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Validation of Biosensor in Detection of Cancer and Cancer Cell Characterization with Spin Electrons

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Abstract

A biosensor is one which is used in biotechnology field to detect pathogens. It contains a ligand and a transducer. A ligand is a biological element and a transducer is one which converts one form of energy to another form. The ligand which is used in this work is Glucose oxidase (GODx) enzyme to detect cancer at what stage it is. The work is done in 2 parts, one is experimentation and the second one is simulation. The experimentation is done in DCCV method. The biosensor which is used in my work is Amperometric biosensor. The output of amperometric biosensor is current which order of milli amperes is. The simulation part is carried over with MATLAB 18 software. The applied physics variables like viscosity, surface tension, thermal Engg, dynamics and kinematics, interfacial coefficients, resonators etc. are used in detection of cancer. In this paper, the work has been presented the validation techniques of working of biosensor which is amperometric in nature and one Nano Technology parameter which is spin that is notified for cancerous cells. In this paper the results that are shown are taken in ORIGIN 18 software for cancer patients in nano scale. Next the cancer cells characterization is shown with spin electrons which are up and down spins for normal living cells and NO spin for cancerous cells. This work is an insight of my research to determine the cancer present at what stage it is with the help of biosensor. Cancer is growing exponentially all over the world. This is a burning problem today around the field of medicine, pharmacy and biotechnology. The research is ongoing around the globe to find a drug which can enable T cells to identify cancer cells immediately after their entry into human body.

Keywords*: Biosensor, Cancer, DCCV, Spin, Origin, MATLAB*

INTRODUCTION

BIOSENSOR was invented by Lenard Clarke in 1914.The electro chemical biosensors are categorized by

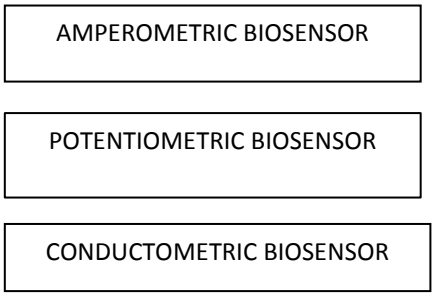

Fig: 1. *shows the Categorization of electro chemical biosensors*

The above 3 diagrams show the electro chemical biosensors whose outputs are given as current, voltage and temperature respectively. The biosensor I have taken in my work is AMPEROMETRIC BIOSENSOR. The three terminals of amperometric biosensor are working electrode, Reference electrode and Counter Electrode. The Working electrode is made of glassy carbon, gold and stainless steel. The reference electrode is made of Silver and silver chloride. The counter electrode is made of Platinum or calamel. The biosensor is also known as simply CELL. It resides on a substrate which is made of

glass or semiconductor. Cancer, which is known as Carcinoma, oncology is because of unregulated growth of living cells, uncontrolled growth of living cells, abnormal growth of living cells. The cancer cells are also referred to be Malignant cells. Carcinoma refers to cancer cells and sarcoma refers to cancer of tissues. Cancer cells have un-even division and they never get differentiated. Cancer cells have abnormal nuclei and loose grip with human body. The cancer cells become flat and have no distinct size and shape. Cancer cells have uncontrolled growth which leads to high blood pressure. Applied physics variable like surface tension, viscousity, momentum, thermal engineering variables, dynamic and kinematic variables vary in a large quantity. The molecular momentum decreases due to a loose grip with human body which results in less concentration output in biosensor. Biosensors are bio transducers with ligands. The ligand used in this work is glucose oxidase GODx. This ligand interacts with human blood and results in output current order of milli amperes to atto amperes. The nano technology used in this work is graphene which is best suited for biological applications.

