2010

Air-exposed microbial fuel cells and screening techniques

Justin C. Biffinger
US Naval Research Laboratory, justin.biffinger@nrl.navy.mil

Bradley R. Ringeisen
Naval Research Laboratory, Bradley.ringeisen@nrl.navy.mil

Published in Journal of Biotechnology, Volume 150, Supplement, November 2010, Pages 24-25

[B.41]

Air-exposed microbial fuel cells and screening techniques

J.C. Biffinger*, B.R. Ringeisen

US Naval Research Laboratory, United States

Keywords: Microbial fuel cell; Shewanella; High throughput screening; Carbohydrates

Microbial fuel cells (MFCs) harvest energy from a wide variety of natural carbon sources to produce electricity at neutral pH and ambient temperatures. To date, standard H_2/O_2 PEMFC technology has yet to generate significant power under those conditions. Because most environments on earth are exposed to significant levels of oxygen, we believe the transition from sediment based MFCs to oxygen-tolerant MFCs is necessary. This transition would require both a way to simultaneously sequester the metal-reducing microbes and reduce the overall concentration of oxygen in the anode chamber. Recent work suggests that power can be generated with significant oxygen in the anolyte when using three dimensional (3D) electrodes in a miniature MFC design; potentially expanding the role of MFCs to function in more diverse regions (i.e., water column, air/water interface). Exposing the anode to air will also create unique growing conditions for the microbes themselves compared to the standard anaerobic anode conditions used in MFCs.

The efficiency of MFCs are based primarily on the interaction between a microbe and electrode surface. *In situ* monitoring of both cellular and culture conditions is important for improving the long-term survivability of MFCs, but there are currently few published results for monitoring an active electrode surface in real-time. By utilizing the miniature modular design of a voltage based screening assay (VBSA), time dependent biofilm formation was correlated directly with current output in an operating MFC for the first time. The data collected from a single VBSA experimental run was used to show a relationship between real-time current output from an operating MFC, planktonic cell concentration, and biofilm coverage on a carbon electrode at defined time points. The combination of

Published in Journal of Biotechnology, Volume 150, Supplement, November 2010, Pages 24-25

these data resulted in the first physiological description of how *Shewanella* respond to glucose and lactate in the presence of oxygen in an operating MFC.

doi:10.1016/j.jbiotec.2010.08.074