

Polymer Nanowire Based Impedance Biosensor

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INTRODUCTION

NANOWIRE BASED SENSOR

- Nanowire based biosensors derives primarily from the potential for such sensors to be label-and reagent-free.
- Nanowires offers the prospect of high sensitivity and rapid Detection.
- Polyaniline (PANI) are more easily modified with biomolecules and attractive features such as mechanical flexibility, ease of processing, and modifiable electrical conductivity.
- The covalent bond between PANI and the antibody enables the direct measurement of the physical change of conductance, capacitance, or impedance upon the binding of antibodies to target proteins.

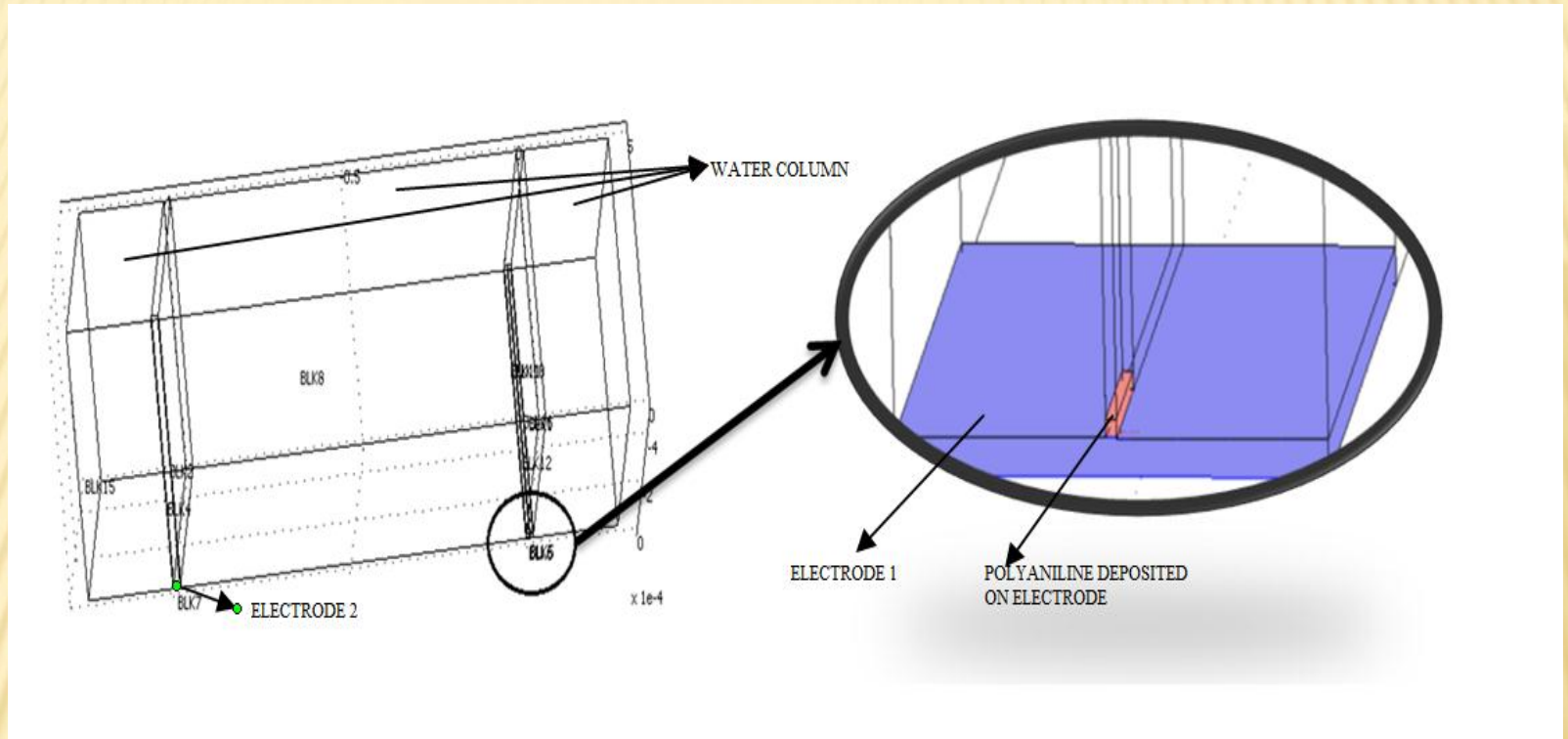
The existing limitation to achieve high sensitivity are as follows-

