Glucose Bio Sensor Base Nanocomposite Graphene/TiO2

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Abstract. The use of graphene and titanium oxide nano-mixtures in a wide variety of physical products, such as solar panels, biosensors and fuel cells. Owing to the special general physical properties of TiO2 and graphene, graphene has a huge conductivity to sustain TiO2 and is used as a photo catalyst in water and moisture solutions in bio nano sensors. TiO2 has special features, such as stability low toxicity and cost-effectiveness. Primary findings have shown that the manufacture of the system sensor displays a great and quick reaction to glucose to be the ideal biosensor unit. The use of TiO2 is limited by its wide band gap energy contributing to light absorbance in the UV spectrum area and the relatively high rate of recombination of photo-generated electrons. The use of G / TiO2 to improve photocatalytic behavior and stability so that maximum electrical sensitivity can be achieved. Preparation of Titanium dioxide / Graphene nanocomposite thin film for glucose exposure by spray pyrolysis technology (SPT), Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD) are structural and morphology studies.

Keyword: graphene-TiO2, nanocomposite-Biosensor.

1. Introduction

Nanomaterials are commonly used in numerous applications such as communications Systems, energy transfer, energy harvesting, environmental remediation catalysts, medical equipment, antimicrobials, cosmetics and biomedical applications. [1].

Bio nanocomposites based on carbon nanomaterials and metal / metal oxide nanoparticles provide a convenient forum for the immobilization of biomolecules due to the synergistic impact of their different components. [2].

The nano-structured semiconducting metal oxide such as TiO2 is used in wide range of electronic application such as, drug delivery system, sunscreens and wound healing [3][4]. Recently graphene derivatives and TiO2 nano-composites discover diverse application covering from electronic to biomedical applications [5] [6].
Graphene, a two-dimensional lattice of sp2-hybridized carbon, has attracted a great deal of interest in recent years owing to its unusual mechanical, electrical, thermal and optical properties, opening up a promising new research area due to its immense potential.[7][8].

Much of the interesting and unusual properties of Graphene can only be known after being integrated into more complex assemblies. Some hybrid materials based on graphene have shown greater versatility as advanced electrode materials for the manufacture of electrochemical sensors and biosensors [9][10]. TiO2 is a metal oxide widely used in the development of electrochemical sensors and biosensors thanks to its biocompatibility and high conductivity [11][12]. The most recently published TiO2–graphene (TiO2–Graphene) nanocomposite used in the construction of electrochemical biosensors and used in some biomolecule sensing processes, such as dopamine, glucose, adenine and guanine.[13][14] TiO2–Graphene-based analytical methods have demonstrated outstanding performance due to the properties and benefits of TiO2–Graphene nanocomposite, such as high selectivity, high dynamic range and low detection limits, and have provided a new forum for electrochemical sensors and biosensors.

2. Technical Approach

2.1 Preparation of TiO2–Graphene nanocomposite

The famous method used to prepare thin film and nanocomposite materials which is Spry pyrolysis Technique, it is started with weighing of 60mg of graphene to 180ml of distilled water with sonication process in an ultrasonic machine for two hours. After that, mix the materials (mixture) by using magnetic stirrer device for two hours, then add 6mg of TiO2 with an ultrasonic device for an hour. Finally, use magnetic stirrer device for two hours until the solution become homogeneous and ready to deposited on the glass samples by Spry pyrolysis Technique.

2.2 Spraying Pyrolysis Technology (SPT)

The process can be defined as a material structure in which the components of the vapor phase react to form a solid at some surface; the presence of a chemical reaction is a key feature of the pyrolysis system [15].

The pyrolytic decomposition of the desired compound to be deposited is the basic concept of the spray pyrolysis process. Sprayed droplet has penetrated the surface of the hot substrate underneath which is pyrolytic and forms a single substrate to create a crystalline or crystalline group as a result. Substrates provide thermal energy for thermal decomposition and recombination of composite materials, along with sintering and crystallization of the crystalline component, resulting in a coherent loop. It's the plot. Chemical spray pyrolysis process has been used in the present research. In this process, thin film was prepared by spraying the solution on a hot glass substrate at appropriate temperatures and the film could then be produced by a chemical reaction on a hot glass substrate.
3. Results and discussion

Scanning electron microscopy technique allows the visualization of high-resolution samples and it is a type of electron microscope that scans the sample surface with a high-energy electron beam. The electrons communicate with the atoms that make up the sample's output signals, which provide information on the surface of the sample, morphology and other propriety.

