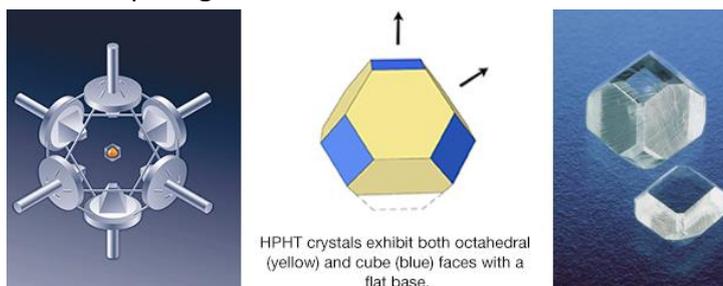
*The author of this article is a FGA qualified gemmologist and laboratory gemmologist at EGL South Africa. This article aims at aiding those in the diamond and jewellery industry with regards to synthetic diamonds.*

A diamond is a mineral made up of essentially crystallized carbon. They occur naturally and can be grown in a laboratory using two methods: High Pressure High Temperature (HPHT) and Chemical Vapour Deposition (CVD). Both methods imitate the environment within which natural diamonds grow, in order to grow diamond onto a seed plate (made of a thin slice of diamond - either natural or synthetic).

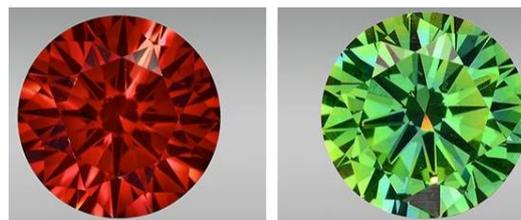
## HPHT-grown Diamonds

HPHT synthetic diamonds are grown by applying high temperature and high pressure to a chamber containing pure carbon powder that gets dissolved in a molten metal flux mixture. As the mixture cools down, the carbon crystallises onto a seed plate within the chamber and the synthetic diamond begins to grow (*Shigley, 2016 - Identifying Lab-Grown Diamonds*).

HPHT synthetic diamonds can be grown as a vivid yellow colour (caused by nitrogen), but by adding 'nitrogen-getters' into the chamber during growth, colourless diamonds can be created. By adding boron during the growth process, a blue colour can be created. Any colour can be produced by subjecting the stones to post-growth treatments that alter the atomic structure of the stone (*Wang et al, 2014*).



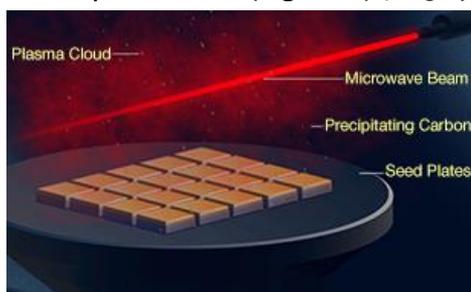
**Figure 1:** Basic diagram of the HPHT synthesis method, crystal form and rough. *Shigley, 2016 - Identifying Lab-Grown Diamonds*



**Figure 2:** Two HPHT synthetic diamonds that have undergone post-growth colour-treatment. *Zhou & Johnson, 2016 - Treated Red and Green*

## CVD-grown Diamonds

The most common CVD synthetic growth method involves diamonds being grown inside a vacuum chamber at a very low pressure. Within this chamber, methane (a carbon and hydrogen gas) is irradiated by microwaves that form a plasma cloud around seed plates. These seed plates are on top of a platinum base that gets heated up to a very high temperature. During this process, carbon is separated from the gas and deposited onto the seed plates and the diamond is grown. CVD synthetic diamonds are usually grown as a brownish or greyish colour (Figure 3) and are often treated afterwards in order to reduce the overtone of colour (Figure 4). The diamond may be subjected to different post-growth treatments to create a wide variety of colours (Figure 5) (*Shigley, 2016 - Identifying Lab-Grown Diamonds*).



**Figure 3:** Basic illustration of the CVD synthesis method and rough specimens with polycrystalline diamond around the edges. *Shigley, 2016 - Identifying Lab-Grown Diamonds*



**Figure 4:** A CVD synthetic diamond sample before (left) and after (right) treatment. *Martineau et al, 2004*



**Figure 5:** A CVD synthetic diamond that has undergone a multistep treatment process to create a Purple-Pink colour. *Photo by Author*

## Terminology

- The following terms are acceptable to refer to diamonds that are grown in a laboratory: “Synthetic”, “Laboratory-grown”, “Man-made” or “Laboratory-created”.
- The following terms are not acceptable to refer to diamonds that are grown in a laboratory: “Cultured”, “Eco-friendly” or “*Manufacturer name*-diamond”.
- A “simulant” is a gemstone that imitates diamond but does not have the same chemical, physical or optical properties – for example cubic zirconia, YAG and synthetic moissanite.

Full disclosure that a diamond is laboratory-grown is extremely important to ensure consumer confidence.

