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Electrochemical Polymerization of ANALINE in GLASSY Carbon and Stainless Steel Working Electrodes through CYCLIC VOLTAMETRY

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Abstract:

Biosensors are versatile devices in detection of diseases. The biosensor which I used in my research is electrochemical type. it is divided into Amperometric biosensor, conductometric biosensor, potentiometric biosensor. The output of amperometric biosensor is current in the order of milliamperes. Where as the output of potentiometric biosensor is voltage in mv. My research is to detect cancer at early stage through cyclic voltammetry. In this method, electrochemical polymerization of analine(PANI) plays a key role in detection of cancer. This is performed in vitro domain ie at CSIR-CECRI Lab in KARAIKUDDI, Tamil Nadu.

1. Introduction

The Biosensor is invented by Michael Clarke in 1962, to do experiments on electro chemistry. The biosensor consists of 3 terminals namely, WORKING electrode, COUNTER electrode and REFERENCE electrode.

The working electrode is composed of glassy carbon or stainless steel. The counter electrode is composed of Platinum and Reference electrode is composed of Ag and AgCl. The experimental setup is given by the following schematic:

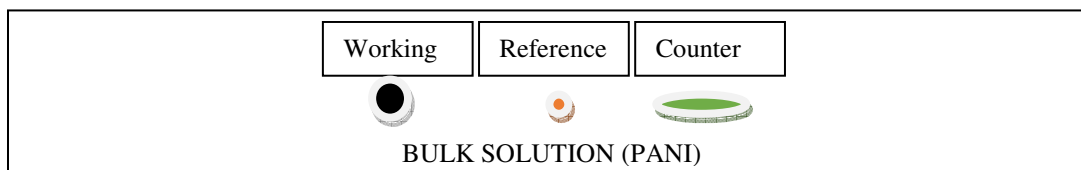


Figure 1

The above diagram shows the set up of a biosensor with 3 electrodes. The experimental set up is given by the above diagram which is connected to a PC with **electrocomm software**. The electro comm software is a software which plays a key role in electro chemistry, it shows the various stages of bulk solution on which biosensor electrodes reside. It conveys the state of bulk solution in terms of current in Milli amperes. The output is a Cyclic voltametry containing OXIDATION and REDUCTION cycles.

2. Experimentation

First the biosensor cell is cleaned with water and the Pani solution is poured into Biosensor cell. The Pani is prepared by mixing two acids HCL and ANALINE in fixed proportions by weighing on the weigh balance. Next the electrodes are fixed on to the bulk solution which is going to be PANI (ELECTRO CHEMICAL POLYMERIZATION of ANALINE). The setup is now connected to PC and set the reference voltage to -0.5 V to +0.5V. Then it is clicked on RUN to show the oxidation and reduction cycles.

The out puts are shown below which illustrate the working of PANI. First the working electrode is rubbed on cushion type circular box to make it free from other substances.

Next, it is tested with FERRO FERRI solution to make the device ready for giving Oxidation and Reduction cycles. In ferro ferri test, the biosensor peak to peak voltage should be 0. 01V. Next, the biosensor with PANI solution is tested for cyclic voltammetry. The resultant graph is shown below.

3. Result

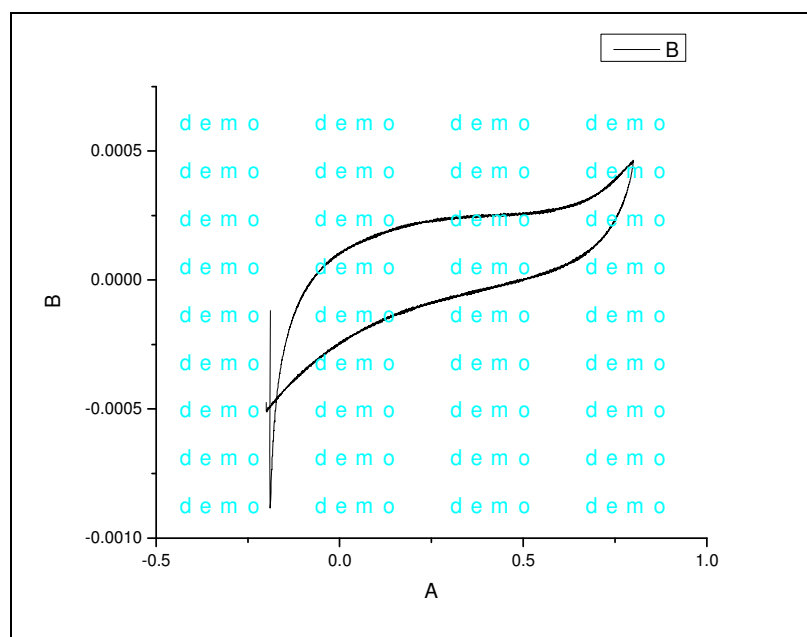


Figure 2

The above diagram shows the redox cycle of Biosensor cell for normal cells which contains oxidation and Reduction cycles. The upper portion is OXIDATION which runs between rated voltage -0.5v to $+0.5\text{V}$. The lower portion shows the reduction of Pani which runs between the rated -0.5v to $+0.5\text{V}$. Poly aniline is conducting polymer discovered 100 years ago, which is used in textile industry is drawing attention of researchers to detect diseases at early stage. My work is to make the working electrode composed of Electrochemical polymerized aniline which is mixed with HCL. The working electrode end gets polymerized to detect cancer cell which is contained in bulk solution which is drop casted by cancerous blood into BULK SOLUTION.

