Self-monitoring of tear glucose: the development of a tear based glucose sensor as an alternative to self-monitoring of blood glucose

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Tear glucose sensing for diabetes management has long been sought as an alternative to more invasive self-monitoring of blood glucose (SMBG). However, tear glucose sensors were known to have limitations, including correlation issues with blood glucose due to low sample volume, low concentration of glucose in the tear fluid, and evaporation of the tear sample. An engineering design approach to solve these problems led to the development of an integrated device capable of collecting the tear sample from the ocular surface with little to no stress on the eye, with an extremely low limit of detection, broad dynamic range, and rapid detection and analysis of sample. Here we present the development of a prototypical self-monitoring of tear glucose (SMTG) sensor, summarizing bench studies on the enzymes and their specificity, the development of the fluid capture device and its manufacture and performance and results of system testing in an animal study where safety, lag time and tear glucose to blood glucose correlation were assessed.
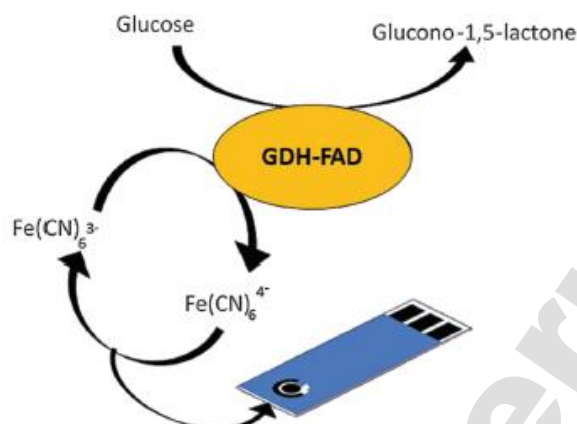

Fig. 3 Schematic diagram of the catalytic reaction between glucose and GDH-FAD using ferricyanide as an electron mediator. The electrons detected by the sensor are then correlated to glucose concentrations.
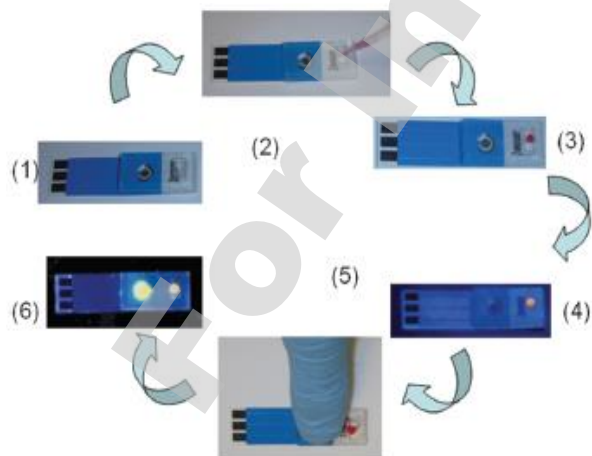

Fig. 9 Experimental representation of the lag time of blood glucose (BG) *versus* TG for a single animal.

Fig. 6 Schematic detailing the operation of the microfluidic device.

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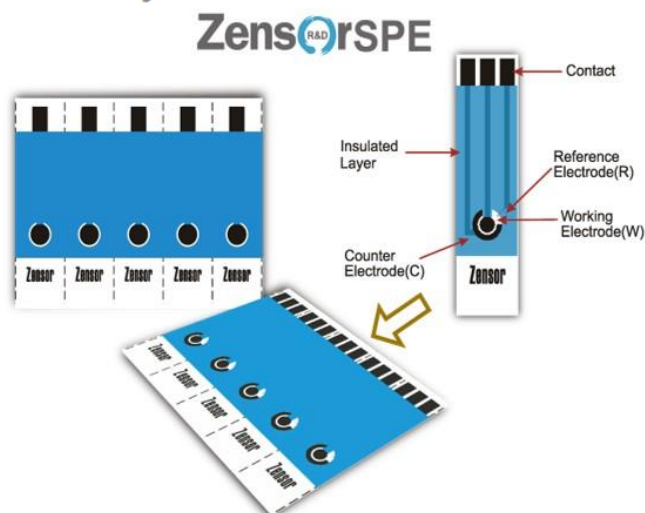
Non-invasive screening for early Alzheimer's disease diagnosis by a sensitively immunomagnetic biosensor

