Poster Session 1

Commons East, Easel 66

11:00 AM to 1:00 PM

Characterization of Organic Electrochemical Transistor (OECT) with Nafion

Chey (Cheyenne) Flinkman, Junior, Pre-Major, UW Bothell
Mentor: Seungkeun Choi, STEM

PEDOT:PSS is a conducting polymer that is very promising as the next-generation materials for the transparent electrode. An organic electrochemical transistor (OECT) can control the amount of current flow in a conductive channel through an electrochemical reaction in the PEDOT:PSS channel assisted by an applied electric potential at a gate electrode. PEDOT:PSS-based OECT devices are widely used for biological and chemical sensing applications due to their high sensitivity, low cost, flexibility and lower operating voltage, typically less than 1 V. In addition, OECT has shown improved sensing performance when the gate electrode is modified with biocompatible polymers, such as Nafion. Nafion can lead to a more highly selective OECT-based sensor. A key feature of OECT is that both ions and electrons are used as charge carriers. This is of particular interest and importance for chemical sensors. For example, by combining a proton-conducting electrolyte, a simple Nafion-based OECT humidity sensor can be implemented as Nafion changes its conductivity upon exposure to humidity. In previous work we examined the impact of a double-in-plane gate electrode on OECT performance and found it to have a much higher transconductance. Branching off from that, we now investigate the impact of Nafion on OECT performance. Particularly, we want to investigate whether OECT sensitivity depends on the presence of Nafion film. In order to determine that, we fabricate several devices in which all transistor electrodes are in the same plane. High conductivity PEDOT:PSS is combined with Nafion in order to create a channel between source and drain. Once fabrication is complete, we plan to test and characterize the OECT's to determine whether OECT performance is optimized with Nafion film. This work is important as it will allow the development of highly sensitive portable OECT arrays for various chemical/biological sensing applications.

Poster Session 1

Commons East, Easel 67

11:00 AM to 1:00 PM

Temperature Effect on Organic Electrochemical Transistor

Anna Kirchan, Senior, Electrical Engineering (Bothell), Chemistry (Bothell)
Mary Gates Scholar
Mentor: Seungkeun Choi, STEM

PEDOT:PSS is a conducting polymer that is very promising as the next generation materials for the transparent electrode. PEDOT:PSS-based organic electrochemical transistor (OECT) has been widely used for various sensing applications such as glucose, antigen, DNA, and pH sensing thanks to the much lower working voltages, typically less than 1 V, and known biocompatibility of a PEDOT:PSS. OECT comprises three electrodes (source, drain, and gate), a PEDOT:PSS channel between source and drain, and electrolyte solution of analytes. Electric current flows through the conductive PEDOT:PSS channel. However, upon the application of a positive gate voltage, cations from the electrolyte are injected into the channel, decreasing a conductivity of the PEDOT:PSS. Hence, electric current decreases as a gate voltage becomes more positive. In our previous work we examined the impact of double-in-plane gate electrode on the OECT performance and found it to have a much higher transconductance of 35 mS as compared to 13 mS of a single gate. Now we investigate if applying heat can further improve the device performances such as sensitivity and response time of the OECTs. To test this, we have integrated a micro heater made of ITO on top of the glass substrate then covered the heater with aninsulative layer on which all transistor electrodes are fabricated in the same plane. High conductivity PEDOT:PSS was used to create a channel between source and drain. Fisher brand pH meter calibration solution was used as the electrolyte with pH values of 4, 7 and, 10. A drop of electrolyte was placed just over the channel and the gate electrodes. Once fabrication has been completed the OECT's are tested and characterized at various temperatures by resistively heated micro-heaters. This work is important as it will allow the development of highly sensitive portable OECT arrays for various chemical/biological sensing applications.

SESSION 2R

EXPLORING PROTEIN FUNCTION AT SCALES FROM WHOLE TISSUES TO SINGLE ATOMS

Session Moderator: Celeste Berg, Genome Sciences
JHN 111
3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Characterizing Control of a Metabolic Network Model

Yoshi Goto, Senior, Bioengineering
Mentor: Herbert Sauro, Bioengineering
Mentor: Kiri Choi, Department of Bioengineering

Cells, making up every living organism on earth, are extremely complicated biological machines. Much research has been done on how cells function, including how proteins made by cells work together to create biochemical pathways necessary for growth. Recently, computational simulations of biological processes have become possible, such as in the field of systems biology, which takes a holistic view of an organism to elucidate function. Previous research has constructed an accurate ”whole-cell” model of *E. Coli* metabolic function. But, understanding metabolic behavior is still a challenge, especially from external perturbations in the environment or an internal alteration in the form of an insertion of an extra protein. This research uses an *E. Coli* whole-cell model—containing carbon-dependent metabolic pathways in *E. coli*— to study how perturbations will affect the pathway. External changes in the resources available to the cell or an internal change to the cell's components are simulated. In response, specific changes to the metabolic behavior of proteins will be made. These changes are made using optimization algorithms, which minimize the output of a growth “cost” function, which maximizes the growth rate of the cell. This represents the effect of evolution over time for the cell to reach an optimal level of growth. The “Tellurium” software package, using the Python programming language and created by the Sauro lab, was used for this experiment, and a collection of scripts that can be used in Tellurium were made to generalize the reproduction of this process to any model, and to visualize the results. This research can give greater insight to how cellular metabolic processes as a whole behave, and can give scientists working with *in vivo* experiments better predictions of the consequences of perturbations, externally or internally, on a cell.