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Iron -basec nano biocatalytic systems for lignocellulosic biomass hydrolysis for bioethnol production.

The growing demand for renewable energy has accelerated research on efficient enzymatic conversion of lignocellulosic biomass into biofuels. However, the large-scale application of free cellulase enzymes is limited by high cost, low stability, and poor reusability. Iron-based nanobiocatalytic systems, particularly cellulase immobilized on iron oxide nanoparticles, have emerged as effective solutions to these challenges. This paper highlights the application of iron oxide nanoparticle-immobilized cellulase in biofuel production and biorefinery processes. The magnetic nature of iron oxide nanoparticles enables easy separation and repeated reuse of enzymes, while their high surface area and tunable surface chemistry improve enzyme stability and catalytic efficiency. Recent studies demonstrating enhanced saccharification performance and reduced enzyme loading are discussed. Key challenges, including enzyme leaching, nanoparticle aggregation, mass transfer limitations, and scale-up feasibility, are also addressed. Overall, iron-based nanobiocatalysts offer a sustainable and promising platform for advancing lignocellulosic biofuel technologies.
Keywords: Lignocellulosic biomass Biocatalysts, cellulase immobilization, iron oxide nanoparticles, biofuel production,Feasibility is also addressed. Overall, iron-based nanobiocatalysts offer a sustainable and promising platform for advancing lignocellulosic biofuel technologies. Keywords: Iron-based nanobiocatalysts, cellulase immobilization, iron oxide nanoparticles, biofuel production, lignocellulosic biomass.

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