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Insights: Publications

Fundamentals, applications, and future directions of bioelectrocatalysis

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Bioelectrocatalysis is an interdisciplinary research field combining biocatalysis and electrocatalysis via the utilization of materials derived from biological systems as catalysts to catalyze the redox reactions occurring at an electrode. Bioelectrocatalysis synergistically couples the merits of both biocatalysis and electrocatalysis. The advantages of biocatalysis include high activity, high selectivity, wide substrate scope, and mild reaction conditions. The advantages of electrocatalysis include the possible utilization of renewable electricity as an electron source and high energy conversion efficiency. These properties are integrated to achieve selective biosensing, efficient energy conversion, and the production of diverse products. This review seeks to systematically and comprehensively detail the fundamentals, analyze the existing problems, summarize the development status and applications, and look toward the future development directions of bioelectrocatalysis. First, the structure, function, and modification of bioelectrocatalysts are discussed. Second, the essentials of bioelectrocatalytic systems, including electron transfer mechanisms, electrode materials, and reaction medium, are described. Third, the application of bioelectrocatalysis in the fields of biosensors, fuel cells, solar cells, catalytic mechanism studies, and bioelectrosyntheses of high-value chemicals are systematically summarized. Finally, future developments and a perspective on bioelectrocatalysis are suggested.