International Journal of Electrical and Electronics Research ISSN 2348-6988 (online)
Vol. 4, Issue 2, pp: (121-125), Month: April - June 2016, Available at: www.researchpublish.com

Some Case Studies on Biosensors

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Abstract: **Biosensor is one which is used to detect Diseases in human body. They are voltametric, amperometric and immunosensors. Amperometric biosensors are those which give current as output. The degree of oxygen content is measured in terms of current in milliamperes. Many dangerous diseases are detected through Biosensors mainly with amperometric biosensors. Biosensors are those which contain a biological element and a transducer. A transducer is one which converts one form of energy to electrical energy. In a biosensor the biological signal is converted into electrical signal. The biological element is Glucose Oxidase (GODx) popularly known as GODx Enzyme. It reacts with the living cell or a diseased cell and gives output in terms of current in milliamperes.**

Keywords: **Biosensor, oxygen, Enzyme.**

1. INTRODUCTION

Biosensors are invented by Micheal Clarke in 1962.It is popularly known as BIOSENSOR Cell. It consists of 3 terminals namely Working electrode, Reference electrode and counter electrode .Working electrode is made of Glassy carbon ,reference electrode is made of Ag, AgCl and counter electrode is made of platinum. The Biosensor cell is having 4 openings for the electrodes and another one for Bulk solution.

The schematic is given by BIOSENSOR- The entire set up is connected to PC with electro com software. The adjustable key is present in electro com software to adjust the potential with respect to reference. Let the range of potential be between -0.25v to +0.25v. Then press the green button to run the software. The oxidation and reduction cycles will be occurring. The process runs like photosynthesis. In this process, carbon dioxide is taken as Input and oxygen as output. It is a reversible process in BIOSENSOR. It works like plants and trees which take CO2 as input and O2 as output. The Biosensor works in environments like oxygen environment whose output is of oxygen gas in lab.The electrodes are anode and cathode, at Anodic part, GLUCONIC acid and H2O2 releases and at Cathodic part, H2O2 reduces to H2O and O2(oxygen).

2. CASE STUDIES

Case1:

First test is performed with the Ferro ferri solution with some reference voltage then observe the oxidation and reduction curves. This is one of the results that occur after ferroferri test.

The below result figure1 shows the anodic and cathodic part reactions. At anodic part oxidation occurs releasing gluconic acid and hydrogen peroxide. At cathodic part, reduction part occurs releasing Oxygen at cathode. This is done by testing the biosensor with ferroferri solution. This test is called BARE GLASSY CARBON Test. Bare GC refers to no chemical is added to WORKING electrode which is GLASSY Carbon. This is a preliminary test before we start the actual testing the analyte. The difference in potential is taken between upper peak and lower peak. It should be greater or equal to 0.01V for some fixed value of current.

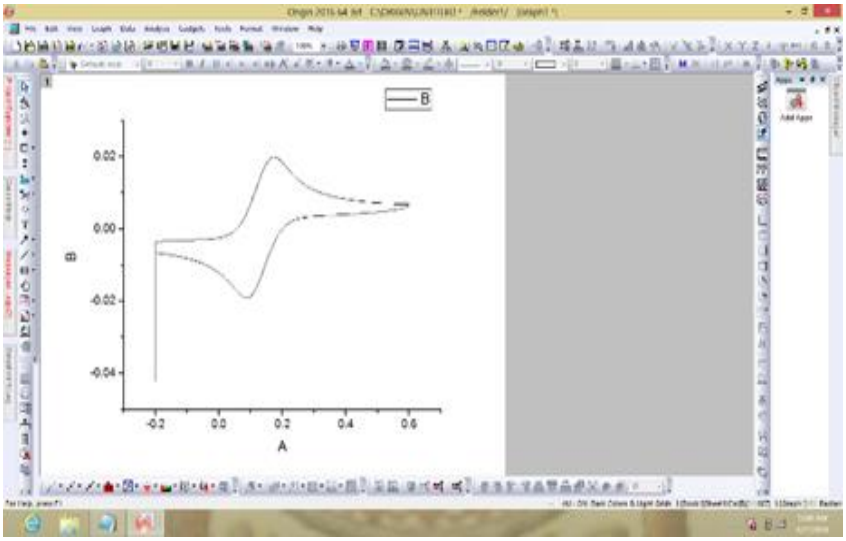

Fig.1 The above result shows BIOSENSOR test after ferroferri.

