Bioresource Technology 120 (2012) 45–51

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Tropical mangrove sediments as a natural inoculum for efficient electroactive biofilms

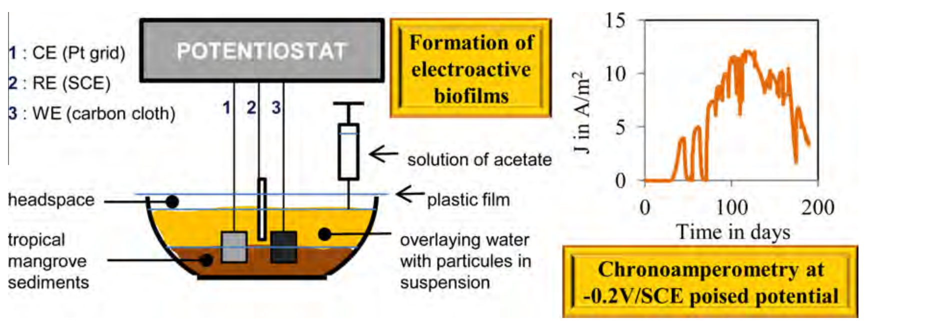
Paule Salvin, Christophe Roos, Florent Robert *

Laboratoire des Matériaux et des Molécules en Milieu Amazonien, Université des Antilles et de la Guyane, UAG-UMR ECOFOG, F-97337 Cayenne, French Guiana

HIGHLIGHTS

- ▶ Tropical mangrove sediments investigated as a natural inoculum for EA biofilm.
- ▶ A maximal current density of 12 A/m^2 obtained with an adequate procedure.
- ▶ An enriched medium makes it possible to form secondary EAB more quickly efficient.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 7 April 2012
Received in revised form 25 May 2012
Accepted 27 May 2012
Available online 16 June 2012

Keywords:
Electroactive biofilms
Microbial fuel cells
Three-electrode systems
Chronoamperometry
Cyclic voltammetry

ABSTRACT

Chronoamperometry is known to be an efficient way to form electroactive biofilms (EAB) on conductive electrodes. For the first time, tropical mangrove sediments are analyzed as a potential inoculum to form MFC anodes with the use of acetate as substrate. The performance of the EAB-coated carbon cloth electrodes are evaluated according to the maximal current density, the coulombic efficiency and the cyclic voltammogramms. Working electrodes (WE) polarized at −0.2 V/SCE gave better results compared to −0.4 V/SCE and 0.0 V/SCE. The maximal current density attained was 12 A/m^2 with a CE of 24%. Contributions of the EAB in the generation of current were discussed and mechanisms of electronic transfer by the bacteria were discussed. Epifluorescence and SEM images showed the evolution of the biofilms on the electrode surface and the heterogeneity of the structure.

1. Introduction

For a few years now, the technology of the microbial fuel cell (MFC), exploiting the properties of the specific biofilms called electroactive biofilms (EAB), has been of great interest as a future alternative in energy production. The MFC is based on the classical fuel cell principle, with for main difference the catalysis of the electrochemical reactions realized by the EAB, adhered on the electrodes (Kim et al., 1999; Rabaey and Verstraete, 2005; Logan et al., 2006). In general, in the published studies, only the anode is covered with an EAB and the cathode is an abiotic one such as for example an air–cathode using platinum as a catalyst or the supply of chemical oxidizers (ferricyanide or Mn(IV)) (Rabaey et al., 2003; Rhoads et al., 2005; Shantaram et al., 2005). With more details, the anodic EAB catalyzes the oxidation of the organic matter or the carbon source present in the anodic chamber and transfers the generated electrons to the conductive anode. Then, the difference of potentials between the anode and the cathode induces that the electrons pass through an external circuit composed of generally one resistive device and go to the cathode where the reduction of the dioxygen or another oxidizer takes place abiotically (Logan et al., 2006). A proton exchange membrane separates the anodic and cathodic electrolytes. This membrane constitutes a filter through which the protons from the anodic oxidation can migrate to the cathode to participate to the reduction, but also

* Corresponding author. Tel.: +33 5 94 29 75 12, fax: +33 5 94 28 47 86.
E-mail address: florent.robert@guyane.univ-ag.fr (F. Robert).

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.05.131