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Application of Biogenic TiO_2 Nanoparticles as ORR Catalysts on Cathode for Enhanced Performance of Microbial Fuel Cell

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Abstract: Microbial fuel cells (MFCs) use microorganisms to break down organic matter and generate power, which is an exciting new field of research. MFCs' power generation relies on oxygen reduction (ORR) at the cathode. However, the slow kinetics of the ORR can severely limit the performance of MFCs. Additionally, the growth of biofilm on the cathode hampers the ORR process. In order to ensure the sustainability of MFCs over time, it is crucial to employ bifunctional catalysts that can address these issues. Biogenic titanium dioxide (TiO_2) nanoparticles (NPs) were synthesized and applied to a graphite sheet cathode in this study. Cyanobacteria, Phormidium species NCCU-104, was used to bio-fabricate titanium dioxide (TiO_2) nanoparticles. NPs were characterized using SEM and TEM analysis to determine their size, shape, surface morphology, and XRD. The particles had an average size of 18.11 nm, were spherical, and were well-dispersed, according to the results of the physicochemical characterization. TiO_2 NPs were evaluated in MFC using different concentrations (0.5–2.5 mg/cm^2) in the cathode to generate electricity and coulombic efficiency. MFC with a cathode impregnated with 2.0 mg/cm^2 TiO_2 NP produced maximum power density (15.2 W/m^3), which was 38% more than 0.5 mg/cm^2 TiO_2 NP. The overall study results indicated that biogenic TiO_2 nanoparticles (NPs) could be an effective and low-cost catalyst in the oxygen reduction reaction (ORR) and significantly improve biofouling. Due to its efficient and affordable contribution to the ORR, these results imply that biogenic TiO_2 NPs might be a feasible alternative for improving the performance of MFCs.

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Citation: Kumar, A.; Siddiqui, T.; Pandit, S.; Roy, A.; Gacem, A.; Souwaileh, A.A.; Mathuriya, A.S.; Fatma, T.; Sharma, P.; Rustagi, S.; et al. Application of Biogenic TiO_2 Nanoparticles as ORR Catalysts on Cathode for Enhanced Performance of Microbial Fuel Cell. *Catalysts* **2023**, *13*, 937. https://doi.org/10.3390/catal13060937

Academic Editor: Yat Li

Received: 9 May 2023
Revised: 19 May 2023
Accepted: 20 May 2023
Published: 26 May 2023

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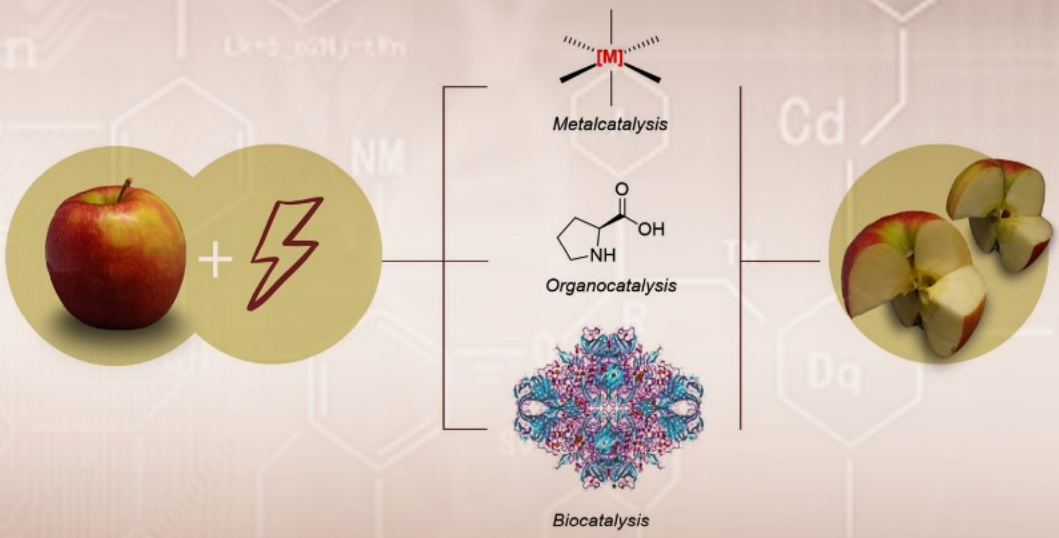

Enantioselective Catalytic Electrochemical Organic Transformations

Volume 13 · Issue 6 | June 2023

MDPI

mdpi.com/journal/catalysts
ISSN 2073-4344