SEM is a very valuable method for the analysis of nanoscale materials, since the three-dimensional images offer greater detail on the sample as a result of the large depth of concentration of the beam electron in SEM.

Characteristics The SEM image of Graphene (Fig. 2) displays the usual crumpled and wrinkled shape of the Graphene sheet.

Fig. (3) Shows that the TiO2 coating represents the porous structure and the TiO2 particles have a uniform distribution on the substrate and that the film has a large degree of homogeneity and smooth surface.
Figure 2. SEM images of graphene.

Figure 3. SEM images of Titanium dioxide.

Figure 4. SEM image of Graphene and Titanium dioxide G/TiO2 nanocomposites.
Nanocomposite can be clearly seen in the SEM images of Fig. 4. It is observed that for TiO2 / G nanocomposites, TiO2 is covered by spherical graphene sheets to create a uniformly spaced network of conductive tunnels that improve the conductivity and porosity of nanocomposites.

One of the most well-known ways of analyzing the composition of bulk materials as thin films is X-ray diffraction.

X-rays are high-frequency electric waves, but short wavelengths that therefore no rest area.[16]

XRD is used to provide details on crystal phase composition and phase purity in crystalline materials. In addition, the total particle size can be determined by expanding the relevant value in the XRD spectrum.

The X-Ray diffraction (XRD) spectra of TiO2 NP (green curve) and TiO2 / graphene (purple curve) was recorded in the range of 10° to 100° of the angle of view The x-ray findings suggest that the films were crystallized in a monoclinic process with a polycrystalline structure and arranged in a polycrystalline form (101), (004), (200), (105), (201), (204), (116), (215) and (220) at 25.3°, 37.8°, 48°, 54°, 55.2°, 62.7°, 68.9°, 70.3° and 75.3° PhasTiO2 anatasis flights, respectively. The highest point of the X-ray is achieved in(101) direction and the other peaks are smaller than the (101) point with the TiO2 and TiO2 / graphene surfaces. The XRD results reveal that the final crystalline structure is not changed by the binding of the graphene to the TiO2 surface and does not disturb the crystalline structure of TiO2. The lattice constants (a) and (c) of TiO2 films are (3.6) and (9.5) respectively. We are explicitly in line with the regular values (3.7) and (9.5) taken from (ASTM) and other papers. [17].

Figure 5. XRD of Graphene and Titanium dioxide G/TiO2.
Figure 6. Shows the relation between Resistivity and glucose.

Figure 6 explains the interaction between conductivity and glucose where there is an increase in electrical resistance with a rise in glucose in the range from 150 to 440, and then decreases and persists at a steady glucose level of 440 mg / dl. This means that the work of the sensor is within these values and can be considered a great and excellent line of function as a biosensor which encompasses much of the blood glucose values. The stability can be due to the saturation level of Graphene / TiO2 at 450, after which the Glucose level does not increase the resistance factor.

Figure 7. Schematic of the preparation process of TiO$_2$-rG/TiO$_2$ electrode.

TiO2 When exposed to light in the ultraviolet range from the solar system that enters the Planet, the electrons migrate from the valence band to the conduction band, and the electrons in the conduction band to the surface of the graphene, to the surface of the graphene, to the surface of the graphene, to the graphene to the surface of the graphene, and to increase the offset potential produced by the carbon loop They contribute to the production of current and electrical signals that can be used to create a system that detects moisture, certain organic compounds, live cells, and glucose.
4. Conclusion

In this study, graphene was used with nanoscale titanium dioxide to manufacture the system sensor using the technique of spray pyrolysis, SEM and XRD, explains the interaction between conductivity and glucose where there is an increase in electrical resistance with a rise in glucose in the range from 150 to 440, and then decreases and persists at a steady glucose level of 440 mg / dl. This means that the work of the sensor is within these values. TiO2 is covered by spherical graphene sheets to create a uniformly spaced network of conductive tunnels that improve the conductivity and porosity of nanocomposites. Where the results indicate that G/TiO2 composite materials are suitable for use as sensor.

5. References

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