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The effect of nitric acid, ethylenediamine, and diethanolamine modified polyaniline nanoparticles anode electrode in a microbial fuel cell

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ABSTRACT

Anode materials are important in the power generation of microbial fuel cell. In this study, polyaniline was used as a conducting polymer anode in two chambers MFC. XPS and SEM were used for the characterization of functional groups of anode materials and the morphology. The power generation of microbial fuel cell was elevated by the modification of anode by nitric acid, ethylenediamine, and diethanolamine. The time that MFC reaches its maximum power generation was shortened by modification. Moreover the SEM photos prove that, it causes better attachment of microorganisms as biocatalysts on electrode surface. The best performance of among the MFCs with different anode electrodes, was the system working by polyaniline modified by ethylenediamine as that generated power of 136.2 mW/m^2 with a 21.3% Coulombic efficiency.

1. Introduction

Wastewaters are renewable energy resources in the form of biodegradable organic matters. It means that renewable energy which reduces greenhouse gas emissions, can be extracted from wastewater [1,2]. Microbial Fuel Cells (MFCs) are devices that convert chemical energy stored in biodegradable materials of wastewater to electrical energy using

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microorganisms as biocatalysts [3,4]. The main advantage of MFC is that by eliminating the use of exogenous mediator it makes the cost more economical which is very important issue in wastewater treatment [5,6]. The performances of MFCs were affected by several factors such as microbial community, proton exchange membrane (PEM), internal and external resistance of the cell, electrode spacing, and materials. Among all these factors, electrode material is most essential [7]. The anode is the limiting factor for high power output of MFC because the anode materials and structure can affect microorganisms attachment, substrate oxidation and electron transfer [8]. Traditional carbon materials such as carbon cloth, carbon paper (CP), graphite (felt and granules) can be used as anode materials in MFCs due to their high conductivity, high specific surface area, and stability in microbial inoculums mixture. However, they have little electro catalytic activity; the pores within such materials can be blocked by the bacteria, which can result in cell death and the reduction of electrochemical reaction surface [9,10]. Thus, modification of these materials and development of new type of anode materials is necessary for higher power production [11–14]. Conductive polymers such as polyaniline (PANI) are ideal anode materials for MFC due to facile processability, high conductivity, environmental stability and biocompatibility [15]. The surface of anode materials modified by nonmetals had positive impact on power generation. Moreover,

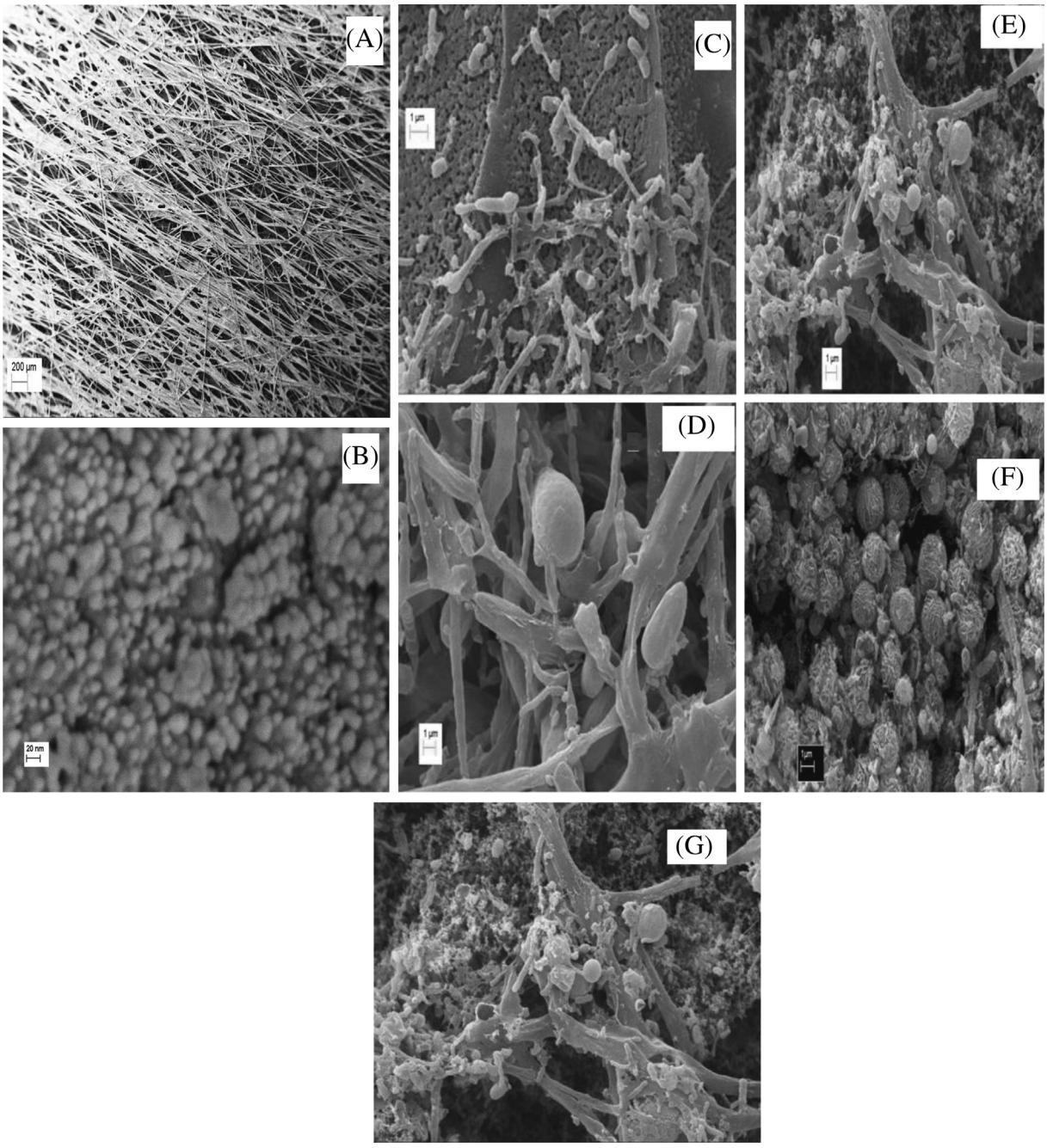

Fig. 1 – Electrode surface before inoculation (A) CP, (B) PANI; after attachment of microorganisms (C) CP, (D) PANI, (E) PANI1, (F) PANI2, (G) PANI3.