Scientific Reviews & Chemical Communications

Sci. Revs. Chem. Commun.: 2(3), 2012, 361-364
ISSN 2277-2669

– A BRIEF REVIEW

ADVANCES IN BIOSENSOR TECHNOLOGY

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(*Received : 28.02.2012; Revised : 15.03.2012; Accepted : 24.03.2012*)

ABSTRACT

Development of chemical and physical sensors is the current need of society, because from that the recent useful and multipurpose biosensor is made. After the discovery of first biosensor i.e. glucose enzyme electrode in 1962 by Clark and Lyons, there are rapid and many inventions related to the biosensors are done. In the last two decades, we have seen the tremendous development in the field of biosensors, its types and applications in the various areas such as medical diagnostics, food processing, military, environmental monitoring, and biotechnology and among others. In this article detailed information about biosensor and its journey from sense, sensor to biosensor is discussed.

Key words: Sensor, Biosensor, Enzyme electrode, Fiber optics.

INTRODUCTION

Any life without the sense is impossible. An individual person will have five types of sensing elements, i.e. nose, tongue, ears, eyes and skin. These sensing elements represent the main types of sensors occurring in nature. The best known simple type of sensor is the litmus paper test for acids and bases. The litmus sensing element gives a qualitative indication by changing color in the presence or absence of an acidic or basic aqueous solution. There is a need of some reliable means to monitor the changes in surroundings. From the sense, there is a development of sensors and undoubtly sensors have become part and parcel of our daily life. Sensor technology represents one of the emerging areas of physics, electronics and biotechnologies in the similar way individually in microelectronics, optical and computer science technologies. Now a day's sensors have been considered as a highly potential field of scientific research. However, biosensors have got vital importance in different biomedical instrumentations, because there is a revolutionary development in the field of biosensors for scientific research.

Fifty years have passed since Clark and Lyons proposed the concept of glucose enzyme electrodes on 1962 from children hospital in Cincinnati[1]. Indeed, the entire field of biosensors can trace its origin to this glucose enzyme electrode[2].

Diabetes is a world-wide public health problem. It is one of the leading causes of death and management of diabetes requires a tight monitoring of blood glucose levels. The challenge of providing such tight and reliable glycemic control remains the subject of enormous amount of research[3,4]. Electrochemical

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biosensors for glucose play a leading role in this direction. We have witnessed tremendous activity towards the development of reliable devices for diabetes control. In addition to diabetes control, such devices offer great promise for other important applications, ranging from food analysis to bioprocess monitoring. The great importance of glucose has generated an enormous number of publications, the flow of which shows no sign of diminishing[2]. These devices provide accurate results in no time and at low cost[5].

EXPERIMENTAL

Biosensors

A sensor is a device that detects an external stimulus and records, indicates or otherwise responds to it[6-8]. The sensors can be of two basic types' i.e. physical sensor and chemical sensor. Physical sensor concerned with measuring physical quantities such as length, temperature, pressure, electricity, weight, sound etc.[9,10] and a chemical sensor concerned with detecting and measuring a specific chemical substance[11]. Biosensor is subset of chemical sensor, but is often treated as a topic in its own right. They are used in large-scale health in the area of petrochemicals, food industry and environmental control.

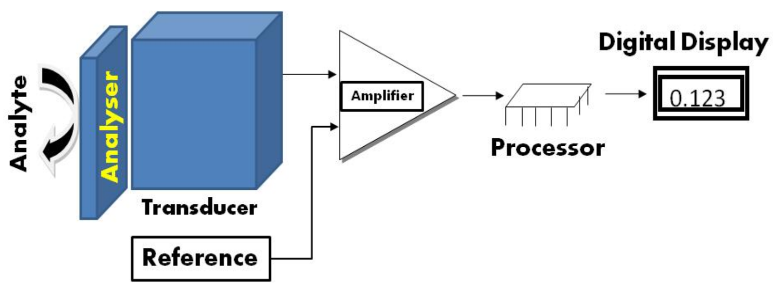

Fig. 1: Schematic diagram with basic components of biosensor

The Analyte converts the substrate to product. This reaction is determined by the transducer that converts an electrical signal. This signal to the transducer output is amplified in amplifier, processed in processor and displayed in digital display unit.