- i) The existing nanowire based biosensors depend on diffusion mediated capture of biomolecules.

- ii) The whole length of the nanowire is exposed to the analyte and for low concentration the percentage volume coverage by biomolecules is less.

USE OF
COMSOL
MULTIPHYSICS

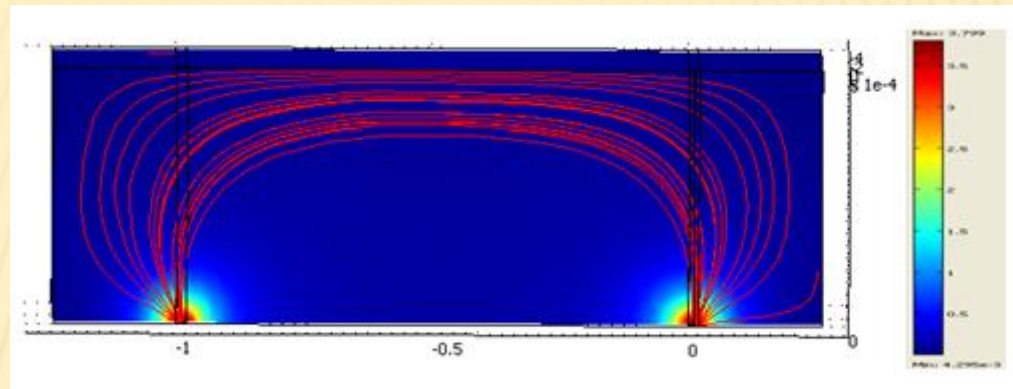
STRUCTURE 1



Cross sectional view

- Electrode Dimensions- $20\mu\text{m} \times 20\mu\text{m} \times 1\mu\text{m}$
- Distance between two electrodes- $980\mu\text{m}$
- Polyaniline Dimensions- $5\mu\text{m} \times 500\text{nm} \times 500\text{nm}$