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Shan-Shan Li[1,*], Chih-Wen Lin[1,*], Kuo-Chen Wei[2,*], Chiung-Yin Huang[2], Po-Hung Hsu[3], Hao-Li Liu[3], Yu-Jen Lu[2], Sheng-Chi Lin[1], Hung-Wei Yang[4] & Chen-Chi M. Ma[1]

Amyloid-beta peptide 1–42 (Aβ42) is considered as a reliable biomarker for the early diagnosis of Alzheimer's disease (AD). Thus, it is urgent to develop a simple and efficient method for the detection of Aβ42. In this work, a reusable biosensor based on magnetic nitrogen-doped graphene (MNG) modified Au electrode for the detection of Aβ42 has been developed. The antibodies of Aβ 1–28 (Aβ$_{ab}$) are used as the specific biorecognition element for Aβ42 that were conjugated on the surface of MNG. In the presence of magnetic nanoparticles on MNG, the electrode coating material, the biosensor can be quickly constructed, without requiring an electrode drying process, which reduce the analysis time and is convenient for proceeding to detection. The reusable biosensor with good reproducibility and stability was linear within the range from 5 pg mL^{-1} to 800 pg mL^{-1}, covering the cut-off level of Aβ42 and a detection limit of 5 pg mL^{-1} had been achieved. Furthermore, the fabricated biosensor for Aβ42 detection not only improves the detection performance but also reduces the cost and shortens the response time, demonstrating its potential in diagnosing applications.
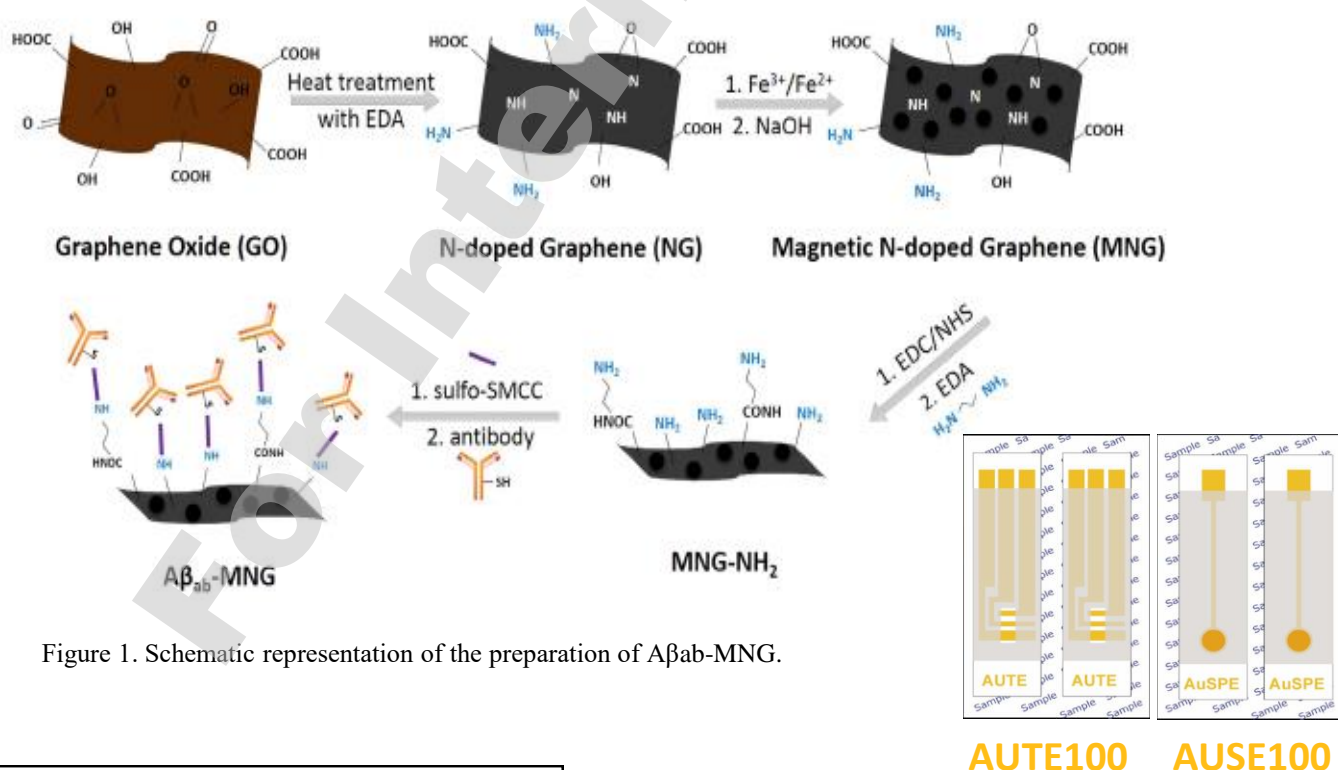
Figure 1. Schematic representation of the preparation of Aβab-MNG.

