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"Gheorghe Asachi" Technical University of Iasi, Romania

COMPARISON OF A CHEMICAL AND AN ELECTROCHEMICAL ENRICHMENT METHODS OF INOCULA FOR MICROBIAL FUEL CELLS

Sathish Kumar K.[1], Solorza-Feria O.[2,1], Poggi-Varaldo H.M.[*3,1]

[1]Doctoral Program of Nanoscience and Nanotechnology, CINVESTAV del IPN, Mexico D.F., México; [2]Depto. Química, CINVESTAV del IPN, México D.F., México; [3]Environmental Biotechnology and Renewable Energies R&D Group, Dept. Biotechnology and Bioengineering, CINVESTAV del IPN, P.O. Box 14-740, 07000 México D.F., México; e-mail : hectorpoggi2001@gmail.com

Abstract

Suitable microbes for microbial fuel cells (MFC) can be selected by the different redox potentials of electron acceptors and methods, such as use of *(i)* internal electron acceptor (such as fumarate), *(ii)* external electron acceptor such as insoluble Fe (III), and *(iii)* solid electrode with an internal electron acceptor. Therefore, the objective of this study was to compare a chemical (final terminal electron acceptor –Fe(III)) and an electrochemical enrichment methods of a saline-sodic soil inoculum.
An alkalophilic inoculum was obtained from saline-sodic soil of the former Texcoco lake, Mexico City. A lab scale single-chamber microbial fuel cell was built as reported elsewhere. Electrochemical impedance spectrum (EIS), linear sweep voltammetry (LSV), and Cyclic voltammetry (CV) experiments were performed as previously described. The Chemical (***C***) and Electrochemically (***E***) enrichment methods were carried out as reported elsewhere. The ***C***-enrichment was performed in successive cultures of the original inoculum using Fe(III) citrate as electron acceptor and sodium acetate as carbon source. The ***E***-enrichment method was carried out in an electrolysis cell poised with 150 mV with sodium acetate was used as carbon source. The ***hybrid E*** enrichment was performed by subjecting an incoulum from the ***E***-enrichement to serial transfers similar to those of the ***C***-method.
Variation of current intensity during biofilm formation in the ***only E*** during the first 30 days resembled the bacterial sigmoidal growth curve. Afterwards, current intensity decreased to 0.4 mA, likely due to depletion of carbon source. The CV performed at the 28th day showed a midpoint potential deduced of +108 mV. This value is close to the alkaliphilic cytochromes potential range. The impedance spectra from EIS fitted to equivalent circuits showed that the resistance of the biofilm (R_2) decreased with time, it was 11.1 Ω at the 28th day and 5.5 Ω at the 136th day. Results of ***only C*** were superior ($P_{An,max}$ = 48.5 and $P_{V,max}$ = 558, results of 3rd transfer) to ***only E*** ones (33 and 379, respectively, results of 0 transfer). Yet, the ***hybrid E*** method (***E*** followed by ***C*** as given by the three serial transfers) gave the best results (higher $P_{An,max}$ and $P_{V,max}$, lower internal resistance).
It can be concluded that the best results were obtained for ***hybrid E*** method > ***only C*** > ***only E***. The decrease of biofilm resistance with time given by EIS tests in the ***only E*** could be ascribed due to the adaptability/ enrichment of electroactive bacteria on the surface of the graphite rod.