

# Identification of CVD Created Diamonds by Crossed Polarizing Filters

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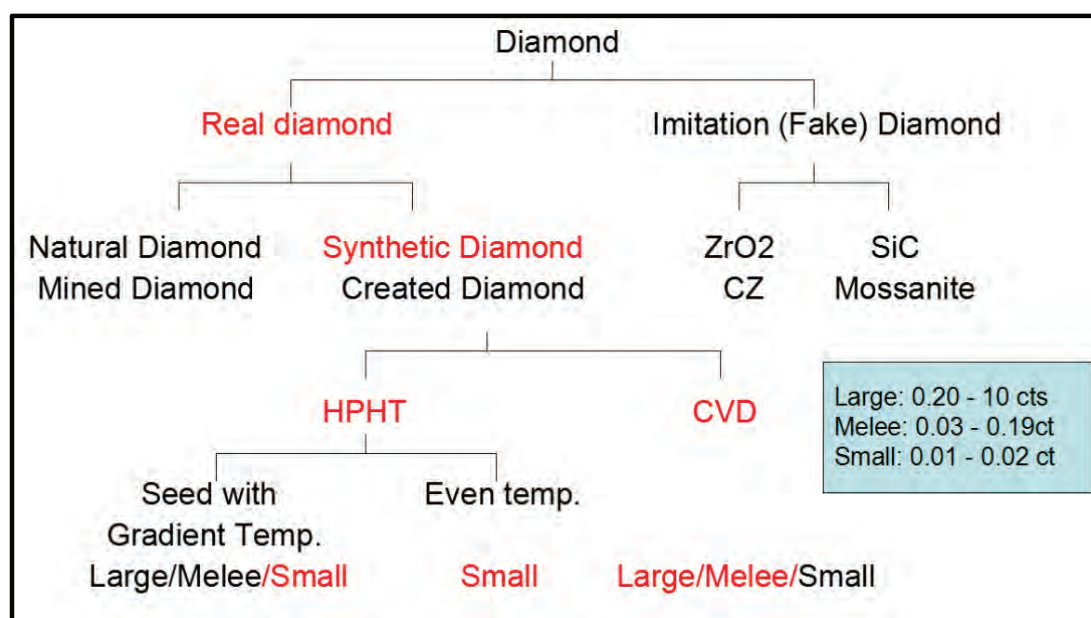
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## Extended abstract

The total reserve of diamonds on Earth is about 2.5 billion carats, of which about one-fifth are gem quality. Currently about 100 million carats are mined each year, so in a few decades natural diamonds will be exhausted. Created diamond growth technology has improved greatly over recent years and the product will gradually fill the vacancy for the natural diamond market. The author has equipment to grow HPHT colourless small diamonds and CVD colourless and coloured large diamonds and has researched methods to identify them effectively from natural diamonds

## Definition of Synthetic Diamond

The diamond classification on the market is as bellow:



## Identification of CVD Diamonds

There is no only evidence to identify synthetic diamonds from natural diamonds. It needs crossed checks to make the identification.

Here are several methods to identify synthetic diamonds, as:

1. UV-Vis Spectroscopy (DiamondSure)
2. Microscope Magnification Observation
3. Microscope + Crossed Polarizing Filters
4. Phosphorescence
5. Magnet Attachment
6. DiamondView
7. CL Cathodoluminescence
8. TEM Transmission Electron Microscope
9. PL Photoluminescence Spectroscopy (DiamondPlus)
10. FTIR

## Using Microscope + Crossed Polarizing Filters to identify CVD Diamonds

The growing circumstance of CVD diamonds is in low vacancy condition, and under crossed polarizing filters, through magnification of microscope, it shows that the whole stone is full-filled with visible anomalous birefringence columns.

