THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

DNA Testing Using an Enzyme Based Amperometric Biosensor with Nano Composites and Its Instrumentation

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Abstract:
BIOSENSOR is an instrument in biomedical engineering which plays a key role in instrumentation systems and transducers. The instruments are divided into type in which they are used for a specific purpose. Example: LVDT, THERMO COUPLE are mechanical parametric measuring instruments. Voltmeters and ammeters are used in electrical measuring parameters. Biosensors are used in medical field with biological elements as transducers. Biological elements are ANTIBODIES, DNA, RNA, ENZYME, MICRO FLUIDICS. Transducers are electrical or electronic type which convert biological signal into measurable electrical signal.DNA is basic building block of human body which is sequenced and is used for cancer detection using biosensor.

1. Introduction

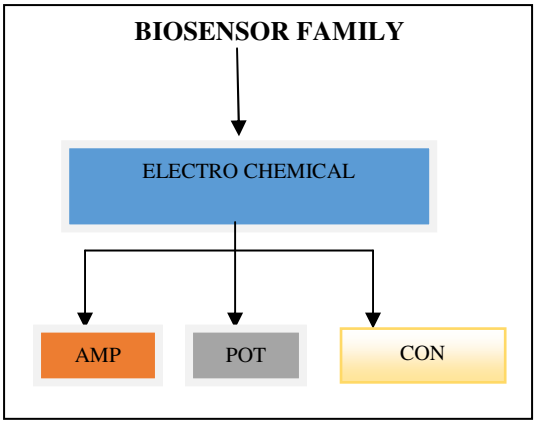

Figure 1

In the above FIGURE I is the basic family of electrochemical biosensors are shown, they are divided into AMPEROMETRIC, POTENTIOMETRIC and CONDUCTOMTERIC Biosensors. In amperometric biosensors, the output is current order of milliamperes, in potentiometric the output is voltage, in conductomteric biosensors, the output is thermal temperature calibrated in terms of voltage. The basic amenities of an instrument are SIGNIFICANT FIGURES, ACCURACY, PRECISION, REPEATEABILTY, ERROR HANDLING Capability, ENIVIRONMENT CONDITIONS. The significant figurers are round off digits showing the output of amperometric biosensor. Accuracy refers to how perfect reading it has given for a suitable measurement .Accuracy depends upon internal alignment of the sensor and its action and time independent and temperature independent. Repeatability refers to how many times the instrument repeats itself for a set of readings. Error handling should be maximum, so that it should be minimized. It depends upon environmental surroundings, worn out parts of the instrument. The environmental errors refers to aging, temperature changes, humidity changes, vacuum changes are liable for errors in biosensors.

2. Instrumentation Building Blocks

SENSITIVITY
ERROR HANDLING
REPEATABILITY
SIGNIFICANT FIGURES
ACCURACY

Table 1

The above blocks refer to building back bones of an instrument. Any instrument you take in this world, the above said parameters are must. Then only the instrument is said to be in GOOD efficiency.

3. Amperometric Biosensor

Biosensor was invented in 1962 by CLARK to take up biological measurements and convert them into electrical signal. Earlier ECG, EEG, EMG instruments are used to measure the amplitude of HEART, MUSCULAR ACTIVITY, BRAIN PULSES in milli or micro volts. In addition to that we have PULSE RATE measurement, BLOOD PRESSURE measurement, LUNG capacity measurement using SPIROMETER. All these instruments do not directly involve in biological activity, we take a jelly apply on the human body, and stimulate it and corresponding electrical signal is taken. AMPEROMETRIC biosensor is used to detect cancer at early stage with GODx catalyst.The output of Amperometric biosensor is current of order of milliamperes.