Case2: Electrochemical polymerization of Analine:[PANI].

This is the most important part of my experimentation. PANI refers to ELECTROCHEMICAL POLYMERIZATION OF ANALINE. The molarities, density, molecular weights of HCL and Analine are taken in equal proportionate and added. They are very dangerous acids, so while taking them out, Glouses are to be wore and with the help of micro pipette the chemicals are taken.

Procedure: Mix 2 chemicals (acids) ie HYDROCHLORIC Acid and Aniline in equal proportionate ratios. Pour the bulk solution in the cell and connect the entire setup to electrocom software. The resultant graph is given below.

The below graph figure2 illustrates the result of PANI on glassy carbon electrode which is referred to WORKING electrode. The oxidation and reduction cycles are observed in a short span of time index. The x axis refers to potential and y axis refers to current in milli amperes. The graph is very sharp with REDOX potentials. Now my working electrode is polymerized with PANI solution .Now this is ready to detect any disease by cyclic voltametry.

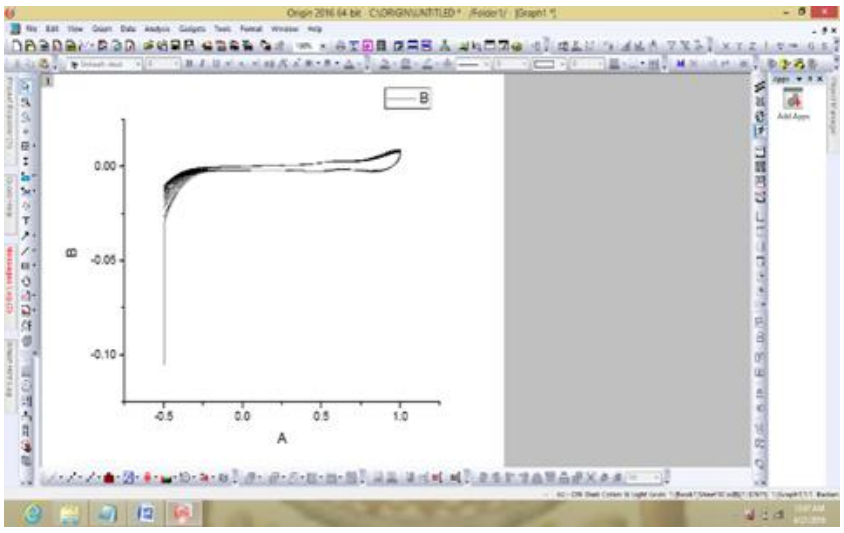

Fig.2 The above result shows BIOSENSOR test after PANI.

Case3: Mixture of GODx enzyme with phosphate buffer solution:

The below graph figure3 is plotted at only one scan rate ie10Mv/sec. Actually the scan rate is varied from 10mv to 100mv in steps of 10mv as I specified above. The experiment is continued for various scan rates. But unfortunately, the output plot is getting blurred when all scan rates are mixed and plotted once together. So I have taken only one scan rate that is 10mv/sec. The x axis is voltage in mv and y axis is current in milli amperes. The OXIDATION and REDUCTION are observed ,first current is small and increases with increase in scan rate.