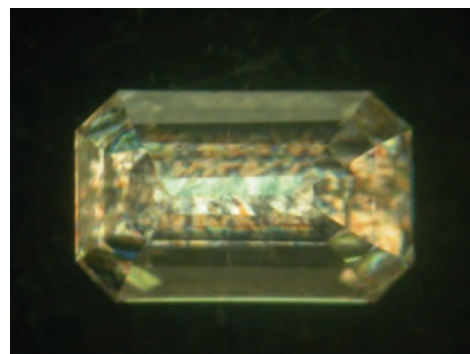
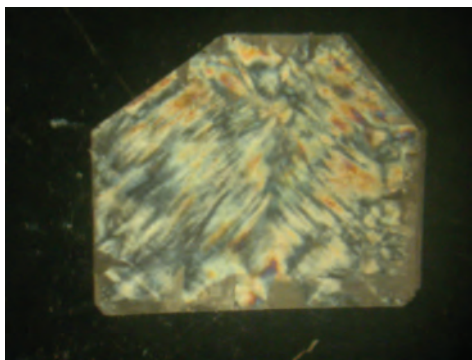
As grown CVD created diamonds have lots of hydrogen, the hydrogen make the anomalous birefringence columns with color under crossed polarizing filters. The color of as grown CVD diamonds shows brownish shades, needing HPHT treatment enhanced to colorless/ near-colorless. The HPHT treatment drive hydrogen out from the CVD diamonds, the degree of HPHT treatment makes the color and shape of anomalous birefringence columns some changes, as bellow:



**Figure 1:** Microscope + Crossed Polarizing Filters

### Mosaic pattern, None HPHT treatment

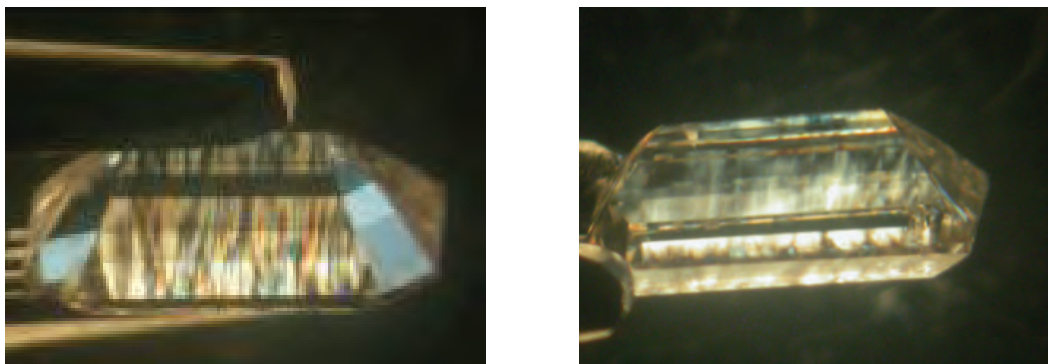
See Figure 2, Left side photo is an as grown thin plates which shows crossed section of anomalous birefringence columns with color mosaic patterns; right side photo is as grown emerald cut diamond, using crossed section of anomalous birefringence columns as table, so we can see the color mosaic patterns from culet.



**Figure 2:** Mosaic pattern, none HPHT treatment

### Parallel columns, None HPHT treatment

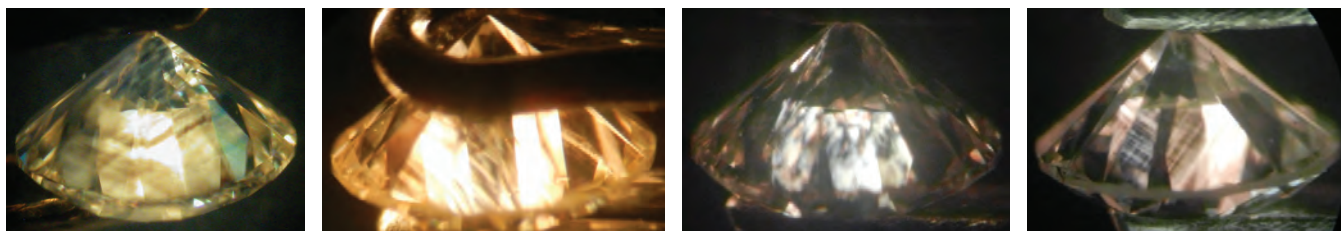
As grown emerald cut diamonds, using crossed section of anomalous birefringence columns as table, so we can see the color parallel columns from bottom facets (Figure 3).



