

Research Article

Detection of Cancer through Nano Amperometric Biosensor by Viscosity

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Summary

Biosensors are invented by Lenard C. Clarke in 1962 to perform experiments on Bio electric potentials. It consists of 3 electrodes namely, Working electrode, Reference electrode and Counter Electrode. Working electrode is made of Glassy carbon and Stainless steel. Reference electrode is made of Silver or Silver chloride; Counter electrode is made of platinum. The substrate is made of glass. The solution that is poured into the biosensor is called Analyte. It is otherwise called Bulk solution. When substrate appears in Bulk Solution, the operation of biosensor takes place. Michaels Manton equations are taken into consideration for illustration of basic working of Biosensor. The basic biosensor contains a Ligand and a transducer. The ligand is biological element in which I used is GODX chemical (Glucose Oxidase), and Transducer is one which converts one form of energy to another form. The output of Transducer is electrical signal. The Viscosity which is Applied Physics Variable is used in detection of Cancer Pathogen. Viscosity [1] is defined as ratio of shear stress to velocity gradient in a fluid. It plays a key role in detection of cancer pathogen in a blood sample. Viscosity variables are simulated in MATLAB software and numerical simulation is performed and from the output graphs, it is found that Viscosity is high for Non- Cancerous cells and low for cancerous samples.

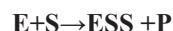
Keywords: Biosensor; Cancer; Nano Technology; Viscosity

Introduction

The biosensors usage is increasing day by day in the fields of Biotechnology, Nano Technology and Pharmacy, last but not the least in the field of instrumentation [2]. The research and development started in the year of 1962 in the field of Biosensors, where it stated to diagnose various Disturbances in the body. At first, the biosensor is used in the detection of diabetes, later small pox, chicken pox and finally used in detection of dangerous cancer. The Biosensor used in my PhD is electro chemical type. The other electro chemical Biosensors are Potentiometric, Conductometric and Amperometric Biosensors. The output of Amperometric Biosensor is order of milliamperes.

Whereas the output of potentiometric biosensor is of millivolts and the output of conductometric biosensor is of thermal voltage. The experimental procedure which I did is direct current cyclic voltammetry technique. It contains two graphs namely volt-

tammogram and cyclic voltammetry. The voltammogram is of voltage versus time, whereas cyclic voltammetry is voltage versus current. The cv graph contains two cycles namely oxidation and reduction. At anode oxidation occurs whereas at cathode, reduction occurs. The procedure involves Michelas, Manton [3] equations which involves as following:



Whereas E stands for GODx chemical known as Enzyme, which is very costly and takes minimum 06 months for delivery of the chemical to the customer.

S stands for Substrate -Glass used in this paper.

ESS- Enzyme Substrate complex

P- Product- oxygen gas observed in milli amperes.

Experimental Procedure [4]:

First the biosensor is tested with Ferro Ferri Solution to start the transfer the movement of electrons from anode to cath-

ode. Next it immersed in Aniline to perform pani test. pani stands for electro chemical polymerization of aniline. Next the ligand is poured into the solution. Ligand is glucose oxidase chemical. Next analyte is poured. Analyte stands for Blood sample taken from a Cancerous patient. If the order of current decreases, it is definitely a cancer pathogen.

VISCOSITY-Core theory of paper [5]:

Viscosity is taken into consideration for detection of cancer through Numerical Simulation using MATLAB Software. Viscosity refers to measure of thickness of a fluid deformed by Shear stress. Generally, Blood contains Serum in which WBC and RBC are contained in it. WBC-White Blood Corpuscles. RBC-Red Blood corpuscles.

The healthy blood will have more HB(Hemoglobin) and viscosity when compared to cancerous blood sample. The cancerous blood sample are loose and lose their grip with the skin and become shapeless. So, basing on this, I say the viscosity of Cancerous cell will be less.

Governing equations [5]:

$F = KA/Y$. Where F stands for force, A stands for area of cross section, Y stands for separation, and K stands for constant.

Consider the below 2-Dimensional fluid flow. Their area of cross section may be A, and their separation between them is Y. The below figure illustrates the above stated Governing Equation. The Horizontal line denotes Fluid and Vertical Line illustrates Y dimension whose gradient is du/dy . U stands for velocity of fluid.

