Sustainable Electricity Generation Through Geothermal Energy by Using Graphene

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***Abstract*—**The simplest way to describe grapheme is that it is a single, thin layer of graphite .in this graphite the soft, flaky material used in pensile lead .Graphite is allotropes of the element carbon, meaning it pusses the same atom but they are arrange in a different way, giving the material different properties. It's a 2D atomic layer structure and unique electronic band structure makes it attractive for many application .Its high carrier mobility, high electrical and thermal conductivity make it an existing material. Graphene is a semi metal with the small overlap between the valence and the conduction bands it means it is a zero band gap material. Nowadays graphene is use for electricity generation, In this paper we providing a strong evidence about the sustainable electricity generation by graphene. The geothermal energy available from the earth is potentially enormous bytransferring the heat of geothermal element generated in earth crust is wire up through a graphene wire we are purposing the clean and limitless source of electricity.

***Keywords*—**Introduction of graphene, properties, formation of graphene, application

I. INTRODUCTION

THEMaterials, whether naturally occurring, manufactured, or even extra-terrestrial, come in solid, liquid or gaseous form and the current engineering revolution brings extraordinary combinatorial accomplishments that establish scientific progress as a universal treasure. Many unique examples, e.g. amorphous metal , Starlight thermal insulator, liquid glass, carbon nanotubes or graphene, have captured interest with remarkable properties such as virtually indestructible structural integrity, ultimate insulation and antibacterial qualities. In that the graphene have useful thermal and electrical properties like, graphene is the more than the 100 times stronger than the strongest steel ,electron travel ballistic ally in graphene over a long distance which for exceed the length of advance FET's, graphene can sustain a current densities exceeding those of copper at comparable dimensions. Mechanical properties of graphene include an elastic strechability of up to 20% as structure is change when graphene is strained. Graphene can be traced by 1859, there has been explosion in research around the material since 2004 by Mr. Andre geim and Mr. Konstantin novoselov discovered and isolated single atomic layer of carbon for a first time. Sheetsof graphene are compose of carbon atoms link in a hexagonal shape with each carbon atom covalently bonded to three other carbon atoms. Each sheets of graphene is only one Atomthick and each graphene sheet is consider a single molecule. Graphene has the same structure of carbon atoms link inhexagonal shapes to form carbon nano tubes, but graphene is flat rather than cylindrical. Because of the strength of covalent bond between carbon atom ghaphene has very high tensile strength which is about 130.5 GPa and a young's modulus of 1 TPa (150000000 psi).Graphene is a basic structural element of many other alltrotops of carbon, such as graphite, Diamond,charcoal, carbon nanotubes,and fullerenes. It is a fifth allotrope of carbon discovered in 2003 is called graphene, and it is in the form of a layer of carbon arrange in a honey comb shape formation. The molecular weight of graphene is 2043.856g/mol.

S.N	Property	Value
1	Saturation velocity(cm/sec)	$4\text{-}5X10^7$
2	Carrier mobility(cm sq./vs)	>100,000
3	Current density (A/cm sq.)	$\sim10^9$
4	Thermal conductivity (W/m-k)	4800
5	Optical opacity (%)	2-3%per layer
6	Young's modulus(pa)	0.5-1 tera
7	Mechanical strechability	Up to 20%

Table No 1:- Intrinsic properties of graphene

II. FORMATION OF GRAPHENE

Garphene is a two dimension material which consist of carbon atom arrange in hexagonal lattice. There is several typical manufacturing method of Graphene such as mechanical exfoliation method, thermal decomposition of silicon carbon and chemical vapor deposition method. However, this method is difficult to obtained large area and uniform graphene film. As of 2014 exfoliation produced graphene with the lowest number of defects and highest electron mobility:-

- Adhesive tape
- Wedge base
- Graphite oxide reduction
- Shearing
- Sonification
- molten salts
- Electrochemical synthesis

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- Chemical vapor deposition

Carbon comes in two basic but initially in different forms, namely graphite and diamond. Both these radically different materials are made up of identical carbon atoms. The atoms inside the two materials are arranged in different ways, and these is that gives the two allotropes their completely different properties. Graphite is black,dull and relatively soft; diamond is transparent and the hardest natural material.

