Module B. Colour from the Cosmos

Lesson 9 - Diamond Mineralogy and Gemology

Can Diamond be Produced Synthetically?

Diamonds have been produced synthetically since the early 20th century. However, early experiments were only able to produce small diamonds that were better suited for industrial applications rather than as gemstones. It hasn't been until recently that producers have been able to move away from industrial quality into gem quality stones.

Two main methods are currently being used to grow gem quality diamonds synthetically: Carbon Vapor Deposition (CVD) and High Pressure High Temperature growth (HPHT). Diamonds produced using these methods are large enough (usually in the 0.5 carat range) to be used as gemstones. Rough sizes of up to 25 carats are being achieved by experimental laboratories and it is nearly impossible to distinguish these from natural diamonds. Companies producing synthetic diamonds (e.g., [Gemesis](http://www.gemesis.com/), Element Six, and Apollo) often provide authenticity certificates for their products and inscribe the girdles (the 'waist' of a cut diamond) with identification numbers.

The HPHT method imitates the growth of natural diamond by creating an environment that is near 1,500 °C and 60,000 atm of pressure. This pressure is equivalent to loading a 600-km tall column of water on top of a diamond! Small seed diamonds are placed in a chamber, which is then flooded with molten carbon and other metal catalysts. The seed diamond crystals act as growing points (i.e., nucleation points) where C atoms attach to as the diamond grows. The growth process is fairly slow (though fast in geological terms): about 1 carat per day can be achieved. Faceted crystals can be produced up to about ½ carat.

The CVD method takes a different approach and growth is conducted under low pressure. Like HPHT, CVD also uses a diamond seed crystal or silicon carbide substrate to act as a nucleating point for the new diamond growth. The key to the CVD method is to flow hydrogen and methane gas (CH4 acts as the carbon source) through a chamber with a plasma flame in the flow path. This effectively destabilizes the methane; carbon is then released and become available for attachment to diamond at the nucleating site. Single crystals are grown by this method. After cutting, sizes reach just over ½ carat.