Glucose detection using fluorine doped tin oxide extended gate field effect transistors upon varied functionalizations of glucose oxidase

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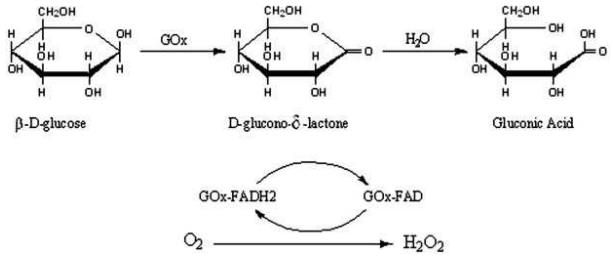
Glucose detection is very important for many biomedical applications. Among the available processes, the use of extended gate field effect transistors lead to an indirect electrical quantification of the desired probe solution. That is possible due to the locally varied pH when glucose meets and reacts with the glucose oxidase according to the following sequence:



For that aim, glucose oxidase must be attactched to the top of the desired film in order to construct the sensing part of the device. Several materials and processes can be used for that. In this work the basic film is fluorine-doped tin oxide (FTO). When in the presence of varied pH buffer solutions this material itself presents a 51mV/pH sensitivity (attached to a commercial CD4007UB MOSFET). Immobilization of glucose oxidase was performed using three fixing materials on top of the FTO: i) glutaraldehyde; ii) chitosan; and iii) APTS. For all these cases we will discuss the immobilization processes and present the calibration curves. This will be done for one single use or multiple reutilizations also. A typical current variation with the addition of glucose is presented in Figure 1, for the case of glucose oxidase immobilization using glutaraldehyde.

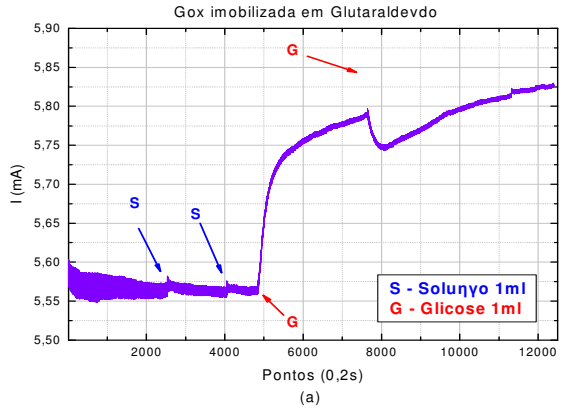


Figure 1 – EGFET current variation as a function of time with the addition of glucose in the solution. Glutaraldeide was used for fixing the glucose oxidase.

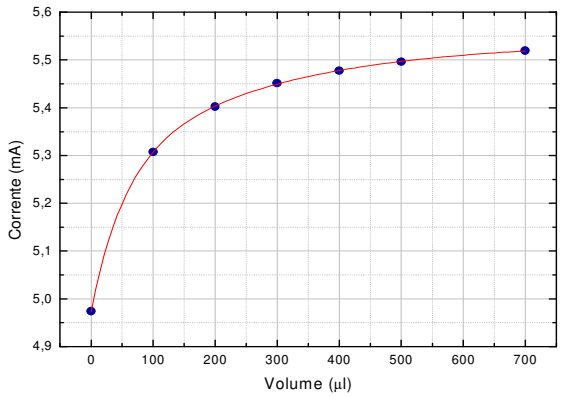


Figure 2 – EGFET current variation as a function of added volume of a solution that contains glucose. Volume variation from 50µl to 1000 µl corresponds to glucose concentrations from 1.74e-3 mol/L to 3.39e-2 mol/L.

Figure 2 presents the current variation for several glucose concentrations when glucose oxidase was immobilized using glutaraldehyde. A calibration process was developed and the results are compared for the three fixing elements. The best response up to now was obtained for glutaraldehyde. The future use of the sensors will also be discussed. Work supported by Capes, CNPq and FAPESP.