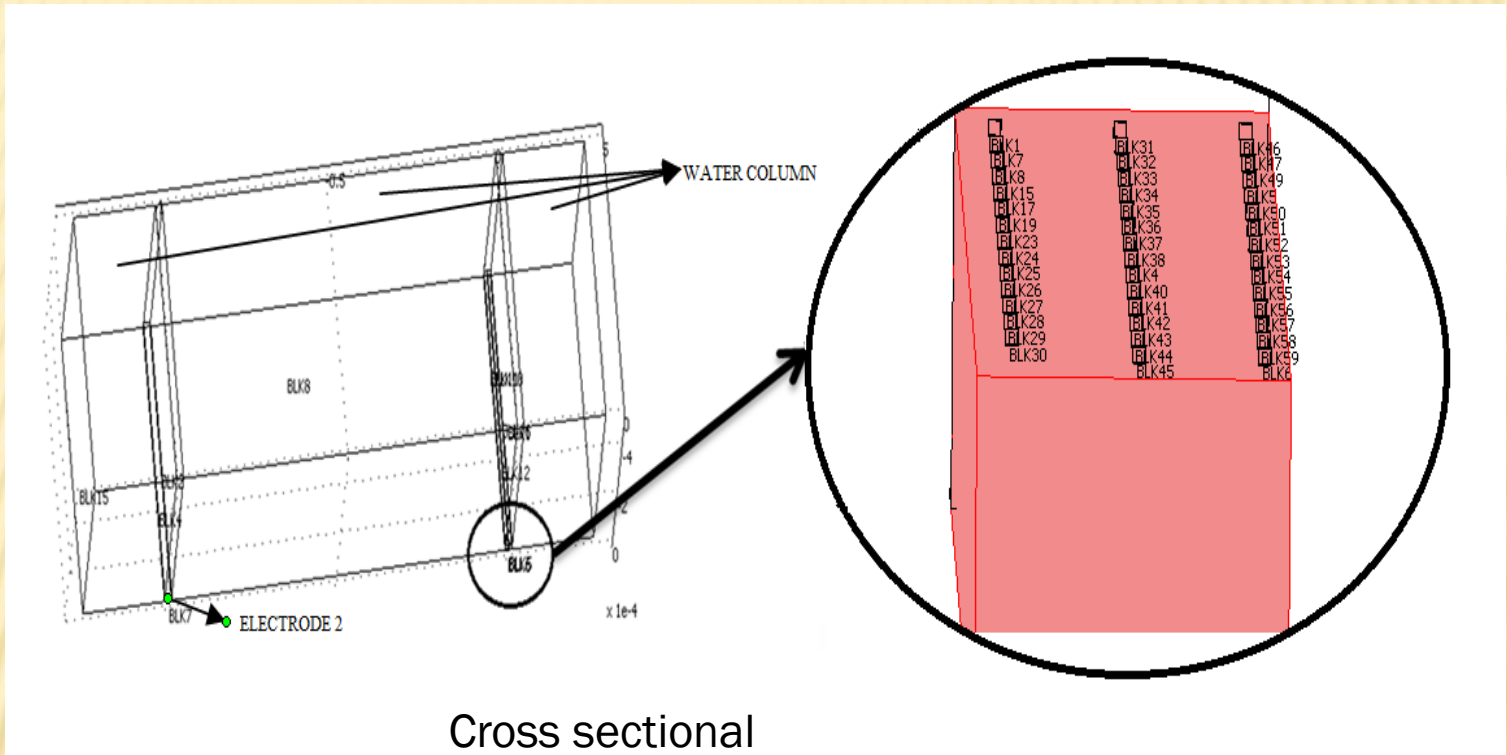
STRUCTURE 1 continue...



Current flow distribution

It is observed that the electric field in every point of the liquid column on the structure is high enough to detect biomolecules very efficiently. Parts adjacent portion of the electrodes have the maximum current density and electric field. when we move away from the electrodes total current density and electric field are gradually decreases.