4. Governing Equation

F=$\int$ $(QE + P.A + MA)$ dt. NEWTONS

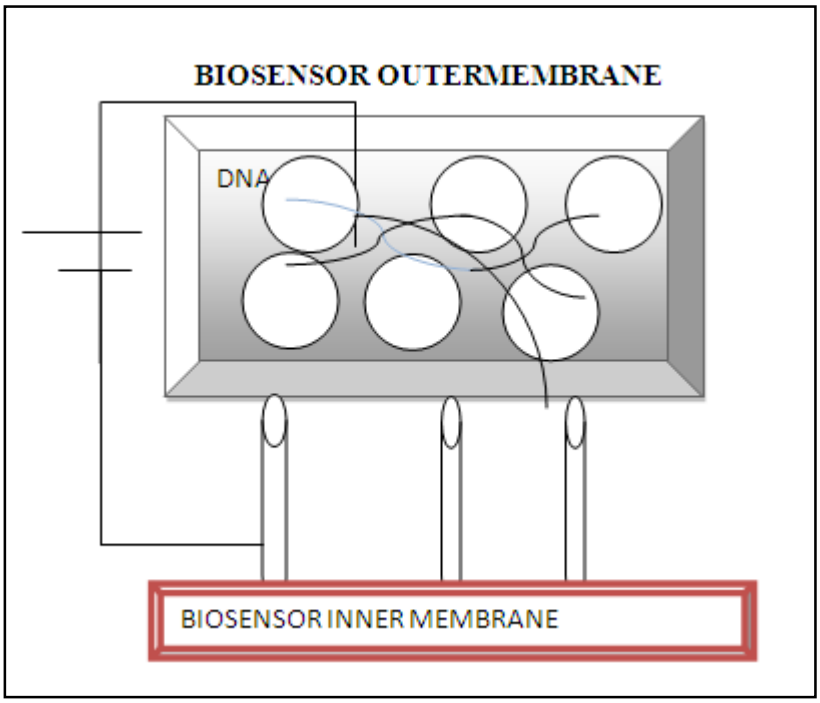

Figure 2: BIOSENSOR inner membrane and outer membrane with LIVING CELLS and DAMAGED DNA and closed DNA

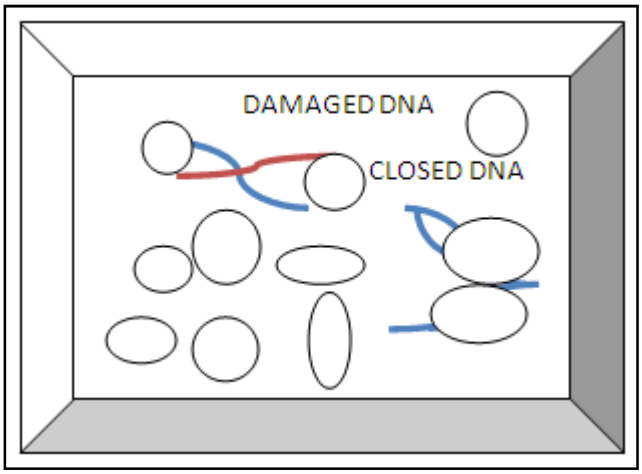

Figure 3

The above diagram (Figure III) shows the experimental set up of DNA hybridization on nano composites. Nano material used is Graphene, this is best suited for biological applications.
The long circles denote Living cells and Cross couplings denote DNA.

5. DNA

DNA is composed of millions of nucleotides which in turn made of nucleo bases (ADENINE, QUANINE, TERMINE, CYTONINE).
DNA is composed of hydrogen bonds linked with sugar and phosphate molecules.
The equation of current in terms of force when we apply during DNA translocation is given by i= Q/t.
The force equation is given by

$F = m*(dv/dt) + Q*E + P*A$

$=M*ACC + Q*V/D + P.A$

$V=[(F-P.A-M.ACC)/q].D$

Where V = Potential Difference
D= Distance
M =mass of individual nano composite
Q = Charge of Electron
E = Electric Field Intensity
P=Pressure on DNA molecule
A = Area occupied by NANO COMPOSITE and DNA molecule.
ACC = Acceleration of Electrons

I=(F-(mdv/dt+P.A))/E.t (in case of Cancerous DNA).
I=(F-(mdv/dt))/E.t (in case of non CANCEROUS DNA).

