

جامعة الانبار
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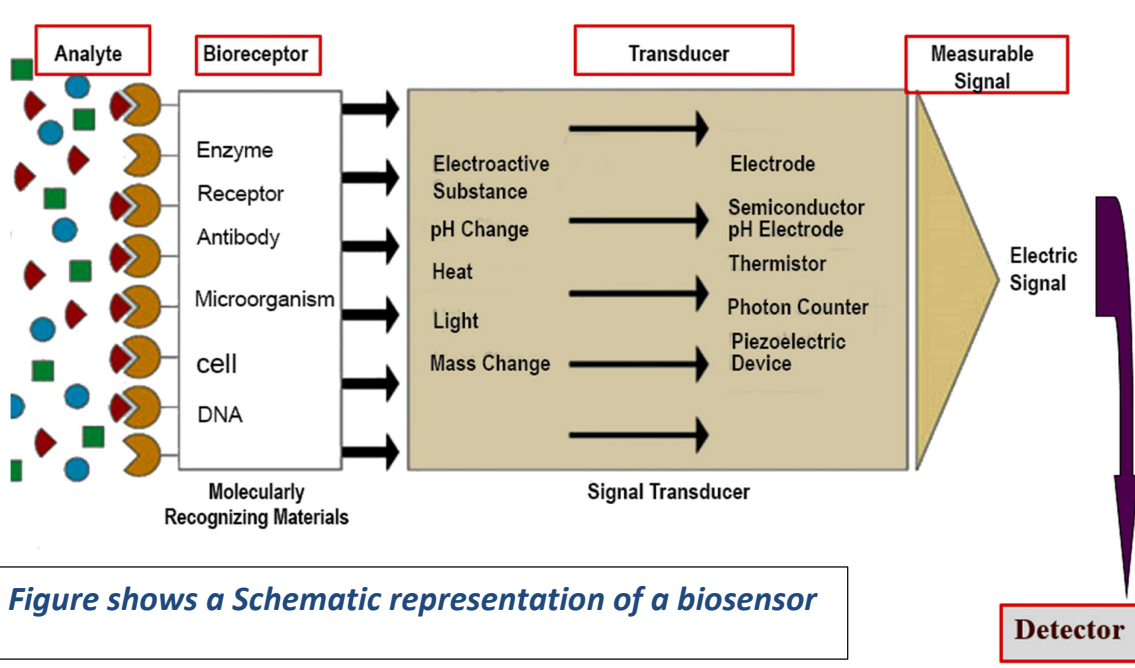
التقانة الحيوية Biotechnology

المتحسسات الحيوية
Biosensors

م. د. رأفت حمدي الحديثي
قسم التقنيات الاحيائية

Biosensors

- The history of biosensors started in the year 1962 with the development of enzyme electrodes by the scientist Leland C. Clark.
- Biosensor is a device that consists of two main parts: A bioreceptor and a transducer.
- Bioreceptor is a biological component (tissue, microorganisms, organelles, cell receptors, enzymes, antibodies, nucleic acids, etc) that recognizes the target analyte.
- Other part is transducer, a physicochemical detector component that converts the recognition event into a measurable signal.

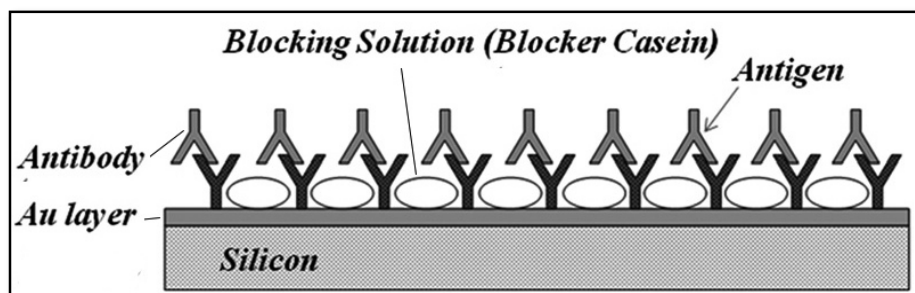


- Biosensors can have a variety of biomedical, industry, and military applications.
- The major application so far is in blood glucose sensing because of its abundant market potential.
- Biomolecules such as enzymes, antibodies, receptors, organelles and microorganisms as well as animal and plant cells or tissues have been used as biological sensing elements