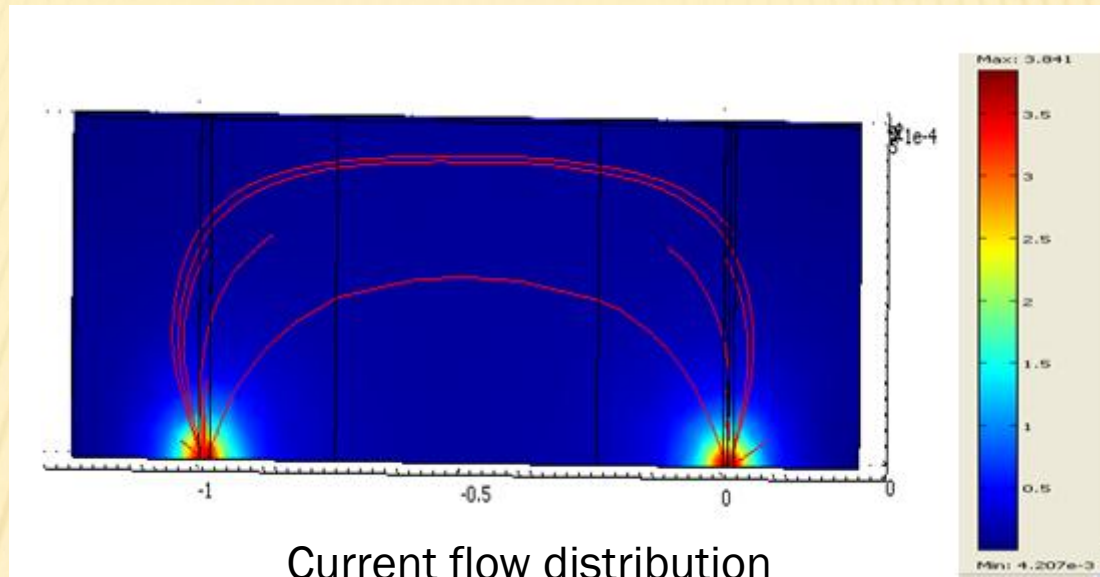
STRUCTURE 2



Cross sectional
view

- Electrode Dimensions- $20\mu\text{m} \times 20\mu\text{m} \times 1\text{nm}$
- Distance between two electrodes- $980\mu\text{m}$
- Polyaniline Dimension- $5\mu\text{m} \times 500\text{nm} \times 500\text{nm}$
- Square block dimensions- $20\text{nm} \times 20\text{nm} \times 20\text{nm}$

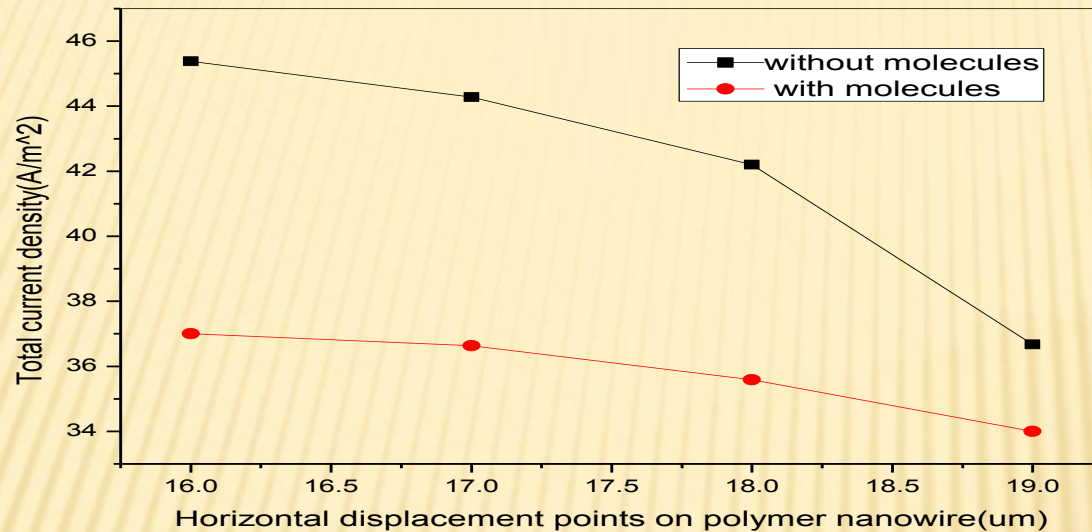
STRUCTURE 2 continue...



It is observed that number of electric field lines are less than structure 1 due to presence of the square block. Also we observe that there is change in total current density. when we move away from the electrodes total current density and electric field are gradually decreases.

RESULTS AND DISCUSSIONS

Results & Discussions



current density comparison with and without molecule on nanowire

Above graph shows current density comparison with molecule and without molecule. We observe that compared to Structure 1, and structure 2 current density gradually decreases in both. Due to the presence of the square molecules on nanowire in structure 2 current density decreases compare to structure 1.

CONCLUSION

CONCLUSION

- Our proposed device overcome the problem of low sensitivity due to the small length of the nanowire is exposed to the analyte.
- This device shows very high sensitivity by proper design of electrodes which enable electric field mediated capture over a small volume of the nanowire so that the percentage volume occupied by biomolecules is larger than the conventional cases.
- Hence the developed sensor is used to detect biomolecules very efficiently with very high sensitivity than all existing reports of electrical sensors for nanowire based impedance biosensor.

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THANK YOU