PART I-Materials and methods

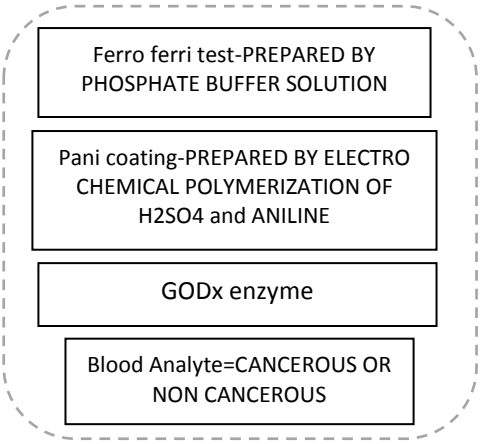

Fig: 2. *shows the materials and methods used in this work*

The above flow chart shows my Research insight with the following steps [14]:

- First the biosensor is tested with Ferro ferri test, this is done by phosphate buffer solution [16], if the output voltage is around 0.01v, the biosensor is ready for characterization.
- Next, the biosensor [18] is coated with Pani Solution, this solution is prepared by electro chemical polymerization of Aniline.
- Next the biosensor [17] is added GODx [26], [23] enzyme is added to speed up the reaction of biosensor with blood analyte.
- The governing equation [17] is given by Michaels Menton equation.

E+S > ESC+P

Where, E stands for Enzyme, ESC stands for enzyme substrate complex, P stands for Product, S stands for Substrate.
The experimentation got validated by the following observation.

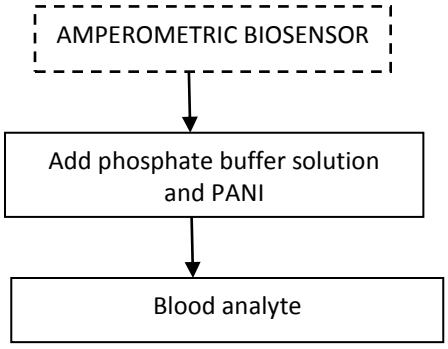

Fig: 3. *shows the experimentation procedure got validated by the above observation*

Metastatic stage. It is observed that that the current is of milli amperes for Normal living cells and it is order of Micro amperes, Nano Amperes, Pico Amperes and Fempto amperes for cancerous cells.

Table: 1. *Different Current Ranges For Cancers*

Input	Current	Result
Normal Blood	Milli amperes	No cancer
Cancerous blood	Micro amperes	Meta stage cancer
Cancerous blood	Nano amperes	Metastatis cancer
Cancerous blood	Pico amperes	Middle stage
Cancerous blood	Fempto amperes	Advanced stage

Previous works

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The above observation is validated with the following results.

RESULTS

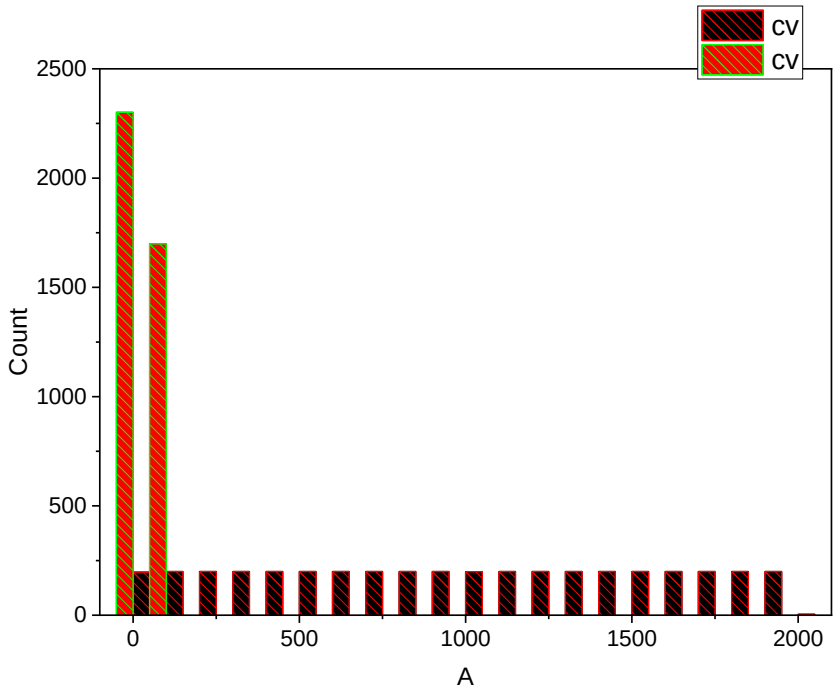


Fig: 4. *The above figure 4 shows Output current for a Breast cancer Patient in metastage*

Where, A stands for Nano volts and Count stands for Current in nano scale, which shows a Metastasis cancer patient for breast cancer patient.

