

Difference Between Allotrope and Isomer

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Key Difference - Allotrope vs Isomer

Some elements in the [periodic table](#) can occur in different formulas or different arrangements while being stable at room temperature. They can be a [compound](#) made out of a single element or a compound made of several elements. Allotropes and isomers are good examples for such elements. The key difference between allotrope and isomer is that **allotropes are compounds with same elements but different chemical formula in different arrangements** whereas **isomers are compounds having different elements but same chemical formula in different arrangements**.

What is an Allotrope?

The word allotrope can be defined as an alternate type. In detail, it refers to different types of compounds made out of the same single element but in different chemical formulas and different arrangements. These allotropes exist in the same physical state in the same conditions (room temperature) but show differences in their [physical and chemical properties](#). Different allotropes can be observed in [metals, non-metals](#), and [metalloids](#).

Examples of Allotropes

Allotropes of Carbon

Carbon allotropes exist in the solid state. The most common types are [diamond](#), [graphite](#) and carbon black. Here, it is not so easy to change one allotrope type into another allotrope structure. Diamond is an extremely hard structure whereas graphite is not that hard. Carbon black exists as a powder.

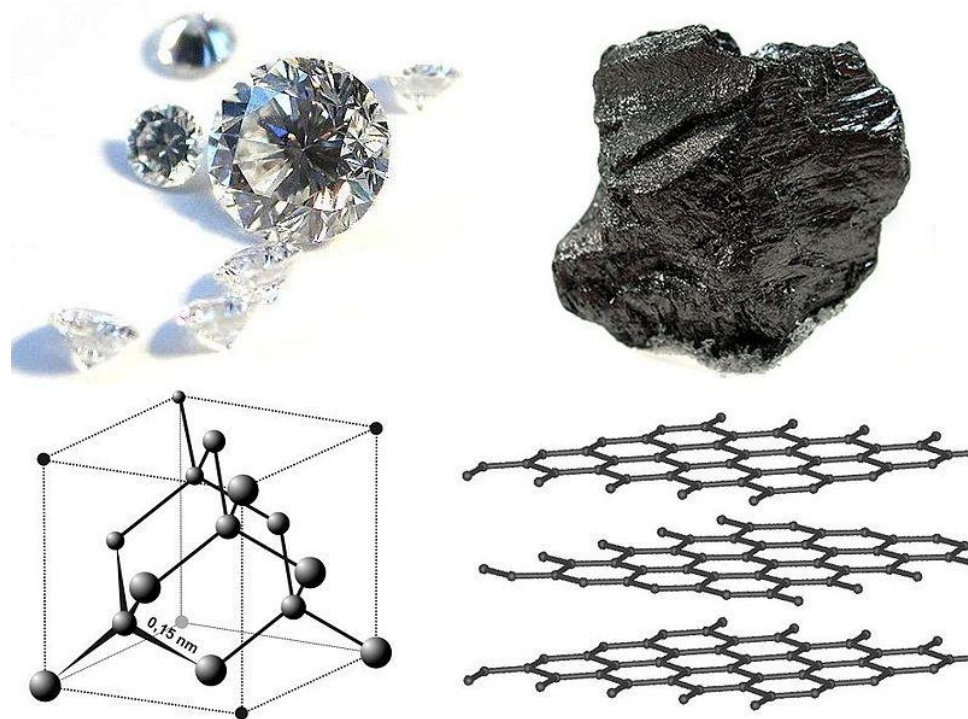


Figure 01: Structure and Appearance of Diamond (in the left) and Graphite (in the right)

Allotropes of Oxygen

The most common types of oxygen allotropes that are found naturally are diatomic oxygen (O_2), and [ozone](#) (O_3). The difference between them is that oxygen has two oxygen atoms bonded with a double bond whereas ozone is composed of three oxygen atoms which exist as a resonance structure.

Allotropes of Sulfur

The allotropes of sulfur are different from each other according to the number of sulfur atoms attached and their arrangement. In the case of sulfur, it is somewhat easy to change one form of sulfur into another.

What is an Isomer?

Isomers are compounds having the same chemical formula but different arrangements. Isomers have same number and types of atoms but these atoms are arranged in different ways. Therefore the chemical structure of isomers is different from each other. Isomers are divided into two broad categories known as [structural isomers](#) and [stereoisomers](#).

