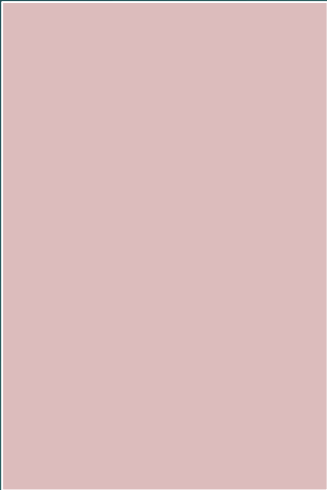




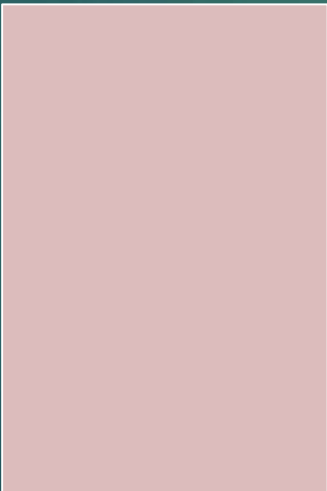
Bioinorganic Chips and Biosensors

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What is a BIOSENSOR ?



A biosensor is a chemical sensing device in which a biologically derived recognition entity is coupled to a transducer, to allow the quantitative development of some complex biochemical parameter



Or A biosensor is an analytical device incorporating a deliberate and intimate combination of a specific biological element (that creates a recognition event) and a physical element (that transduces the recognition event).



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Nanostructured transition metal chalcogenide embedded on reduced graphene oxide based highly efficient biosensor for cardiovascular disease detection



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ABSTRACT

Herein, we report nanostructured metal chalcogenide (molybdenum tetraselenide, nMo_3Se_4) embedded on reduced graphene oxide (rGO) based electrochemical immunosensor for cardiovascular disease biomarker [cardiac troponin I (cTnI)] detection. The nanostructured molybdenum tetraselenide-reduced graphene oxide (nMo_3Se_4 -rGO) was synthesized via low temperature hydrothermal method and further functionalization was carried out using 3-aminopropyltriethoxy silane (APTES). Deposition of functionalized nanostructured material (APTES/ nMo_3Se_4 -rGO) was conducted onto hydrolysed indium tin oxide (ITO) coated glass platform by using electrophoretic deposition (EPD) technique at a DC potential of 15 V for 60 s. The APTES/ nMo_3Se_4 -rGO/ITO platform was then immobilized with monoclonal anti-cardiac troponin I (anti-cTnI) via EDC-NHS chemistry and bovine serum albumin (BSA) was employed for blocking of non-specific sites. The morphological and functional characterization of synthesized materials and fabricated electrodes were characterized by X-ray diffraction, Scanning electron microscopy, Transmission electron microscopy, Fourier transmission infrared spectroscopy and Atomic force microscopy. The electrochemical characterization and biosensing performance of the fabricated bioelectrodes was investigated by cyclic voltammetry studies. The fabricated biosensing (BSA/anti-cTnI/APTES/ nMo_3Se_4 -rGO/ITO) platform shows wider linear detection range [1 fg mL^{-1} – 100 ng mL^{-1}] with higher sensitivity [$36.2 \mu\text{A log (mL ng}^{-1}) \text{ cm}^{-2}$] and remarkable lower detection limit [1 fg mL^{-1}]. We believe that our fabricated biosensor has potential for the detection of cTnI biomarker and towards the better understanding of cardiovascular disease.

A review on electrochemical detection of serotonin based on surface modified electrodes

