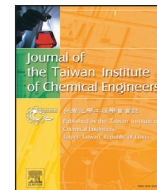




Contents lists available at ScienceDirect

Journal of the Taiwan Institute of Chemical Engineers

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

Mesoporous Co_3O_4 nanoflakes as an efficient and non-precious cathode catalyst for oxygen reduction reaction in air-cathode microbial fuel cells



Ravinder Kumar, Lakhveer Singh*, A.W. Zularisam

Faculty of Engineering Technology, Universiti Malaysia Pahang, 26300 Kuantan, Malaysia

ARTICLE INFO

Article history:

Received 6 February 2017

Revised 13 June 2017

Accepted 14 June 2017

Available online 6 July 2017

Keywords:

Microbial fuel cell

Oxygen reduction reaction

 Co_3O_4 nanoflakes

ABSTRACT

Cobalt oxide is well known for its excellent oxygen reduction reaction (ORR) activity, however, its ORR activity can be further improved by synthesizing its porous architecture. Therefore, mesoporous Co_3O_4 nanoflakes were prepared by a two-step hydrothermal method and were employed as the cathode catalyst in a double-chamber microbial fuel cell (MFC) to explore its ORR activity for electricity generation. The electrochemical tests suggested that addition of Co_3O_4 nanoflakes enhanced the electrocatalytic activity of the cathode significantly. Besides, the cathode with a higher concentration of Co_3O_4 nanoflakes (COF-2) showed faster ORR kinetics as compared to the bare cathode. Evidently, COF-2 achieved an exchange current density of 4.18 mA/cm^2 , which was 3.2 times higher as compared to the bare cathode. Consequently, this improved ORR activity increased the power output in MFC. COF-2 obtained a maximum power density of $347 \pm 7 \text{ mW/m}^2$, which was approximately 8 times higher than the bare cathode. The enhanced ORR activity and improved electric output in the MFC can be attributed to the mesoporous nature of Co_3O_4 nanoflakes that exposed a higher number of ORR active sites at the cathode surface. Overall, mesoporous Co_3O_4 nanoflakes proved to be highly efficient and *ca.* 30 times cheaper than platinum, therefore, can be preferred in large-scale MFC applications over other expensive cathode catalysts.

© 2017 Taiwan Institute of Chemical Engineers. Published by Elsevier B.V. All rights reserved.