Types of Biosensors

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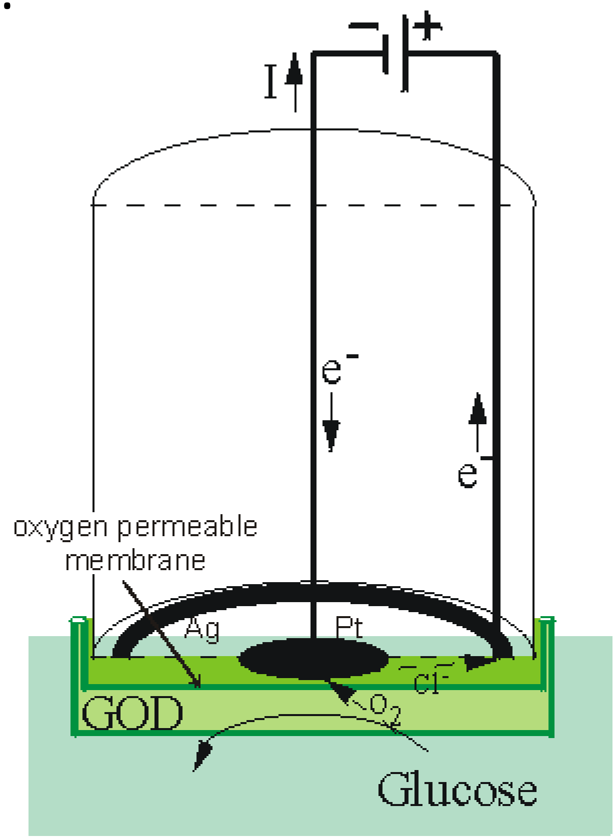
1- Amperometric biosensor

Electroactive species present in natural test samples can be easily detected by high affectability biosensor. The oxidation or diminishment of electroactive species is estimated and connected to the centralization of the analyte e.g. glucose biosensors for diabetes checking which produces current due to the potential difference between two electrodes. These anodes limit Eventually Tom's scrutinizing the preparing of a current at plausibility might be associated between two cathodes, the degree from guaranteeing current constantly corresponding of the substrate centralization. The Clarke oxygen cathode for presence of oxygen in the test (analyte) result during reduction is used by these biosensors for facing less difficulty.

The Clarke oxygen cathode for presence of oxygen in the test (analyte) result during reduction is used by these biosensors for facing less difficulty. Amperometric biosensors function by the production of a current when a potential is applied between two electrodes. They generally have response times, dynamic ranges and sensitivities similar to the potentiometric biosensors. The simplest amperometric biosensors in common usage involve the Clark oxygen electrode (Figure 1).



Schematic diagram of a simple amperometric biosensor. A potential is applied between the central platinum cathode and the annular silver anode. This generates a current (I) which is carried between the electrodes by means of a saturated solution of KCl. This electrode compartment is separated from the biocatalyst (here shown glucose oxidase, GOD) by a thin plastic membrane, permeable only to oxygen. The analyte solution is separated from the biocatalyst by another membrane, permeable to the substrate(s) and product(s). This biosensor is normally about 1 cm in diameter but has been scaled down to 0.25 mm diameter using a Pt wire cathode within a silver plated steel needle anode and utilising dip-coated membranes.

This consists of a platinum cathode at which oxygen is reduced and a silver/silver chloride reference electrode. When a potential of -0.6 V, relative to the Ag/AgCl electrode is applied to the platinum cathode, a current proportional to the oxygen concentration is produced. Normally both electrodes are bathed in a solution of saturated potassium chloride and separated from the bulk solution by an oxygen-permeable plastic membrane (e.g., Teflon, polytetrafluoroethylene). The following reactions occur:

Ag anode $4Ag^0 + 4Cl^- \longrightarrow 4AgCl + 4e^-$

Pt cathode $O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O$

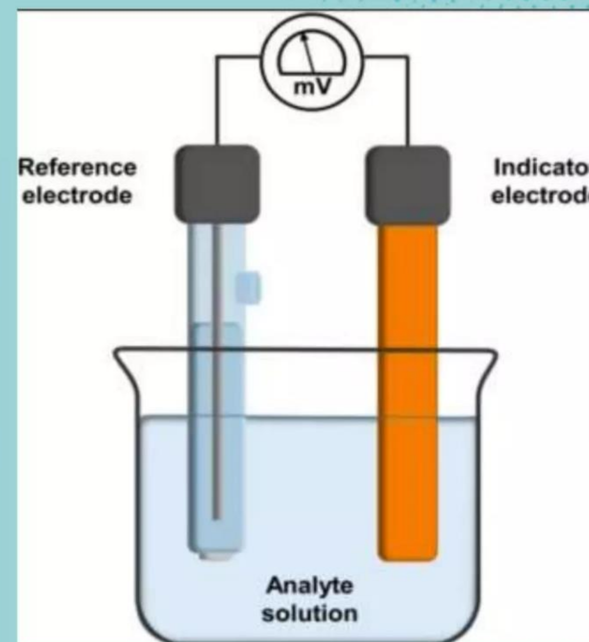
The efficient reduction of oxygen at the surface of the cathode causes the oxygen concentration there to be effectively zero. The rate of this electrochemical reduction therefore depends on the rate of diffusion of the oxygen from the bulk solution, which is dependent on the concentration gradient and hence the bulk oxygen concentration. It is clear that a small, but significant, proportion of the oxygen present in the bulk is consumed by this process; the oxygen electrode measuring the rate of a process which is far from equilibrium, whereas ion-selective electrodes are used close to equilibrium conditions. This causes the oxygen electrode to be much more sensitive to changes in the temperature than potentiometric sensors. A typical application for this simple type of biosensor is the determination of glucose concentrations by the use of an immobilised glucose oxidase membrane.

A main problem of such biosensors is their dependence on the separated O_2 fixation in the analyte result. This may be beat Eventually Tom's examining using go betweens; these particles trade the electrons made Toward the reaction clearly to the cathode as opposed to diminishing those O_2 deteriorated on analyte result. Those present-day anodes, in any case, remove those electrons particularly beginning with the diminished proteins without the assistance of arbiters, moreover require help secured with electrically coordinating normal salts. So, the natural test samples may not be characteristically electrodynamic, catalysts are expected to catalyze the generation of radio-dynamic species. For this situation, the deliberate parameter is present

2. Potentiometric biosensor

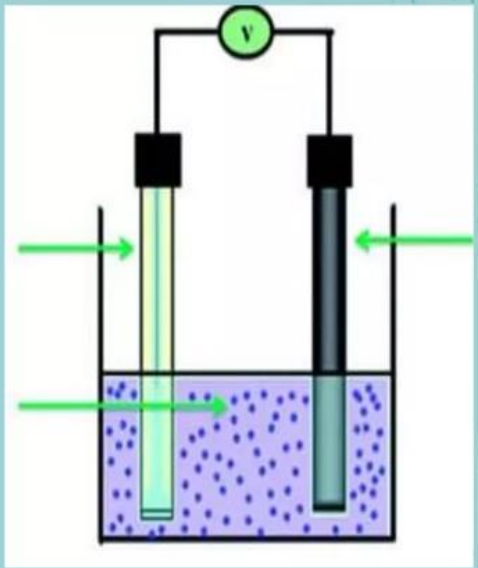
Potentiometric sensor:

A potentiometric sensor is a type of electrochemical sensor that may be used to measure potential difference of an electrode.



Principle:

- The signal is measured as the potential difference (voltage) between the working electrodes and the reference electrode. The working electrode's potential must depend on the concentration of the analyte in the gas or solution phase.
- In the potentiometric sensor the ion-selector electrode is coupled with the reference electrode to complete the circuit and the sensor measure the potential difference between two electrode.



Where we use potentiometric sensor:

The potentiometric sensor are used in analysis of glucose in blood. Glucose is converted into ions, which is detected by ion-selective electrode. Glucose is oxidized into gluconic acid which is further undergoes decomposition and gives H+ ions which are detected by pH electrode.

Glucose + o_2 $\xrightarrow{\text{glucose oxidase}}$ gluconic acid +H_2O_2.

H_2O_2 $\xrightarrow{\text{electrode}}$ $2H^+ + O_2 + 2e^-$

+ ion measured by pH meter, a potential difference is set-up between glass electrode and reference electrode which is sense by potentiometric sensor which analyze the glucose level in blood.