AUTE100   AUSE100

Regular Article

Electrochemical properties of the acetaminophen on the screen printed carbon electrode towards the high performance practical sensor applications

CrossMark

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A B S T R A C T

Acetaminophen is a non-steroidal anti-inflammatory drug used as an antipyretic agent for the alternative to aspirin. Conversely, the overdoses of acetaminophen can cause hepatic toxicity and kidney damage. Hence, the determination of acetaminophen receives much more attention in biological samples and also in pharmaceutical formulations. Here, we report a rapid and sensitive detection of the acetaminophen based on the bare (unmodified) screen printed carbon electrode (BSPCE) and its electrochemistry was studied in various pHs. From the observed results, the mechanism of the electro-oxidation of acetaminophen was derived for various pHs. The acetaminophen is not stable in strong acidic and strong alkaline media, which is hydrolyzed and hydroxylated. However, it is stable in intermediate pHs due to the dimerization of acetaminophen. The kinetics of the acetaminophen oxidation was briefly studied and documented in the schemes. In addition, the surface morphology and disorders of BSPCE was probed by scanning electron microscope (SEM) and Raman spectroscopy. Moreover, the BSPCE determined the acetaminophen with the linear concentration ranging from 0.05 to 190 μM and the lower detection limit of 0.013 μM. Besides that it reveals the good recoveries towards the pharmaceutical samples and shows the
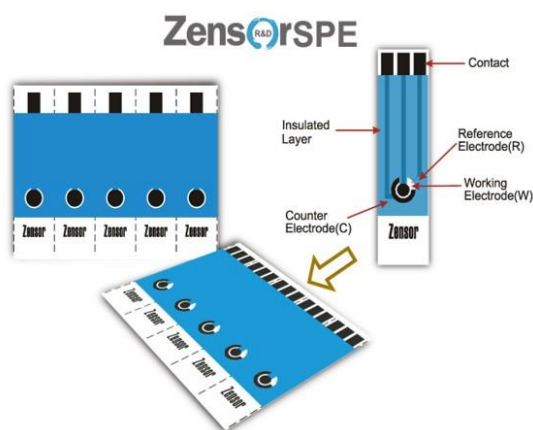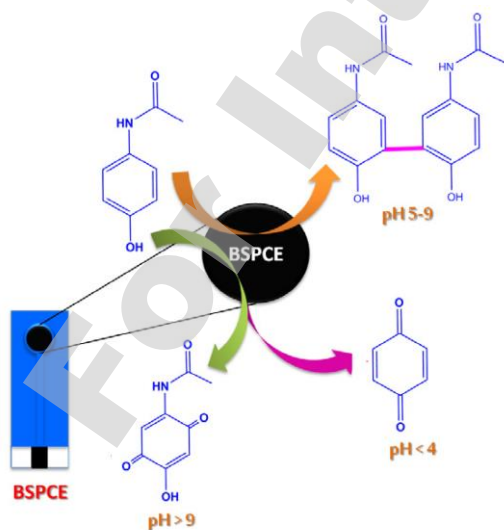
Label-free electrochemical immunosensor for the rapid and sensitive detection of the oxidative stress marker superoxide dismutase 1 at the point-of-care

CrossMark

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ABSTRACT

In this work, we have fabricated a label-free electrochemical immunosensor for the detection of Cu,Zn superoxide dismutase (SOD1) which is clinically important to a wide variety of neurodegenerative, cardiovascular, and chronic immune diseases. The immunosensor is comprised of a screen printed carbon electrode (SPCE) modified with self-assembled monolayers (SAMs) of gold nanoparticles (GNPs) in electropolymerized polypyrrole (PPy) and biofunctionalized with monoclonal anti-SOD1 antibody. The morphological changes of each electrode modification step were analyzed by scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX) while electrochemical changes were monitored *via* cyclic voltammetry (CV) and impedance spectroscopy (EIS) by using ferri-ferrocyanide as electrochemical redox probe. The GNP nanostructured immunosensor indirectly monitors the SOD1 levels *via* electrocatalytic oxidation of nitrite, due to inherent nitrite oxidase activity of SOD1, with a wide linear sensing range ($0.5\,nM$ to $5\,\mu M$), low detection limit ($0.5\,nM$), and high sensitivity ($46.6 \pm 3.5\,nA\,nM^{-1}$). SOD1 concentration levels were also measured in real biological samples (*i.e.*, cultured human epidermal keratinocytes) and the results correlated well with a western blot densitometry assay. Such rapid detection of SOD1 concentration levels in real biological samples is well-suited for point-of-care (POC) diagnostics.

