Power Generation from Microbial Fuel Cell Using Microcontroller

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Abstract: **In this project, microbial fuel cell used to generate the power of 28.4w/cm^2.The fuel cell contains:1)it is suitable for multilayer carbon anodes 2)The extension of the period of time it will hold the anode and cathode. The anode is used to restrict the hydrophobic and the paper based tanks are modeled by saturating and polymerizing photo resist through UV lithography and the catholyte current of 211A/cm^2 was created. The multi anode MFC uses the power and current density raised by 5x and 3x also compare with single anode. This fuel cell is very simple to use and using the bio sensor even the sewage or soiled water in a pool become to operating the MFC and reap electricity.**

Keywords: **Microbial fuel cell(MFC), Paper based power sources, Multi anode configuration, Bacterial digestion, Discarding bio sensor.**

I INTRODUCTION

Biosensors are used to detect the different ecosystem adulteration in water/air [1]and it identifies the number of sickness for hospital purposes[2]. To design and improve their performance of MEMS and thereby asserting the disposal and portable for on-site measurements [3]. The transformation from more expensive in flexible substrate(glass and silicon) into low cost, flexible(polymer and textile) thin materials[4] and paper is the most popular material to transform the device landscape[5] .Paper proposes a number of merits for bio sensor I) It is very cheap and omnipresent are available .II)paper is discardable , so the paper based devices can be economically discarded by an furnace.III)paper is weightless ,thin and stretchy. IV) Paper is recyclable and bio compatible. V) It occupies high the rise area for substance to be stored [6-8]. Moreover, the paper is appealing because it has the ability to aqua through capillary action. The Paper device has more advantage ,but no need of external pumps/plumbing to transport liquid through fluid pathways in this paper and this bio sensor used in many applications. It is illustrated by a bio sensing system using paper as a substrate and the analytical paper based devices [4-6]. The primary detection technique for the paper based devices is controlled by colorimetric methods and it is used to visualize the color intensity of the of the chemical reaction by the naked eye or CCD camera[9]. There are two methods used here such as electrochemical and then fluorescent method for finding the new analytical method[10-11]. This method is colorimetric method is very simple and easy to use any devoid of any additional power. If any additional power is required for using new analytical methods it can fulfils the power. Using bio sensors requires a small amount of power for a group of minutes are very attractive by using longer miniature batteries which are very expensive. Nowadays paper based power source had been developed various applications[12]. These power sources are directly integrated on to papers by previously used for system integration. Many paper based batteries were used in chip assay, rine paper based battery for a compact a robust [13]. The multi layered anode electrodes have to be improved through power or biosensors, and also used lithium ion paper based battery for flexible reading devices and RFID tags. First time used single anode microbial fuel cell (MFC)[15],[16].

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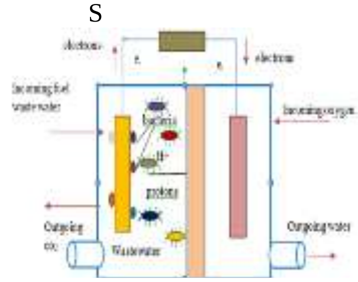


Fig.1.Operation principle of Microbial fuel cell (MFC)

The advantage of the MFC is easy to use, high portability and mobility, low cost. The proposed MFC is used to generate power of 5.5W/cm^2.But still using MFC have small amount of hundreds of micro watt level power. An operating system can be obtained by stacking the MFC s in series or in parallel, paper based MFC needed to develop current density .It is able to generate a current density of 211μA/cm^2 and a power density of 28.4μW/cm^2 [17].

