International Journal of Trend in Research and Development, Volume 8(5), ISSN: 2394-9333
www.ijtrd.com

Application Status and Development Trends of Biosensors

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Abstract: As a new type of sensor, biosensor is a biomolecule sensitive element, which converts chemical signal, thermal signal and optical signal into electrical signal or generates electrical signal directly for amplification and output, so as to obtain the detection result.Biosensor is a new and high technology which is permeated by biology, chemistry, physics, medicine and electronic technology.Because of its good selectivity, high sensitivity, high analysis speed, low cost, on-line continuous monitoring in complex system, especially its high automation, miniaturization and integration, it has been developed rapidly in recent decades.It has wide application prospects in various sectors of the national economy, such as food, pharmaceutical, chemical, clinical testing, biomedical, environmental monitoring, etc.Especially, the combination of molecular biology with microelectronics, optoelectronics, microfabrication and nanotechnology is changing the faceof traditional medicine, zoology,phytologyandenvironmental science.This paper explains the basic principle of biosensor, the current mainstream classification, the current mainstream research results, the application in various fields and the possible development trend of biosensor in the future.

Keywords: *Biosensor; Electrochemical; Information Detection; Bioengineering*

I. INTRODUCTION

The biosensor is essentially a sensor, which involves many basic disciplines such as biochemistry, electrochemical, etc. Its function is to detect and analyze the substances to be tested. The biosensor actually combines many detectors. With the help of the identification device, the biosensor can be obtained by combining many chemical substances and biological substances, converters and signal amplifiers [1-3]. The biosensor can measure different measurements with the principle of various biosensors. The biosensor can be re-encapsulated with a series of technologies such as Internet of Things (IOT), cloud computing, big data, integrated circuit, etc. The above components are integrated into the chip, not only in the biological field, biomimetic field, artificial intelligence field, intelligent food detection, intelligent industry, etc. In many fields, such as intelligent detection of environmental pollution, biosensors can also help these disciplines to build a better social home.

Biosensor is an interdisciplinary subject of analytical chemistry and biochemistry. At present, biosensor research is still in a very active stage. The biosensor research has gradually become specialized, miniaturized, integrated and has some biocompatible biosensors, which are made of biocontrollable and intelligent sensors [4-5]. Based on the basic structure and performance of biosensor, from the characteristics and trend of its selectivity, stability, sensitivity and integrated development of sensor system, researchers mainly study biosensor in the aspects of medical treatment, food industry and environmental monitoring, its development has great influence on production and life, especially, biosensor has good specificity, easy to operate, simple equipment, field detection, portable, rapid and accurate measurement, wide application range, which is favored by researchers. This paper mainly summarizes the application of biosensor in environmental analysis and detection in recent three years, so as to help the future research of biosensor technology.

II. BASIC PRINCIPLES OF BIOSENSOR

The biosensor is composed of biometrics and signal analysis. The biological recognition part is composed of biosensitive recognition elements with molecular recognition ability, including cells, biotin, enzyme, antibody and nucleic acid [6]. The signal analysis part is usually called a transducer. Their working principle is generally according to the substance electrochemical, optical, mass, heat, magnetism, etc., the physical and chemical properties of the analyte and biometrics between the reaction between the signal to be detected, quantization of another signal, such as electrical signal, burning light signal, etc., and through the signal reading equipment conversion process, finally can be qualitative or quantitative detection of the analyte data [7].

The working principle of biosensor identification and detection of the object to be tested: firstly, the molecule of the object to be tested is in contact with the identification element; secondly, the molecule of the object to be tested is separated from the sample by the identification element; thirdly, the converter converts the corresponding signal of the identification reaction into the analytical chemical or physical signal; finally, the output signal is converted into the identifiable signal by the modern analytical instrument [8].Each part of the biosensor includes an analytical device, an instrument and a system. The identification element in the biosensor determines the specificity of the sensor, which is the decisive factor of biological qualitative identification. The affinity between the identification element and the molecule to be tested, as well as the precision of the transducer and the detection instrument, largely determine the sensitivity and response speed of the sensor [9].