Scheme 1. Schematic representation of the label-free SOD1 immunosensor.
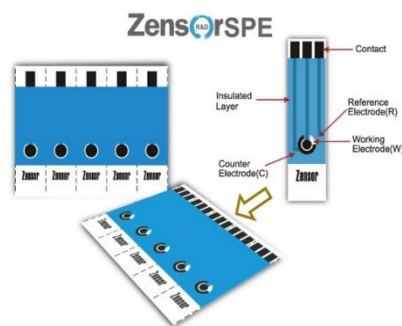
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Quantification of ethanol in plasma by electrochemical detection with an unmodified screen printed carbon electrode

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Simple, rapid and accurate detection of ethanol concentration in blood is very crucial in the diagnosis and management of potential acute ethanol intoxication patients. A novel electrochemical detection method was developed for the quantification of ethanol in human plasma with disposable unmodified screen-printed carbon electrode (SPCE) without sample preparation procedure. Ethanol was detected indirectly by the reaction product of ethanol dehydrogenase (ADH) and cofactor nicotinamide adenine dinucleotide (NAD$^+$). Method validation indicated good quantitation precisions with intra-day and inter-day relative standard deviations of $\leq$9.4% and 8.0%, respectively. Ethanol concentration in plasma is linear ranging from 0.10 to 3.20 mg/mL, and the detection limit is 40.0 μg/mL (S/N > 3). The method shows satisfactory correlation with the reference method of headspace gas chromatography in twenty human plasma samples (correlation coefficient 0.9311). The proposed method could be applied to diagnose acute ethanol toxicity or ethanol-related death.
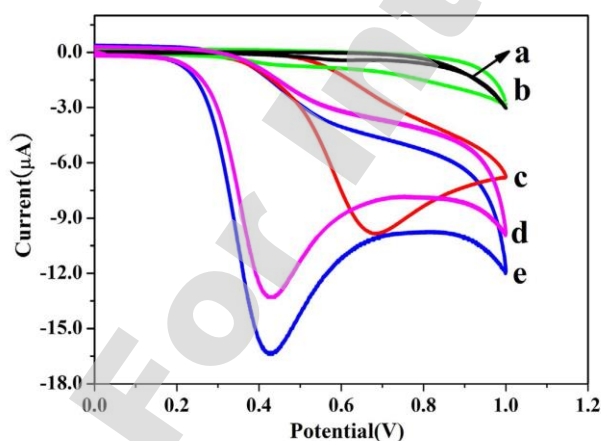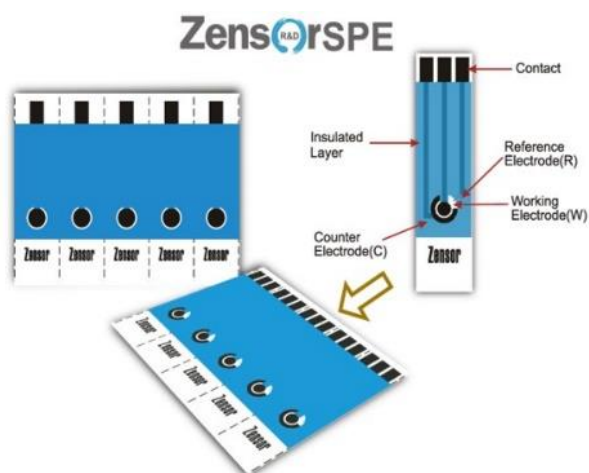
Figure 3. Cyclic voltammetry (CV) curves in 220 mM PBS (pH 10.4) (**a**), blank plasma in PBS (**b**), 4 μL NAD$^+$ (100 mM), 4 μL ADH (360 U/L) and 4 μL spiked ethanol (20.0 mg/mL) plasma in 80 μL PBS (**c**), 4 μL NAD$^+$ (100 mM), 4 μL ADH (360 U/L) and 4 μL 100-fold dilution spiked ethanol (20.0 mg/mL) plasma in 80 μL PBS (**d**), 0.05 mM NADH in PBS (**e**).