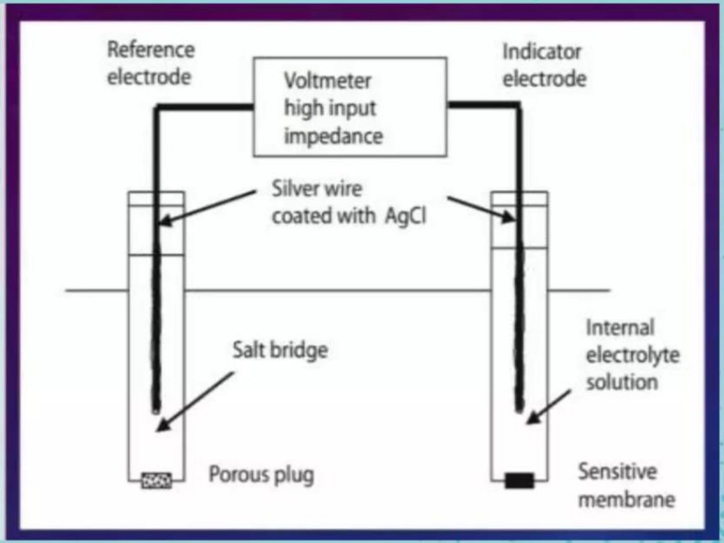
pH meter

- The measuring system consists of a Ph. measuring electrode (indicating electrode) and reference electrode.
- The potential difference between the two electrode is a function of the pH value of the measured solution.

Working

- Use the potentiometer to determine the difference b/w the potential of two electrode. (Potentiometery)

- Two types of electrode
  - ✓ Reference Electrode (fixed potential)
  - ✓ Indicator Electrode (Analyte activity)

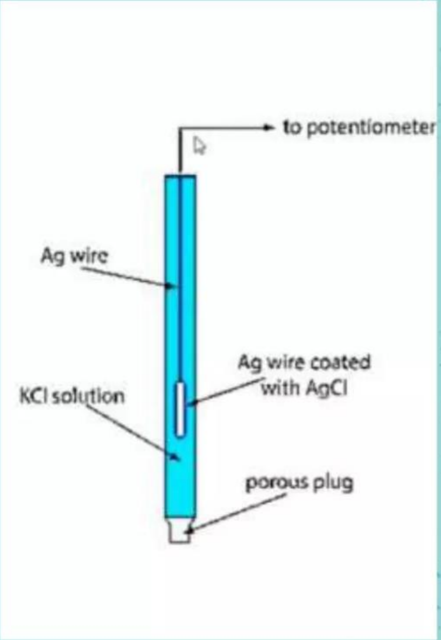


In this strategy the scientific data is acquired by changing over the biorecognition procedure into a potential flag which results in oxidation or decreasing capability of biochemical responses. A perm selective particle conductive layer is typically used to gauge the potential flag, which happens when the analyte atom collaborates with the surface e.g. utilization of H+ particles for penicillin discovery utilizing chemical penicillinase, triacyglycerol utilizing lipase. A high impedance voltmeter is used to check the electrical potential qualification or electromotive power (EMF) between two cathodes. One of the terminals builds up an adjustment in potential as a component of analyte movement or fixation in arrangement and this cathode is known as the pointer anode or now and again called a ion selective electrode (ISE). The potential reaction of an ISE is portrayed by the Nernst condition (i.e., the potential is relative to the logarithm of the centralization of the substance being estimated). The second cathode is the reference and is utilized to finish the electrochemical cell by giving a consistent half-cell potential, which is autonomous of the analyte fixation. ISEs are compound sensors with the longest history and with the biggest number of uses. Actually, billions of estimations are played out every year in almost every clinic everywhere throughout the world. This shocks no one considering that these gadgets are outstanding for giving immediate, fast, upkeep free and non-costly estimations

Reference Electrode

Types of reference electrodes used;

- ✓ Standard Hydrogen electrode
- ✓ Ag/AgCl electrode



Classification of sensors

Potentiometric solid state gas sensors have been generally classified into three broad groups

- ✓ Type I
- ✓ Type II
- ✓ Type III

Type I

- Type I sensors have an electrolyte containing mobile ions of the chemical species in the gas phase that it is monitoring. The commercial product, YSZ oxygen sensor, is an example of type I.

Type II

- Type II sensors do not have mobile ions of the chemical species to be sensed, but an ion related to the target gas can diffuse in the solid electrolyte to allow equilibration with the atmosphere.

Type III

Type III sensors make the electrode concept even more confusing.
With respect to the design of a solid state sensor, the auxiliary phase looks as part of the electrode.