GRAPHENE

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ABSTRACT: Graphene, a thin two-dimensional carbonaceous nanomaterial, has attracted tremendous research interest in both scientific studies and technological development due to its great electric, mechanical, and chemical properties. Since the discovery of graphene, many efforts have been made to modify the graphene structure for integrating this promising material to vast applications. Specific attention is devoted to the recent progresses on the development of graphene derivatives such as graphene oxide, porous graphene/graphene oxide, reduced graphene oxide, and graphene quantum dots. In this chapter, the definition, intrinsic properties, and various approaches for the synthesis of graphene derivatives based on top-down and bottom-up approaches are discussed. Furthermore, the related works on the preparation of graphene derivatives via chemical oxidation method are also included. In addition, the pitted and peeled out mechanism of the formation of graphene derivatives was also highlighted, and this will lead to a better understanding of the physicochemical properties of graphene derivatives.

1. INTRODUCTION

Graphene is a two-dimensional, crystalline allotrope of carbon atoms that form a hexagonal lattice structure with a sp^2 hybridization. This 96.6% optically transparent material is the strongest known to mankind per unit size with incredible electrical properties and the best heat conductor at room temperature which can lead to many applicable uses in the research and technical industries. With a molecular bond length of 0.142 nanometers and an atomic thickness of 0.345 nanometers, thermal instability is prevented due to its carbon-to-carbon bonds that are so small yet strong. Its tensile strength is far greater than steel at approximately 0.4 GPa while having elastic properties with Young's Modulus of 500 GPa, much more elastic than rubber.

2. CHARACTERSTICS OF GRAPHENE

Mechanical Strength: - Graphene is the world's strongest material, and can be used to enhance the strength of other materials. Dozens of researchers have demonstrated that adding even a trace amount of graphene to plastics, metals or other materials can make these materials much stronger - or lighter.

Thermal characterstic: - Graphene is the most heat conductive found to date. As graphene is also strong and light, it means that it is a great material for making heat-spreading solutions, such as heat sinks or heat dissipation films. This could be useful in both microelectronics and also in larger applications.

Energy Storing capacity: - Since graphene is the world's thinnest material, it also extremely high surface-area to volume ratio. This makes graphene a very promising material for use in batteries and supercapacitors. Graphene may enable batteries that can store more energy - and charge faster, too.

3. FUTURE SCOPE

Biomedical Application:- Graphene's unique properties allow for ground-breaking biomedical applications. Targeted drug delivery; improved brain penetration; DIY health-testing kits and 'smart' implants.

Graphene based Composite material:-One of the simplest and most effective ways of harnessing the potential of graphene is to combine it with existing products - so called composite materials.The impact of graphene-based composites is set to reverberate throughout countless industries, enhancing performance and increasing application possibilities.

Electronics: - Graphene can be used as a coating to improve current touch screens for phones and tablets. It can also be used to make the circuitry for our computers, making them incredibly fast. These are just two examples of how graphene can enhance today's devices. Graphene can also spark the next-generation of electronics.

In Batteries: - Graphene could dramatically increase the lifespan of a traditional lithium ion battery, meaning devices can be charged quicker - and hold more power for longer. Batteries could be so flexible and light that they could be stitched into clothing. Or into the body. For soldiers, who carry up to 16lbs of battery at one time, the impact of this could be huge. Carrying less weight, and using batteries that can be recharged by body heat or the sun would allow them to stay out in the field for longer.

Graphene Membrane: -The simplicity of the technique and the sophistication of the membranes developed at The University of Manchester means the scope for potential applications is widening quickly, while each day of research brings with it new ideas. A single layer of atoms that can act as a perfect barrier has the potential to open up vast new markets and revolutionise countless industrial processes.Using graphene coatings on food and pharmaceutical packaging can stop the transfer of water and oxygen, keeping food and perishable goods fresher for longer. The removal of harmful carbon dioxide released into the atmosphere by power stations is not currently done on any scale, graphene membranes could change that.

Sensor: - Graphene is an ideal material for sensors. Every atom in graphene is exposed to its environment allowing it to sense changes in its surroundings. For chemical sensors, the goal is to be able to detect just one molecule of a potentially dangerous substance.

4. CONCLUSION

Graphene is a cheap and multifunctional material with unique physical and chemical properties. Graphene-based nanomaterials have been widely explored in nonmedical fields for at least a decade. Remarkable progress in synthesis and functionalization of graphene materials has opened new avenues exploring their use in drug/gene delivery, biosensors, and tissue engineering. However, the merging of graphene and biotechnology is in its infancy, with many challenges remaining. Better understanding of physics and chemistry at the surface of graphene and interaction of chemicals and biomolecules at the interface of graphene will play an important role in applying graphene as nanoscaffold in catalysis, chemical/biosensing, imaging, and drug delivery. However, in spite of the considerable advances, substantial fundamental research is still necessary to provide a basic understanding of these materials to enable full exploitation of their nanoengineering potential.

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