Shikha Sharma ^a, Nidhi Singh ^a, Vartika Tomar ^a, Ramesh Chandra ^{a, b}  

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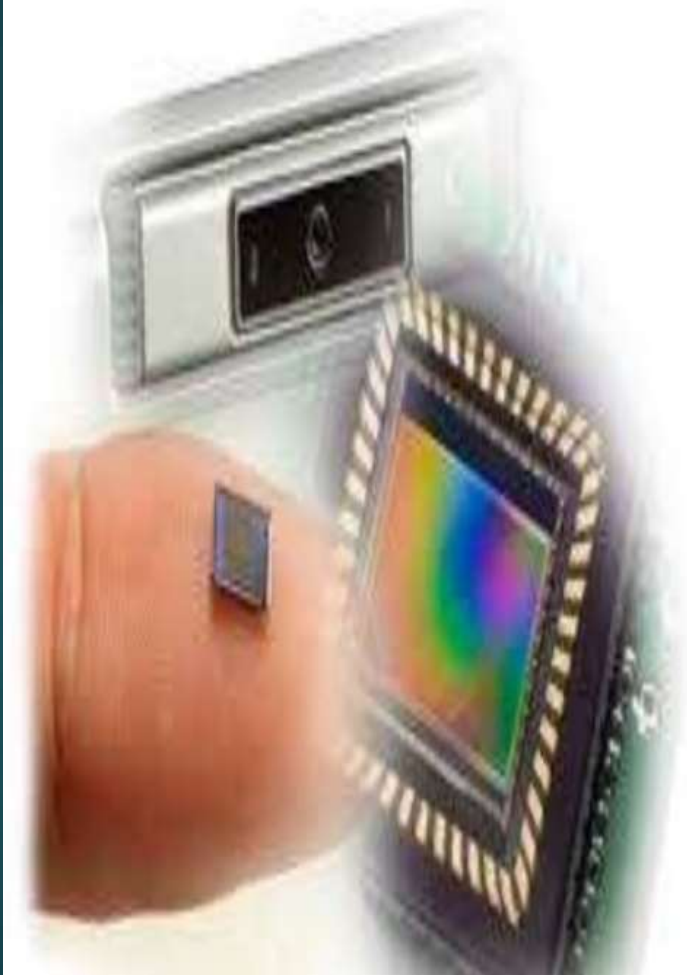
Highlights

- This review is focused on electrochemical detection of ST using surface modified electrodes.
- SME based on conducting polymers and polyelectrolytes, nanomaterials, and other conducting materials are presented.
- Analytical figures of merits of various research approaches are compared.
- Chemical interactions at the interfaces and electrocatalytic effects of modified surfaces are also discussed.

Abstract

Serotonin is one of the important neurotransmitters of our body. It's abnormal concentration is associated with multiple disorders and diseases. Sensitive and precise electrochemical determination of serotonin is not possible with bare working electrodes due to various reasons viz. electro-chemical fouling, presence of other biological molecules having similar oxidation potential, and lower concentration of serotonin in biological samples. Surface modification of working electrode is required for fast, precise, selective, and sensitive detection of serotonin. We have extensively reviewed the research approaches where serotonin has been sensitively detected using surface modified electrodes in the presence of other interfering agents. This review aims at presenting the electrochemical detection of serotonin using various surface modified electrodes such as glassy carbon, graphite, carbon fiber, diamond, screen printed, ITO, and metal electrodes modified with conducting polymers and polyelectrolytes, carbon nanomaterials, metal or metal oxide nanoparticles, biological compounds, and other conducting materials. The analytical figures of merits of various research approaches for detection of serotonin have been compared in the article. The properties of material used for surface modification, chemical interactions at the interfaces, and electrocatalytic effects of modified surfaces on sensing of serotonin have been thoroughly discussed in this review.

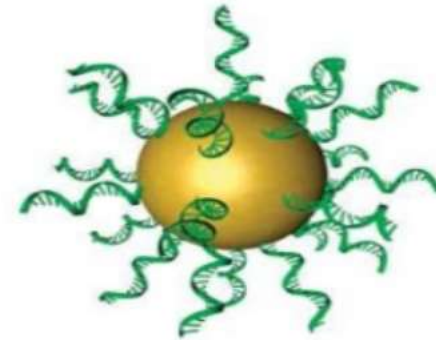
WHAT IS SENSOR...??



