Study on biosensor and its whole blood detection under the background of integrated traditional Chinese and western medicine

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Abstract. The quantitative detection of biomolecules related to various diseases in blood is the basis of clinical diagnosis, prognosis monitoring, early disease prevention and controllability detection. However, so far, it is difficult to detect whole blood by clinical detection methods. Biosensors can be widely used in detection and analysis in the fields of medicine, environmental protection and industrial and agricultural production. Under the background of integrated traditional Chinese and western medicine, countries all over the world have invested heavily in technical research and product development of biosensors. The starting point of this paper is that it is difficult to realize direct detection of whole blood by fluorescence immunoassay technology at present. Based on the research of biosensors with solid-phase optical fiber and glass slide as biosensors, innovative research has been carried out in new probes and sensing methods of biomarkers. The research shows that combining the advantages of nano-probe with optical fiber evanescent wave biosensor can effectively reduce the influence of spectral scattering, light absorption and autofluorescence background in whole blood on detection signals, improve the accuracy of whole blood detection, realize the rapid detection of hemoglobin by biosensor, and meet the needs of clinical detection of hemoglobin concentration range.

Keywords: Traditional Chinese and western medicine, Whole blood detection, Biosensor.

1. Introduction

Biosensors can be widely used in detection and analysis in the fields of medicine, environmental protection and industrial and agricultural production. At present, countries all over the world have invested heavily in technical research and product development of biosensors. In addition to good sensitivity and specificity, biosensor has the advantages of rapidity, simplicity, economy, practicality, no batch restriction, automatic operation, no pollution, and detection of different types of biomolecules [1].

Clinical measurement tools of traditional Chinese medicine refer to tools that collect clinical data of traditional Chinese medicine and make clinical diagnosis, evaluation and prediction of traditional Chinese medicine under the guidance of traditional Chinese medicine theory or with the participation of traditional Chinese medicine scholars in designing conceptual framework, implementing development and evaluating performance. Universal quality of life refers to individuals' subjective feelings about their own lives according to their cultural background and value system, which includes physiological functions, psychological status, symptoms and health-related quality of life, as opposed to the disease-specific scale [2-3]. The comparison of health concepts between traditional Chinese and western medicine is divided into two steps [4]: systematic evaluation is included in the scale of traditional Chinese and western medicine with good psychometric performance, and the item pool is re-formed; The content analysis method is used to re-code the items of the Chinese and Western Medicine Scale to establish a new measurement structure, and then compare the conceptual differences of the items of Chinese and Western Medicine. The starting point of this paper is that it is difficult to realize direct detection of whole blood by fluorescence immunoassay technology at present. Based on the research of biosensors with solid-phase optical fiber and glass slide as biosensors, innovative research has been carried out in new probes and sensing methods of biomarkers.

2. Overview of biosensor

The core of biosensor mainly consists of two parts: molecular recognition and information conversion. The molecular recognition part refers to the immobilized enzyme, microorganism, antibody, cell or tissue and other signal conversion parts, generally including electrochemical measuring devices, thermistors, field

effect transistors, optical fibers, piezoelectric elements and so on [5-6].

Compared with traditional analytical methods, biosensors have highly selective molecular recognition components, so there is generally no need for sample pretreatment, and they use excellent selectivity to unify the separation and detection of tested components in samples [7]. Generally, biosensor can be widely used to detect trace proteins, small molecular organic substances, nucleic acids and other substances in body fluids without adding other reagents.

In modern medical examination, these items are important basis for clinical diagnosis and disease analysis. Among them, biosensors that can be monitored in real time in vivo are very helpful for patients in operation and intensive care, and portable biosensors are favored because they can be used for bedside detection and home use.

3. Whole blood detection experiment

3.1 Instruments and reagents

The deionized water used in the experiment comes from Milli-Q water maker, and its resistivity is 18.3 MΩ. All the blood used in the experiment came from healthy volunteers. After blood extraction, heparin was added for anticoagulation, and the preservation condition was-25℃ [8].

The electrochemical experiment was carried out on an electrochemical analyzer. A three-electrode system is used: a glassy carbon electrode modified with nano zinc oxide or an enzyme biosensor is used as a working electrode, and the diameter of the glassy carbon electrode is 3 mm; The saturated calomel electrode is the reference electrode; The platinum wire is the counter electrode.