Sensing Good Life   Zensor

Electrochemical detection of *Pseudomonas* in wound exudate samples from patients with chronic wounds

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Abstract

In clinical practice, point-of-care diagnostic testing has progressed rapidly in the last decade. For the field of wound care, there is a compelling need to develop rapid alternatives for bacterial identification in the clinical setting, where it generally takes over 24 hours to receive a positive identification. Even new molecular and biochemical identification methods require an initial incubation period of several hours to obtain a sufficient number of cells prior to performing the analysis. Here we report the use of an inexpensive, disposable electrochemical sensor to detect pyocyanin, a unique, redox-active quorum sensing molecule released by *Pseudomonas aeruginosa*, in wound fluid from patients with chronic wounds enrolled in the WE-HEAL Study. By measuring the metabolite excreted by the cells, this electrochemical detection strategy eliminates sample preparation, takes less than a minute to complete, and requires only 7.5 microliters of sample to complete the analysis. The electrochemical results were compared against 16S rRNA profiling using 454 pyrosequencing. Blind identification yielded 9 correct matches, 2 false negatives, and 3 false positives giving a sensitivity of 71% and specificity of 57% for detection of *Pseudomonas*. Ongoing enhancement and development of this approach with a view to develop a rapid point-of-care diagnostic tool is planned.
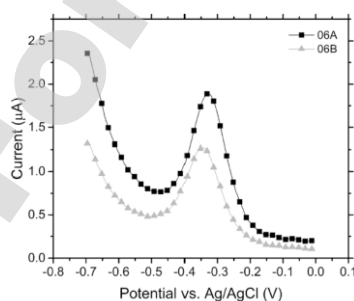
Figure 2.
Square wave voltammograms of several fluid exudate. Pyocyanin peak indicates the presence of *Pseudomonas aeruginosa* in the sample.
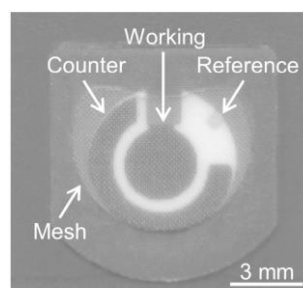
Figure 1.
Disposable, screen-printed electrode sensor with mesh modification for small-volume analysis.

Sensing Good Life   Zensor R&D

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Rudimentary simple method for the decoration of graphene oxide with silver nanoparticles: Their application for the amperometric detection of glucose in the human blood samples

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A B S T R A C T

Graphene oxide decorated with silver nanoparticles (GO-Ag) was prepared by anodic dissolution of silver in the aqueous dispersion of GO. The composites were characterized by XRD, XPS, TEM, AFM, and Raman spectroscopy. The electrooxidation of glucose on GO-Ag modified electrodes have been tested by cyclic voltammetry and chronoamperometry. The detail mechanism of redox processes on the GO-Ag electrodes has been studied. A few μg loading of silver has demonstrated to give current in μA for the mM concentration of glucose. A linear relationship between peak height in the voltammograms and glucose concentration in the range 1–14 mM has been proposed for amperometric detection of glucose. From the results, the detection limit for glucose sensing is estimated to be as small as 4 μM. The selectivity for glucose in presence of interfering molecules viz. ascorbic and uric acids is tested. Proof-of concept is presented by carrying out the measurements in real human blood samples.
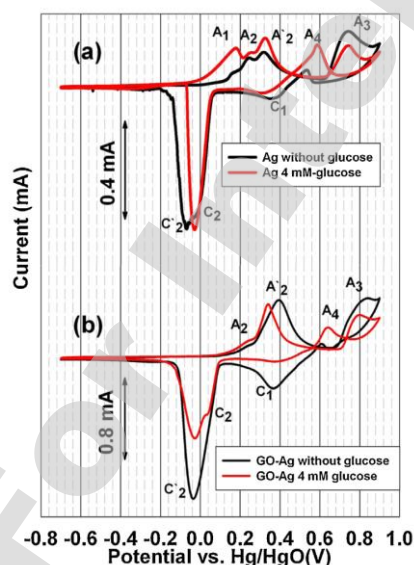
Fig. 5. CVs recorded on (a) silver nanoparticles (b) GO-Ag composite, drop-casted on glassy carbon electrode. Black curve is for without glucose and the red curve is for 4.0 mM glucose. The electrolyte was 0.1 M NaOH. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)