Graphene is including the most metals that is like crystal lattice,lots of atoms arranged in regular, endless repeating, 3D structure a bit like an atomic climbing frame,only instead of bars there are visible bonds between the atoms that hold them together. Diamond and graphite both have a 3D structure,though it's completely different.

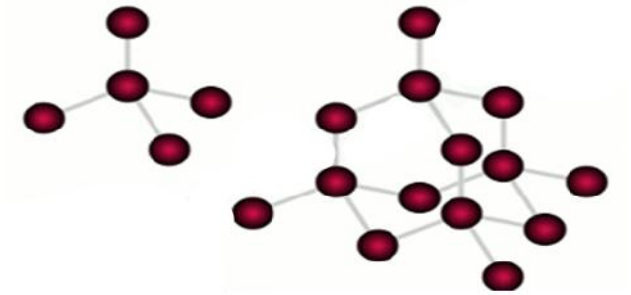
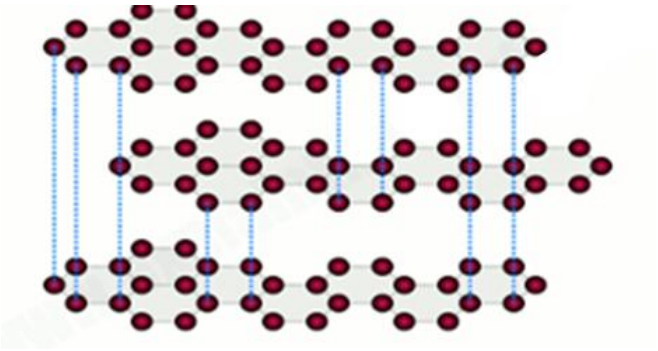


Figure No.1:-Diamond has a strong 3D crystal lattice



FigureNo.2:-Graphite 3D structure

Graphene is a single layer of graphite. The remarkable thing about it is that its crystalline structure is 2D.The atoms in graphene are laid out flat,like billiard balls on a table.Just like in graphite, each layer of graphene is made of hexagonal rings of carbon, giving a honeycomb like appearance.

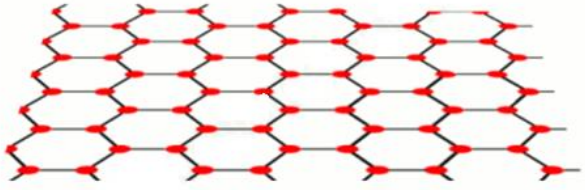


Figure No.3:-Graphene has a 2D crystal lattice

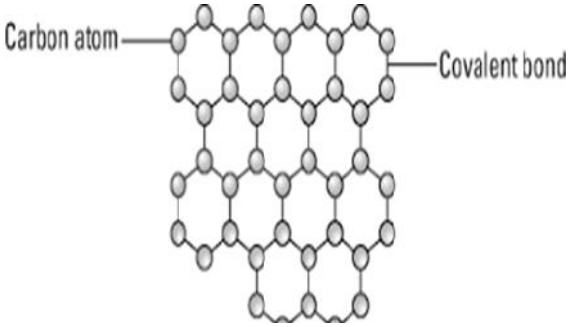


Figure No.4:-Atomic structure, 24 carbon atoms making 7 hexagons in 0.9 x 0.9 nm of graphene

III. FUNDAMENTAL PROPERTIES OF GRAPHENE

- zero band gap:-

A graphene has no band gap. a band gap is the gap between the energy of an electron when it is born to an atom, an so called conduction band , where it is free to move around. an electron can't have an energy level between those two states

- Tensile strength :

Graphene is a strongest material ever discovered, with an ultimate tensile strength of 130Gpascal compare to steel. Its strength is 0.142 Nm long carbon bonds.

- Ballistic conduction:

The hexagonal lattice has the longest mean free path of any known material of the order of micron. This is the distance an electron can travel freely without bumping into anything, or having with spark disrupted by scattering,the things that induced resistance. Whenever the free mean path is longer than the dimension of the material, material provides ballistic transport.

