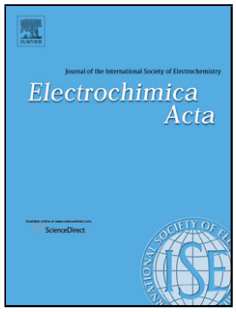

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Dynamical Analysis of Microfluidic Microbial Electrolysis Cell via Integrated Experimental Investigation and Mathematical Modeling

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Research Highlight

- Biohydrogen production from glucose and urea in microfluidic MEC was investigated.
- A novel integrated modeling approach with chemotaxis phenomena was established.
- A maximum hydrogen production rate of 1.4 μl (μl substrate)$^{-1}$ day^{-1} was obtained.
- At higher applied potential, attached bacteria and the EPS content increased.

Abstract

The present study deals with the feasibility of a microfluidic microbial electrolysis cell (MEC) as an efficient biohydrogen generator for medical usage for the first time. The evaluation of nickel in microfluidic MEC as an alternative for conventional electrodes indicates successful performance in the improvement of bioenergy production. The maximum biohydrogen production rate and produced power density of 2.2 μW cm^{-2} and 1.4 μl H_2 μl substrate^{-1} day^{-1} were obtained, respectively. It is considered a promising technology for medical usage due to the following factors: significant biohydrogen generation, low consumption of expensive materials, simple construction, and utilization of human excreta. In addition, the study established a novel integrated modeling approach with chemotaxis phenomena. This was to interpret the distribution mechanism of the suspended microorganisms in anolyte and/or their attachment to anode surface to extend the biofilm, and improve the performance of