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Applications of Graphene: A Review

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ABSTRACT: In energy storage systems, most technologies revolve around the use of graphene. Graphene is potential of boosting the effectiveness, flexibility and reliability of many systems, but further research work is still needed for the commercialization of graphene. The use of graphene in energy storage systems, absorbers and electrochemical sensors was discussed in this investigation. In order to extend the use of graphene, its present drawbacks must be urgently discussed in order to maximise its existing performance. Also, in terms of potential, their use in both electroanalytical and electrochemical sensor has extended the benefits of graphene.These strong graphene properties must be further expanded and enhanced to make them ideal for other applications. The efficiency of this novel material can also be enhanced by crucial analysis of simple graphene synthesis combined with thorough investigation into the framework of graphene oxide at the molecular level. The effects of defects on graphene oxide performance have also been described as another key research field that requires a great deal of focus to speed up the commercialization of this material.With the exponential growth in the implementation of graphene in various energy storage/conversion systems, the latest advancement in the implementation of graphene in these areas needs to be summarised and addressed.

Keywords: Absorber, Composite material, Electrochemical, Graphene, Sensors, Storing.

INTRODUCTION

The key aim of the Paris Agreement signed in 2015 was to explore, through the evaluation of new sources of energy production, constructive options to tackle climate change. Owing to the harsh effects of fossil commodities being used as alternate sources of electricity production, this target is inevitable. The sustainability of the consumption of electricity by means of fossil fuels has also added greatly to the need for other means of producing resources. The primary predictor for the clarion call for consideration of other new forms of energy production was the decline of oil fuels. These assertions have been further reinforced by the prices of carbon fuels not being constant. The pollution further result in the ozone layer being depleted.The unexpected surge in renewable sources of energy production accounts for these issues.

Renewable electricity is an ample energy supply that is therefore environmentally sustainable. The key drawbacks relating to the energy generated by this medium are the question of the intermittent existence of these energy sources [1]. In the electricity sector, for example, solar and wind power already do so well, but their intermittency needs a power storage or conversion unit to be built into the system to make the process more efficient and cost-effective.Fuel cells are new energy conversion systems with little to no environmental effects but high potential performance and power, but practical energy efficiency and energy density are smaller than the theoretical ones [2]. Dye synthesised solar cells (DSSCs) are equally appealing instruments for energy transfer, but in terms of their stability, they have certain limitations. The recorded efficiency of DSSCs, for example, is about 10 percent using Fluorine Tin Oxide (FTO).

Batteries and supercapacitors are energy storage systems that are undergoing substantial study to maximise their energy density in order to meet the exponential growth in renewable energy [3].Graphene is a continuous, two-dimensional graphite layer with excellent characteristics in view of maximum electrical conductivity, mechanical durability, thermal conductivity, and absorption of solar radiation. In many uses, like catalytic reactions, catalyst support, CO2 capture, and several other power transformation and power storage products, Graphene showed outstanding performance. This study summarised the up-to-date use of graphene in various converting devices, including a history on graphene synthesis and properties, demonstrating the role of graphene in each use. The guidelines and results are illustrated at the top.

GRAPHENE UTILIZATION

In modern years, the use of graphene has been tremendous. The next few parts demonstrate the numerous uses of graphene that concentrate on its use in varied uses, such as energy storage/conversion systems[1].

Composite material

Graphene is often used in composite materials as usable components, and this helps to enhance the composite's properties and also efficiency. When blended together, graphene with strong elasticity, resilience and porosity has a favourable impact on the composites. Under pressure, the power of certain graphene increases. Under cross-linked conditions, these forms of graphene demonstrate heavy compression. The spongy framework of these graphene makes them suitable for polymer matrix reinforcement. This ensures that the graphene matrices have good strength, improved hydrophobicity and high conductivity[2][3].

Electrochemical sensors

Trace target identification can be accomplished with graphene possessing strong conductivity and also high surface area. Because of the large pores, there is an improvement in analyte transport, thereby enabling the identification of binding targets. They are capable of detecting beneficial biological moieties at lower doses as graphene is used in specific sensing systems.

Absorbers

The high surface area is demonstrated by three dimensional graphene. Their designs make them perfect for cases of absorption. In contrast to other materials, graphene is ideal for organic liquids and therefore favourable in terms of recyclability. Once again, graphene sheets have shown that certain gases can be absorbed at lower concentrations. The graphene functional group is even able to decrease the sensitivity to gas for trapping and also in the industries to transform undesirable gases[4].