- Best at electricity:

It has a highest current density a, milliontimes than that of copper at room temperature, the highest intrinsic mobility and conduct electricity in the limit of no electron. Which means it can carry ore electricity more efficiency, faster and with more precision than any other material.

- Best at electronics :

One of the most useful properties of graphene is that it is a zero overlap semimetal (with both holes and electrons as charge carriers) with very high electrical conductivity. Carbon atoms have a total of six electrons, 2 in the inner shell and 4 in the outer shell.

- Transparency

The graphene has an amazing transparency property is absorbed just 2.3% of light that lands on it, but if you have a blank sheet to compare it to, you can see that the single layer of atom with your naked eye, as well as making graphene even more useful as a potential solar cell component.

- Elasticity

Graphene stretches up to 20% of its length and it is also the stiffest known material,even stiffer than diamond.

- Thermal conductivity

Graphene also beats diamond in thermal conductivity. In fact,graphene now holds the record for conducting heat. It's better than any other known material.

IV.ELECTRICITY GENERATION USING GRAPHENE

Graphene does conduct electricity this is because of its structure. In graphene each carbon atom is covalently bounded to 3 others, this atom contains free delocalize electrons that can carry a pass on an electric charge. Graphite is soft and slippery because there are only week intermolecular forces between its layers. Graphite is a good conductor of heat and electricity. This is because like metals graphite contain delocalize electrons. These electrons are free to move through the structure of the graphite.

Conventional electricity generation by using graphene

- By geothermal energy
- By solar energy
- By composition of water and graphene
- By salt water and graphene

How will the world continue to push the boundaries of sustainable energy? It seems that the solution for a new, revolutionary energy source is right under our feet. Ultimately, we could solve the world's energy problems by collecting geothermal energy in a newfound way and they are working to do just that.

A] GEOTHERMAL ENERGY WITH GRAPHENE:-

A section of the groundbreaking documentary, Billions in Change, highlights the immense potential of a new geothermal energy concept. This idea starts with a modern substance beingutilized by entrepreneur-turned-good-Samaritan,Mr. Manoj Bhargava, and his team of highly skilled engineers.This substance is known as graphene.

At a glimpse, graphene sounds like it's straight out of a science fiction novel. It's essentially carbon dissected at single-molecule level: The world's first two-dimensional object. It's almost transparent, and almost weightless, but it's stronger than steel and possesses amazing property. Namely, graphene is one of the best conductors in the world.

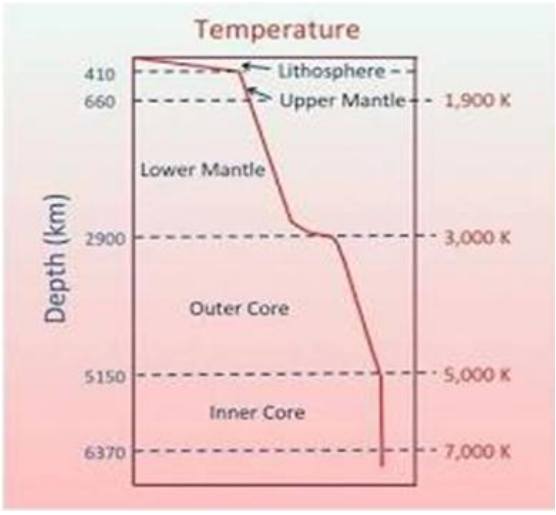
B] ENERGY POTENTIAL OF GRAPHENE:-

As we seegraphene conducts 100 times better than copper,it also conducts heat in direct way. Energy is transferred through graphene from end to end without any heat remaining in between.

To that end, just a few miles beneath us lies nearly unlimited potential. There is an outstanding amount of heat below us; all we need to do is collect that energy. It's possible to transfer geothermal heat into clean energy.

Simply, it's the resources we have to transfer the Earth's heat, or lack thereof rather. Copper based instruments melt the further down they go, and so do most other conductive materials, but not graphene. This is because graphene is the world's most conductive substance, all while being malleable and stronger than metal.

