Sweat Sensors

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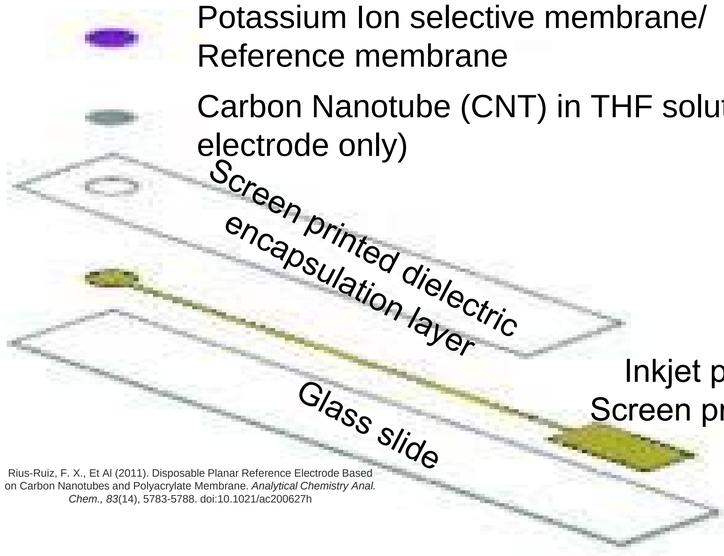
Abstract

The levels of lactate, sodium, potassium, and ammonium within human sweat can be used to glean information about the overall condition of the person sweating. The goal is to create a fully flexible and wearable sweat sensor that will give real-time information while a person does a physical activity. Using perspiration as a reference point for wearable biosensors is an example of non-invasive technology being used to greater potential in terms of the ease at which we can monitor health indicators. The sweat is probed for information by using different working electrodes that can detect each specific compound and reference the potential against a reference electrode giving a small voltage for each. This project aims to create a flexible and wearable sensor array that can simultaneously monitor each of the above metabolites while relaying this information via bluetooth to an external portal such as a cell phone.

Printed Electrode Structure



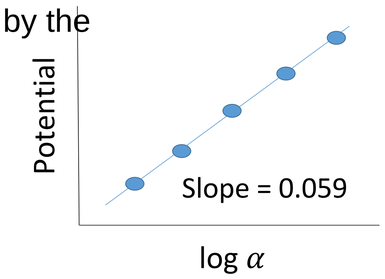
Rius-Ruiz, F. X., Et Al (2011). Disposable Planar Reference Electrode Based on Carbon Nanotubes and Polyacrylate Membrane. *Analytical Chemistry Anal. Chem., 83*(14), 5783-5788. doi:10.1021/ac200627h

Ideal "Nernstian" Behavior

The ideal potassium selective electrode displays "Nernstian" behavior, guided by the below equations

$$E = E^0 + \frac{RT}{zF} ln \frac{\alpha_{ox}}{\alpha_{red}}$$

$$E = E^0 + \frac{0.059}{z} ln \frac{\alpha_{ox}}{\alpha_{red}}$$



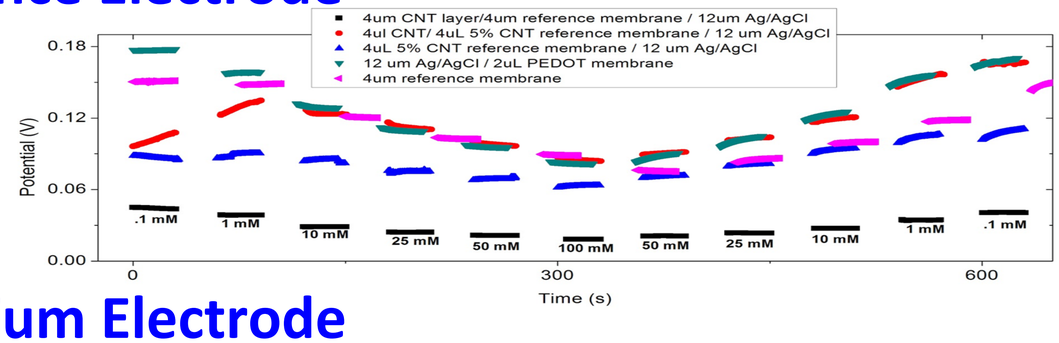
where E^0 is $E_{reduction}$- $E_{oxidation}$, z is the number of moles of electrons transferred, α is the chemical activity defined by the activity coefficient of the species * concentration of the solution.

Skoog, D. A., & Skoog, D. A. (2000). *Analytical chemistry: An introduction*. Fort Worth: Saunders College Pub.

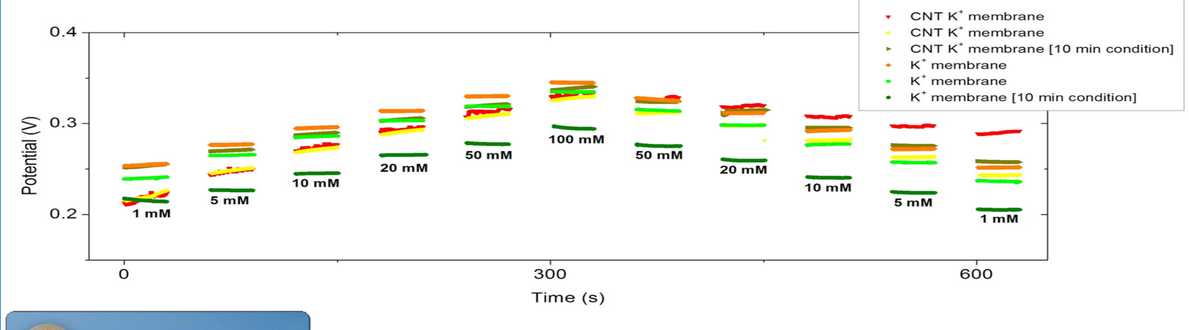
Printed Reference Electrode

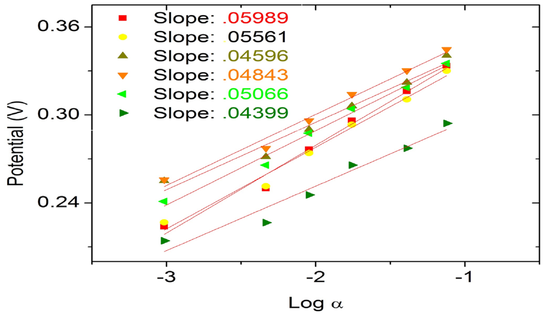
Ideally, the voltage between a printed reference electrode and the commercial reference electrode would be zero.

After exploring multiple avenues, it became evident that adding a CNT layer, a PVB-based reference membrane, and a screen printed dielectric encapsulation layer would improve the performance of the printed reference electrode the most.



Printed Potassium Electrode





Adding CNT to the potassium sensing membrane drives the performance of the printed potassium electrode closer to "Nernstian" behavior

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