Graphene, amazing nano material made of carbon atoms

Mina. Jalilvand[1], Solmaz. Malmir[2]
1- Young Researchers Club, Toyserkan Branch, Islamic Azad University, Toyserkan, Iran
Email: Jalilvandmina@yahoo.com (Corresponding author)
2- Young Researchers Club, Toyserkan Branch, Islamic Azad University, Toyserkan, Iran
Email: Malmir_s2002@yahoo.com

Received: November 15, 2012 Revised: December 17, 2012 Accepted: December 25, 2012

ABSTRACT:
In the last two decades, new allotrope of carbon and other related Nano structures have been discovered. Graphene is a Two-dimensional of single layer of graphite, and the starting point for many of the Nano-carbon material that is generally called Nano-graphite. This material has a different atomic structure and they bring a lot of electronic features. Graphene's electrical, mechanical and heat properties are very well. The extraordinary properties of graphene have led to extensive research done in recent years. In this paper, Brief about graphene, its applications and its promising future is discussed.

KEYWORDS: Graphene - graphene Nano-strips - graphene sensors

1. INTRODUCTION

Carbon is a Basic matter in life and organic chemistry. Due to the flexibility of the carbon bonds, Systems based on Carbon has an infinite variety of structures with different physical characteristics. These physical characteristics, largely due to the scale of structures.

Among the structures that are only carbon atoms, an allotrope of two-dimensional (2D) carbon is important, because it is essential to understand the electronic properties of other structures. Graphene is made of carbon atoms, these atoms in a honeycomb structure have been together. Although graphene crystals not exist in nature as a free, but the foundation have several other structures which are made of carbon atoms. For example, carbon nanotubes are obtained by twisting a graphene layer, for this reason it is essential to understand the characteristics of graphene, and helped in discovering the unique applications of this material.

2. GRAPHENE AND ITS FEATURES

Graphene is a single layer made of as a single plane of two-dimensional hexagonal carbon atoms (Fig. 1).

Two-dimensional graphene has 2 planes and multi-dimensional graphene is between 3 to 10 planes. Graphene structures that include more than 10 of these layers are known as thick graphene plane and not much attention. In two and multi-layer graphene, carbon atoms can be arranged in different ways, such as AA or hexagonal arrangement, Bernal Arrangement or AB, and Rhombic Arrangement or ABC (Fig. 2). Graphene is a hybrid junction sp2. This junction represents the three bonds σ in plane, and π orbitals perpendicular to plane (Fig. 3).

While strong connections σ as the columns is hexagonal structure, Off-plane connectors π controls interactions between various layers of graphene [1].

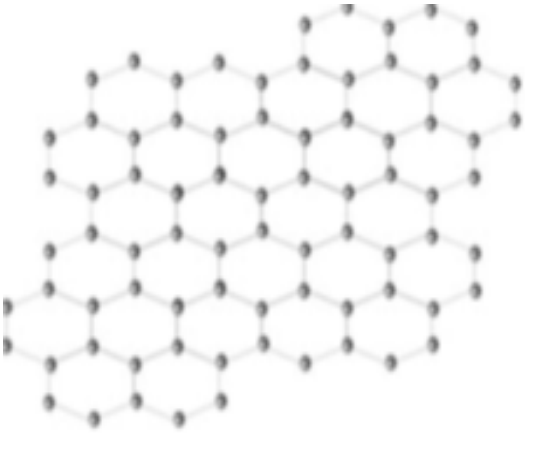

Fig. 1. Graphene consists of a single layer of carbon atoms in two dimensions [1]

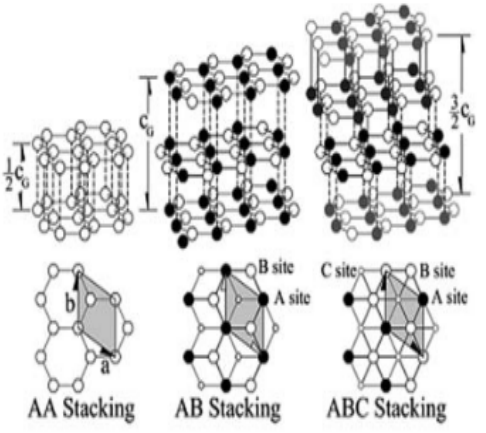

Fig. 2. Three structures of multilayer graphene [1]

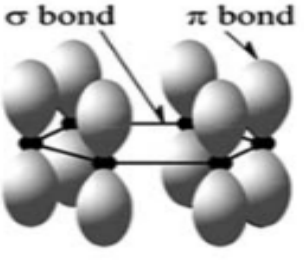

Fig. 3. Display a bonds σ in plane, and π orbitals perpendicular to plane [1]

Graphene is an amazing material, it is the thinnest and strongest material known in the world. The charge carriers show a high inherent mobility and a zero effective mass, and can be pasted micrometers without scattering at room temperature. Graphene can sustain current densities to 6 times greater than the amount of copper. This shows that the thermal conductivity is maintained [1-5].

