Boosting mediated electron transfer in bioelectrochemical systems with tailored defined microbial cocultures.

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Details

Abstract

Bioelectrochemical systems (BES) hold great promise for sustainable energy generation via a microbial catalyst from organic matter, for example, from wastewater. To improve current generation in BES, understanding the underlying microbiology of the electrode community is essential. Electron mediator producing microorganism like Pseudomonas aeruginosa play an essential role in efficient electricity generation in BES. These microbes enable even nonelectroactive microorganism like Enterobacter aerogenes to contribute to current production. Together they form a synergistic coculture, where both contribute to community welfare. To use microbial co-operation in BES, the physical and chemical environments provided in the natural habitats of the coculture play a crucial role. Here, we show that synergistic effects in defined cocultures of P. aeruginosa and E. aerogenes can be strongly enhanced toward high current production by adapting process parameters, like pH, temperature, oxygen demand, and substrate requirements. Especially, oxygen was identified as a major factor influencing coculture behavior and optimization of its supply could enhance electric current production over 400%. Furthermore, operating the coculture in fed-batch mode enabled us to obtain very high current densities and to

harvest electrical energy for 1 month. In this optimized condition, the coulombic efficiency of the process was boosted to 20%, which is outstanding for mediator-based electron transfer. This study lays the foundation for a rationally designed utilization of cocultures in BES for bioenergy generation from specific wastewaters or for bioprocess sensing and for benefiting from their synergistic effects under controlled bioprocess condition.

Involved units

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