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Conference Presentations:

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An Electrochemical Aptasensor for Monitoring HER2 Protein - A Biomarker for HER2-Positive (HER2+) Breast Cancer

UNIVERSITY OF NEW BRUNSWICK

THESIS DEFENCE AND EXAMINATION

in Partial Fulfillment

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Master of Science

by

Aloyna C. Mendonce

in the Department of Chemistry

U.N.B., Fredericton, N.B.

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Science Library, Room 108

Examining Committee

Dr. Anna Ignaszak	Supervisor
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Abstract

Aptasensors are cutting-edge biosensors that utilize aptamers, single-stranded nucleic acids, as recognition elements to detect a wide range of biomolecules with high specificity and sensitivity. This sensor operates on the principle of molecular recognition, where the 76-base pair DNA aptamer utilized as a receptor, targets and binds to human epidermal growth factor receptor 2, HER2. This aptamer-analyte binding event forms an insulating layer on the sensor electrode, which induces a measurable change in the sensing signal. This signal change has been transduced into a detectable electrochemical signal, allowing for rapid and precise detection of HER2. This project uses the aptasensor as a medical monitoring device, and the proposed research displays the bioelectrode design, allowing to prototype a device with good sensitivity.

In this project, several significant findings have led to the development and optimization of the prototype. Experiments conducted revealed that HER2 attaches to the gold electrode indicating the need for a blocking agent such as HDT (1,6-Hexanedithiol). However, co-immobilisation (incubating the mixture) of aptamer and HDT is not feasible as the individual contribution to R_{CT} is uncertain which necessitates adopting a layer-by-layer (sequential) incubation method. Furthermore, maintaining the three-dimensional structure of aptamer is very crucial for optimal binding to HER2. It is also important to note that HER2 protein remains stable and attaches to aptamer only below room temperatures. The experiments conducted by immobilising the protein on an electrode surface saturated with aptamer and HDT revealed a significant resistance to charge transfer, this increased charge transfer resistance confirms successful immobilization of the protein and indicates the formation of a structured bio interface.

The outcome of this thesis is an optimised and highly favourable environment for HER2 attachment to the aptamer on the electrode in an electrochemical setting.