3.2 Biosensor preparation

The direction of seeking common ground in the integration of traditional Chinese and western medicine should be to adopt the latest knowledge and technology of modern medicine, and strive to continuously obtain new achievements and progress. The developed theory and research results of integrated traditional Chinese and western medicine can be used in clinic to further seek clinical development. The introduction of nanotechnology into the development of modern Chinese medicine, the research and development of new Chinese medicine technology, the development of nano-Chinese medicine diagnosis and treatment equipment, the development of new high-performance nano-Chinese medicine, and the sublimation of modern Chinese medicine theory provide a new thinking mode for the improvement and development of Chinese medicine concepts. The combination of nanotechnology and traditional Chinese medicine will accelerate the integration of traditional Chinese medicine with the international community, form a unique nano-traditional Chinese medicine and its theoretical system, and play a huge role in disease diagnosis, medical prevention, health care and improvement of health status [9-10].

The quantitative detection of biomolecules related to various diseases in blood is the basis of clinical diagnosis, prognosis monitoring, early disease prevention and controllability detection. However, up to now, it is difficult to detect whole blood by clinical detection methods [11-12], so it is necessary to separate serum/plasma in advance. The simplest and most reliable way to avoid strong light scattering is to avoid the spread of light in blood. However, in the whole blood detection, there will still be blood in the evanescent wave field, and background fluorescence will still be generated, which will reduce the sensitivity of detection.

The biosensor used for rapid detection of hemoglobin includes insulating substrate, electrode, insulating layer, sensitive film and covering layer. The thin-film electrode prepared by MEMS technology is a two-electrode device with an electrode thickness of 100nm, and the electrode surface is pretreated by plasma cleaning [13]. Suck the prepared blood on the sample machine, then put about 0.5μL of blood on each point of the two carbon electrodes of the sensor, and then put it in a clean place to dry for 10 hours.

In this paper, we established a simple, sensitive and label-free fluorescent probe based on silver nanoclusters for one-step detection of protein kinase activity and screening of its inhibitors. Fluorescent silver nanoclusters use peptides as templates, and their templates consist of two parts.

The first part is CCY, which can reduce Ag^+ to Ag atoms by using phenolic hydroxyl groups in tyrosine (Y) under alkaline conditions and be captured by sulfhydryl groups of cysteine (C) to form stable nanoclusters.

The second part is LRRASLG, which is an amino acid sequence specifically recognized by protein kinase. PKA can phosphorylate the serine (S) site of the substrate fragment in the presence of ATP. According to the change of fluorescence signal, we can effectively monitor protein kinase.
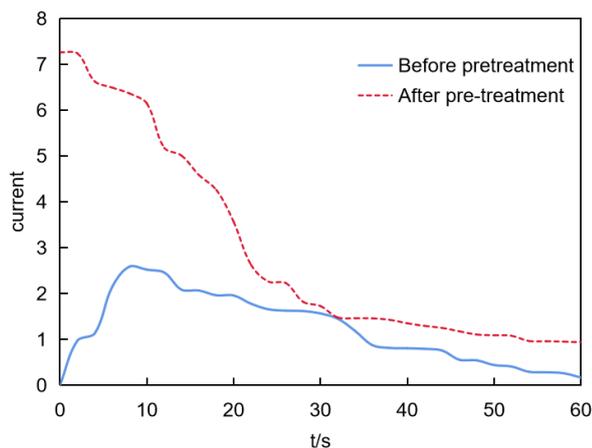
4. Results and discussion

The understanding, evaluation and mutual influence of Chinese and Western medicine and the development course of integration of Chinese and Western medicine show that both Chinese and Western medicine are influenced by their political, economic and cultural environment, and they all meet the needs of today's social development. The ultimate goal of both is to save lives and serve human health, which is the most fundamental commonality between Chinese medicine and Western medicine. With the development of life science, nanotechnology, biotechnology, information technology and cognitive science, subject differentiation and subject integration occur constantly. The research results of some branches and interdisciplinary subjects not only deepen the understanding and treatment of complex diseases, but also subvert the traditional medical model.

