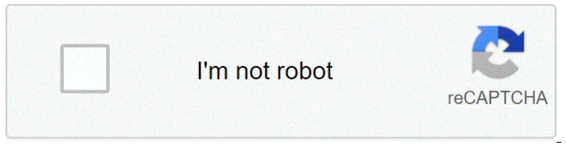

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Chemical sensors and biosensors fundamentals and applications pdf

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For the magazine, see Biosensors (Official MDPI) and biosensors (Official Elsevier). Probe which tests for biological molecules A biosensor is an analytical device used for the detection of a chemical substance, which combines a biological component with a physicochemical detector. [1] [2] [3] The sensitive biological element, for example, tissues, microorganisms, organelles, cell receptors, enzymes, antibodies, nucleic acids, etc., is a component of the material, or biologically derived biomimetic that interacts with, binds with or recognizes the analyte in question. The biologically sensitive elements can also be created by biological engineering. The transducer or sensing element, which transforms a signal in another, it works in physicochemical way: optical, piezoelectric, electrochemical, electrochemiluminescence etc., resulting from the interaction of the analyte with the biological element, to easily measure and quantify . The biosensor reading device connects with the associated electronics or signal processors that are primarily responsible for displaying the results in an intuitive way. [4] what is sometimes the most expensive part of the sensor device, however it is possible to generate an easy-to-use display which includes the transducer and the sensing element (holographic sensor). Readers are usually custom designed and manufactured to meet the different principles of operation of biosensors. Biosensor A biosensor system it is typically constituted by a bio-receptor (enzyme / antibody / cell / nucleic acid / acid aptamer), transducer component electronic system, and which includes a signal amplifier, processor and display (material / nanomaterial semiconductor). [5] Transducers and electronics can be combined, for example, in CMOS-based microsensor systems. [6] [7] The component recognition, often called bioreceptor, uses biomolecules from organisms or receptors modeled biological systems to interact with the analyte of interest. This interaction is measured by biotransducer that provides a measurable output signal proportional to the presence of the analyte in the sample target. The overall aim of a biosensor design is to allow fast, convenient test to the point of worry or care where the sample has been procured. [8] [9] bioreceptors biosensors used for screening of combinatorial DNA library in a biosensor, the bioreceptor is designed to interact with the specific analyte of interest to produce a measurable effect from the transducer. High selectivity for the analyte between a matrix of other chemical or biological components is a fundamental requirement of bioreceptor. While the type of biomolecule used can vary widely, biosensors can be classified according to the common types of interactions involving bioreceptor :. Antibody / antigen, [10] enzymes / ligands, nucleic acids / DNA, cellular structures / cells, or biomimetic materials [11] [12] Antigen / antibody interactions An immunosensor uses the same specific affinity of antibody binding to a compound or antigen specific. The specificity antibody-antigen interaction is analogous to a lock and key wearability by the fact that the antigen will only bind to the antibody if it has the correct conformation. binding events cause a physico-chemical change which in combination with a tracer, such as fluorescent molecules, enzymes or radioisotopes, can generate a signal. There are limitations using sensors antibodies: 1. The antibody binding capacity is strongly dependent on the analysis conditions (eg, pH and temperature), and 2. the antibody-antigen interaction is generally robust, however, the bond can It is interrupted by chaotropic reagents, organic solvents, or also ultrasonic radiation [13]. antibody-antigen interactions can also be used to test o The detection of circulating antibodies in response to a specific disease. Above all, serological tests have become an important part of the global response to the pandemic Covid-19. [14] Artificial binding proteins the use of antibodies like component of biosensors has several drawbacks. They have high molecular weights and limited stability, contain essential disulfide bonds and are expensive to produce. In an approach to overcome these limitations, recombinant binding fragments (Fab, Fv, or scFv) or domains (VH, VHH) antibody were engineered. [15] In another approach, â â small scaffolding proteins with favorable biophysical properties are designed to generate artificial Antigen protein families â â binders (AgBP), capable of binding to different proteins â â target, while maintaining the favorable properties of the specific parent molecule. The elements of the family that bind specifically to a given target antigen, are often selected in vitro by means of visualization techniques: phage display, ribosome display, yeast display, or mRNA display. The artificial proteins â â binders are much smaller compared to the antibodies (usually less than 100 amino acid residues), have a strong stability, they lack disulfide bonds and can be expressed in high yield in cell reducing environments such as the cytoplasm bacterial, unlike antibodies and their derivatives. [16] [17] They are therefore particularly suitable to create biosensors. [18] [19] The enzyme interactions ability of specific binding and catalytic