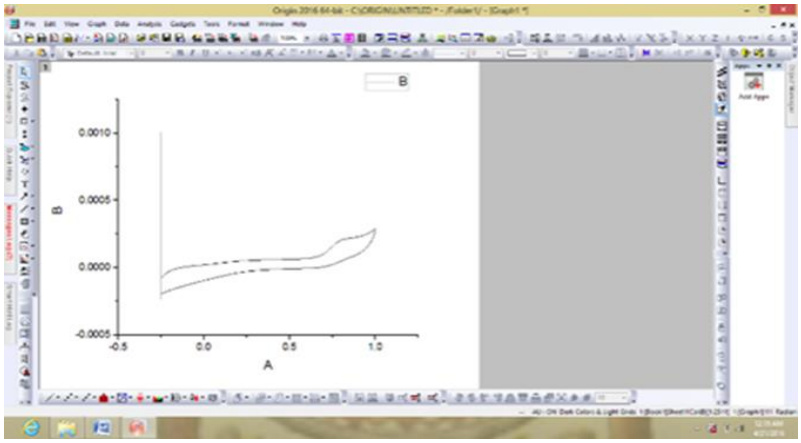

Fig.3 The above result figure3 shows the BIOSENSOR test after GODx test

Case4:

This is the crucial step of the experimentation in detection of cancer in analyte. The cancers are of so many types. They are brain cancer, blood cancer, lung cancer and stomach cancer etc .The cancer is also called CARCINOMA or TUMORS. The blood where we suspect cancer, that area is rounded and taken a sample of blood and micro pipette ,the sample is poured into biosensor cell. For example, for breast cancer, blood at breasts are taken, for blood cancer, we can taken from any part of the body, for lung cancer, the flum is taken, for cervix cancer the ladies menstrual blood sample is taken and examined.

This is called analyte testing. Analyte means analysis on whom the final value of current or voltage is carried out. In this case, cancer BLOOD is taken into account. The cancerous blood cancer sample is 5ml/ 15 ml phosphate buffer solution in taken into the cell. After that software is made to run between -0.5mv to +0.5mv. The output graph is very low current output. It is tested with living cell which gave high current and for cancer, it is of very low value. After running the software, it is found that the current drastically falls down with increase in scan rate. Generally when scan rate increases, the current increases, but in the case of Cancerous Blood Samples, the output current falls due to decrease in mass ,loosing oxygen content, less cell division and loosing grip with human body and become lifeless. If we test a normal living cell, it is good mass, good oxygen content and tight grip with human body. Thats the reason when we connect to a biosensor, the output current drastically increases in oxygen environment. But for a cancerous cell, it is completely reverse product.

The below graphs figures4,5 show the analyte output for different values of scan rate. The scan rate be 50mv/sec and 500MV/sec. It is clearly observed that the analyte current down falled against living cell current. The scan rate of 50mv to 500mv is tested by clicking LOAD cell to view the comparision of currents. It may not be observed in this paper due to blur output. So I kept only the analyte output at scan rate of 50mv/sec. This is one of the tests for detection of cancer ie through C.V. which stands for CYCLIC VOLTAMETRY.

