

DIAMONDS as SUPERIOR MATERIAL

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Introduction

The Diamond and its flawless shining flare have probably done more to shape our life than any other things existed in this planet. It has given women fidelity and love, made men looking rich and high class, opened up new lives, and offered us novel feeling. While in the technological world, scientists have found diamond very impressive because of its wide range of extreme properties, which are all the best. In this paper, we will walk through all aspects of diamonds and explain as much as we can its beauty as well as its super characteristics that make diamond so unique.

Natural Diamonds

Diamond and its cousin graphite share the same chemistry, carbon, and covalent bonds but have very different structures, of course, the properties. Diamond is the hardest substance found on earth. While graphite is real soft, in fact, it is a pencil lead that we use every day. Diamond is an excellent electrical insulator; graphite is a good conducting material. Diamond is the ultimate abrasive; graphite is a very good lubricant. Diamond is transparent and graphite is opaque. All these differences can be explained by the fact that diamond crystallizes in three-dimensional structure with the cubic or isometric system, while graphite crystallizes only in two-dimensional structure with the flat hexagonal sheet [1]. Based on Bohr model, each carbon atom is a sphere, these atoms have packed closest under the heat and the pressure of volcano. This packing scheme has been a major unsolvable problem since 1611, when Kepler proposed his packing solution. Recently, Sloane with "On Kissing Numbers in Dimensions 32 to 128" [2], Hales with "An Overview of The Kepler Conjecture" [3], and Singh with "Close-Packed Structures" [4], have all agreed that Kepler solution may be right, and the cubic structure is the best use in packing spheres together. Diamond is the hardest and strongest substance found in nature, , at least four times harder than the next hardest natural minerals that are sapphire and ruby. Hence, it is a perfect "10", defining the top of the hardness scale. Diamond has also the highest melting point of 3820 degrees Kelvin. Diamond is a good electrical insulator, and its resistivity at room temperature is 10^{16} Ω cm. Diamond can also be doped to reduce its resistivity to the range of 10 to 10^6 Ω cm. So, it becomes a semiconductor with a wide band gap of 5.4 eV. This process has opened a vast potential in modern electronics, [5]. Diamond conducts heat better than anything else found on earth, five times better than the second best element, silver. It has highest known value of thermal conductivity at room temperature of 2 10^3 W/m/ K. Its thermal expansion coefficient at room temperature is 0.8×10^{-6} K, which is comparable with that of invar, the man-made alloy with a lowest expansion performance. No wonder why diamond has found used in heat sinks, high frequency filters [6]. Diamond is transparent over a larger range of wavelengths, from deep ultraviolet to far infrared region of electromagnetic spectrum than is any other substance found on earth.

Precious Gemstone Production

The rough precious gemstones, taken out from ground, are transferred to a specialized factory for producing jewelries. The process starts with identification of gemstones, then cut and polishes them. Tools used by gemologists for the identification and grading of different gemstones are ranging from the simple to the high-tech and exotic ones. A few basic tools can identify most gemstones are Binocular Microscope, Refractometer, and Polariscope. All gemstones are cut and polished by progressive abrasion using finer and finer grits of harder substances. Several common techniques used in lapidary work are Sawing, Grinding, Sanding, Lapping, Polishing, Drilling, and Tumbling [7]. Using these techniques, various gemstones are typically fashioned into one of following familiar forms; cabochons, faceted stones, beads, spheres, inlays, intarsias, mosaics, cameos, intaglios, and sculptures, and particularly, diamonds are cut to the shape such as, round, pear, and oval.

Diamond Evaluation Criteria

After having cut and polished, the jewelry diamond is normally sent to one or both of these two international recognized laboratories, which are the Gemological Institute of America (GIA), and European Gemological Laboratory (EGL) for evaluation and certification. The quality of a diamond is evaluated based on four parameters, Clarity, Color, Carat Weight, and Cut, which are normally called the 4C. The first three parameters, clarity, color, and carat weight, are solely determined by nature. However, the beauty of a diamond is in the cutting, and surely the cutter, in fact, expresses truly his artistic skill, [8, and 9].

Unnatural Diamonds

Most diamonds have impurities or flaws, stones with clarity between Flawless (FL) and VVS2 are considered particularly rare and consequently pricey. Therefore, eliminating, reducing impurities in a diamond, and improving its quality play important roles in jewelry businesses.

Enhanced Diamonds: A finished diamond can be enhanced by inserting a substance into the surface imperfections of the diamond, which makes them invisible, and with this process, the sparkle, reflections, and overall brilliance stays the same as a non enhanced diamond.

