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EFFECT OF ANODIC MATERIAL ON THE PERFORMANCE OF A SINGLE CHAMBER MICROBIAL FUEL CELL

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Abstract

Several groups have investigated anode materials in microbial fuel cells in attempts try to increase the power output per unit volume of reactor. Several types of materials and shapes have been used, such as carbon paper, graphite plate, carbon cloth, carbon mesh, granular graphite, granular activated carbon, carbon felt, reticulated vitrified carbon, carbon brush, stainless steel mesh. Thus, the objective of our work was to evaluate the effect of two anodic materials on the performance of microbial fuel cells (MFCs) that used $Ru_xMo_ySe_z$ as a catalyst for oxygen reduction reaction in the cathode.

A new design of a single chamber MFC-A was based on extended electrode surface (larger ξ, ratio of electrode surface to cell volume) and the arrangement of the anode-PEM-cathode. The cell was built with a plexiglass cylinder, the two extreme circular faces were fitted with PEM-cathod assemblage, i.e., left and right faces. The anode consisted of 65 triangular pieces of graphite (1.4 x 1.8 x 0.5 cm, side x height x thickness) filling the anodic chamber. The single chamber MFC-B had an assemblage or 'sandwich' arrangement of the anode-PEM-cathode. The cathodes were made of flexible carbon-cloth containing 1mg/cm^2 $Ru_xMo_ySe_z$ catalyst. The cell was loaded with inoculum and substrate according the specific literature. The MFC was characterized by linear sweep potential method as reported elsewhere.

First, each face (left and right) of the MFCs was characterized by separate. Values of $E_{MFC, OCP}$ obtained were 0.591 and 0.593 V for the left and right face (MFC-A), and 0.255 and 0.260 V for the left and right face the cell B, respectively. The $P_{V\text{-}max}$ values for MFC-A were 1 200 and 1 125 mW/m^3 and those of MFC-B were 43 mW/m^3 for both separate faces. The polarization curves were very close to straight lines; the values of R_{int} were estimated from the slopes of corresponding regression lines as 146 and 167 Ω for MFC-A and MFC-B were 2 075 and 2 017 Ω, respectively.

The proportion of R_{int} decreased by a factor of 27.9 and 26.1 for MFC-A. Parallel connection significantly decreased the internal resistance of the cell and almost doubled volumetric power for FMC-A and MFC-B, respectively. The results for $P_{V\text{-}max}$ for parallel connection can increase the volumetric power efficiently. The $P_{V\text{-}max}$ for MFC-A was comparable with values reported elsewhere.

Finally, application of graphite anode made of small triangular pieces significantly improved the performance of a MFC-A that used $Ru_xMo_ySe_z$ as a cathodic catalyst for oxygen reduction reaction.

Key words: anodic material, graphite, internal resistance, microbial fuel cell