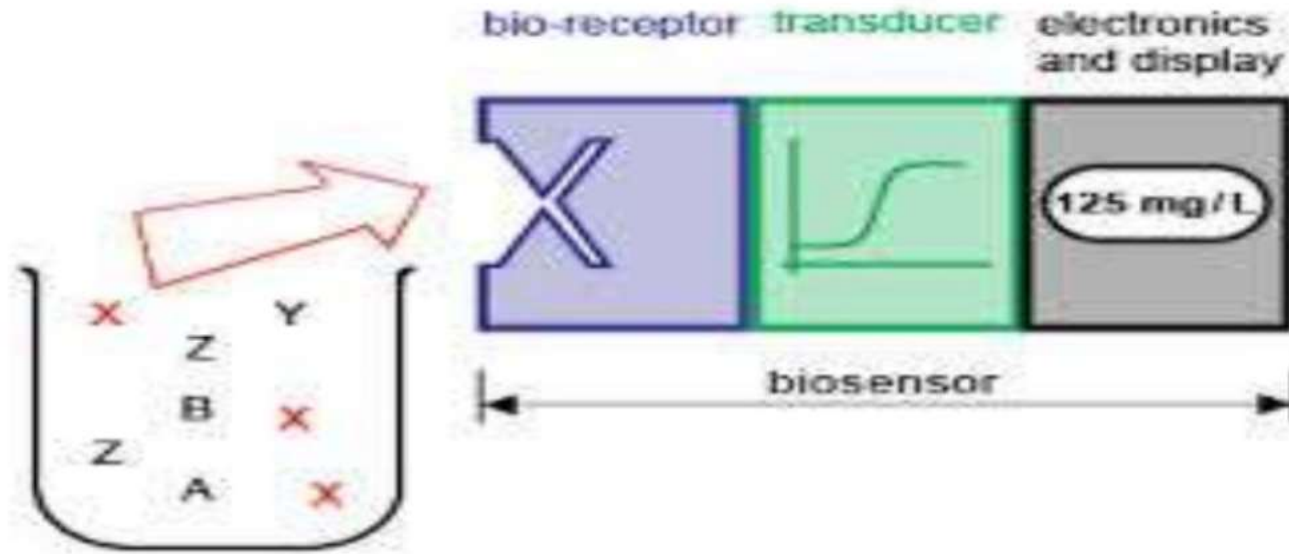
A **sensor** is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument.

WHAT IS NANO - SENSOR...??

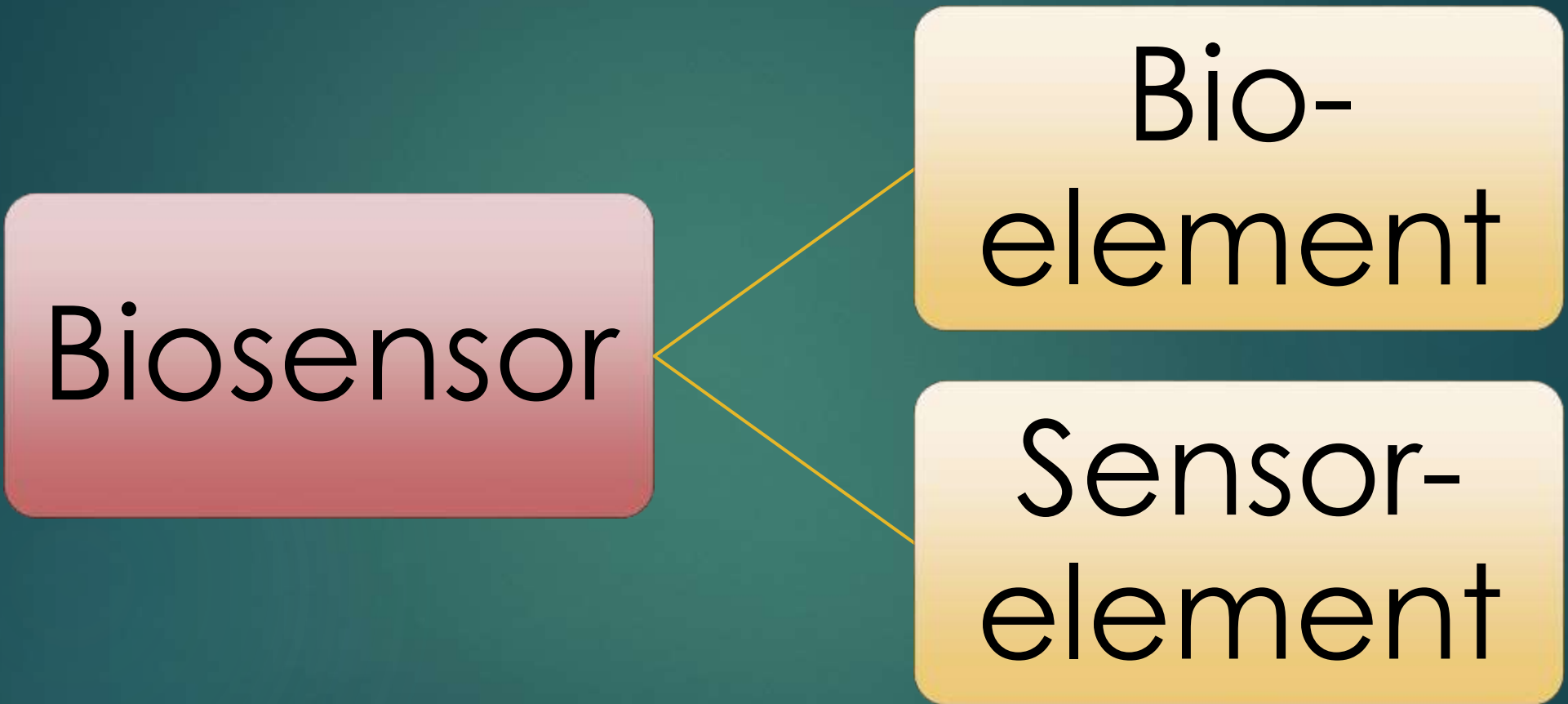
- **Nanosensors** are any biological, chemical, or surgical sensory points used to convey information about nanoparticles to the macroscopic world.
- ✓ medicinal purposes
 - ✓ nanoproducts, such as computer chips that work at the nanoscale and nanorobots.