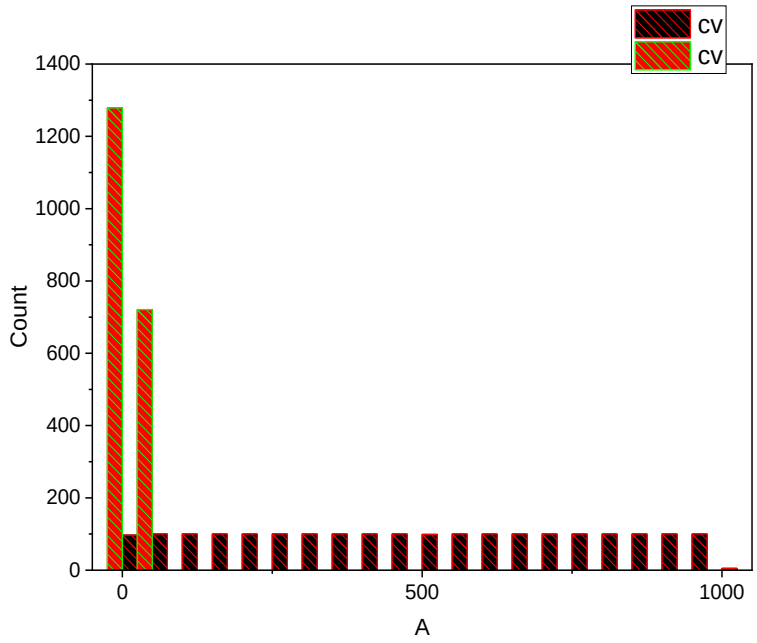


Fig: 5. *shows the output current for a lung cancer patient.*

The above result shows a result of Nano volts-A- Vs COUNT –Nano scale amperes[29], [30], [31] for Lung cancer patient.

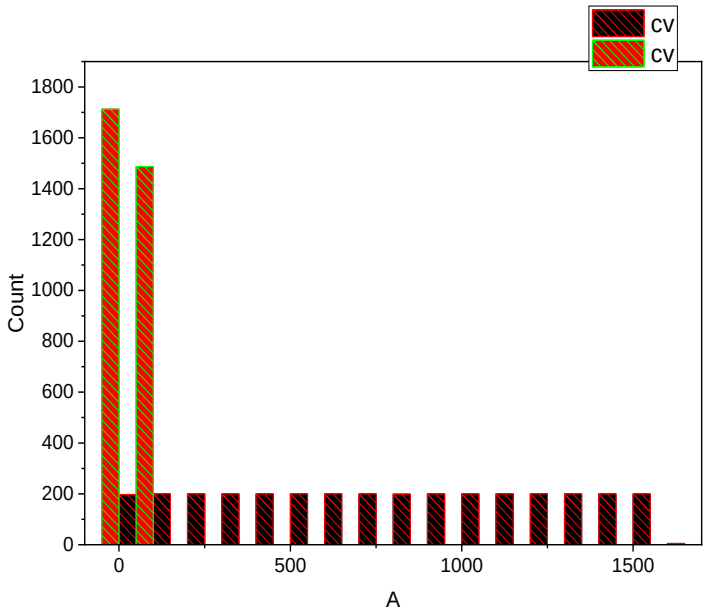


Fig: 6. *shows for blood cancer patient in Metatstais stage.*

The above graph shows for blood cancer patient in 2Metatstais stage. In this way I have validated my Research insight at two labs [24,[25] in INDIA CSIR Lab at Chandigarh and Karaikkuddi.

PREVIOUS WORKS

- **Eva Vargis** et al have contributed that Single-Step Incubation Determination of mRNAs in Cancer Cells Using an Amperometric

Biosensor Based on Competitive Hybridization onto Magnetic Beads in 2018.

- **Zhi-Da Gao1** et al have Development of Amperometric Glucose Biosensor Based on Prussian Blue Functionalized TiO2 Nanotube Arrays in NOVEMBER 2014.Amperometric biosensors consisting of oxidase and peroxidase have attracted great attention because of their wide application.

