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Nanocarbon Allotrope Graphene Application in Biosensing an Editorial

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Editorial

Carbon (C) nanomaterials (e.g. grapheme (G), Carbon Nanotubes (CNTs), crystalline diamond, diamond like Carbon Nanoparticles (CNPs), nanofibers) are continuously more sophisticated in their range of physicochemical tunable properties (e.g. 2D surfaces, 3D structures, stiffness, porosity, permeability, biodegradability, and biocompatibility), and their range of applications for biomedical and biochemical sensing (e.g. microbiology, environmental chemistry, oncology, regenerative medicine, tissue engineering, stem cell culture, and maintenance) continues to grow, potentially enhancing bioefficacy and biosafety.

Graphene, a relatively new two-dimensional (2D) nanomaterial, has a special structure (e.g., lighter, tougher, and more versatile than steel) as well as tunable physicochemical (e.g., electronical, optical) properties, which may lead to a wide variety of eco-friendly and cost-effective biosensing applications. Furthermore, graphene-related nanomaterials (e.g. graphene oxide, doped graphene, carbon nanotubes) have piqued scientists' and industry's interest in developing novel biosensing platforms, such as arrays, sequencers, and other nano-optical/biophotonic sensing systems (e.g. FET, FRET, CRET, GERS). Indeed, combinatorial functionalization approaches are continuously improving graphene's overall properties, such as sensitivity, stability, specificity, selectivity, and response for potential bioanalytical applications. Real-time multiplex identification, monitoring, qualitative, and quantitative characterization of molecules (i.e. analytes H_2O_2, urea, nitrite, ATP, or NADH); ions (Hg^{2+}, Pb^{2+}, or Cu^{2+}); biomolecules (DNA, RNA, peptides, proteins, vitamins, or glucose); disease biomarkers such as genetic mutations in BRCA1, p^{53}) disease biomarkers such as (cancer cells, stem cells, bacteria, or viruses). However, comparative studies that objectively assess the relative toxicity of carbon Nano allotropes in humans are still scarce. Dresselhaus and Araujo introduced graphene, which is the most commonly, used nanomaterial for a number of applications. Because of graphene's broad specific region, biomolecules can be loaded in high concentrations on the sensing base, resulting in high detection sensitivity. Because of its small bandgap and high conductivity, electrons can easily pass between the graphene surface and biomolecules. Because of the superior uniform surfaces, extremely pure graphene with no impurities and its derivative materials are inert and cost-effective. The highest sensing surface area of graphene boosts the loading of targeted chemical species including proteins and enzymes, either by submissive adsorption or chemical cross-linking to the active groups of the analytes. Graphene's conductivity differs depending on the process of preparation or treatment. Graphene has 60 times the electrical conductivity of Single-Walled Carbon Nanotubes (SWCNTs), and particulate graphene has a reported electroconductivity of 64 mS/cm compared to graphene's 108 mS/cm.

Graphene-based sensors are capable of detecting a wide range of molecules and ions due to their pluripotent nature. G is used as a sensor in a range of fields due to its chemical, electrical, electrochemical, and optical properties. It is used as a pressure sensor, strain gauge, biosensor, chemical sensor, and gas sensor. In G-dye hybrid optical sensors, the interaction of G with dye molecules induces deep changes in G's electronic structure, which is ideal for a range of applications. Biomolecules, metal ions, and synthetic molecules can all be detected using these sensors.

All-G strain sensors can detect a number of strains that are caused by torsion, bending, and stretching. As a force sensing material, single-layer graphene is used, along with a conductive film made of graphene flake for the electrode. Flexible materials may be used to make the finished strain sensor fully flexible.

Both 3D graphene and reduced GO are commonly used as sensor materials, and dispersion of these graphene materials on the sensing surface is usually achieved by dropcasting graphene and its derivatives. Polymers and other multifunctional components could be used to coat the graphene nanohybrid-modified electrode bases. Noncovalent graphene hybridization methods with a polymer or small organic molecules should be approached with caution, as additional raw materials can exhibit intrinsic electrochemistry or interfere with the desired properties. Chitosan, a biocompatible organic material, can disperse graphene and allow bioconjugation for sensitive biosensors. Graphene-based electrochemical sensors are more convenient to use than traditional methods like spectrometers. Flexibility, resistance, conductivity, and stability are also advantages. These characteristics are used in the development of a variety of sensors that detect biologically significant molecules. For the creation of glucose sensors, pure types of graphene, oxide, and biocomposites have been customised with nanofibers, nanotubes, and other geometrical NPs.