3. THE FUTURE OF GRAPHENE

Despite optimism about the future of electronics based on graphene, it appears that graphene microprocessors Sent to market in the next 20 years. Although we had hoped that the other applications based on graphene. Of this comments can be the balance of the nanotubes considered and guess what's about to happen soon. The closest application for graphene is likely Applications in composite materials. In fact, it has been shown that graphene powder can be produced from micro-sized crystals. It may provide manufacturing Conductive plastics with Volume percent of filler less than 1%.

Another tantalizing possibility is the use of a graphene powder in electric batteries, which is one of the most important markets for graphite. Large surface to volume ratio and high conductivity of graphene powder can lead to improvements in battery performance. Carbon nanotubes are useful for this application, but production of graphene powder is cheap and it is great advantage.

Another expected application for graphene is emission field. Although not yet reported this type of application for Graphene. But thin sheets of graphite were used in plasma display before graphene was isolated, and many discussions took place regarding this issue. This is because sender Characteristics of graphene powder is excellent.

Carbon nanotubes have been proposed as excellent materials for solid state gas sensors, but graphene offers certain advantages in this particular field. Superconductor field effect transistors and etc. Are important research goals. Recent research shows features magnetic resistance and the super current of the two terminals, and confirming the potential of graphene for applications in these areas.

Finally, we cannot afford to ignore the potential for hydrogen storage, which important but controversial topic in the field of nanotubes Has also been reported that graphene is able to attract a high volume of hydrogen, and Expected Many laboratory work will done in this field [3].

4. APPLICATIONS OF GRAPHENE

4.1. Field emission of graphene

One of the potential applications of graphene is in field emission displays. Field emission is electron emission process in which electrons from the material which is located in a high electric field be sent. Simplest way to create such a field is increasing the field in sharp points of object. for the use of increasing the field single-layer or multi-layers of graphene must be installed on substrate [1].

4.2. Gas and biological sensors based on the graphene

One of the important applications of graphene is in both gas sensors and bio-sensors. Functional Principles of electronic gas sensors and biological is based on changes in the electrical conductivity of the graphene because other molecules absorbed on the surface of graphene. These Changes lead to changes in the carrier density, and it is because of absorbing gas molecules that act like donor or acceptor [1].

4.3. Field effect transistors (FET)

Another application of graphene is in field effect transistors (FET). But because graphene is a zero gap semiconductor, cannot be used directly in FET applications. For transistor applications graphene should be a quasi-one-dimensional structure with low width and smooth edge. It is expected that such

structures are called graphene Nano-ribbons have the band gap at room temperature showing that it is very suitable for FET applications. Such transistor has very good switching speed and high mobility carriers [1].

4.4. Transparent Electrodes

LTO is widely used as conductive transparent coatings for liquid crystal displays (LCD), flat screens, touch screens and solar cells. Nevertheless, high prices limited resources and fragile nature of indium limits its use in the flexible substrates and thus leads to search for a replacement with high conductivity. Graphene is one of the most important materials for Optoelectronics applications in devices such as transparent electrodes for solar cells and LCD displays. Thermal, chemical and mechanical stability of graphene and high conductivity with atomic-layer thickness causes this material to be an ideal material for transparent conductive electrode applications [1].

4.5. Batteries

Lithium ion batteries are a crucial component in handheld devices because it is clean and renewable. Among carbon material graphene anodes suggested as an effective alternative to lithium ion batteries, because graphene has more electrical conductivity than graphite, with the larger and more chemical resistant. Single layer graphene has bipolar characteristics at room temperature while the multi-layer graphene has no energy gap. Metallic properties with increasing number of layers structure will increase; graphene has a large surface area and low-gas adsorption. Graphene Nano ribbons (GNNRS) with zigzag or armchair structures show different electrical properties, zigzag GNRs are conductor and armchairs, can be conductor and also semiconductor. Energy band gap in armchair graphene Nano-Ribbone is inversely proportional to its wide [1].

5. CONCLUSION

Graphene consists of carbon atoms that in recent years, scientists have been highly regarded; According to the extraordinary electrical, mechanical and thermal features of graphene it is expected that great changes happen in the world of electronics in various devices, such as graphene transistors based on graphene. These devices have high speed and high current characteristics due to graphene specifications. This issue may also provide developments in digital world.

REFERENCES

[1] W Choi, I Lahiri , R Seelaboyina , Y Soo Kang, **"Synthesis of Graphene and Its Applications: A Review, "** Critical Reviews in Solid State and Materials Sciences, 2010.

[2] A.K.Geim**, "Graphene: Status and Prospects,"** Science, 2009.

[3] A.K. Geim and K.S. Novoselov, **"The rise of graphene,"** Manchester Centre for Mesoscience and Nanotechnology, 2007.

[4] M. M Deshmukh , V Singh, **"Graphene – An Exciting Two-Dimensional Material for Science and Technology, "** Resonanse, 2011.

A.H Castro Neto, **"The electronic properties of**