- **JOSEÄ I. REYES-DE-CORCUERA et al** have contributed about Enzyme−Electropolymer-Based Amperometric Biosensors: An Innovative Platform for Time−Temperature Integrators in 2005.
- **Japing Pali et al** have contributed their work of detection of cancer through biomarkers by electrochemical biosensors in **2012.**
- **Ajith Sadhana et** al have contributed that Detection of Cancer Biomarkers on Biosensor Surfaces in the year **2015.**

CONCLUSION FOR PART I:

In this way I validate my PhD BY THE ABOVE STATED METHOD. This method got validated by a Cancer physician Dr.Murali Krishna, CEO, MAHATHMA GANDHI CANCER HOSPITAL, VIZAG, M AP, India.

FUTURE SCOPE

The amperometric biosensor can be fabricated by the above stated method and can be used in home as thermometer where detect fever at what stage it is. The method can be extended with a Receptor of T cells who detect foreign bodies entry in human body. The cancer cells escape from the insight of T cells, but by using my methodology, T cells can easily detect the presence of cancer in human body.

PART II

SIMULATION

In addition to the above stated experimentation, I did work on Simulation of applied physics variables. The applied physics variables are

- Surface tension
- Viscosity
- Thermal Engg
- Interfacial Coefficients
- HALL effect
- Resonator
- Dynamics and Kinematics variables.
- Molecular Momentum
- Inherent capacitances

The above stated all the applied physics variables are simulated in MATLAB 2016 version software and published in various national and international journals.

In this paper I would like to present the spintronics [1] of cancerous living cells which have No spin.

There is lot of room in the down said the founder of Nano technology [2]. It is of the order of 10exp (-9). Based on very large scale integration of components, Moore's law [12] states that number of transistors on a particular chip doubles for every 18 months. Electrical transistor has three terminals namely Emitter, Base and Collector. Emitter emits the carriers whereas collector collects the carriers emitted by emitter. It works on the principle of charge transfers from low resistance path to high resistance path. Whereas nano transistor works on SPIN. There is an up spin and down spin and spin technologies developed in a Nano transistor. Flexible electronics are electronic devices which are fabricated on flexible substrates. The fabrication techniques involve CVD [12] process and Nano Imprinting. CVD stands for

Chemical vapor deposition which is used in construction of Electrical transistors such as FET, JFET,MOS FET and BJT.FET stands for field effect transistor, JFET stands for junction field effect transistors and BJT [4] stands for Bipolar junction transistors. MOS FET [3] stands for Metal oxide semiconductor filed effect transistor. There are completely charge based movements between the terminals whereas the Nano transistor works on SPIN of electrons. Nano transistors can produce magnetic media on a non-magnetic medium with their spin .Cancer[13] cells are developed in living cells unregulated ,uncontrolled abnormal growth of normal cells which are known as cancer cells in MEDICAL field. These cells initially look like healthy living cells, but on time bound they grow unevenly and perform uneven cell division and multiplication resulting in cancer cells. They loose grip with human body and become flexible as time bounds. Their REDOX potentials come down, bio electric potentials come down and electrolytic imbalance occurs. Various cancers [6] are found to be breast cancer, cervix cancer, kidney cancer, bone cancer, lung cancer, jaw cancer etc. They are being detected by BIOPSY test and BIO MARKER tests.

After detection of cancer, the treatment of cancer is done through removal of cancer area in the human body through Surgery or Radio frequency diathermy. The different stages of cancer are Meta stage, Metastasis stage, Intermediate Stage and Advanced stage. Cancer is affected through any media not through hereditary or by viral transfer.it can affect to any part of the body.

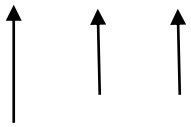
The research on cancer is going on to detect it at early stage and take necessary drugs in time to reduce the life loss due to cancer. The cancer cells have low molecular weight, low mass and its atomic structure is completely destroyed because of cancer.

The well-known theory of atoms is given by presence of electrons, protons and neutrons. Generally, number of electrons is equal to number of protons which is electrically neutral. Human cell has NO magnesium as nucleus. The magnesium is a magnetic chemical which controls the flow of electrons and protons in vivo studies.

The human body contains biochemical like GLUCOSE, PROTEINS and ENZYMES. All enzymes are proteins but all proteins are NOT enzymes. The healthy living cells contains the above said chemicals in equal proportion, but whereas in Cancer these above said chemicals are NOT in equal proportion due to uneven division of cells.

The spin [1] is taken into consideration in this paper to synthesize the cancer cell.

LIVING CELL CHARACTERIZATION



The above shown is a schematic of a living cell with correct UP SPIN.

