Preparation of Graphene Oxide Based Hydrogel for Diabetics Foot Ulcer

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Abstract - Diabetes is a condition that impairs the body’s ability to process glucose otherwise known as blood sugar. High levels of blood glucose caused by diabetes can over time affect the nerves and lead to poor blood circulation making it hard for the blood needed for skin repair to reach areas of the body affected by wounds. In this paper we produce a component material which heals the wound for diabetic patients in a short period of time. Normally, wound is healed in slow process therefore we designed a hydrogel for fast recovery in diabetic patient. In this work the Graphene oxide (GO) is synthesized using popular chemical method and the particle size is characterized using FTIR analysis. This Graphene Oxide (GO) as hydrogel can make the process of healing is faster method for diabetic patients. Graphene oxide (GO) have been incorporated into hydrogels to improve the properties of conventional hydrogel and healing property.

Keywords Graphene Oxide (GO), Fourier-transform infrared spectroscopy (FTIR), Hydrogel

1. Introduction

Nanoscience and nanotechnology essentially manage the combination, portrayal, investigation, and abuse of nanomaterials. Carbon, one of the most widely recognized molecules on Earth, happens normally in numerous structures and as a segment in endless substances which are called allotropes of carbon. Graphene, a "wonder material" is the world’s most slender, most grounded, and stiffest material, just as being an incredible transmitter of warmth and power [1]. It is the essential structure square of other significant allotropes. Graphene oxide (GO) is of extraordinary enthusiasm because of its ease, simple access, and broad capacity to change over to Graphene [2]. Adaptability is additionally a much wanted component. Graphene oxide is graphite that has been oxidized to sprinkle the carbon layers with oxygen particles, and afterward diminished, to isolate the carbon layers totally into individual or not many layer graphene. Graphene oxide is adequately a side-effect of this oxidation as when the oxidizing operators respond with graphite, the inter-planar separating between the layers of graphite is expanded. The totally oxidized compound would then be able to be scattered in a base arrangement, for example, water, and graphene oxide is then created.

Graphene oxide is graphite that has been oxidized to dissipate the carbon layers with oxygen particles, and thereafter diminished, to confine the carbon layers absolutely into individual or scarcely any layer graphene [3]. Graphene oxide is enough an aftereffect of this oxidation as when the oxidizing masters reacts with graphite, the inter-planar isolating between the layers of
graphite is extended [4]. The completely oxidized compound would then have the option to be dissipated in a base plan, for instance, water, and graphene oxide is then conveyed. A tremendous number of oxygen-containing down to earth social occasions have been introduced onto the different sides of a lone graphite sheet (explicitly, graphene) The implantation of helpful get-togethers overcomes the between sheet van der Waals power and grows the interlayer isolating. The sheets in such an all-encompassing structure are then viably pulled open using an external force, for instance, sonication. That is, the all-inclusive graphite is stripped into multi-layered or even single-layered sheets [5]. All things considered, the oxidized graphene sheets, to be explicit, GO, acquire various disfigurements and the degree of the flaws is reliant upon the additional substance proportion of oxidant and the oxidizing time [6]. GO is conveyed by the oxidative treatment of graphite by one of the standard strategies made by Brodie, Hummers or Staudenmeir natural and biomedical limits.

1.1 Properties of GO

Graphene, a "wonder material" is the world’s extraordinary enthusiasm because of its ease, simple access, and broad capacity to change over to graphene [7]. Adaptability is additionally a much wanted component. There are vast possibilities for graphene oxide in medicine. One of the most critical applications is in Cancer and Diabetic treatments. Graphene oxide (GO) is an allotrope of carbon two dimensional(2D) form, made by the powerful oxidation of graphite, which is cheap and abundant. Graphene oxide (GO) is an oxidized form of Graphene, laced with oxygen containing groups [8-10]. Graphene oxide (GO) is not a good conductor and its sold as powder from, dispersed or as a coating on substances [11-13].

It is used as films can be deposited on essentially any substrate, and later converted into a conductor [14]. This is why Graphene Oxide (GO) is especially fit for use in the production of transparent conductive films, like the ones used for flexible electronics, solar cells, chemical sensors and more [15].

There are vast possibilities for graphene oxide in medicine. One of the most critical applications is in Cancer and Diabetic treatments [16]. It has been suggested that functionalized nano-sized graphene can be used as a drug carrier for in vitro intracellular delivery of anticancer chemotherapy drugs.

The major contribution of the work in this paper are as follows

- To prepare Graphene Oxide Based Hydrogel for Diabetics Foot Ulcer
- This type of Graphene based oxide Hydrogel is prepared by eminent method of “Modified Hummer’s procedure” which is simple and easy step to synthesis the Hydrogel component
- The so-formed Hydrogel has a good tissue rejuvenate property which is the best suited for wound healing for its fast recovery.
- Finally, the component is characterized with FTIR spectrometer to detect the presence of molecular component.

