

Conducting polymer-based hybrid assemblies for electrochemical sensing: a materials science perspective

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Abstract

In this topical review, progress achieved in amperometric sensing of different analytes over conducting polymer-based hybrid electrocatalysts is summarized. We report a variety of synthetic methods and the resulting hybrid assemblies, with the effectiveness of such strategies, for designing conjugated polymer-based hybrids as robust sensors for amperometric detection. Beyond incorporation of metal nanoparticles, metal-oxide and non-oxide semiconductors, carbon-based nanomaterials (nanotubes, graphene, and graphene oxide), and special dopant ions are also discussed. Moreover, some particularly interesting miscellaneous approaches, for example photo-amperometric sensing or use of overoxidized polymers, are also emphasized. Determination of dissolved gases (for example O₂, NO, and NO₂), ions (sulfite, nitrite, nitrate, chlorate, bromate, and iodate) and smaller and larger molecules (for example H₂O₂, ascorbic acid (AA), dopamine (DA), urea (UA), amino acids, hydrazine, NADH, serotonin, and epinephrine) is discussed. These achievements are reviewed from the materials perspective, addressing both synthetic and electrocatalytic aspects of the polymer-based modified electrodes. Beyond simple or more sophisticated mixing, a wide range of methods of preparation is presented, including chemical (one-pot polymerization, impregnation), electrochemical (co-deposition, doping type inclusion, etc.) and combined strategies. Classification of such synthetic routes is also included. However, it is important to note that we omit studies in which conducting polymers alone were used for determination of different species. Furthermore, because excellent reviews-cited in this work also-are available on immobilization of biomolecules (for example enzymes) for biosensing purposes, this topic, also, is excluded.