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Biomass-derived graphene and metal–organic frameworks for sustainable sensing applications

Abstract

Across the world, biomass serves as a natural and plentiful carbon source. It comes in several forms such as plant leaves, grasses, rice husks, coffee grounds, biomolecules, and wastes from agriculture, food production, and municipal sources. Consequently, the exploration of sustainable and preferably affordable assets for creating high-efficiency materials remains a key objective. Nowadays, there is a notable advancement in the development of biomass-derived graphene-based nanomaterials and MOFs, due to their stable, renewable, and economically viable nature. Additionally, it contributes to effective waste management. In this sense, graphene-based nanomaterials and metal–organic frameworks (MOFs) have drawn considerable interest in sensing applications due to their remarkable features, including characteristics like extensive surface area, optical and electrical qualities, biocompatibility, and reliable stability. This review focuses on the research conducted to date and the advancements made in the potential application of graphene-based nanomaterials and MOF probes in sensing technologies. Initially, the review discusses the basic and chemical properties of biomass, the characteristics of graphene and MOFs, and green synthesis techniques for graphene-based nanomaterials and MOFs derived from biomass. Following this, the latest developments in graphene-based nanomaterials and MOFs from biomass are explored. Lastly, the future prospects of graphene-based nanomaterials and MOF probes are discussed. Finally, graphene-based nanomaterials and MOFs emerge as novel probes with a range of benefits, including high sensitivity, strong selectivity, remarkable stability, and quick response times in sensing applications. Therefore, this study aims to provide insights for emerging researchers to design advanced graphene-based nanomaterials and MOF probes for sensing applications in the future.

Keywords

Biomass; Graphene; Metal–organic framework; Nanomaterial; Sensor