Flow Enhancement and Dynamics of Microfluidic Base Biosensor

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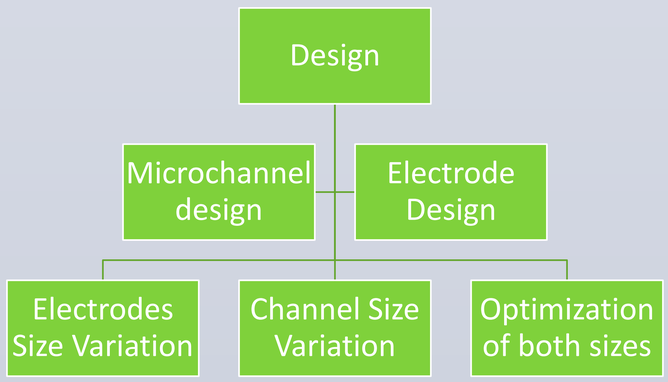
BACK GROUND AND INTRODUCTION

The development of advance technology for medical and biological diagnostician is significantly increased. Electrochemical biosensors become more desirable since it offered an attractive replacement for the bulky and expensive analytical instruments. The design and fabrication of a novel electrochemical biosensor was achieved base on microfluidic chip. The designed biosensor is consisting of two chips; microfluidic chip which was made of PDMS (Polydimethylsiloxane) and the microchannels was created. The second chip is made of glass, where the three electrodes cell was fabricated. This design offered more flexible testing and multi diagnostician at the same chip. The enhancement of the flow in the biosensor was achieved by varying the channel size as well the electrode size. The diffusion of the electrons from the reaction sits to the electrodes surface is the measure obstacles which limits the biosensor sensitivity. In summary, the suggested design is seems to be the key for more efficient and sensitive biosensor.

OBJECTIVES

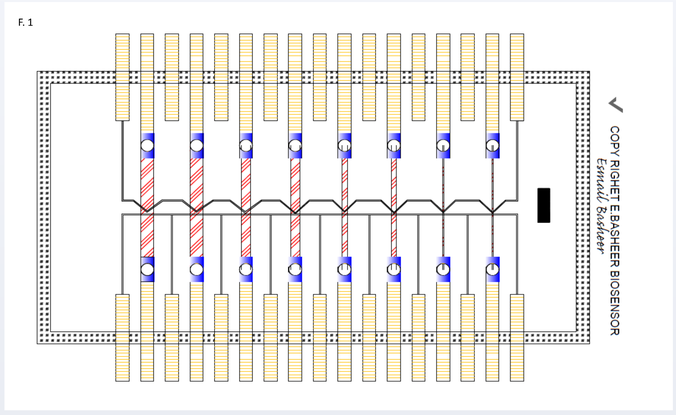
The aim of this project is to introduce a high accuracy and sensitivity biosensors by optimizing and integrating both microfluidic channels and electrodes size.

METHODOLOGY



DESIGNED BIOSENSOR

F. 1



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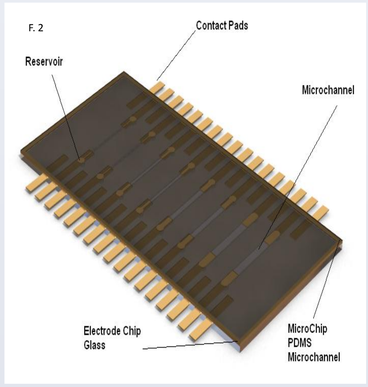
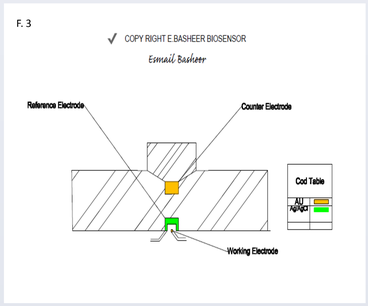
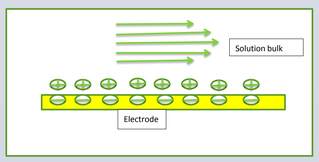


F. 3

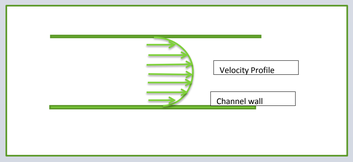


The species has to be transported to the electrode surface in order to reacts and exchanges electrons with the electrode. Rate of chemical reactions is dependent of the mass transport phenomena and the electrode kinetics. Three physical phenomena are involved in the transport of molecules: diffusion, migration, and convection [1-3]. Diffusion is the random motion of species that arises from thermal energy transferred by molecular collisions as showing in Figure 4 & 5.

F. 4



F. 5



The design has several advantages where the limitation of diffusion of electrons to the electrodes by varying and optimizing the electrodes size. The microfluidic channels in PDMS are constructed by a soft lithography Technique.

The design of the microchannels is important for the flow enhancement of the diffusion step where the electrons totally will be transferred. On the other hand the electrode cell consists of a Au working electrode, a Ag/AgCl reference electrode, and a Au counter electrode. The reference electrode is located 9 µm away from the working electrode. This short distance helps reduce uncompensated solution resistance. The counter electrode is located 70 µm away from the working electrode in order to avoid interference from the redox products generated at the counter electrode. Therefore, this enhancement and improvement of biosensor will result in higher sensitivity and accuracy.

CONCLUSION

This design was aimed to improve the sensitivity of the biosensor by introducing microchannel. The design is integrating both microfluidic and electrochemical response which lead to better result. The present work would be a key to more powerful and higher sensitivity diagnostic tool.

REFERENCES

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[3]. Myszka, D. G. (1999). Improving biosensor analysis. *Journal of Molecular Recognition*, *12*(5), 279-284.

Acknowledgement

This research work project was funded by University Malaysia Pahang.