Modeling and Optimization of Microbial Fuel Cells Using Artificial Intelligence to Enhance Energy Generation Efficiency

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In the search for renewable energy, microbial fuel cells (MFCs) powered by organic waste represent a promising solution. This research is significant due to the integration of AI for intelligent MFC management, enhancing both system stability and environmental efficiency. 1. Significance of the Study: The work is vital for developing eco-technologies that convert waste into energy and implementing AI to maximize the stability and operational efficiency of MFC systems. 2. Hypothesis: An MFC powered by human urine is capable of powering low-power devices. Its efficiency can be maximized through AI that analyzes real-time sensor data and automatically adjusts environmental parameters for peak performance. 3. Research Goal: To develop a prototype capable of autonomous power generation sufficient to fuel its own control units, and to justify the optimization of operating modes through AI application. 4. Methods: Experimental method, mathematical modeling, statistical data analysis, and machine learning. 5. Scientific Novelty: The creation of an intelligent system that integrates energy generation, self-sufficiency, and process automation based on predictive AI models. 6. Practical Significance: Development of autonomous energy sources for remote regions, sensor networks, and wastewater treatment systems. 7. Future Prospects: Scaling the prototype to industrial levels, expanding the range of usable waste, and full commercialization of the technology as a turnkey ecological solution.

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