Energy storage/conversion devices

Graphene is also suitable for energy storage system processing. This is particularly possible if metal oxide is processed, thereby illustrating minimal sheet restacking. The highly conductive entangled graphene channels also lead to the factors underlying their interest in implementations for energy storage. Other variables such as their porous microstructure, electrochemically robust as well as mechanically strong reliability are some of the graphene merits when used as energy storage instruments. Some of these products include fuel cell applications, solar panels, batteries, and supercapacitors.The proton exchange membrane (PEM) fuel cell supports are mostly made of graphene, although they are used as anodic and cathodic materials in the cell for batteries such as Li batteries. Graphene has been used as a electrode material in supercapacitors for both the double layer capacitors and also the pseudo capacitors. They are used as desensitizers in fuel cells as well[5].

RECOMMENDATIONS AND FUTURE DIRECTIONS

With many experimental studies presently being undertaken, research into the use of graphene in many energy storage/conversion systems is still novel. The appropriateness of graphene for both electrochemical and electrochemical applications was discussed in this study. It also addressed the merits of graphene oxide and graphene relative to other carbon allotropes of carbon. Any of these merits involve good surface area, fast synthesis, highly conductive, solubility, and it is also cheap to source the material. There has been plenty of technical development, but there is also much room for growth in terms of both electroanalytical and electrochemical sensors.The electrochemical use of graphene oxide materials must also be expanded to include potential directions for other electrochemical applications.

Any difficulties correlated with this material, such as simple synthesis, must be approached critically. It is also very important to determine the composition of graphene oxide at the molecular level. The impact of faults on graphene oxide conductivity is also another key field that requires more attention. A ground-breaking area of study that will further improve the use of graphene oxide in other applications will also be a detailed understanding of the passage of electrons on the graphene oxide substrate interface.In the potential growth of this material, the architecture and methodology followed in the production of graphene oxide-based devices are also important. Despite these difficulties, the use of graphene oxide in electrochemical sensors continues to be the key potential use of graphene oxide.

Any of the major benefits of the use of graphene and graphene oxide in many energy storage/conversion systems are the benefits of graphene and also graphene oxide, like 2D graphene networks and strong hydrophobicity. The latest technical developments in the synthesis of these advanced technologies, classification and present day applications were extensively discussed in this study. Today, 3D graphene structures have been developed that have also demonstrated improved performance compared to 2D graphene. This research ventured into ways to synthesise graphene with the primary purpose of improving both its consistency and efficiency.Such approaches include CVD, which also contributes to the formation of larger pore structures with good conductivity.

Using this technique, the consistency of the substance is often much increased? In terms of scalability that use this method, there are still increasing questions. The size and efficiency of the graphene oxide precursor is similarly subject to the characteristic and also the quality of graphene and graphene oxide. The performance of the sponges is also focused on the consistency and dimension of the precursor of graphene oxide, the form of reducing agent, the cross-likers and the pH of the synthetic solution.Again, its durability must be greatly increased in order to manufacture graphene sponges on a wide scale, since it is actually fragile. Another recent path for study in this field is research into the implementation of innovative strategies aimed at optimising inter-sheet linking. These features can be accomplished by the merging of elastic graphene sponges and polymers[6].

CONCLUSION

Graphene has some benefits, as well as several drawbacks. There is the need for more modification to be made in order for graphene to be sold and interact with notable products now in nature. Most of the graphene sponges discussed in this research are only on a small scale and, despite being flexible and also elastic, such sponges may possibly be weakened, so researchers classify these as delicate if not handled properly. In terms of strategies that can create improved inter sheet linking and also composite that demonstrates versatility and resistance to tear, future studies must take this path seriously.Utilizing elastic polymers and even changing the fibres or optimising the crosslink agents accountable for the framework will do this. Model growth strategies are decreased by the furnace size and also sheet faults in terms of the scale. In order to improve a furnace architecture that is able to withstand more layers, more investigations should be carried out. Particularly for commercial applications, graphene sponges produced by dry and self-assembly methods need freeze drying processes. The binding of the sponge framework may also be halted by other influences. The classification of precursors of graphene must also be further explored in future scientific research.The use of three-dimensional graphene and graphene oxide is the potential of several technologies and must therefore be regarded seriously in future development work.

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