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Uses of Porous Carbon Sensors in Conductive Sensing

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Description

Nobel laureate was the first to introduce the notion of nanotechnology. Since then, significant breakthroughs in nanoscience and nanotechnology have resulted in unique nanometer-scale devices and materials, mostly driven by the need to miniaturise electronic, optical, sensing, and actuation systems and their components. Carbon nanoparticles are so expected to be an important component of nanotechnology. Nanohorns, carbon nanotubes, carbon nanofibers, graphene, graphite, and related CNMs can be integrated as the core of sensing platforms due to their excellent abilities for direct interaction with a wide range of analytes, applicability in aqueous media, and superb electrical conductivity, among other things. Escarpa's group recently developed black carbon nanoparticles and carbon nanomaterial scaffold films as unique conducting CNMs, with both shown to be very efficient transducers for microscale detection. Different modifiers can be integrated on the walls of CNMs after surface activation with selective groups, allowing for unprecedented electrochemical sensing strategies [1].

However, the potential for nanocomposite materials reinforced with carbon fillers, with exceptional particular stiffness and strength, represents a huge possibility for use in the twenty-first century. From it has been prevalent in nature and used since historical times, the notion of nanocomposite has recently emerged. In general, a nanocomposite material is the product of the combination of two or more distinct materials, at least one of which has a nanoscale scale dimension [2,3]. Among the numerous nanocomposites, the creation of nanocomposites based on conductive phases distributed in polymeric matrix has resulted in significant improvements in the field of analytical electrochemistry.

This new form of electrode, which was originally created as an alternative to the falling mercury electrode, was presented. CPEs have since played various roles in the development of electrochemical sensors and biosensors, offering mechanical stability and enhancing filler dispersion, resulting in increased sensitivity and selectivity. If the composition of CPEs was initially based on graphite powder distributed in a binding solvent, a relatively recent development in the field of CPE modification is the use of various CNMs as conducting fillers to construct nanocomposite carbon paste electrodes. These carbon-based conducting fillers are often concentrated on nanohorns as 0D, CNTs and carbon nanofibers as 1D, graphene as 2D, and graphite as 3D CNMs.

Because of the great malleability of the nanocomposite paste before hardening, alternate ways for including a range of modifiers ininto the NC-CPE, such as nanoparticles, enzymes, antibodies, aptamers, or chemical recognition agents. According to the IUPAC definition, a biosensor based on a bionanocomposite is a hard material formed by mixing two or more materials, at least one of which has a biological origin and the other consists of particles with at least one dimension in the range of 1-100 nm.

A number of recent reviews have been published on the use of CNMs in electrochemical sensing. There are also a few reviews devoted to CPEs, the most of which are concerned with conducting polymer-filler composites. However, to the best of our knowledge, there is no report on ways for bio-functionalizing such NC-CPE transducers for electrochemical applications. This is the premise for the current short review, which aims to provide a complete overview of current methodologies for functionalized NC-CPEs with a variety of modifiers for electroanalytical sensing and biosensing applications [4,5].

Future Perspective

Furthermore, this manuscript discusses the different electrocatalytical performance provided by modifier incorporation, which results in decreased overpotentials, higher intensity peaks, lower detection limits, improvements in redox reversibility, or better signal-to-noise ratios, which may serve as a general outlook for future research. The vast majority of NC-CPEs used globally are pastes containing insulating liquids. A pasting liquid must have practical insolubility in the solution under measurement, a low vapour pressure to provide mechanical stability and extended lifespan, and, in the case of voltammetric applications, electrochemical inactivity in the potential window of interes.

Conflict of Interest

None.

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