**Figure 3:** Parallel columns, none HPHT treatment

#### Medium HPHT treatment

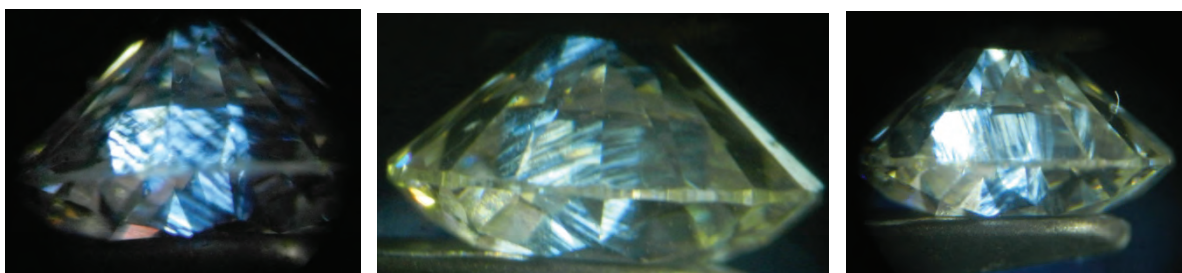
After medium HPHT treatment, the color on anomalous birefringence columns disappeared, the direction of the columns was cut around 45°, the direction of the columns show mixing as different parallel directions, mosaic patterns (Figure 4).



**Figure 4:** Medium HPHT treatment

#### Strong HPHT treatment

The anomalous birefringence columns become dark color and rough surface (Figure 5).



**Figure 5:** Strong HPHT treatment

#### Ultra Strong HPHT treatment

The anomalous birefringence columns almost disappear, only left light similar marks (Figure 6).

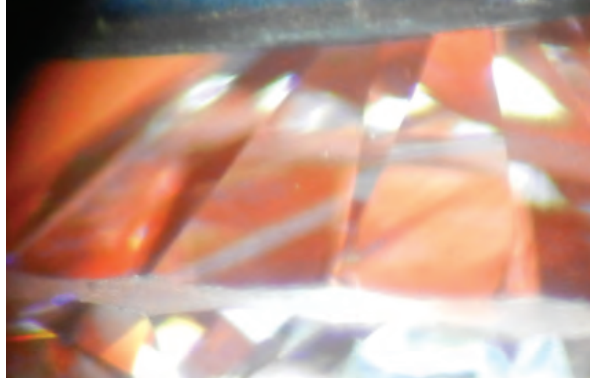


**Figure 6:** Ultra Strong HPHT treatment



### Pink Strong HPHT treatment

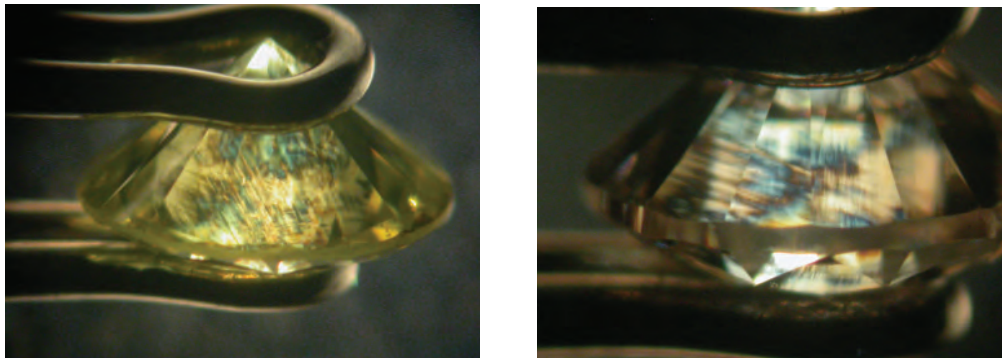
The anomalous birefringence columns become one color and simple (Figure 7).