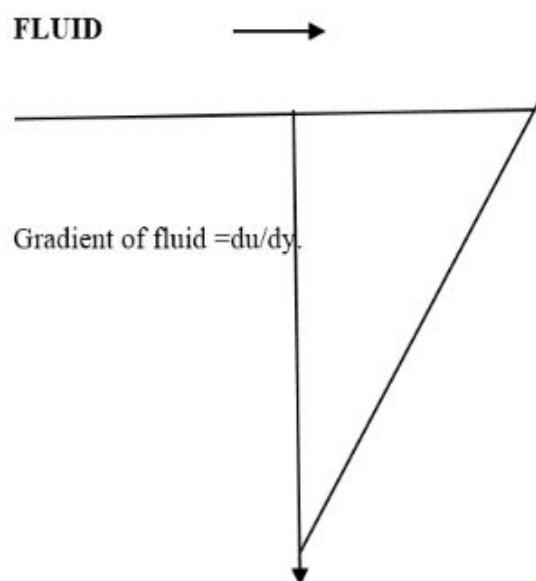


Figure 1: The above figure shows the 2-dimensional fluid flow, whose gradient is given by du/dy -U- Velocity of fluid, Y stands for separation between water shelves. Courtesy: Wikipedia of Viscosity [6].

Nano technology

Nanotechnology [7] is growing exponentially in the fields of Biotechnology and Pharmacy. The Nano materials are CNT and Graphene. CNT- Carbon Nano Tube. Nano Technology is order of $10^{exp(-9)}$. The graphene [8] coated Biosensor is best used for detection of cancer at what stage it is. Now it is referred to as NANO biosensor. The Carbon Nano Tubes are Single walled and Multi walled CNTs. The various combinations of CNTs along with ligand, transducer [9] combination can be illustrated as Nano Biosensor with glass substrate and Blood sample as Analyte.

The viscosity is found to be LOW (1.0) for Cancerous cells (Figure 2) [10]. The program in Matlab is written [11] and numerically simulated in MATLAB, it is found that Viscosity for Cancer cells is very low.

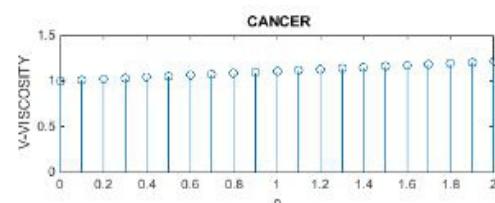


Figure 2: The above figure 2 shows the Cancer plot with various Number of moles (No of living cells).

The viscosity (100) is found to be High for Non-Cancerous Cells (Figure 3) [10]. Program in Matlab [11] is written and numerically simulated, it is found that viscosity for Non-cancerous cells is found to be very high.

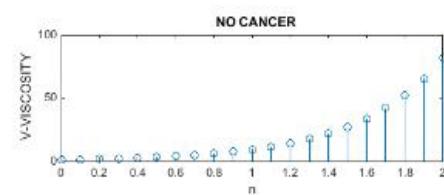


Figure 3: The figure shows the plot of No Cancer with various no of moles (living cells).

Case studies for Cancer Testing:

S.NO	Force	Viscosity	Result
Cancer	Low	Low	Positive which says it is a Cancer Sample.
Non-Cancer	HIGH and Tightly Fit with Skin	Very High	Negative: Which says it is definitely NO cancer.
Intermediate stage	Average Value	Mid of Low and High.	Cannot judge.

Table 1: Case studies for Cancer Testing.

Conclusion

Finally, in this paper I have brought comparisons between Cancer and Non-Cancerous cells with respect to viscosity. Viscosity will be very high for Non-cancerous cells and Low for Cancerous cells. From this paper it is confirmed that Viscosity plays a key role in detection of cancer pathogen in blood samples. Many applied physics variables are used in my phd like surface tension, thermal engineering variables, fluid mechanic variables, dynamics and kinematic variables, molecular momentum, out of all viscosity plays a key role in detection of cancer at early stage because it is known for finding molecular strength in a living cell. Generally, cancer cells have high flexibility and lose their grip with human body and become uneven mass shapes, so obviously viscosity will be low for cancer cells and high for Noncancer cells.

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