Although hemoglobin has electroactive centers, on the one hand, because of its huge molecular space structure, the electroactive centers are not easy to be exposed; On the other hand, because of its strong adsorption on the

electrode surface, the electrode is passivated, so its electron transfer rate on the general electrode is very slow, and no effective current response can be obtained. With the help of electron transfer mediator, the electron transfer rate of hemoglobin on the electrode surface can be improved.

When the working voltage is set at +0.3V, when the output current tends to be stable, 3μL of the measured solution is directly contacted at one side of the sample channel of the sensor. Due to the capillary force, the solution quickly spreads over the whole reaction area, so that the current response curve of the measured solution (hemoglobin here) can be obtained. Fig. 1 compares the influence of electrode pretreatment on the sensitivity of detection signal (after fixing the sensitive film).
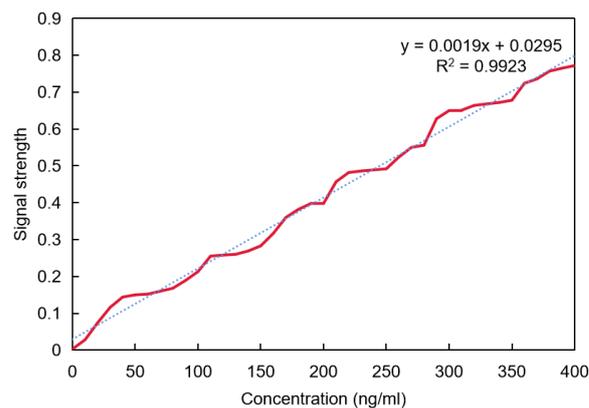

Figure 1. Response curve of biosensor

It can be seen that the plasma cleaning method is used to pretreat the electrode surface, and the effect is obvious. It can not only remove the pollutants on the electrode surface, but also activate the electrode surface, and improve the sensitivity and consistency of the response.

At present, blood immune test based on tumor markers has become an important means and basis for medical clinical disease diagnosis. For example, the increase of AFP content has been used as a specific index for clinical diagnosis of primary liver cancer. In our work, the detection of AFP in whole blood was successfully realized by combining fluorescent nano-markers with FOB.

AFP-modified fluorescent nanotags are bound to the surface of optical fiber through the interaction of antigen and antibody. When the optical fiber is immersed in the solution containing AFP, the AFP-modified fluorescent nanotags on the surface of the optical fiber are replaced and far away from the action region of evanescent waves, which leads to the weakening of the labeling signal.

Figure 2 shows the dependence of signal change and AFP concentration in whole blood AFP detection by fluorescent nano-labeled optical fiber biosensor.

Figure 2. Dependence between signal change and AFP concentration

It can be found that the change of labeling signal has a good linear relationship with AFP concentration, and the correlation coefficient is 0.992. The difference in the range and accuracy of whole blood detection may mainly come from the influence of the complex environment of whole blood, which reduces the probability of rabbit anti-AFP combining with AFP. Combining the advantages of nano-probe and optical fiber evanescent wave biosensor, the influence of spectral scattering, light absorption and autofluorescence background in whole blood on detection signals is effectively reduced, and the accuracy of whole blood detection is improved.

The detection method of solid-state biosensor for rapid detection of hemoglobin mentioned in this paper is simpler, and the sample is added once in the test process. Moreover, the response time for detecting hemoglobin is shortened to 30s, which realizes the rapid detection of hemoglobin by biosensor and meets the needs of clinical detection of hemoglobin concentration range.

5. Conclusions

In addition to good sensitivity and specificity, biosensor has the advantages of rapidity, simplicity, economy, practicality, no batch restriction, automatic operation, no pollution, and detection of different types of biomolecules. Compared with traditional analytical methods, biosensors have highly selective molecular recognition components, so there is generally no need for sample pretreatment, and it uses excellent selectivity to unify the separation and detection of the tested components in the sample. Combining the advantages of nano-probe and optical fiber evanescent wave biosensor, the influence of spectral scattering, light absorption and autofluorescence background in whole blood on detection signals is effectively reduced, the accuracy of whole blood detection is improved, the rapid detection of hemoglobin by biosensor is realized, and the demand for clinical detection of hemoglobin concentration range is met.

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