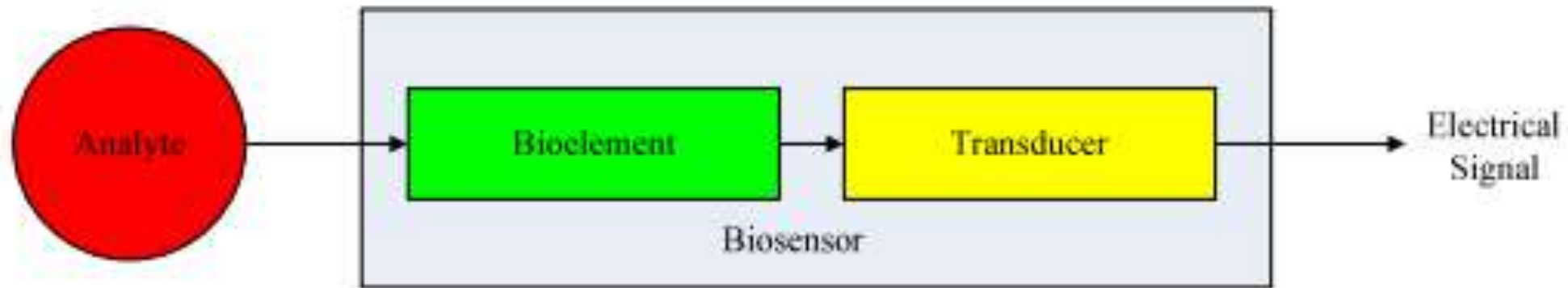
WHAT IS BIO - SENSOR...??



A **biosensor** is an analytical device, used for the detection of an analyte, that combines a biological component with a physicochemical detector.

