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Theoretical Modelling of Interdigitated Electrode Sensor for Mammalian Cell Characterization (Conference Paper)

Mansor, A.F.M. [✉](#), Nordin, A.N. [✉](#)

Department of Electrical and Computer Engineering, KOE International Islamic University Malaysia, Kuala Lumpur, Malaysia

Abstract

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Interdigitated Electrodes (IDEs) have been widely used in biological cellular characterization such as the Electrical Cell -Substrate Impedance Sensing (ECIS). Optimization of IDEs are crucial to obtain high accuracy of measurement that associates with the biological cell activities. However, not much research studies the generation of electric field by the IDEs geometry especially in cellular application. In this work, theoretical modelling of IDEs was done by modelling the IDEs equivalent circuit consisting of 3 major components; double layer capacitance, C_{DL} , solution capacitance, C_{SOL} and solution resistance, R_{SOL} . Simulation using MATLAB and COMSOL Multiphysics was done to study the effect of geometrical parameters (width of electrodes (W), spacing between electrodes (S) and total number of electrodes (N)) on the cut-off frequency (F_{LOW}), solution resistance (R_{SOL}) and the average electric field magnitude based on the equivalent circuit model. The simulation results show three main findings; lowest F_{LOW} to be at the ratio of $a=0.54$ and $textbf{N}$ le 16, lowest R_{SOL} at smaller a and higher N , and saturated electric field at $textbf{N}$ ge 18. The results suggested that the optimal configuration of IDEs with a fixed length of electrode of 7000 μm is to have the ratio of (S/W) as 0.54 and N as 18. © 2018 IEEE.

SciVal Topic Prominence [i](#)

Topic: Electric Impedance | Biosensors | electric cell-substrate

Prominence percentile: 89.891 [i](#)

Author keywords

Cellbased biosensor IDEs Interdigitated electrodes Optimization

Indexed keywords

Engineering controlled terms:

Capacitance Chemical sensors Electric fields Electrochemical electrodes Geometry Mammals MATLAB Optimization Transport properties

Engineering uncontrolled terms

Cell -based biosensor Cellular applications Double-layer capacitance Electric field magnitude Equivalent circuit model IDEs Inter-digitated electrodes Theoretical modelling

Engineering main heading:

Equivalent circuits

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