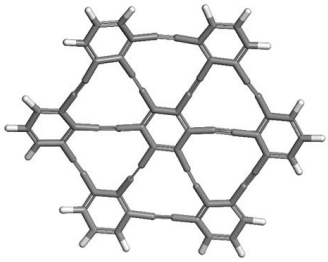

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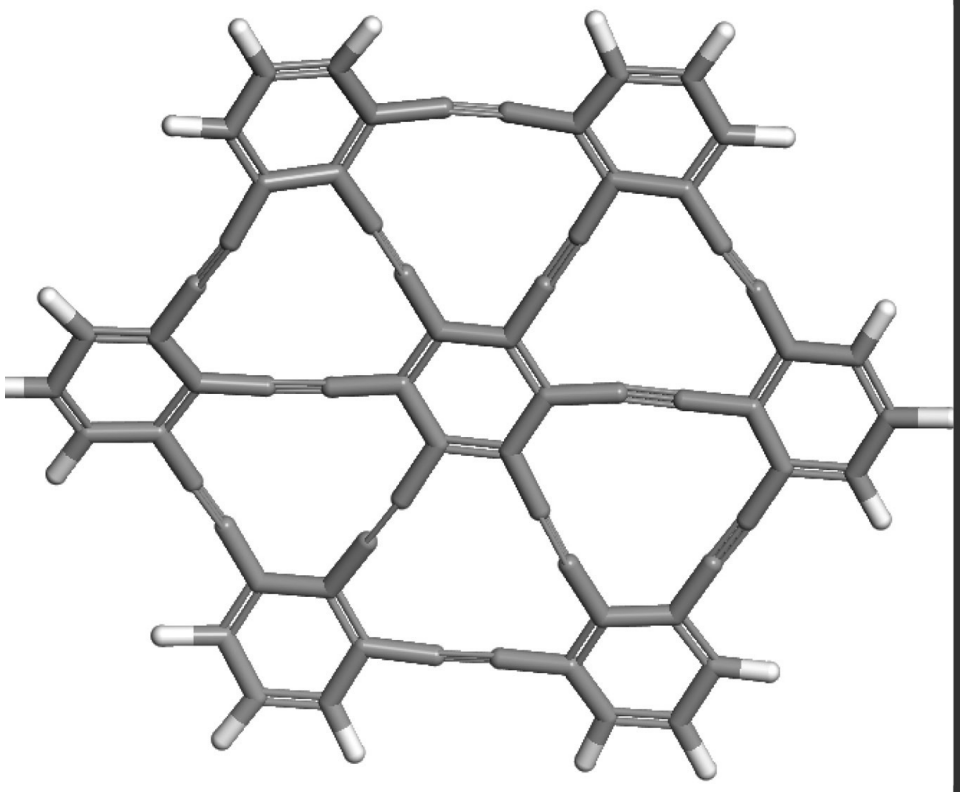

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Contents

1 Carbon Allotropes
Past to Present Aspects

Chandra Shekhar Yadav, Iqbal Azad, Abdul Rahman Khan, and Prashant Singh

1.1 INTRODUCTION: ALLOTROPES OF CARBON

Carbon allotropes are one of the most plentiful materials on Earth and are found almost everywhere. In the universe, this element is the fourth most prevalent, and on the earth's surface, it is the fifteenth most prevalent [1]. The word "carbon" originates from *carbo*, the Latin word for both coal and charcoal. Stable single and multiple carbon-carbon covalent bonds are responsible for the existence of a variety of carbon inorganic forms [2]. Many allotropes of carbon exist that can be grouped based on the type of chemical bond associated with hybridization [3]. While sp^3 has insulating qualities, the first two have the ability to form electrically conducting bonds [4]. Every allotrope has mechanical and electrical characteristics that differ noticeably. Graphene has a unique semimetal electronic structure with a straight band dispersion and very high electron mobility. On the other hand, diamond is an insulator with a wide band gap and one of the hardest-known natural materials. The characteristics of carbon allotropes originating from sp^2 hybridized carbon, such as graphite, graphene, fullerenes, and nanotubes, and sp^3 hybridized carbon, such as diamonds, are widely recognized and have several applications [5].

Carbon can develop various allotropes due to its valence. Carbon is found in well-known materials such as graphite and diamond. Researchers have found and studied various allotropes in recent decades, including sheets like graphene and ball-shaped ones like Buckminsterfullerene (C_{60}) [6]. Some other carbon allotropes include carbon nanotubes (CNTs), amorphous carbon (C_{70} fullerene), fullerite (C_{540}), and lonsdaleite [1, 7,8] (Table 1.1).

1.2 HISTORICAL PERSPECTIVES ON CARBON ALLOTROPES

In 1997, Andrei V. Rode discovered the fifth known allotrope of carbon (graphite), which is made up of about 4000 carbon atoms [7]. All clusters have a diameter of around 6 nm and are arranged in sheets [8]. The negative curvature of the sheets results from the inclusion of heptagons in the regular hexagonal layout.

1.2.1 Key Scientists and Their Contributions to Understanding Carbon Allotropes

The carbon has exceptional electrical conductivity, rendering it a very suitable material for the electrode of an electrical arc light. In graphite, the π– electrons of the carbon atoms delocalize, allowing for the conductivity of electricity, a process not possible in diamond. Diamond is used in glass cutting and rock drilling machines and also used in ornaments [17]. Also among their many uses, carbon allotropes are used for preparing lubricants and building carbon electrodes; used as insulators, catalysts in water purification, and fuel in factories and homes; and used to obtain coke, coal gas, and coal tar.

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