Restatement of Lesson 9 Learning Objectives

* List the physical properties, composition, and crystal structure of diamond
* Describe the importance of electrical and thermal conductivity of diamond
* Describe the cleavage of diamond and its importance for diamond cutters
* Compare the composition, crystal structure, and bonding of graphite and diamond
* Differentiate between Type Ia, Ib, IIa, IIb diamonds in terms of composition and colour
* Identify the cause(s) of different colours of diamond
* Describe the primary morphology of diamonds and secondary modifications of uncut diamond
* Identify common diamond treatments and methods of creating synthetic diamonds

What Is Diamond and What Are its Basic Qualities?

Mineralogically, diamond is pure carbon that is packed into a dense crystalline structure (3.51 g/cm3) with**cubic symmetry** and perfect octahedral cleavage. It is ranked at the top of the Mohs hardness scale with a value of 10, has high durability, shows a high refractive index of 2.42, and exhibits great dispersion (splitting of light into the spectral colour of a rainbow). Pure diamond is colourless. However, various rare structural defects, elemental substitutions, and laboratory procedures allow diamond to show the full range of colours found in the rainbow.

Many people are familiar with the 4Cs of diamonds: colour, cut, clarity and carat. These four variables are important for describing specific stones, but the qualities described by the 4Cs vary from stone to stone and we'll cover their importance later. The physical properties mentioned in this section and lesson apply (mostly) to all diamonds.

Uncut (rough) diamond octahedron (left) and cut (polished) diamond in a round brilliant shape sitting on kimberlite rock. Photo courtesy of the[Gemological Institute of America](http://www.gia.edu/).

Beyond the typical physical characteristics that we learn for most minerals and gems, as listed above and found in your textbook, diamond has a few more that stand out. In particular are its thermal and electrical conductivities, two other properties along with refractive index and dispersion that are extensively used to confirm or reject an unknown material as being diamond.

The very high thermal conductivity of diamond is due to the covalent bonding that holds its carbon atoms together, and is three times higher than that of gold and silver, two metals known for their own high thermal conductivity. Compared to its simulants, such as cubic zirconia or quartz, diamond's thermal conduction is leaps and bounds higher. However, there are some simulants, such as moissanite, which have similar thermal conductivities and so additional properties are required to be tested.

Thermal conductivities of some materials commonly encountered in the gem and jewellery industries.

The electrical conductivity of diamond is not remarkable per se, however, its low electrical conductance paired with high thermal conductance is unusual. Consequently, these properties together can also be distinctive from other materials, such as moissanite. Diamond itself is an insulator (high resistivity) whereas some of its simulants, such as moissanite, are semiconductors and will more readily pass electricity when an electrical charge is placed across the stone in question.