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Harnessing the Power of Amino-graphene and Chitosan: Novel Nanohybrid Supports for Enzyme Applications

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Abstract

Composite materials and hybrid organic-inorganic systems have surfaced as advantageous platforms for the immobilization of industrial enzymes. The hybrid supports utilize the beneficial characteristics inherent in both inorganic nanoparticles and biopolymeric materials. Nanomaterials are particularly well-suited for use as enzyme supports owing to their extensive surface area. Graphene, characterized by its two-dimensional arrangement of sp^2 hybridized carbon atoms, exhibits distinctive properties, such as exceptional mechanical, electrical, and chemical attributes, while also being cost-effective. Nevertheless, numerous intriguing properties may be augmented via functionalization. The incorporation of bioactive compounds, including amines, onto materials offers numerous benefits. These advantages encompass enhanced stability of the active compound, improved dispersibility, increased surface area, protection from specific environmental factors, and the potential for controlled release, among others. Chitosan, the most abundant natural biopolymer, is derived from chitin, a major component of the exoskeletons of crustaceans, such as crab and shrimp shells. Chitosan is associated with excellent biological, physicochemical, antimicrobial, and nontoxic properties, making it a superior eco-friendly material. In this study, we synthesized novel nanohybrid supports by combining amino-functionalized graphene nanoplatelets and chitosan nanoparticles. AG was dispersed in water and mixed with a CS solution, and then the mixture was dripped into NaOH to form AG/CS beads. These beads were cross-linked with glutaraldehyde and washed to obtain stable AG/CS nanohybrids. Characterization with FTIR, XRD, DLS, and FE-SEM showed nanohybrid production. The synthesized AG/CS

nanohybrids exhibit considerable promise as adaptable platforms for enzyme immobilization, integrating the advantageous characteristics of both inorganic and organic nanomaterials. This study demonstrates the potential for developing enzyme-based biotechnologies through the use of logically constructed inorganic-bio hybrid systems. On these nanohybrid supports, more research is necessary to fully understand enzyme loading, activity, and operational stability.

Key words: Amino-graphene, Chitosan, Nanohybrids, Enzyme Immobilization