Using graphene to collect geothermal energy is possible, and Bhargava is the person at the forefront of this incredible idea. As the CEO of the popular Five Hour Energy drink, he's taken his immense wealth and channeled it into creating the energy source the world needs. What we need is energy that is limitless, without creating pollution. In those regards this idea is extremely promising. Two Russian scientists discovered that graphene can have exceptionally large thermal conductivity, up to 5300 W/ (m.K), something like 12,000 times better than copper and got rewarded with the Nobel Prize in 2010. The Mr. Manoj Bhargava Indian billionaire thinks that graphene (carbon) cables could revolutionize how we extract heat from geothermal wells and distribute heat and invests in the technology. The idea is to abandon the concept of geothermal heat transfer through fluid motion, and instead use thermal conductivity of graphene to bring heat to the surface of the earth via wires, without moving material, pumps and pipes.



FigureNo.5:- Earth temperature

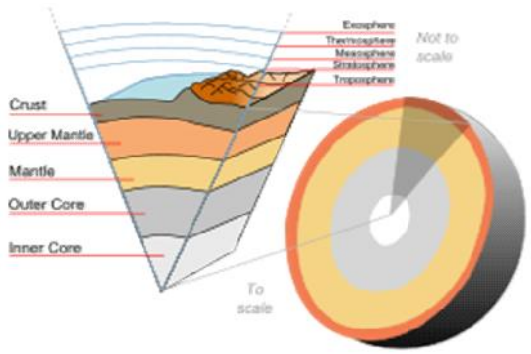


Figure No.6:-Earth internal layers

V.ADVANTAGES OF GRAPHENE:

1. It is Ultra-light and also immensely tough.
2. It is 200 times stronger compare to steel and incredibly flexible
3. It is thinnest material possible and it is completely transparent which can transmit more than 90% of the light.
4. It is ultimate conductor and it can function as perfect barrier, the helium cannot even pass through graphene.
5. It can transfer electron at much faster rate compare to silicon, it can pass the speed of 1000 km/sec which is about 30times fast compare to silicon.
6. It can be used in flexible electronic newspaper foldable televisions.
7. Graphene can be used in popular market of smart phones and wrist watches.
8. It can be used for wide variety of application such as flexible displays (OLEDs,LEDs),RAM, energy efficient transistor,energy storage devices, textile electrode, copper Nano wires, thermal management, spintronic.
9. It can be used in clothing which uses graphene based photovoltaic cell as well as super conductor due to this tablets and mobile phones can be charge in minutes in the pocket its self.

VI. APPLICATION

- BIOLOGICAL ENGINEERING

Bio- engineering is the field in which graphene will become a wide part in the future, because of that some obstacle need to be overcome before it can be used current estimation suggest that it will not be until year of 2030. When we will begin to see graphene widely used in bio logical applications as we still need to understand its bio compatibility (it must undergo numerous safety, clinical and regulatory trials) however, the properties that it displays it could revolutionized this area in a number of ways. With graphene offering a large surface area, high electrical conductivity, thinness and strength, it would may a good candidate for development of fast and efficient bio electric sensory devices, with the ability to monitor such things as glucose level, hemoglobin levels, etc. Eventuallyknown about processed toxic graphene that is able to be used as an antibiotic or even anticancer treatment.

- OPTICAL ELECTRONICS

One particular area in which we will soon begin to see graphene used on a commercial scale is that in optoelectronics; specifically touchscreens, liquid crystal displays (LCD) and organic light emitting diodes (OLEDs). For a material to be able to be used in optoelectronic applications, it must be able to transmit more than 90% of light and also offer electrical conductive properties exceeding 1×10^6 Ω/m and therefore low electrical resistance. Graphene is an almost completely transparent material and is able to optically transmit up to 97.7% of light. It is also highly conductive, as we have previously mentioned and so it would work very well in optoelectronic.

- ULTRAFILTRATION

Another stand out property of graphene is that while it allows water to pass through it, it is almost completely impervious to liquid and gaseous. This means graphene could be used an ultrafication medium to act as a barrier between two substances. The benefit of using graphene is that it is only one single atom thick and can also be developed as a barrier that electronically measured strain and pressure between the two substances. A team of research at Columbia University has managed to create mono layer graphene filters with a pore sizes as small as 5mm.