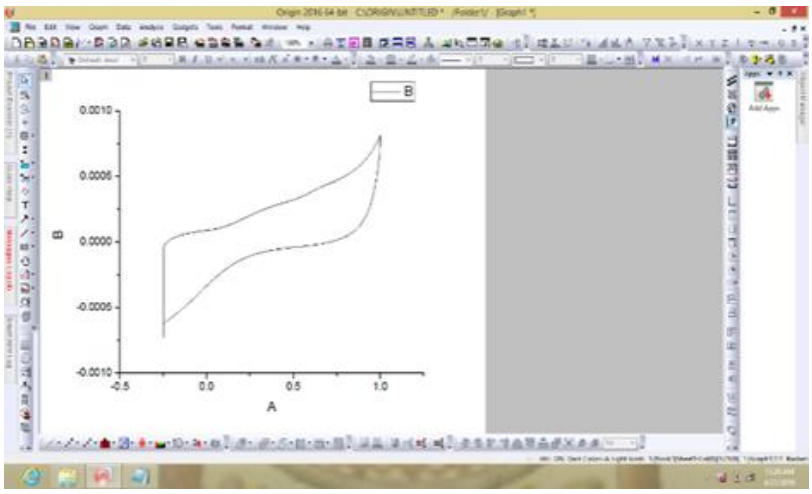

Fig.4

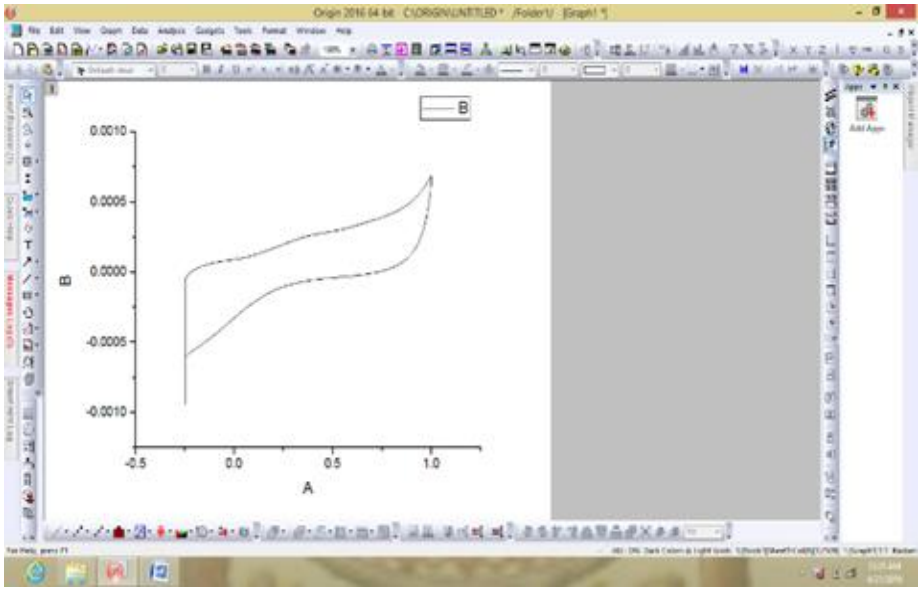

Fig.5

The above 2 figures (fig4 and fig 5) show the BIOSENSOR of cancer analyte.

Procedure for down casting from Biosensor to Present world.

1. First examine the output graphs, then click LOAD CELL and observe Redox cycles for different scanrates.

2. Then click FILE and then click copy and paste the values of current and voltage in a fresh Note pad.

3. Then save the note pad values as per their scan rates.

4. In this paper, the note pad values are for

a) BARE GC

b) GC with PANI

c) GC with GODX enzyme

d) GC+PANI+GODX+ANALYTE

So steps a to d are performed and their corresponding current and voltage values are dumped into different note pads. e) the values collected from note pads are plotted in a specific software called ORIGIN 16 version. The graphing and plotting is done through ORIGIN16 software. The software shows the different plots for living cell and cancerous cell. Living cell is directly analogous to GODx enzyme. Analyte is cancerous cell. It is clearly observed the decrease in current for a cancerous cell in blood sample.

After obtaining the results, the analyte in phosphate buffer solution is poured into washing basin and the cell is discarded by removing the electrodes of WORKING, REFERENCE and COUNTER electrodes. The cell which is not having any electrode is washed with HNO3(nitric acid),for further testing of analytes. The MICROPIPPETE ends are removed and thrown into dust bin without affecting the next sample test.

In this way the some case studies are verified on Amperometric Biosensor in Biosensor Lab located at CSIR-CECERI Lab, India.

3. CONCLUSION

In this paper, the cancer is tested using a BIOSENSOR without going for BIOPSY Test, COLONOSCOPY TESTS. This Biosensor acts like a thermometer which is used to test fever, with my sensor I would like test the cancerous blood sample, if diagnosed as cancer, immediate physician consultation should be made where tumor cells can be removed through radio frequency diathermy.

ACKNOWLEDGEMENT

I would like to acknowledge the CSIR-CECRI lab for doing the above work. Particularly I would say thanks to PROFESSOR DV RAMA KOTIREDDY, my PhD Guide for his support. Further I would acknowledge DR.V.Ganesh, Scientist, EEC division-CSIR-CECRI, Karaikuddi.

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