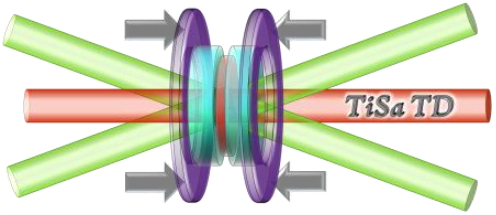

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Chemical Vapour Deposition (CVD) growth of single crystal diamond is a form of homoepitaxial crystal growth. In the process a single crystal "seed" provides a template for the growth of the further crystal. The size and preparation of this seed are critical to defining the quality and size of the crystal to be grown.

The growth species for diamond growth are created in a plasma that is formed above the diamond seed. The excitation of gases to form the plasma for CVD diamond growth can be made in a number of ways, but for the highest purity diamond synthesis microwave excitation is used to form a high temperature plasma. The bulk of this plasma is typically hydrogen, with a small percentage of a hydrocarbon added to provide the building blocks for the new diamond lattice.

Hydrogen molecules are excited and split into hydrogen atoms. These hydrogen atoms are the key part of the plasma – driving almost all of the key reaction steps in the growth of a new diamond crystal. Hydrogen drives activation (breaking down) of the hydrocarbon species in the plasma, activates the growing surface by removing hydrogen atoms bonded to the surface, leaving active sites for further reaction, and also acts to stabilise the growing crystal by reacting with any unstable, newly grown material extremely fast, thereby preventing "reconstruction" of the surface into non-diamond forms of carbon. In theory the hydrogen can also etch away any unwanted graphitic diamond should it form.

With hydrogen playing these critical roles, it is radicals containing carbon that slowly add to the surface to create new diamond. With careful control of conditions only new tetrahedrally bonded carbon atoms are added, maintaining the perfect diamond lattice of the seed crystal, and extending it upwards into the plasma.

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