While these pore sizes are extremely small, as graphene is so thin, pressure during ultrafiltration is reduced. Co-currently, graphene is much stronger and less brittle than aluminum oxide (currently used in sub-100nm filtration applications). It could mean that graphene is developed to be used in water filtration systems, desalination systems and efficient and economically more viable biofuel creation.

- COMPOSITE MATERIALS

Application such as LCD touch screen for smart phones, tablet and desktop computers and televisions. It could be utilized in the process of tissue regeneration.

- ENERGY STORAGE

One area of research that is being very highly studied is energy storage. While all areas of electronics have been advancing over a very fast rate over the last few decades (by using moore's law it states that the number if transistors used in electronic circuitry will double every two years). The problem has always been storing the energy in battery and capacitors when it is not being used. This energy storage solution developing at much slower rate. The problems are a battery can potentially hold a lot of energy, but it can take a long time to charge (comparatively speaking). The solution is to develop energy storage components such as either a super

capacitor or a battery that is able to provide both of these positive characteristics without compromise.

Currently, scientists are working on enhancing the capabilities of lithium ion batteries (by incorporating graphene as an anode) to offer much higher storage capacities with much better longevity and charge rate. Also, graphene is being studied and developed to be used in the manufacture of super capacitors which are able to be charged very quickly, yet also be able to store a large amount of electricity. Graphene based micro-super capacitors will likely be developed for use in low energy applications such as smart phones and portable computing devices and could potentially be commercially available within the next 5-10 years. Graphene-enhanced lithium ion batteries could be used in much higher energy usage applications such as electrically powered vehicles, or they can be used as lithium ion batteries are now, in smartphones, laptops and tablet PCs but at significantly lower levels of size and weight.

- GENERATION

In generation it is use in various fields as given below:-

- Ethanol distillation
- Solar cell
- Charge controller
- Light collector
- Electrode
- Fuel cell
- Thermoelectric
- Charge coating

VII. Conclusion

The traditional description of graphene and its properties are now being expanded by many of the examples highlighted in this review from research. This paper has provided strong evidence that the motion of two dimensional materials could be used as a source of clean, limitlessenergy. The electrical and thermal conductivities of graphene are among the highest of any known element and geothermal energy is the abundance source of energy by using both, this paper provides the method of sustainable electricity generation.

VIII. Acknowlegement

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IX. References

[1] Kassner ME, Smith K, Eliasson V. Creep in amorphous metals. J Mater ResTechnol. 2015.

[2] Hummers Jr WS, Offeman RE. Preparation of graphitic oxide. J Am Chem Soc.1958.

[3] Curl RF. Dawn of the fullerenes: experiment and conjecture. Rev Mod Phys.1997.

[4] Geim AK, Novoselov KS. The rise of graphene. Nat Mater. 2007;6(3):183-91.

[5] Allen MJ, Tung VC, Kaner RB. Honeycomb carbon: a review of graphene. ChemRev. 2009.

[6] Xu M, Liang T, Shi M, Chen H. Graphene-like two-dimensional materials. ChemRev. 2013.

[7] Ionita M, Pandele MA, Iovu H. Sodium alginate/graphene oxide composite filmswith enhanced thermal and mechanical properties. Carbohyd Polym. 2013.

[8] Zhang "Layer-by-layer inkjet printing of fabricating reduced graphene-polyoxometalate composite film for chemical sensors," Phys. Chem. Chem. Phys., vol. 14, no. 37, pp. 12757–12763, Oct. 2012.

[9]. Song, H. Yang, Y. Wang, S. Chen, D. Li, S. Zhang, and X. Zhang, "Controlling the assembly of graphene oxide by an electrolyte-assisted approach.," Nanoscale, vol. 5, no. 14, pp. 6458–63, Jul. 2013.

[10]. C. Chinchen et al., "The measurement of copper surface areas by reactive frontal chromatography," J. Catal., vol. 103, no. 1, pp. 79–86, Jan. 1987.

[11] J. E. Schroeder, D. Pouli, and H. J. Seim, "High Surface Area Silver Powder as as OxygenN Catalyst."