6. Results

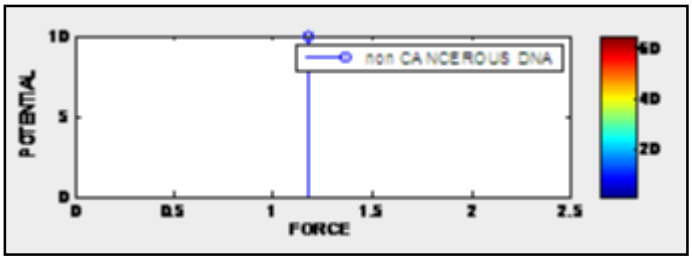

Figure 4: plot between Force and potential for Non-Cancerous DNA

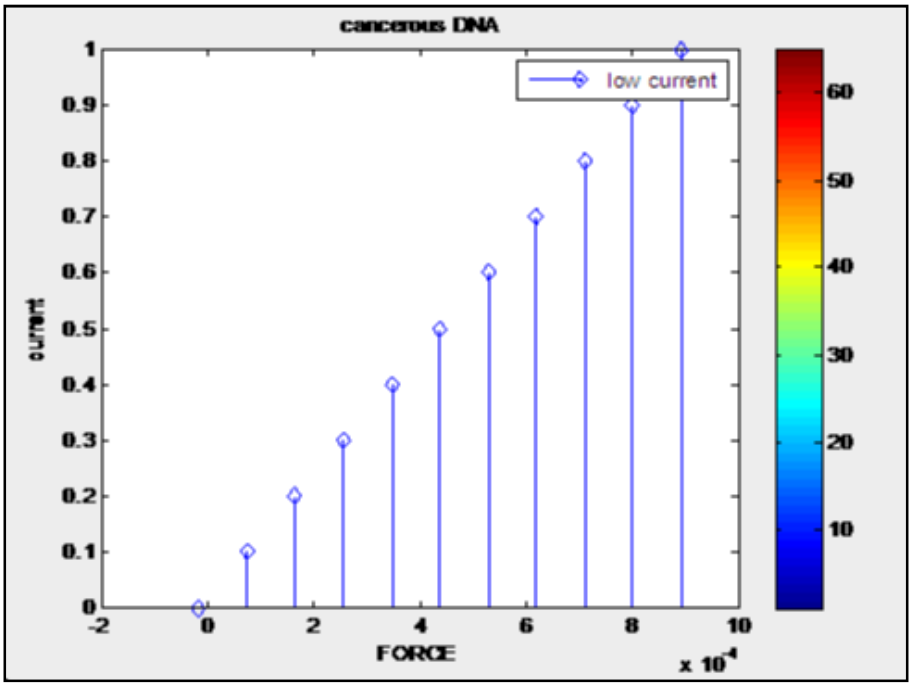

Figure 5: plot between force and current for cancerous DNA

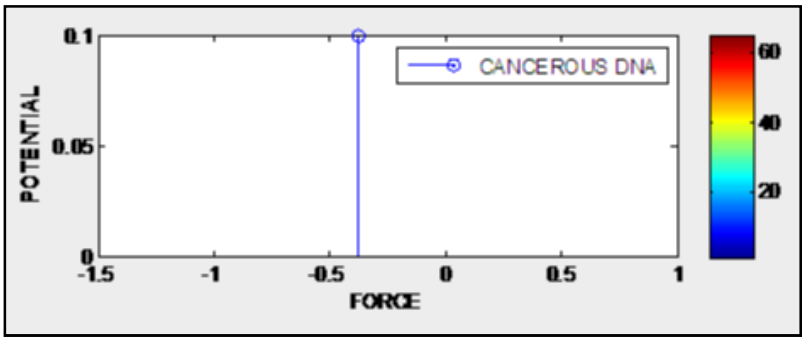

Figure 6: potential vs. force for cancerous DNA

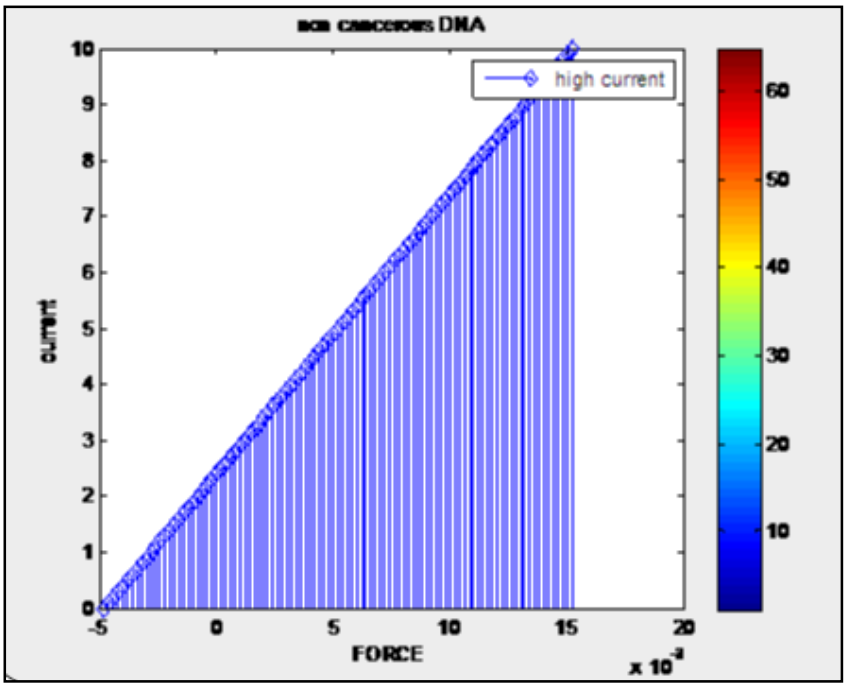

Figure 7: force vs. current for non cancerous DNA

7. Conclusions

In this paper, I presented the Cancerous DNA, non cancerous DNA potentials for fixed force in pico newtons.

Competing Interests:

I have NO competing interest and NO financial support.

8. References

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