2. Materials and methods

2.1 Synthesis of Graphene oxide

Graphene oxide was mixed by Modified Hummers strategy through oxidation of graphite. The stepwise work plan is given in Figure 1.
Figure 1 Synthesis of Graphene Oxide

2.2 Preparation of GO polyamidoamine

Graphene oxide was included with PAMAM (polyamidoamine) to certain ratio (2:1). The materials self-collected into truly cross connected systems. By electrostatic interactions between the oppositely charged GO nanosheet PAMAM is dried. At that point the hydrogel squares self-recuperated after the cut surface were tenderly squeezed and left for 10 mins in room temperature. The process of Stirring and the resultant, Graphene oxide is shown in Figure 2 & Figure 3 respectively.

Figure 2 Stirring Process

Figure 3 Graphene Oxide
3. Results and Discussions

The Graphene oxide was synthesized by modified Hummers method and described by FTIR spectrometer and the resultant graphene powder is shown in Figure 3.

Many methods had been explored to prepare graphene oxide but method observed and explored as fine resultant as Figure 2 shows the stirring work process to prepare hydrogel by the resultant powder. Thus produced powder after analyzed with FTIR shows various bonds groups of functional groups

\[(C-O)(C=O)(COOH)(C-OH)\]

Similarly the ranges may differ in molecular bonding such that they may varied in the range (1047.6), (3704.8),(1732.7),(1614.1),(12223),(1487.9).

Liquid mixture particle then heated to make powder was warmed. Meanwhile it was stabilized and the graphene was warmed before going to place the pellet and by reading FTIR we get peak values and so the skin wound may heal without membrane. Deposited substance may give defined values. As we convert as a Graphite which are abundant and biocompatible. So the corresponding peak values indicates the groups with application values such case FTIR encounters the types of functional groups approximately

3.1 Fourier Transform Infrared Spectroscopy

Fourier Transform Infra-Red Spectroscopy is an instrument which gains broadband close Infra-Red (NIR) to far Infra-Red (FIR) spectra. In contrast to a dispersive instrument, i.e., a grinding monochromator or spectro-strength, FTIR spectrometers gather all frequencies at the same time. This component is known as the multiplex or felgett favorable circumstances. The explanation of utilizing FTIR on account of high goal and other worldly precision.

FTIR depends on the way that the most particles assimilate light in the infra-red area of the electromagnetic range. This assimilation compares explicitly to the bonds present in the particle.

The formulated results of GO by Modified Hummer’s strategies are described by Fourier Transform-Infrared Spectroscopy (FTIR) which is shown in Figure 4.

![Figure 4 Fourier Transform Infrared Spectroscopy](image)

3.2 Inference from the FTIR Spectrum

From the above graphical plot shown in Figure 4, the following inference was made.
1047.6 C-O Fourier Transform Infrared Spectroscopy absorbed structure of 
Graphene (CO) at room temperature is shown as vibration for hydroxyl (COOH) 
and H2O contribution.

For instances the modified hummers leads to strong infrared absorbance oxidized 
with C=O or COOH and C-OH regions of grapheme with sharp peak at 3704.8 
1/cm due to hydroxyl carboxyl and water contribution

The peak at 1732.7 denotes ketone C=O because the 1k cross section C-OH made 
carboxyl groups COOH is stronger than C=O they are dominated in ketone

There is also bond of 1614.1 1/cm that denotes normally asymmetric stretch SP2 
hybridized C=C .it intensity critical depends on the environment being strongest 

when out of plain species are removed restoring C=C.

The stretching vibrational modes of all others derivation of ketone made fall in 
higher frequency region with contribution at peak of 1047.6 1/cm, with overlapped 
within other at 12223 1/cm.

The peak at1487.9 1/cm SP2 hybridization inter starching of C=C from peak values 
which is celebrated with reference confirmed is synthesized material graphene 

oxide of peak values is confirmed

4. Conclusion
As an end comment it is concluded that, Graphene Oxide (GO) is ‘Promising material’ with high 
specific unit area, low density, and high porosity. The experimental values in this article give 
hydrogels which could be prepared from grapheme oxide. The application of Graphene and the 
Graphene oxide (GO) preparation were discussed in detail and the particle size is characterized 
by FTIR analysis and the results are also formulated. The results further shows various presence 
of bonding further Graphene oxide can be used in many medical applications. Various graphene 
oxide layers are also explained which is produced by organic metallic solution, thus proving the 
nanocomposite hydrogel consisting of mechanical reinforcement was good enough in Graphene 

Oxide (GO). In this work it clearly explains about the Graphene Oxide was successfully prepared 
from graphite and also the dendrimer molecular polyamidoamide hydrogel reaction can also be 
done by the process of electrostatic interaction.

The value of FTIR denotes each separate and unique property on the Graphene Oxide (GO) 
molecules which is most suitable for variety of medical applications which in-turn produces a 
promising revolutionary change in biomedical era.

In the above FTIR analysis graph the peak value of 1047.6 shows the accurate presence of 

Graphene oxide functional group which enhances the possibility of healing the wound of 
diabetics foot ulcer patients and also can be used for various would healing applications. The 
simulation also replicates the functional group order to measure statistically significant changes 
in behavior of material.

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