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GRAPHENE THE NEW NANOCARBON IN MODERN ELECTRONICS

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Abstract

Graphene is a single layer of carbon packed in a hexagonal (honeycomb) lattice, with a carbon-carbon distance of 0.142 nm. It is the first truly two-dimensional crystalline material. It is the first truly two-dimensional crystalline material. Graphene is the thinnest material with only one carbon atom. Due to its unique electronic properties, it absorbs a high 2.3% of light that passes through it.Graphene is chemically the most reactive form of carbon. Graphene has a high carrier mobility, as well as low noise. It is mechanically very strong, transparent and flexible conductor. Its conductivity can be modified over a large range either by chemical doping or by an electric field. Recently it has become possible to fabricate large sheets of graphene. Using near-industrial methods, sheets with a width of 70 cm have been produced. The development of this new material, opens new exiting possibilities. It is the first crystalline 2D-material and it has unique properties, which makes it interesting both for fundamental science and for future applications.

keywords:- *graphene,crystalline,carbon,etc*

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1.INTRODUCTION

Paragraph content goes here. Paragraph content goes here. It is all about carbon! Graphene is a single layer of carbon atoms forming a honeycomb latticGraphene is a single layer of carbon packed in a hexagonal (honeycomb) lattice, with a carbon-carbon distance of 0.142 nm. It is the first truly two-dimensional crystalline material and it is representative of a whole class of 2D materials including for example single layers of Boron-Nitride (BN) and Molybdenum-disulphide(MoS2), which have both been produced after. Graphene is a transparent and flexible conductor that holds promise for various material/device applications, including solar cells,[157] light-emitting diodes (LED), touch panels and smart windows or phones.Graphene is practically transparent In the optical region it absorbs only 2.3% of the light. This number is in fact given by $\pi\,\alpha$, where α is the fine structure constant that sets the strength of the electromagnetic force. In contrast to low temperature 2D systems based on semiconductors, graphene maintains its 2D properties at room temperature. Graphene also has several other interesting properties, which it shares with carbon nanotubes. It is substantially stronger than steel, very stretchable and can be used as a flexible conductor. Its thermal conductivity is much higher than that of silver.

1.1 How to get graphene?

The idea is to rub a tiny piece of graphite against another surface, just like writing.Graphene is a semiconductor with zero gap or a **gapless semiconductor**Scientists are developing methods to make useful devices out of graphene.

1.2 Properties of Graphene

Thickness–
With only one layer of carbon atoms, graphene is the thinnest material ever found! The thickness is about 0.335 nm.

Electronic Properties of Graphene For physicists and device engineers, the most behavior of graphene comes from its electronic properties! predicts that a tunnel barrier can become fully transparent for normal incidence of massless particles. Under certain conditions the transparency can also oscillate as a function of energy. That this could be tested in graphene was suggested by Katsnelson, Geim and Novoselov in 2006,5 and verified by Young and Kim in 2009.6

chemical properties

- Graphene is chemically the most reactive form of carbon.

- Only form of carbon (and generally all solid materials) in which each single atom is in exposure for chemical reaction from two sides (due to the 2D structure).
- Carbon atoms at the edge of graphene sheets have special chemical reactivity.
- graphene burns at very low temperature (e.g., 350 °C).
- Graphene has the highest ratio of edgy carbons (in comparison with similar materials such as carbon nanotubes).
- Graphene is commonly modified with oxygen- and nitrogen-containing functional groups

Electronic Properties

- It is a zero-overlap semimetal (with both holes and electrons as charge carriers) with very high electrical conductivity.
- Electrons are able to flow through graphene more easily than through even copper.
- The electrons travel through the graphene sheet as if they carry no mass, as fast as just one hundredth that of the speed of light.
- High charge carrier mobility, for which values of 10,000 cm^2/Vs, in some cases even 200,000 cm^2/Vs were reported.

Mechanical Properties

- To calculate the strength of graphene, scientists used a technique called Atomic Force Microscopy.
- It was found that graphene is harder than diamond and about 300 times harder than steel.
- The tensile strength of graphene exceeds 1 TPa.

It is expected that graphene's mechanical properties will find applications into making a new generation of super strong composite materials and along combined with its optical properties, making flexible displays.

Thermal Properties

Graphene is a perfect thermal conductor.Its thermal conductivity is much higher than all the other carbon structures as carbon nanotubes, graphite and diamond (> 5000 W/m/K) at room temperature

Graphite, the 3 D version of graphene, shows a thermal conductivity about 5 times smaller (1000 W/m/K)

The ballistic thermal conductance of graphene is isotropic, i.e. same in all directions

Optical Properties

Graphene, despite it is only 1 atom thick, is still visible to the naked eye**.** Due to its unique electronic properties, it absorbs a high 2.3% of light that passes through it future scopeGraphene has a number of properties which makes it interesting for several different applications. It is an ultimately thin, mechanically very strong, transparent and flexible conductor. Its conductivity can be modified over a large range either by chemical doping or by an electric field. The mobility of graphene is very high30 which makes the material very interesting for electronic high frequency applications.37 Recently it has become possible to fabricate large sheets of graphene. Using near-industrial methods, sheets with a width of 70 cm have been produced.38,39 Since graphene is a transparent conductor it can be used in applications such as touch screens, light panels and solar cells, where it can replace the rather fragile and expensive Indium-Tin-Oxide (ITO). Flexible electronics and gas sensors40,41 are other potential applications. The quantum Hall effect in graphene could also possibly contribute to an even more accurate resistance standard in metrology.42 New types of composite materials based on graphene with great strength and low weight could also become interesting for use in satellites and aircraft.43,44

Major advantages of graphene are:

It is used in the production of high speed electronic devices responsible for fast technological changes. Chemical sensors effective at detecting explosives. Membranes for more efficient separation of gases. These membranes are made from sheets from which Nano scale pores have been created. It has led to the production of lower costs of display screens in mobile devices by replacing indium-based electrodes in organic light emitting diodes(OLED) which also lower power consumption. Used in the production of lithium-ion batteries that recharge faster. These batteries use graphene on the anode surface. Storing Hydrogen for fuel cell powered cars. Low cost water desalination by using graphene- with holes the size of a nanometer to remove ions from water.

Disadvantages of graphene:

Being a great conductor of electricity, although it doesn't have a band gap (can't be switched off). Scientists are working on rectifying this. The main disadvantage of graphene as a catalyst is its susceptibility to oxidative environments. Research has proven that graphene exhibits some toxic qualities. Scientists discovered that graphene features

jagged edges that can easily pierce cell membranes, allowing it to enter into the cell and disrupt normal functions.

These are just but a few of the 'wonder material's' advantages and disadvantages and since the material is still in the research stage much more is yet to be revealed .

Conclusion

The development of this new material, opens new exiting possibilities. It is the first crystalline 2D-material and it has unique properties, which makes it interesting both for fundamental science and for future applications.

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