**Figure 7:** Pink Strong HPHT treatment

### Natural brownish diamonds HPHT treatment

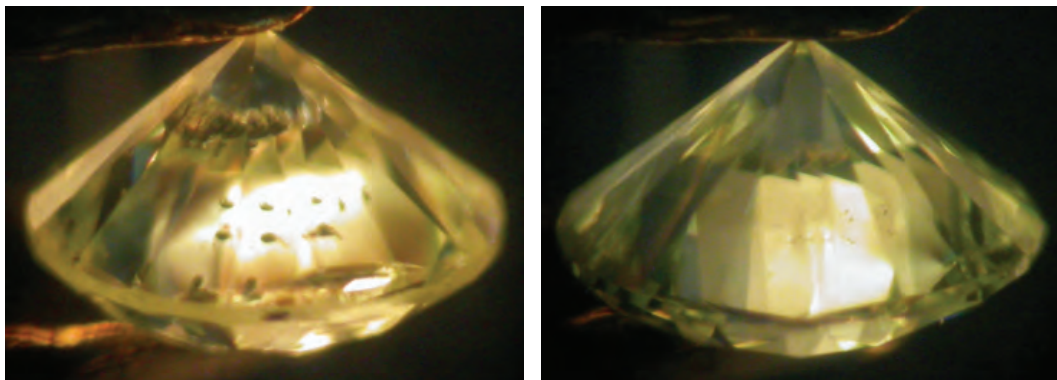
Natural brownish diamonds, received very high stress after growing, because of very high plastic deformation. The structure of face lattices slipped and show with fine, close, parallel, straight, crossed, messy strips, after HPHT treatment enhanced, still can be seen similar patterns (Figure 8).



**Figure 8:** Natural brownish diamonds HPHT treatment enhanced

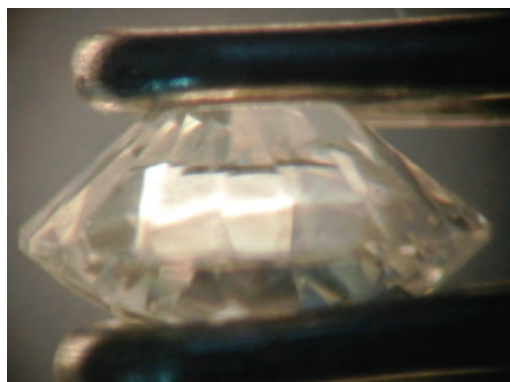
### HPHT Near Colorless Diamonds

HPHT created diamonds will not show anomalous birefringence columns (Figure 9)

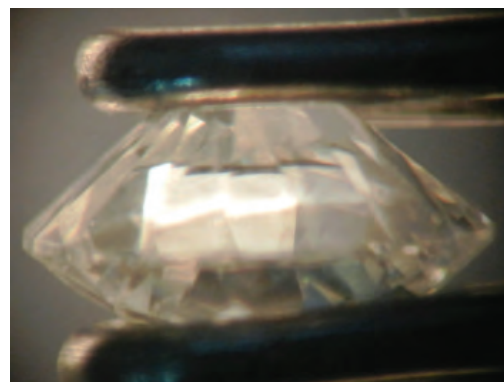


**Figure 9:** HPHT Near Colorless Diamonds

Non-brownish, pinkish, reddish diamonds will not show anomalous birefringence columns (Figure 10). Some of normal natural diamonds have limited area with strain which show colorful or one dark color (Figure 11).



**Figure 10:** Natural normal diamond



**Figure 11:** Natural strain diamond

### Conclusions

Most of the CVD grown diamonds can be identified by the crossed polarizing filters of very low cost. Natural diamond mining has its limitations for supplying the global market and created diamonds grown in the laboratory are considered environmentally friendly and of low cost with unlimited potential supply. At some point in the future it is expected that the volume of created diamonds will exceed that of natural diamonds when the price of created diamonds is likely to be a small fraction of that for natural diamonds. Identification equipment and technology will be improved on function and reduced on price. It will be easy to identify both large and small synthetic diamonds by all diamond dealers.

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### References

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