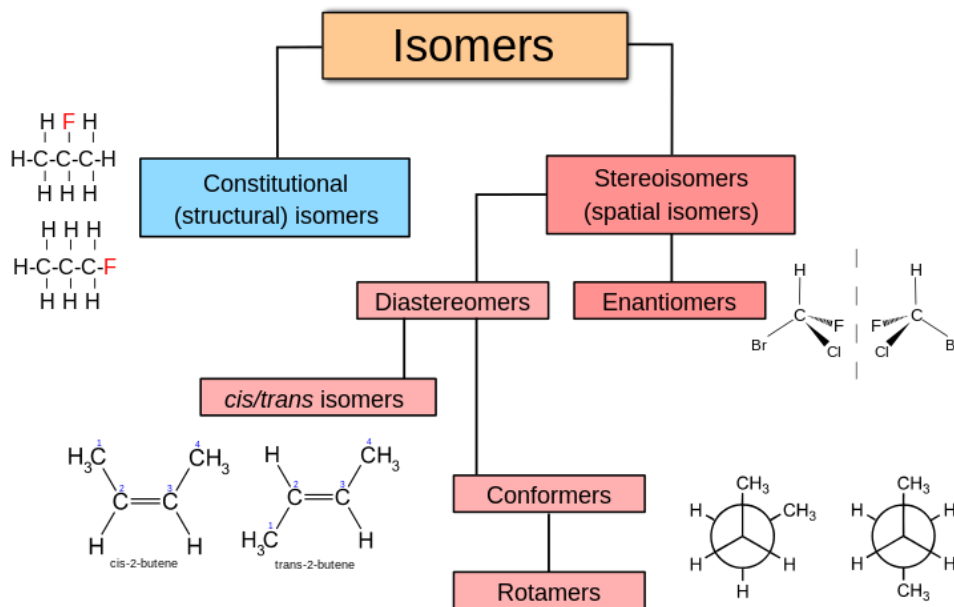


Figure 02: Classification of Isomers

Structural Isomers

In this type, atoms and functional groups are attached in different ways to make the structure. This type includes chain isomerism, position isomerism, and functional group isomerism.

Stereoisomers

The bond structure and position of functional groups are the same for isomers but are different in geometrical positioning. Stereoisomers include cis-trans isomers (=diastereomers) and optical isomers (=enantiomers).

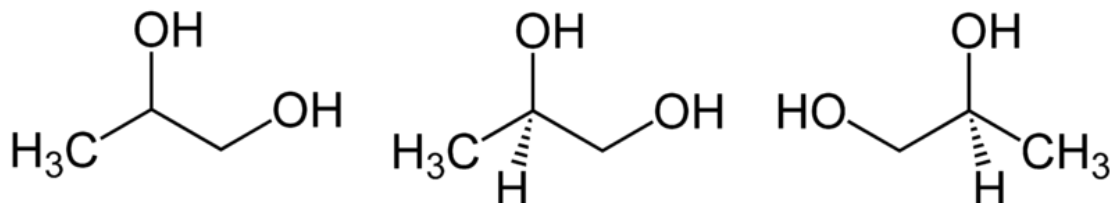


Figure 03: Stereoisomers of Propylene Glycol (note that the geometry of H atom is different in two molecules).

What is the difference between Allotrope and Isomer?

Allotrope vs Isomer	
Allotropes are compounds with same elements but different chemical formula in different arrangements.	Isomers are compounds having different elements but the same chemical formula in different arrangements.
Number of Atoms	
Allotropes are composed of different numbers of atoms.	Isomers have the same number of atoms.
Type of Elements	
Allotropes are composed of the same single element	Isomers are composed of different elements.
Structure	
Allotropes always have different structures.	Isomers may have similar or different structures.
Presence	
Allotropes can be observed in metals, non-metals, and metalloids	Isomerism can be seen in organic molecules (ex: hydrocarbon) and inorganic molecules (ex: silane).
Major Types	
Types of allotropes include metal allotropes, non-metal allotropes a, d metalloid allotropes	Isomers include mainly structural isomers and stereoisomers.

Summary - Allotropes vs Isomers

Both allotropes and isomers can be defined as alternative types of an element or a compound. Most of the times, these are stable and naturally found compounds. The main difference between allotrope and isomer is that allotropes are compounds with same elements in different chemical formulas in different arrangements

whereas isomers are compounds having different elements with the same chemical formula in different arrangements.

Reference:

1. Helmenstine, Anne Marie. "What Is an Isomer? Review Your Chemistry Concepts." ThoughtCo. N.p., n.d. Web. [Available here](#). 01 June 2017.
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