A Portable Biosensor System for Pathogen Diagnostic Applications

Lang Yang¹, Jessie Filer², Tom Chen¹,³
¹Electrical & Computer Engineering Department,²Cell and Molecular Biology, ³School of Biomedical Engineering, Colorado State University

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Electrochemical detection

- **Electrochemical method** is used as a transducer to present the signal of the analyte. Depends on the interact type, binding or recognizing, the bio-sensing interface can behave different electrical property, which can be used as the very signature for identification.

- **Molecule as circuit** is a concept that views all molecule have their equivalent circuit model to describe their electrical response. The circuit model is typically formed by resistors and capacitors in series or parallel.

System Level Implementation

**Specify target**

Zika, chikungunya, HIV...

**Choose Bio-element and protocol**

Specific antibody, complementary DNA...

**Design electrode**

Electrode type, geometry, manufacturing...

**Design electronics**

Data process and transmission

Process analog signal to data Wired or not wired (Wifi, BT)

**Design User interface**

Decide user’s terminal device (PDA, cellphone, standalone display)

**Deliverable Package**

3D Printing or molded manufacturing

Project Overview

- **Zika protein** were used as target, the preliminary data from commercial instrument showed the response from target protein is stronger than non-specific ones when binding with probe antibody.

- Whole system is illustrated below. It can be powered by a rechargeable battery. The prototype case was printed by 3D printer. An app was developed on android system to allow user to receive real time data measured from the biosensor through Bluetooth 4.0.

Conclusions and future work

- A biosensor platform was designed and tested. The resulting errors were reasonably good impedance/capacitance measurements.
- Future work lies in the test of actual virus/bacteria/protein/DNA.
- The platform will be further tested to do 4 electrode system and gets ready for other electrochemistry detection approaches, such as CV, DPV and potentiometry/amperometry.

Electrode

<table>
<thead>
<tr>
<th>Conceptual View</th>
<th>Electrical View</th>
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<tbody>
<tr>
<td>Infected analyte</td>
<td>Healthy analyte</td>
</tr>
<tr>
<td>Bio-element</td>
<td></td>
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<tr>
<td>Enzymes</td>
<td>Antibodies</td>
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<tr>
<td>Nucleic Acid</td>
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<td>Oxidase</td>
<td>Antibodies</td>
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<td>Polysaccharide</td>
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Figure 1. (a) System components. (b) 3D Printed case.

Electronics were tested by both dummy RC model and chemicals can generate reduction-oxidation current (Redox couple, Fe(CN)3-/4-). The data are presented in Bode and Nyquist plot in comparison with commercial benchtop.

Figure 2. (a) Dummy circuit measurements in Bode plot. (b) Redox measurements in Nyquist plot.