

THE FIRST SYNTHESIS OF DIAMOND

HOWARD TRACY HALL

Graphite and diamond are polymorphs and have the same chemical composition. They appear as the element number 6 in the periodic table of the elements. Its symbol is C and its atomic weight is 12.

In the year of 1954, scientists had been trying for over one hundred and fifty years to transform graphite into diamond without any success.

Using my BELT apparatus for which I was the sole inventor (U.S. Patent number 2,941, 248), I filled a small graphite tube with troilite and a small diamond seed crystal. The graphite also served as the electrical resistance heating element.

The idea of placing troilite inside of the graphite tube came from the fact that a few microscopic diamond crystals had been imbedded in the troilite of some meteorites.

It was a wintry but sunny morning when on December 16, 1954, I broke the sample cell open after removing it from the contents of my Belt. The cell had cleaved near a tantalum end disk used to bring in the heating current. Then I wrote the following in my laboratory notebook:

My hands began to tremble, my heart beat rapidly, my knees weak and no longer gave support. My eyes had caught the flashing light from dozens of tiny triangular faces of octahedral crystals that were stuck to the tantalum and I knew at that instant that diamonds had finally been made by man.

After gaining my composure, I examined them under a microscope. The crystals were generally intergrown. The largest crystal measured 150 microns across. The crystals contained triangular etch and growth pits such as I had observed on natural diamonds. They scratched sapphire and other hard substances. They burned in pure oxygen to give carbon dioxide and their refractive index and density corresponded with that of natural diamond. A few days later, a powder diffraction pattern definitely determined that my crystals were diamond.

The pressure and temperature was around 70,000 atmospheres and the temperature was around 1600 degrees Centigrade.

I was able to repeat this experiment twelve times in the next two weeks, learning during this period that iron alone would turn graphite into diamond but sulfur alone would not. Troilite is a non stoichiometric solid and my bottle taken from the chemistry stockroom was high on the iron side. Of course, it follows that if iron is a catalyst for conversion the entire group VIII elements would probably act as catalysts. This turned out to be so,

On December 31, a company General Electric physicist, Dr. Hugh Woodbury, under my tutelage, made diamond and became the first person to confirm my work.

This achievement led to the worlds first diamond manufacturing facility.