Types of biosensors

Biosensors are devices and these are used in physics, chemistry and biology. Biosensors are used to analyze various physical, chemical and biological processes. Heat, light and electricity are the results of various reactions. Those properties are exploited to analyze reactions. There are different types of biosensors depending on the type of property used to analyze a reaction. Depending on the detection technique and transducer, biosensors can be classified as electrochemical biosensors these biosensors have different biosensing applications[12,13], those biosensors are given as,

Amperometric biosensor

Amperometric biosensors measure the current produced during the oxidation or reduction of a product or reactant, usually at a constant applied potential.

Potentiometric biosensor

Potentiometric biosensors measure the voltage produced during the oxidation or reduction of a product or reactant, usually at a constant current. The operating principle is based on the fact that when a voltage is applied to the solution there is a change in current flow due to electrochemical reactions.

Voltametric biosensors

Voltammetry employs a three-electrode system (working, reference and auxiliary electrodes). Usually, the current is monitored as a potential range is swept, either catholically or anodically. The concentration of the analyte is proportional to the peak current of the species being either oxidized or reduced.

Piezoelectric biosensors

Piezoelectricity is defined as, the charge which accumulates on a solid material due to mechanical stain. The electricity generating from pressure is the piezoelectricity measured by a device is called a piezoelectric sensor. When this technology comes to biology, it is renamed as piezoelectric biosensor. This is a key step in any DNA biosensor development.

Conductometric biosensors

The electrical conductance or resistance of the solution is measured by the conductometric biosensors. When the electrochemical reactions produce ions or electrons the conductivity or resistivity of the solution changes, this change is measure and calibrated to a scale more appropriate.

Calorimetric biosensors

The basic principle of calorimetric biosensors is that all biochemical reactions involve a change in enthalpy. Such a change in enthalpy is detected by calorimetric biosensors.

Optical biosensors

Optical biosensors are analytical devices comprising optical element and biological recognition molecule. Optical biosensors can be used to detect the light produced by chemical reactions. The optical biosensors are used to screening of biological products, monitoring of protein purification etc.

Thermometric biosensors

Thermometry is a technology which is used to measure the temperature. There are various ways to measure the temperature such as optical, mechanical and electrical technique. When it comes to biological systems, thermometric biosensors are helpful to measure the temperature. Like as above there are many useful biosensors, such as,

Biosensors for cancer detection

Biosensors for food industry, etc.

Innovations or recent developments in biosensors

Silicon micro sensors: Despite the commercialization of biosensors based on silicon is slow, there is a gradual increase in the use of micro fabrication technologies in the development of biosensors. This trend should lead to the emergence of new markets. This development will allow new applications in clinical analysis, health and environmental monitoring.

Fiber optic biosensors: The use of an optical fiber as a biosensors are gaining ground due to some of its features like the ability to conduct light and immunity to electrical and magnetic interference. A typical optical biosensor uses absorbance measurements to determine a change in concentration of analytes that absorb a certain wavelength of light. The light is transmitted through an optical fiber to the sample; the amount of light absorbed by the analyte is detected through the same fiber or a second fiber. The biological material is immobilized at the end of the optical fiber. The main advantage of optical biosensors is its low cost.

CONCLUSION

After the 50 years of recent successful biosensor, the main advantage of it is that it reaches to everybody's hand for various useful applications, because of its low cost, simplicity, large speed and accuracy. At this age more efforts have to be made to take advantages of biosensor technologies for different fields such as medical, agriculture, military, environmental monitoring etc. These technologies at an early stage must be like as glucose meters to check glucose level in diabetic patient.

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