III. SPECIFIC CLASSIFICATION OF BIOSENSORS

There are many classification methods for biosensors, which are divided into microbial sensors, immunosensors, tissue sensors, cell sensors, enzyme sensors, DNA sensors, etc., according to the types of biosensors, they are divided into two types: affinity type and metabolic type. According to the principle of sensor device detection, there are the following types:

(1) Chemical change to electrical signal

This principle biosensor is the current market mainstream, with the help of amplifier and signal conversion device to convert the required chemical signal into electrical signal [10].This process is not only limited to the re-cell level but also can be lowered to the cell organelle level. Even the basic substances can form part of the biosensor to realize the

measurement function and conversion function and output the effective signal.

(2) Thermal change to electrical signal

This kind of biosensor is used to measure the thermal change of the biological material under test. The working principle of this kind of biosensor is to convert the heat of the physical change or the chemical change into the change of the resistance value through the thermistor, and output the amplified signal to the corresponding instrument to measure the target quantity indirectly [11].

(3) Optical signal to electrical signal

Some biochemical reactions produce fluorescence that is indirectly measured by using a fiber optic sensor or a photosensitive sensor connected to a photocurrent device and output from an amplifier to a corresponding instrument, usually for measuring the content of a class of substance or measuring the concentration [12].

The common point of the above three types is that the corresponding quantity easy to measure is converted into electric signal through the corresponding converter and amplified by the amplifier to obtain the corresponding target quantity. Of course, there is a way to directly measure the measured quantity.

(4) Direct generation of electrical signals

The measured electron transfer quantity is directly output to the corresponding instrument through the amplifier amplification signal, and the target to be measured is measured indirectly according to the current [13].

IV. APPLICATION STATUS OF BIOSENSOR

In recent years, biosensors not only have excellent performance, satisfactory sensitivity, integrated analysis and detection, further improvement in speed, low price, real-time monitoring and measurement in extremely complex environment, but also are highly integrated automation and micro-intelligent [14]. The main driving factors are the proposal of big health, IOT, big data, cloud computing and other solutions; the current research focus is on the combination of various fields and artificial intelligence big data, such as portable wearable detection device, POCT, non-invasive analysis, in vivo assay, online real-time detection, etc. in the medical field. There are different technical bottlenecks in different application fields, but the stability of measuring elements of biosensors is a common problem and needs further efforts.

The biosensor is no longer limited in the field of biological science. Due to its unique characteristics and convenient performance, it can intelligently and automatically control the demand in medical pharmaceutical research [15]. In the detection of environmental pollution, it can also be measured by measuring the concentration of pollution factor in the air. In the process of judicial forensics, the biosensor can quickly and easily obtain the clues to obtain forensics, and it can be more safe and efficient from the situation that marks the biological postgraduates' habit migration. Even in the process of drug production and synthesis, it can be measured by big data and intelligent industry, and intelligent industry can conduct production regulation through biosensor. Improve productivity and accelerate industrial transformation and upgrading.

(1) Food Safety

Food safety mainly refers to whether certain substances in food meet national standards, whether there is virus or harmful substance, whether there is pesticide residue or whether there is illegal molecule maliciously adulterated substance that does not meet national regulations or whether the added substance exceeds national standard value [16]. In view of the characteristics of rapid detection of biosensor, it can meet the needs of food identification.

(2) Environmental monitoring

With the influence of industrial social mechanism transformation, production capacity upgrading and other factors, environmental pollution has come to people's sight. The biosensor can carry out rapid and efficient real-time monitoring by virtue of its characteristics of high efficiency and convenience for large batch production. It can monitor most pollution molecules or heavy metal substances in the environment and combine with the concept of intelligent city. Through the detection of biosensor, the intelligent city can control and stabilize the environmental quality [17].

(3) Fermentation Industry

The fermentation industry mainly uses microbial sensors. Due to the astonishing breeding speed of microorganism, the cost is low, and the equipment for cultivation is simple. In most cases, only the petri dish and regular personnel are required to check whether the petri dish is contaminated [18]. In addition, the conversion by existing sensors is seriously affected by electromagnetic fields, and the electrical signal interference factors during fermentation are complex, so the microbial sensors are not affected by the complex conditions, which can meet the measurement requirements of the fermentation industry.