The above shown Figure is also a schematic of a living cell with correct Down spin

These above specified figures are drawn based upon **Pauli [19]** s expulsion rule. When a cell gets effected by cancer, [6] ,it starts loosing its path in its orbital. There

will be NO specified spin in the electron movement in a particular orbital. The basic orbitals are S orbital, P orbital and D, F[4] orbitals. The path lost by cell when affected by cancer is shown in the below figure.

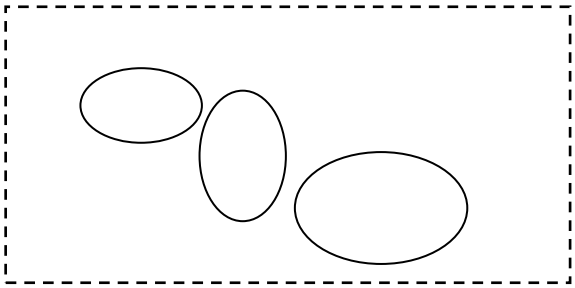


Fig: 7. *shows the path lost by cell when affected by cancer*

Governing Equations for Living and Non Living Cells
(Courtesy: Hyper Physics and Quantum physics)

The electron spin movement is given by its rotation between +1/2 and -1/2.

Taking h as elevation height, the equation for Spin in angular momentum is given by

S=√3 /2.* h. ⟶ (1)

Magnetic moment is given by

€= -e/2m *g*S. ⟶ (2)

Where e stands for electron charge= -1.602*10 exp(-19) coulombs.

g stands for gyro metric ratio= 2.000032 for electron spin.

S with respect to magnetic moment is called electron spin.

S=√3 /2.* h. ⟶ (3)

Magnetic moment is given by

€= -e/2m *g*S. ⟶ (4)

Where e stands for electron charge= -1.602*10 exp(-19) coulombs.

g stands for gyro metric ratio= 2.000032 for electron spin.

S with respect to magnetic moment is called electron spin.

NUMERICAL SIMULATION [7]:

The below diagram shows the UP spin and DOWN spin of an electron whose elevation height varies from -0.5 to +0.5.the below figure 4 shows the pattern of up spin and down spin in Normal Living cells.[7] The up spin is ranged between zero to 0.5 and down spin ranges from -0.5 to zero.

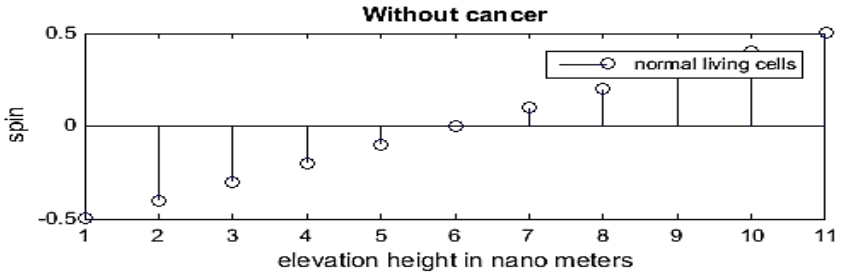


Fig: 8. *shows the normal living cells with up and down spin.*

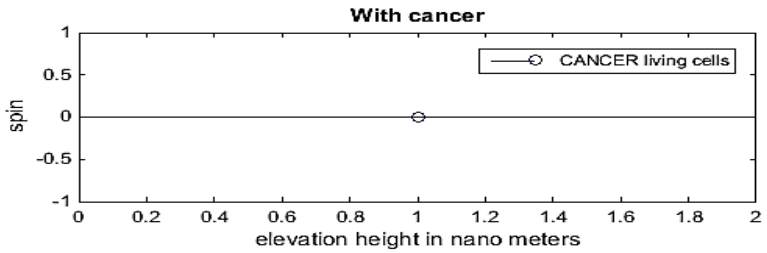


Fig: 9. *shows the cancer living cells without any spin.*

The above figures show the electron spin for a cancerous cell without any spin. This leads to a dead cell after stipulated amount of time. There is NO particular spin pattern in cancerous cells.

CONCLUSION for PART II:

In this paper, I could produce the differences between cancerous cells and Noncancerous cells with respect to electron spin. The results are shown above which are programmed in MATLAB in numerical simulation.

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