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The Effect of ZnO Transfer to Graphene Layer as ZnO/Graphene Nanocomposite: A Potential pH Sensor

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Structured Abstract

Background: The accurate measurement and monitoring of pH levels are crucial in various fields, including environmental monitoring, healthcare, and industrial processes. However, the development of an efficient graphene-based pH sensor with enhanced sensitivity, wide sensing range, and long-term stability remains a challenge. The objective of this research project is fourfold: firstly, to fabricate graphene through Thermal Chemical Vapor Deposition (TCVD) using waste engine oil (WEO) as a carbon precursor; secondly, to transfer graphene onto Indium Tin Oxide (ITO) substrate. Thirdly, to fabricate ZnO/Graphene nanocomposites through a transfer process; and finally, to characterize the structural, optical, and bonding properties of the nanocomposites. The primary focus of this study lies in investigating the effect of transferring ZnO onto a graphene layer as a ZnO/Graphene nanocomposite on the structural, optical, and bonding properties of graphene, with the goal of evaluating its potential as a pH sensor.

Methods: Five samples were created: Graphene on ITO substrate (G/ITO), ZnO layer on ITO substrate (ZnO/ITO), Graphene on ZnO layer on ITO substrate (G/ZnO/ITO), ZnO layer on Graphene on ITO substrate (ZnO/G/ITO), and ZnO-Graphene nanocomposite on ITO substrate (ZnO-G/ITO). Graphene synthesis employed TCVD with WEO, and transfer involved spin coating with Poly Methyl methacrylate (PMMA) followed by Nitric Acid for Nickel etching. ZnO layers were spin-coated five times. Characterization included UV-Vis, XRD, FESEM, and pH testing.

Results: This study shows that ZnO has an effect by combining the properties of Graphene and ZnO. With the presence of ZnO, the absorbance shown in UV-Vis Spectroscopy increased and it is shown that ZnO affects the pH testing of Graphene based devices through the fabrication of ZnO/Graphene nanocomposite due to the combination of unique properties that both ZnO and Graphene exhibit.

Conclusion In conclusion, the findings of this study indicated that there is an effect in applying ZnO layers on Graphene for pH testing, thereby potentially influencing the performance of pH testing. The objectives of this research have been met which were Graphene was fabricated through TCVD from WEO. Next, Graphene was transferred onto the ITO substrate. Thirdly, ZnO/Graphene nanocomposite was synthesized. Lastly, characterization of structural/crystallinity by using XRD, morphological through FESEM and optical using UV-VIS.

Keywords: Thermal chemical vapor deposition, graphene, waste engine oil, pH sensor, zinc oxide.

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