II.OPERATING PRINCIPLES

An ion exchange membrane that involves only H+ or other cations to passing through catholic chamber and MFC is reduced to the anode and cathode chambers(Fig 1).To complete the external circuit by connecting two electrodes. It oxidizes the microorganism's substrate in the anode chamber and the electrons are produced to anode by exhalation process. During this process, chemical energy is accepted throughout the electron chain (ETC), Krebs cycle, glycol sis. The repeatedly oxidizing functions are nicotinamide a demine dinucleotide, NADH and it easily reduces to adenosine triphosphate (STP), the biological unit. It travels the protons passing through PEM cathode. The captured electrons are reduced at the anode and the redox operation is completed. That reaction the potassium ferricyanide used as an electron and it captures the electron easily (from eq.1) at the cathode. Finally the process is completed.

$$[Fe\,(CN)_6]^{3-} + e^- \rightarrow [Fe\,(CN)_6]^{4-} \quad (1)$$

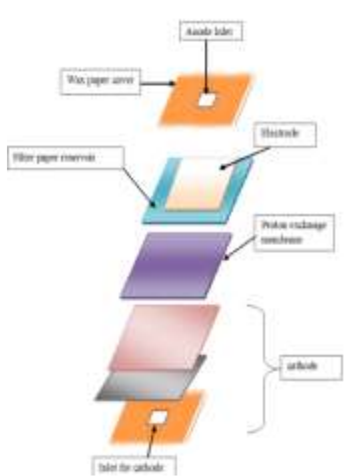
The MFC performance can be affected by many factors such as chemical substrates, membranes, and reactor configuration [18] [19].It determine the power generation are i)To attach a area for bacteria ii)the electron transfer efficiencies iii)chemical diffusion rate. First, the electrodes used as carbon based materials, such as graphite, carbon cloth, etc., that is the reason the carbon cloth is used here and it is used for many applications. Second, the important factor is anode volume chamber to increase the performance because they attribute to the accumulation and acclimation. Paper is very attractive because it has the ability to fluids through capillary action and it provides a high surface area.

III.EXPERIMENTAL SET UP

A.DEVICE FABRICATION

Fig 2 shows single anode and four anode MFC .The paper based MFC having four components i)anode/cathode layers ii)anode/cathode reservoirs iii)proton exchange membrane iv)hydrophobic paper.

Fig 2.a.Schematic diagram of one anode MFC



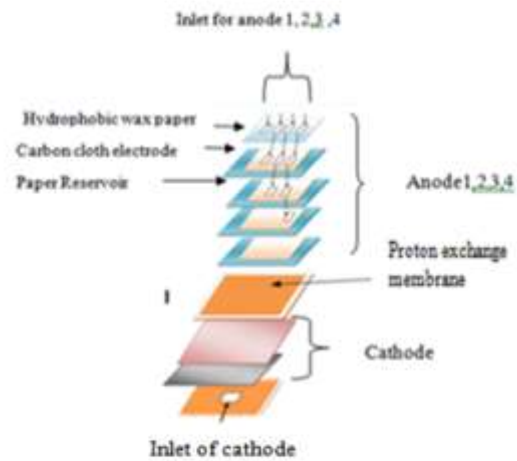


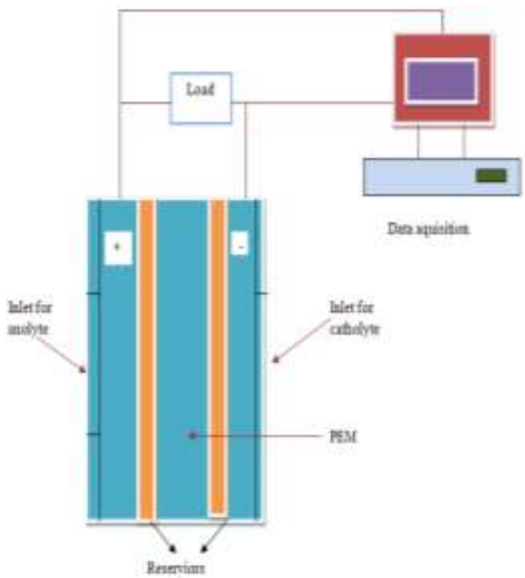
Fig.2.b.Schematic diagram of Four anode MFC

The whatman no.1 is used as a carbon cloth of the anode and this filter is a standard grade filter with medium flow rate and the hydrophobic paper is available. Simple printing technologies used are micro machining, cutting and wax screening printing are not suitable full thickness of carbon clothes and papers.

