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Boolean Logic Network based Biosensor to Detect Wine Adulteration

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In the last decades, much progress in the bioelectrochemistry of redox enzymes has been achieved through the synthesis/electrosynthesis of new nanomaterials to enhance the efficiency of direct electron transfer (DET) between electrodes and several sugar oxidising enzymes (*e.g.*, cellobiose dehydrogenase (CDH), pyranose dehydrogenase (PDH), fructose dehydrogenase (FDH), PQQ-dependent glucose dehydrogenase (PQQ-GDH) *etc.*).[1,2] Besides the evolution of the electrode construction, one of the most intriguing achievements was reported in 2001 by Willner and Katz, who coined the new definition of "self-powered biosensors" correlating the power generation with different glucose concentrations.[3]
In this work, we developed a self-powered biosensor for the detection of sucrose by combining an anodic electrode modified with fructose dehydrogenase (FDH), PQQ-dependent glucose dehydrogenase (PQQ-GDH) and invertase/mutarotase to create a catalytic cascade that is logically operated to oxidise sucrose. After the machine optimization, all the enzymes were physically immobilized onto the multi-walled carbon nanotubes (MWCNTs) modified electrode surface by using the photo cross-linking of poly(vinyl alcohol), N-methyl-4(4'-formylstyryl)pyridinium methosulfate acetal (PVA-SbQ). In addition, the logic operation of the anode related to a cathode electrode modified with glucose oxidase and hemin.[4] The proposed self-powered biosensor was able to detect sucrose with a sensitivity of 48.2 ± 0.2 μW cm^{-2} mM^{-1} with a dynamic linear range up to 500 μM. The so prepared self-powered biosensor was used to detect wine fraud through the addition of sucrose to enhance the content of reducing sugar (adulteration of wine samples).[5]

References

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