(4) Medical diagnosis

In the medical research and diagnosis, biosensors are mainly used to measure various indexes of human body. In view of the high speed and obvious effect of biosensors, the biosensors have strong ability to resist human interference compared with other sensors, which can buy valuable time for clinical diagnosis and accurately diagnose the disease. In the military medical field, it is mainly used to measure the type and concentration of the newborn weapons or inflammable and explosive articles in the shortest time to judge the hazard degree and convey it to the relevant departments for protection and measures [19].

V. FUTURE DEVELOPMENT TREND OF BIOSENSOR

According to the application status of biosensor, biosensor is not limited in the field of biological science. In combination with the accumulation of multi-disciplinary knowledge systems such as computer science, IOT, material science and physics, the development trend of biosensor will have the following three points:

(1) The biosensor will become smaller and smaller along with the application of material in material science, and it will develop into miniaturization [20]. From the above, it can be seen that there is a new breakthrough in nanotechnology in material science, and the biosensor will break through the

limiting effect on the scale to biomolecules and cells, so as to realize more precise, fast, convenient and convenient

(2) Combining artificial intelligence to realize high-intensity intellectualization. Intelligent industry, food detection control and automation, intelligent control of environmental pollution monitoring, artificial intelligence, big health and other concepts are combined to better serve society. Through the computational power of artificial intelligence technology and cloud computing, the data volume of big data is combined with mechanism reform and transformation to realize highly intelligent construction [21]. The data sent by the sensor is accepted by the cloud and processed according to the algorithm. The data is compared with big data to realize accurate detection. The whole system realizes precision systematization and scientization. With the help of further breakthrough of integrated circuit, the chip is continuously packaged into a chip to perform specific functions, realizing customized and directional function architecture [22].

(3)Multiple integrated sensors, in view of the need to measure multiple quantities to be measured and complex causality under certain conditions, the step is directly simplified by using biological sensors.Realize accurate real-time measurement of target measurement [23].

Of course, in order to make the biosensor enter the market as soon as possible, the following four conditions are required. Firstly, sufficient sensitivity and accuracy, which is the basic function of the biosensor. In order to be widely used from the laboratory to the society, the product quality must be guaranteed [24]. The quality factor determines the competitiveness of the product. It is the most powerful guarantee that the quality is replaced by a huge iteration. Secondly,the basic function of the biosensor is always to obtain more accurate and real-time data. The simple operation can accelerate the conversion of the market.Thirdly,it is cheap, easy to carry out mass production and quality monitoring in the production process. In view of the role of biosensors and their own nature and scope of use, as well as the huge commercial prospect, the country needs to establish strong standards and establish new monitoring system and welfare system to stabilize the people and corresponding enterprises [25]. Finally, long service life, high stability and reliability. Based on high sensitivity, high accuracy and high stability, it can further increase the development of biosensor and replace the instruments and equipment before, firmly grasp the market and better serve the society under national supervision.

CONCLUSION

In the coming time, the research work of biosensor will mainly focus on: the biosensor should be transformed from single function to multi-function, one sensor should collect the detection function of multiple pollutants; genetic engineering technology should be used to build high-efficiency target strains to improve efficiency and stability; solve the stability of biological response and the miniaturization and portable problem of biosensor; improve the service life of signal detector, select the bio-sensing element with strong activity and high selectivity; the miniaturization biosensor should be integrated with other analytical instruments and signal terminals, establish high-efficiency biosensor system and improve the early warning efficiency [26].In addition, the detection results obtained by using biosensors must be recognized by authorities before large-scale applications are possible [27].Through these efforts, eventually realize marketization and commercialization. With the development of materials science, physical science, life science, chemical science, computer science, artificial intelligence and other related disciplines, biosensor technology will be developed more mature. Soon, a new generation of biosensors with many advantages such as high sensitivity, low cost and high stability will play a more important role in many fields.

Acknowledgement

This study was supported by National key research and development program, China (2018YFC1707104).

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