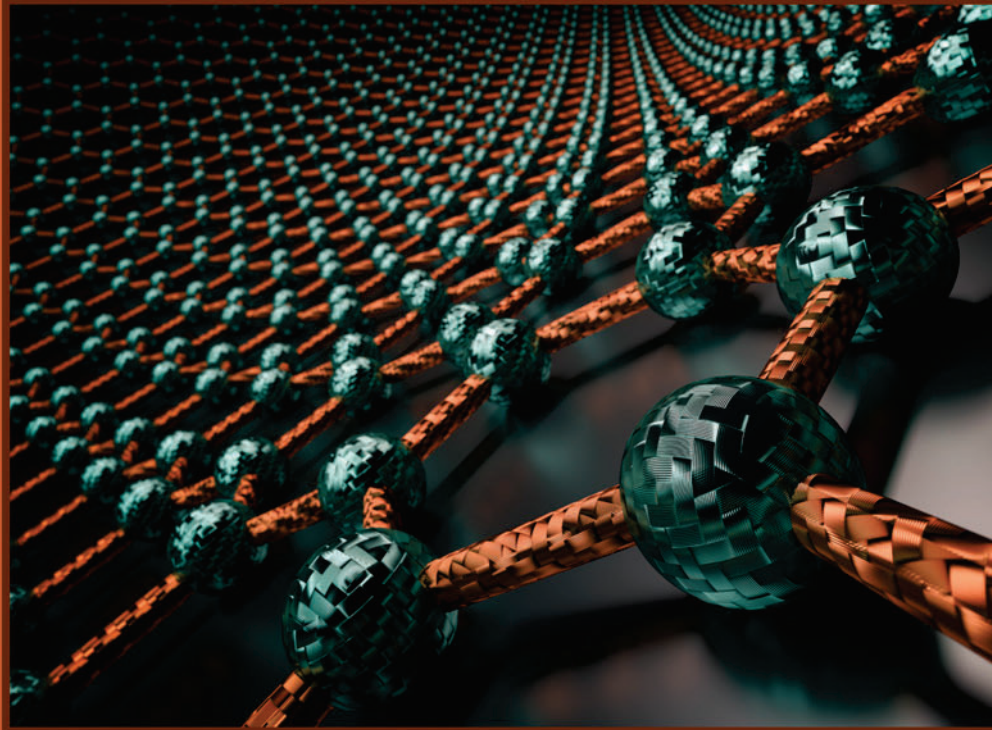


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Graphene: Synthesis, Properties, Technology, and Applications

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Woodhead Publishing in Materials

Graphene: Synthesis, Properties, Technology, and Applications

Edited by

Saritha Appukuttan

Jitha S. Jayan

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4.1 Introduction

The term “graphene” was first introduced by Boehm in 1986. The history of graphene extends back to the 1940s when Schaffhaeutl utilized nitric and sulfuric acids to intercalate and exfoliate graphite [1,2]. Graphene, a form of elemental carbon, has garnered significant attention nowadays because of its inimitable features. It comprises a single layer of carbon atoms arranged in a honeycomb-like model. The first successful production of graphene was achieved by a team led by Konstantin Novoselov and Andre Geim in 2004. However, they informed Hanns Peter Boehm and other scientists who conducted experiments comparing graphene with thin graphite flakes for this discovery. Consequently, Hanns Peter Boehm became the first scientist to utilize the term “graphene” in 1986 [3,4]. Graphene has three main derivatives: graphane, graphene oxide, and fluorographene. Fig. 4.1 displays these alongside other derivatives, like graphite, fullerenes, and carbon nanotubes. These derivatives differ significantly owing to unique characteristics. Derivatives of graphene have distinct properties due to variations in structure and chemical composition [3]. Graphene has various stacking configurations, including monolayer (SLG), few-layer (FLG), and multilayer graphene (MLG). SLG consists of a single sheet of carbon atoms in a hexagonal lattice, with each atom forming sp^2 covalent bonds with its neighbors. The 2D arrangement of graphene serves as the elemental unit for numerous carbon allotropes, comprising zero-dimensional (0D) fullerenes, one-dimensional (1D) carbon nanotubes, and three-dimensional (3D) graphite. Graphene is also lightweight, structurally robust, extremely tough, and has significant electrical and thermal conductivity, among other advantageous qualities. Among nanomaterials, it is acknowledged to be the strongest and thinnest substance. Excellent electrical and thermal conductivity, great electron mobility, and significant mechanical strength are only a few of graphene’s many diverse qualities [5]. This makes SLG incredibly thin, at just one atom thick [6]. Graphene has become a significant carbon nanomaterial, initially identified through the groundbreaking research conducted by Konstantin Novoselov and Andre Geim in 2004. They successfully isolated graphene by exfoliating graphite using adhesive tape [7].

Approximately 40 years ago, the research on graphene gained substantial importance when it was proposed that graphene serves as a condensed matter analog of quantum electrodynamics, encompassing two spatial dimensions and one temporal dimension [8]. Graphene is referred to as “the simplest complex material” and has