Types of Biosensors

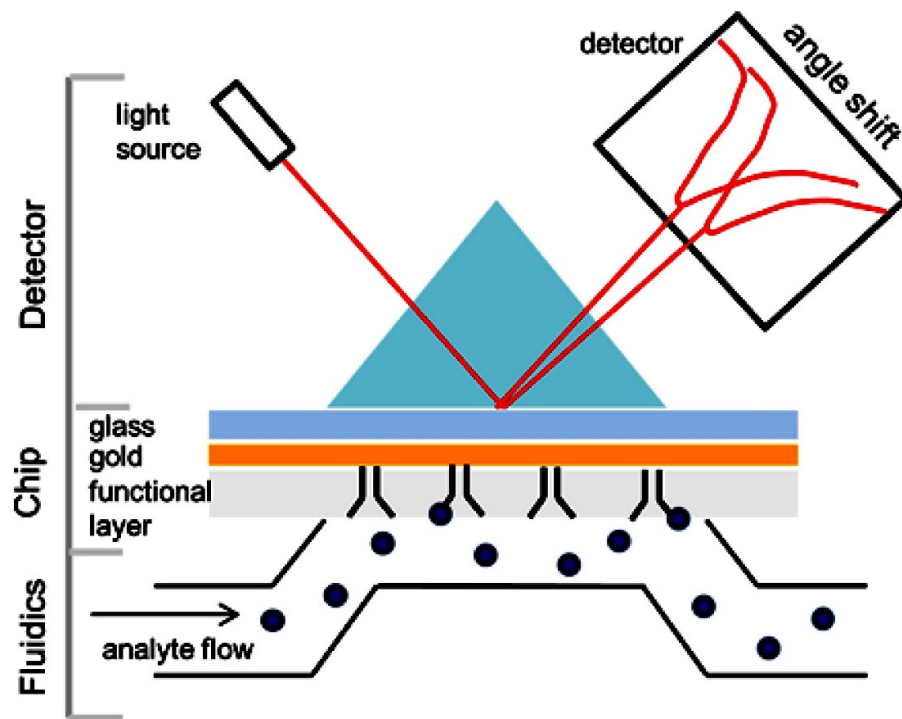
1- Resonant Biosensor

- In this type of biosensor, an acoustic wave transducer is coupled with an antibody (bio element).
- When the analyte molecule (or antigen) gets attached to the membrane, the mass of the membrane changes.
- The resulting change in the mass subsequently changes the resonant frequency of the transducer.
- This frequency change is then measured



2- Optical biosensors

- The output transduced signal that is measured is light for this type of biosensor.
- The biosensor can be made based on optical diffraction.
- Optical transducers are particularly attractive for application to direct (label-free) detection of bacteria.
- These sensors are able to detect minute changes in the refractive index or thickness which occur when cells bind to receptors immobilized on the transducer surface.



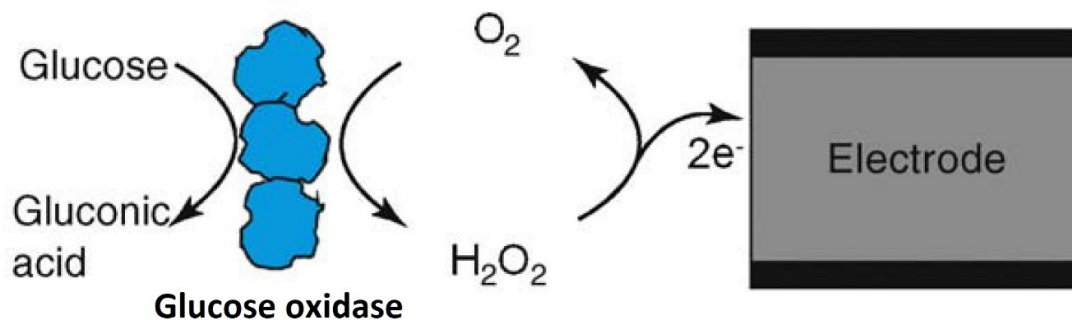
3- Thermal Biosensors

- This type of biosensor is exploiting one of the fundamental properties of biological reactions, namely absorption or production of heat, which in turn changes the temperature of the medium in which the reaction takes place.
- They are constructed by combining immobilized enzyme molecules with temperature sensors.
- Common applications of this type of biosensor include the detection of pesticides and pathogenic bacteria.

4- Electrochemical Biosensors.

Electrochemical biosensors are mainly used for the detection of hybridized DNA, DNA binding drugs, glucose concentration, etc. Standard glucose oxidase (GOx)-based electrochemical biosensors use a GOx layer to recognize glucose and generate an electrochemical signal.

This signal is transferred from the enzyme through O_2 reduction to H_2O_2 .



5- Bioluminescence sensors.

- ✚ This type of biosensors utilizes the ability of certain enzymes to emit photons as a by-product of their reactions. This phenomenon is known as bioluminescence.
- ✚ Luciferases catalyse the oxidation of luciferins and the result of this reaction is light. Such enzymes found in firefly and some species of jellyfish and bacteria (e.g. *Vibrio fischeri*).
- ✚ The potential applications of bioluminescence for bacterial detection were initiated by the development of luciferase reporter phages.

6- Nucleic Acid-based Biosensors.

- ❖ A nucleic acid biosensor is an analytical device that integrates an oligonucleotide with a signal transducer.
- ❖ The nucleic acid probe is immobilized on the transducer and acts as the bio-recognition molecule to detect DNA/RNA fragments.

7- Microbial Biosensors.

- Microbes have a number of advantages as biological sensing materials in the fabrication of biosensors.
- Microorganisms have a great capacity to adapt to adverse conditions and to develop the ability to degrade new molecules with time.
- Whole cells have been used either in a **viable** or **non-viable** form.
- Viable microbes metabolize various organic compounds either anaerobically or aerobically resulting in various end products like

ammonia, carbon dioxide, acids etc. that can be monitored using a variety of transducers.

- Another mechanism used for the viable microbial biosensor involves the inhibition of microbial respiration by the analyte of interest, like environmental pollutants.
- The major application of microbial biosensors is in the environmental field. Environmental applications of biosensors include the detection of harmful bacteria or pesticides in air, water, or food.

Clinical and Diagnostic Applications

One well known example of a clinically applied biosensor is the glucose monitor, which is used on a routine basis by diabetic individuals to check their blood sugar level. Biosensors also can be used to detect pathogens, and diagnose and monitor cancer. The use of emerging biosensor technology could be instrumental in early cancer detection and more effective treatments.

Environmental applications

Biosensors are used to check the quality of air and water. The devices can be used to pick up traces of organophosphates from pesticides or to check the toxicity levels of wastewater, for example.

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