2nd International Conference on Engineering and Technology Development (ICETD 2013)
Universitas Bandar Lampung
Faculty of Engineering and Faculty of Computer Science
ISSN 2301-6590

Recent Advances in Biofuel Cell and Emerging Hybrid System

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Abstract-*The present paper reviews the recent development of biofuel cell. Due to its renewable nature and milder operating conditions compared to conventional fuel cell, the electrochemical system has been extensively studied. However, major problems associated with this type of electrochemical system remain an intimidating challenge, the utmost being the low power output and stability of biocatalyst being used. Various attempts have been made to overcome these problems, some are reviewed here. The authors suggest a new direction in solving these problems by using hybrid system i.e. metal biofuel cell. The new hybrid system developed is of lower cost, less complex, higher OCV and greater power output.*

Keywords: *Biofuel cell, metal biofuel cell, zinc anode, laccase*

1. Introduction

Global depletion of non-renewable energy sources has made research and development in alternative power production critical. Recently, researchers are looking into biological world for inspirations. Enzymes and microbes have been explored as catalysts for energy conversions in so called biofuel cells. Biological fuel cells (BFC) are the progeny of two parent technologies: fuel cells and biotechnology. It is capable of directly converting chemical energy to electrical energy through electrochemical reactions involving biochemical pathways (Bullen et al., 2006). Similar to conventional fuel cells, biofuel cells are made of an anode and a cathode usually separated by a selective membrane that only allows positively charged ions. However, unlike conventional fuel cells, biofuel cells utilize enzymatic catalysts, either as they occur in microorganisms, or as isolated proteins rather than precious metals. Besides offering clean and renewable energy source, BFC is also capable of utilizing wide variety of fuel choices compared to traditional fuel cell which is limited to simple hydrogen gas, methane or methanol. Much more complex fuels can be utilized in a BFC such as ethanol, propanol, butanol, glycerol, fructose, sucrose, glucose, carbohydrate, fatty acid etc. (Moehlenbrock et al., 2009). Rather than just 2 electrons oxidation in fuel cell, BFC's are capable of doing deeper oxidation which means we can get more energy density out of the fuel.

2. Types and Applications Biofuel Cells

In general there are two types of BFC, grouped based on the catalyst being used, microbial biofuel cell (MFC) and enzymatic