Synthetic Diamonds: Man-made diamonds have been synthesized commercially using high-pressure high-temperature (HPHT) techniques, in which diamond is crystallized from metal solvated carbon at pressure from 50 to 100 Bar, and temperature from 1800 to 2300 degrees Kelvin.

A Few Tips for Diamond Lovers

Cutting and Proportioning: The most important consideration is cutting and proportioning of the diamond. Since the quality of the cut is directly responsible for the stone beauty, the precision of facets arranged determines the amount of light reflected to the eye, making more brilliance, or flashy.

Color: The second most important grading aspect when buying diamonds is that of color. Diamonds are graded based on their overall body color, on a scale developed by the GIA, and EGL. This scale runs from "D" to "Z". As seen, the difference between any two colors can be very, very faint. Therefore, it is required to use a Master Color Grading set of diamonds, which have been pre-graded to known color grades on the scale. Thereby, allowing the gemologist to accurately grade a diamond color by comparing it to other diamonds of known color. Of course, it is required that the Master Color Grading diamonds be graded by a qualified gemological laboratory to insure accuracy of the master grading set. There are some new instruments on the market today, which electronically color grade diamonds. However, due to variations in calibration, and the impact that fluorescence has on these machines, they should only be used in conjunction with a Master Color Grading set to insure the most accurate grading.

The Eight Star Diamonds

Perfect diamond cutting can be done, and actually it is a combination of science and fine art. On one hand, art is expressed not by forcing the diamond into a perfect cut, but by simply allowing the diamond to be what nature designed it to be the greatest medium of light reflection and refraction; on the other hand, science provides logical concepts, sophisticated equipments, and precise computer analyses, both are together to produce a perfect diamond cut.

Colors and Vision: In the scientific sense, there are no colors, however there exist Electromagnetic (EM) waves, radiating in an extremely large spectrum from the Radio Frequencies (RF) of Kilometers and Meters in wavelengths, to Cosmic rays of a fraction of Pico-meters, and beyond. However, human visible spectrum is only from 0.7 to .4 Micrometers, which is called the light or white light, having rainbow colors, starting from Red (.7 μm) to Violet (.4 μm). When looking at an object, our eyes receive the light reflected from the object. If there is no light coming to our eyes, we will see nothing that happens when we are in the dark. The normal human eyes have the ability to distinguish among hundreds of such bands of wavelengths as the sensory cells (cones) of the retina receive. The ability of our brain makes it possible for us to perceive the world in color.

Spectrometer: A spectrometer is an optical device used to measure the wavelengths of light colors. It principally includes three components, two prisms, and a frequency counter. A prism is a piece of transparent solid material, which is usually glass or plastic that has two refracting surfaces that are at an angle to each other. When light passes through a prism, it undergoes refraction because of the difference between the angle at which it enters the prism and the angle at which it leaves the prism.

Conclusion

Being created during the extreme conditions of volcanoes, diamond crystallizes in three-dimensional cubic structure with carbon atom spheres packed to the closest possible, forming a magnificent isometric system. No wonder why diamond has long held a special place in the hearts and minds both of scientists and the public at large. As a material science, diamond is the extreme hardest with Knoop numbers of 8000 while the second best sapphire has only 2000, [1]. Diamond conducts heat five times better than the second best silver, has the lowest thermal

expansion coefficient of invar. It is chemically inert and wear resistant, offers low friction, has high thermal conductivity, and is electrically insulating and optically transparent from the ultraviolet to the far infrared. Diamond already finds use in many diverse applications including, of course, its use as a precious gem, but also as a heat sink, as an abrasive, and as inserts and/or wear-resistant coatings for cutting tools. As jewelers, diamond has its flawless shining flare and flashy due to its transparency over a wide range of wavelengths, from the deep ultraviolet to the far infrared region of the electromagnetic spectrum. Since the isometric system is the most symmetrical system possible in three-dimensional space, composing of three crystallographic axes of equal length and at right angles to each other, diamond does not polarize light when it passes through it.

A lot of flash, shining flare, most of all it does the one thing diamonds are meant to do, look beautiful and pretty. It is clear that the cutter must cut diamond with correct proportion that is one of the most important requirements. Proportioning greatly affects price. So be sure that you are looking at all four grades when you shop not just carat weight, clarity, and color. Please ask for a proportioning grade as well.

Color is variable and tends toward pale yellows, browns, grays, and also white, blue, black, reddish, greenish and colorless.

After all, you are what you should be because you have been contributing so much in our lives from engineering materials to various tools but most of all your beautiful shining beauty! You are overall the best, and we all love you.

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