4. Stainless Steel Working Electrode

Now the working electrode is changed from GLASSY carbon to STAINLESS steel electrode. The rest remains as it is which is done for Working GLASSY carbon. Stainless steel which is rugged in nature first it polished with cotton to dip in the bulk solution which is prepared of mixing HCL and ANILINE in equal proportions. This is a preliminary test done before it starts detecting cancer cell. The characterization of stainless steel is inox steel which does not corrode like ordinary steel. Stainless steel differs from carbon which does not corrode. The stainless steel working electrode along with Reference and COUNTER electrodes are connected to PC to observe cyclic voltammetry. The resultant graph is shown below.

5. Result

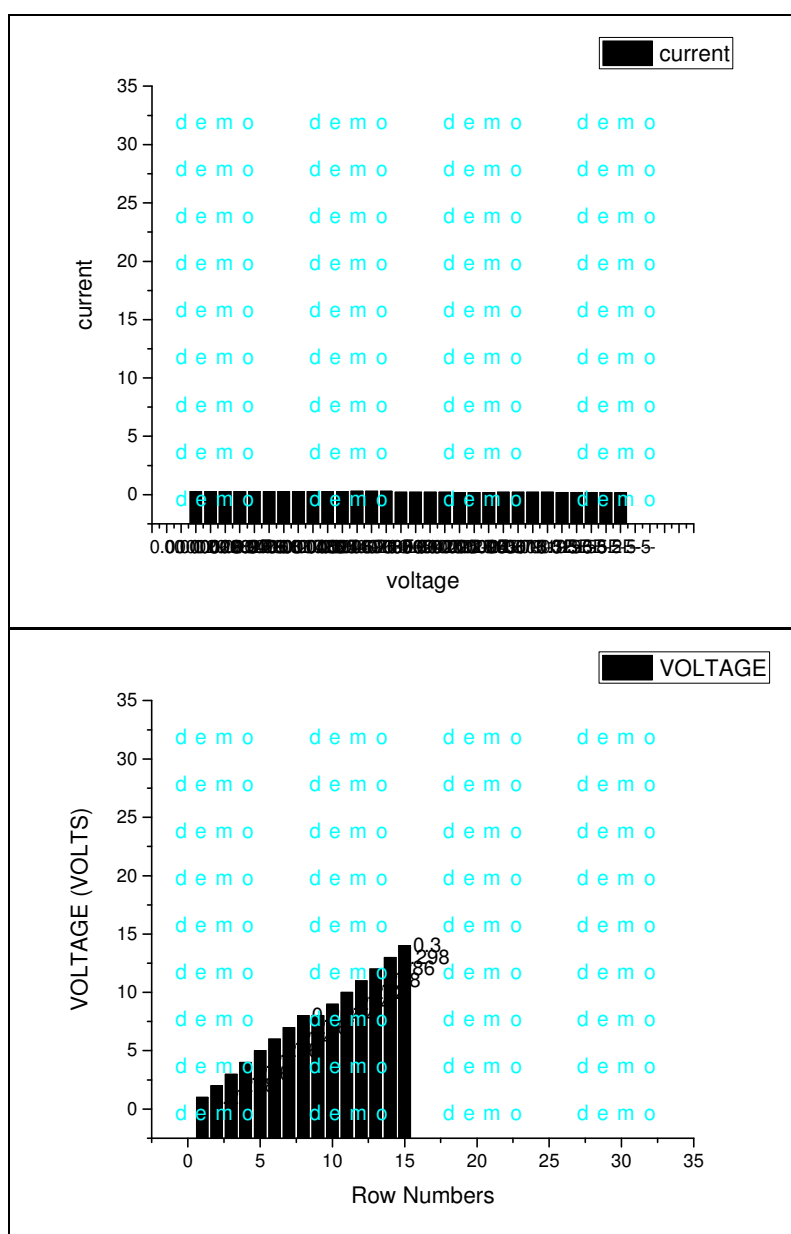


Figure 3: The above two graphs show current vs voltage for stainless steel electrode of biosensor

7. Conclusion

In this article I showed the cyclic voltammetry of BIOSENSOR with GLASSY CARBON and STAINLESS STEEL working electrodes in early detection of cancer with PANI and cancerous blood bulk solution. The current heavily falls down for Cancerous cell. This is done by observing the two graphs for NORMAL and CANCEROUS cells.

8. Acknowledgement

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9. References

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