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Editorial

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Biosensors in Various Fields

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Editorial

Biosensors are the devices which are used to analyze the biological materials. Biosensors consist of a bioreceptor (it is also a biological material like enzyme, cell, cell organelle, tissue, nucleic acid, antibody, protein) which react with the analyte or sample and produces an effect. The effect may be release of gases like oxygen or ammonia or change in the concentrations of protons or heat emission or absorption or other mechanisms. The effect is measured, amplified and displayed by a biotransducer. For example, the most commonly used and commercially available biosensor is blood glucose biosensor. It contains the immobilized enzyme glucose oxidase (bioreceptor) which breaks down the glucose (whose concentration is to be measured) present in the blood sample. In the reaction glucose oxidase reduces FAD to form $FADH_2$, which is further oxidized by the electrode in the sensor. Due the transfer of electrons a current is produced (effect) which is detected, amplified and displayed by the transducer. The amount of current produced is proportional to the amount of glucose present in the blood sample. Clark and Lyons in 1962 invented the first biosensor to measure glucose in samples. There are many glucose biosensors evolved with different transducers of which fluorescent glucose biosensor is used now-a-days.

Biosensors are different types. They are classified based on the bioreceptor and analyte interactions (antibody/antigen interaction, enzymes/substrate interaction, nucleic acid interactions, protein/ligand interaction etc.) They can also be classified based on the biotransducer (electrochemical, optical, electronic, piezoelectric, gravimetric, pyroelectric). The key step in the analysis using biosensor is to fix the biological material on the surface of the biosensor, which is achieved by using immobilized enzymes (in case of enzymes) or using hydrogels or xerogels for the physical/chemical entrapment. The most commonly used hydrogel is silica glass.

Biosensors have a wide range of applications in the field of biotechnology, medicine, agriculture, food technology, environmental science. In biotechnology, the composition of nutrient broth can be measured using biosensor, also the concentration of product obtained can also be measured. Biosensors also help environmental scientists to detect pollutants and harmful pathogens in air, water & soil. Detection of soil PH, availability of nutrients, and presence of harmful pesticides helps farmers, this can be achieved easily by using biosensors. They can also be used to detect the presence of toxins like mycotoxins, pathogens in the food. In medical applications biosensors are classified into *In-vitro* and *In-vivo*. In *In-vitro* biosensors measurements can be made in the lab equipment like test tubes, Petri dishes etc. Whereas in *In-vivo* biosensors the device is implanted in the body. *In-vivo* biosensors are used in critical conditions where continuous monitoring is required. However, it involves many risks like infections due to microbes, inflammations due to problems in compatibility and rejection of sensor by the body. Sometimes there may be failure of the device in the body. So proper sterilization techniques and proper care should be taken while implanting the biosensors. The recent advancement in the field of medicine is development of oncological biosensors for the detection of breast cancer which is the most prevalent cancer especially in the women population. Nanotechnology is also being used for the development of biosensors nowadays. Nanochips can be used for fixing the biological materials. There are many recent advancements in the biosensors with the advancement in science and research. Tagging of nanoparticles that are used in biosensors with radioactive tags and fluorescent tags is also an advancement in biosensors. There advancements are made for increasing the sensitivity and accuracy of the device. With the evolution of different biosensors many other disciplines are being combined. Initially physical chemistry is combined to detect biological materials, then polymer science, nanotechnology, surface chemistry is also combined to make a better biosensor overcoming the disadvantages. Biosensors are a power tools in the hands of scientists of many fields making the research quick and easy.