activity of enzymes bioreceptors make them popular. recognition analyte is activated through several possible mechanisms: 1) the conversion enzyme analyte in a product that is detectable sensor, 2) detecting enzyme inhibition or activation by means of the analyte, or 3) controlling modification of enzymes property resulting from interaction with the analyte. [13] The main reasons for the common use of enzymes in biosensors are: 1) ability to catalyze a large number of reactions; 2) possibility to detect a group of analytes (substrates, products, inhibitors, and modulators of the catalytic activity); and 3) different methods of fitness with different transduction to detect the analyte. In particular, since the enzymes are not consumed in the reactions, the biosensor can be easily used in a continuous manner. The catalytic activity of enzymes also allows lower limits of detection with respect to the common bond techniques. However, the life of the sensor is limited by the stability of the enzyme. Receptor binding affinity antibodies have a high binding constant greater than 10 ^ 8 L / mol, which is an association for almost irreversible once the antigen-antibody pair is formed. For certain molecules of analyte such as glucose â â protein affinity ligands that bind their ligand exist with a high specificity as an antibody, but with a much smaller order of 10 ^ 2 binding constant at 10 ^ 4 L / mol. The association between analyte and receptor is then reversible nature and beside the torque between the two also their molecules occurs in a measurable concentration. In the case of glucose, for example, concanavalin A, can function as a receptor affinity which has a time constant of 4x10 bond ^ 2 L / mol. [20] The use of affinity receptor binding for the purposes of biosensing has been proposed by Schultz and Sims in 1979 [21] and was subsequently configured in a fluorescent assay to measure the glucose in the relevant physiological range between 4.4 and 6.1 in mmol / L. [22] the sensor principle has the advantage that it does not consume the analyte in a chemical reaction as it happens in enzyme assays. Nucleic acid interactions Biosensors employing receptors of the nucleic acid base may be either based on complementary base pairing interactions of the bases named genosensors or specific antibodies based nucleic acid mimics (aptamers) as aptasensors. [23] In the first case, the recognition process is based on the principle of complementary bases adenine: thymine and cytosine: guanine in DNA. If it is known the sequence of the target nucleic acid, Complementary can be synthesized, labeled, and then immobilized on the sensor. The hybridization event can be optically detected and the presence of DNA target / RNA ascertained. In the latter, aptameri generated against the la Recognize by interaction of specific non-covalent interactions and induced mounting. These aptamers can be labeled with fluorophore / metal nanoparticles easily for optical detection or can be used for electrochemical detection or label-free cantilever platforms for a wide range of target molecules or complex targets such as cells and viruses. [24] [25] Epigenetic has been proposed that adequately optimized integrated optical resonators can be exploited to detect epigenetic changes (for example methylation DNA, post-translation modifications histone) in biological liquids of cancer patients or other diseases. [26] Photonic biosensors with ultra-sensitivity are today in the research level development to easily identify cancer cells within the patient's urine. [27] Several research projects aim to develop new portable devices that use low-cost, low environmental impact, disposable cartridges that require only use simplicity without further processing, washing, or manipulation from experienced technicians. [28] Organized organelles form separated compartments within the cells and usually perform the independent function. Different types of organelles have various metabolic pathways and contain enzymes to perform its function. Commonly used organels include lysosomes, chloroplasts and mitochondria. The football space-time distribution model is closely related to the omnipresent signaling way. Mitochondria actively participate in the metabolism of calcium ions to control the function and also modulate the related calcium signaling routes. The experiments showed that mitochondria have the ability to respond to high calcium concentrations generated in their proximity by opening calcium channels. [29] In this way, mitochondria can be used to detect calcium concentration in the ground and detection is very sensitive due to high spatial resolution. Another application of mitochondria is used for water pollution detection. Device compound toxicities damage the cell and subcellular structure including mitochondria. Detergents will cause a swelling effect that could be measured by a variation of absorbance. Data Experiment shows The rate of variation is proportional to the concentration of detergent, providing a high level of detection accuracy. [30] Cells The cells are often used in bioreceptors because they are sensitive to the surrounding environment and can respond to all kinds of stimulants. The cells tend to attach to the surface so that they can be easily immobilized. Compared to the organels remain active for a longer period and reproducibility makes them reusable. They are commonly used to detect global parameter as a condition of stress, toxicity and derivatives â €