The entire sheet of paper and carbon clothes are diluted to UV light and it is removed the photo resist from the materials by washing. Finally, the device was packaged and if the four anodes the device uses four different inlets are used and these inlets are flowing through the different layers and attach on each layer. The anodes are connected to a single electrode.

B.MEASUREMENT SET UP

By using a data acquisition system we can measure the voltage between anode and cathode and it recorded the data every 1min It customized MATLAB interface(Fig 3).The circuit is closed when the 1.5k external resistor connected between the anode and cathode electrodes of the MFC. The current is calculated through resistor via ohm's law and the power via joule's law, P=VI.



C.ANOLYTE AND CATHOLYTE

The graph was grown in standard L-broth medium for 24 hours at 30 °C. It consist of 10.0 gtriptone, 5 g extracted and the 5 g Nacl per liter. Used as a phosphate buffered ferricyanide solution on the catholic side. The four anodes MFC, 1mL of the anolyte was introduced to each individual inlet separately and the temperature is 30°C.

D.Bacterial fixation and Scanning electron microscope (SEM)

The anode has been disassembled ,rinsed ,adherent bacteria were immediately and it will be fixed in 2% glutaraldehyde solution at 4°C.samples are then dehydrated by serial,5 mins through 50,70 and 100% ethanol.

IV.RESULTS

A.SIMULATION OUTPUT

The nominal Fuel Cell Stack voltage is 45Vdc and the nominal power is 6kW. The converter is loaded by an RL element of 6kW with a time constant of 1 sec. During the first 10 secs, the utilization of the hydrogen is constant to the nominal value (Uf_H2 = 99.56%) using a fuel flow rate regulator. After 10 secs, the flow rate regulator is bypassed and the rate of fuel is increased to the maximum value of 85 lpm in order to observe the variation in the stack voltage. That will affect the stack efficiency, the fuel consumption and the air consumption. Fuel cell voltage, current, DC/DC converter voltage and DC/DC converter current signals are available on the Scope2. Fuel flow rate, Hydrogen and oxygen utilization, fuel and air consumption, and efficiency are available on the Scope1.

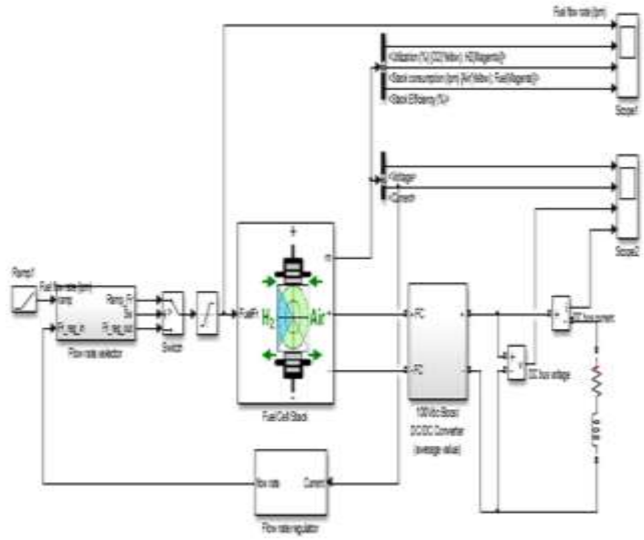


Fig.5.Simulink Model

V.FURTHER DESIGN CONSIDERATON

For our future work, we involved the phosphate buffered ferricyanide as a catholyte. It offers high mass transfer rate, low activation energy and over potentials are produced the power and the open circuit potentials. It is not only suitable for only limited application because it is toxic and expensive.

Fig.6.Hardware Set Up

VI.C

A multi anode devices have been developed for the first time and the features are MFC is flexible carbon cloth anodes, paper reservoirs as an anolyte, catholyte as a time intervals. The maximum power density is 28.4 μW/cm^2 and the current density is 211 μA/cm^2 and the multi anode MFC has been increased to 5x and 3x respectively. The advantage of the paper based MFC is easy to use and construction is very simple for the single use electronics.

VII.REFERENCES

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