## Common misconceptions regarding synthetic diamonds

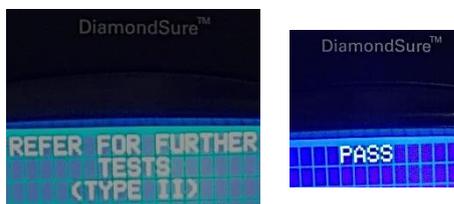
Common misconception	Correction
<b>“Synthetic diamonds are not real”</b>	Synthetic diamonds have the same physical, chemical and optical properties as natural diamonds; its durability, brilliance and lustre is superior to the common simulants of a diamond. Synthetic diamonds are real diamonds; they have just been grown in a laboratory instead of being grown by natural processes.
<b>“Diamond testers can separate natural and synthetic diamonds”</b>	Diamond testers use thermal and electrical conductivity to separate a diamond from its simulants. Because synthetic diamonds have the same physical properties as natural diamonds, they have the same thermal and electrical conductivity levels as natural diamonds; therefore, a diamond tester cannot separate a natural from a synthetic diamond.
<b>“Scratch pens can be used to detect synthetic diamonds”</b>	Scratch pens are made with (usually) a synthetic corundum tip – with a Mohs hardness of 9. The scratch pen cannot scratch a diamond as diamonds have a Mohs hardness of 10 – the pen can only scratch stones with a hardness of 9 or less. Because synthetic diamonds have the same hardness as natural diamonds, a scratch test cannot separate the two.
<b>“Polished synthetic diamonds are not commercially available larger than 1 carat”</b>	Synthetic diamonds come in sizes from melee up until very large sizes. At the time of writing, the largest grown gem-quality HPHT synthetic diamond reported is a 15.32ct cushion-shaped diamond (Magaña & Ardon, 2018) and the largest grown gem-quality CVD synthetic diamond reported is a 9.04ct round diamond (WD Lab Grown Diamonds, 2018).
<b>“Synthetic diamonds are only created in the colourless range”</b>	Synthetic diamonds can be grown in various colours. The colours that cannot be achieved by the growth process can be done so by post-growth treatments (such as irradiation, annealing, HPHT treatment, LPHT treatment or a combination of these treatments.) – See Figure 2.
<b>“Synthetic diamonds only have faceted girdles and cannot have ‘naturals’”</b>	‘False naturals’ can be carved onto the girdles of synthetic diamonds and they can also be cut to leave a small part of the synthetic rough skin on the girdle that can imitate the look of ‘naturals’ found on naturally grown diamonds. Synthetic diamonds can be found with bruted, faceted or polished girdles.

**Figure 6:** A ‘False natural’ on a bruted girdle of a synthetic diamond. *Photo by author*



## Indications that your diamond could be synthetic

Having access to a 'screening device' can be very useful for indicating whether your diamond may be synthetic. Screening devices use various methods to either 'pass' or a 'refer' a stone. 'Pass' means that the stone is a natural diamond, whereas 'refer' means that the stone could possibly be a synthetic diamond (or even a simulant) and needs further testing by a gemmological laboratory to determine the stone's growth origin.



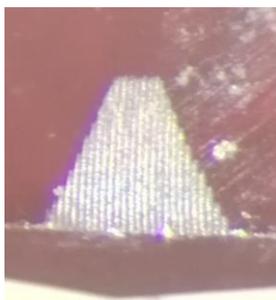
**Figure 7:** The De Beers DiamondSure 'passing' (right) and 'referring' (left) two diamonds.  
Photo by author

Some synthetic diamond producers laser inscribe "Laboratory Grown" or similar onto the girdles of their diamonds. Therefore, it is always wise to check the girdles of your diamonds.

**Figure 8:** A "Laboratory Grown" laser inscription on a synthetic diamond.  
Photo by author



When CVD synthetic diamonds are grown they often have black *polycrystalline diamond* around the edges of the rough (see Figure 3). In order to maximise the potential yield from the rough, synthetic diamond producers will often laser-core the diamond out of the rough in order to remove the *polycrystalline diamond*. The laser-coring can sometimes leave 'laser grooves' on or below the girdle.



**Figure 9:** 'Laser grooves' below the girdle of a CVD synthetic diamond. Photo by author

When HPHT synthetic diamonds are grown, diamond powder is dissolved in a molten metal flux mixture – sometimes this process leaves metallic flux inclusions (Figure 11) inside the grown diamond. If these flux inclusions are abundant enough it can cause the diamond to be attracted to a strong magnet (Figure 10).

Some colourless HPHT synthetic diamonds exhibit prolonged phosphorescence (when the diamond still emits light after the UV exposure has been removed) after exposure to short wave UV light (most jewellers and dealers use long wave UV light to observe fluorescence).



**Figure 10:** HPHT synthetic diamond attracted to a strong magnet. Photo by author

**Figure 11:** Yellow HPHT synthetic diamond with metallic flux inclusion. Photo by author



*These are only indications that your diamond could be synthetic; even if your diamond is not synthetic, it could still be treated. If you are suspicious of your diamond's origin or colour origin, always submit it to a gemmological laboratory that has the necessary equipment to test for synthetics and treatments.*

## References

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[2] Magaña, S.E. & Ardon, T. 2018. 15 Carat HPHT Synthetic Diamond. *Gems and Gemology, Summer 2018*. Vol 54 (2).

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