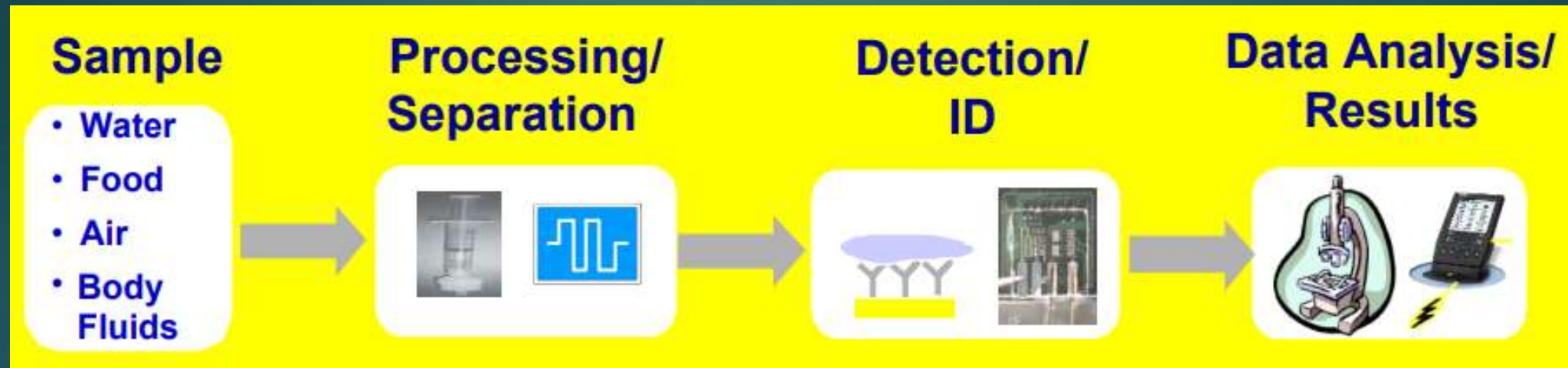


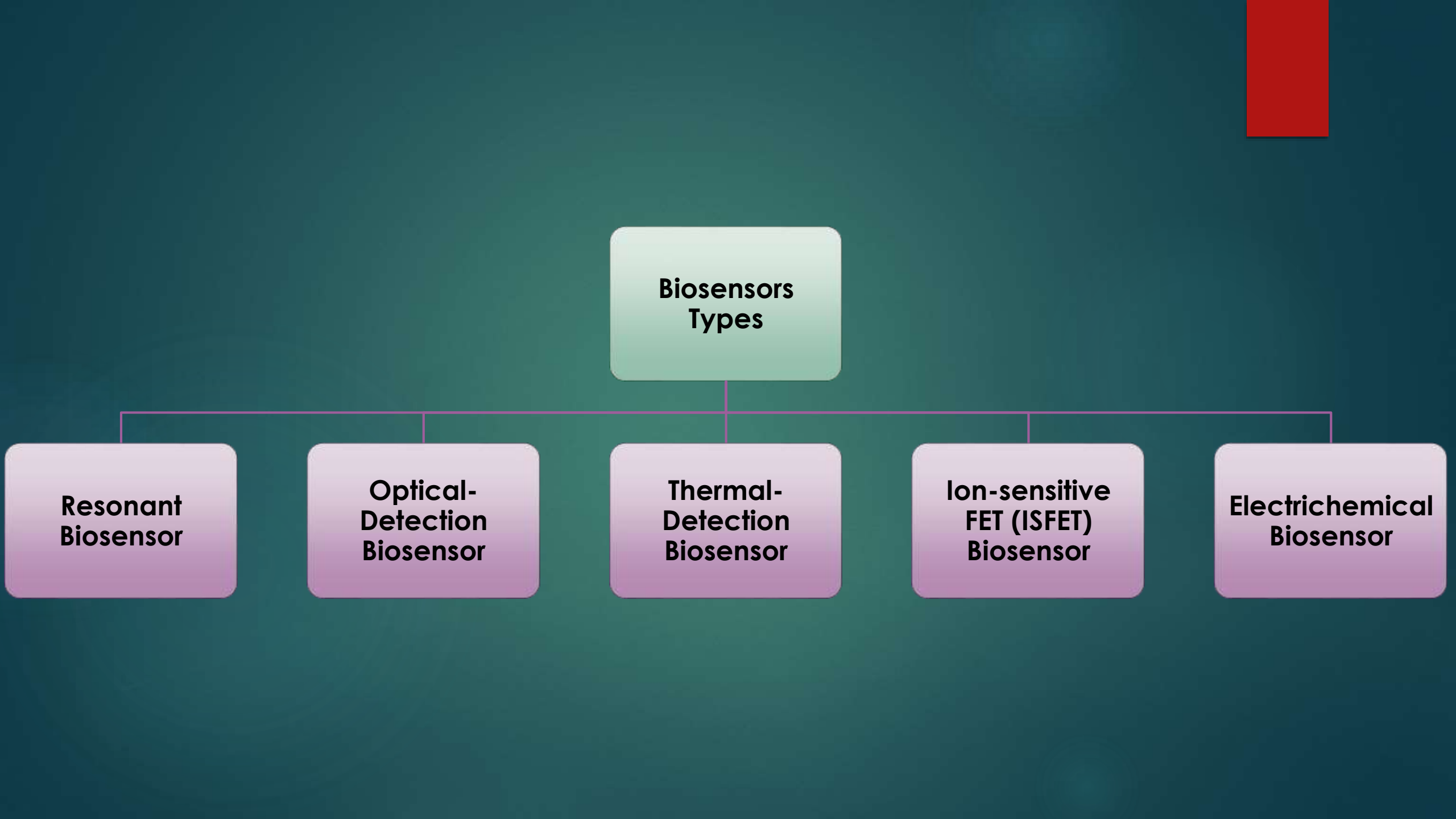
A specific “bio” element (say, enzyme) recognizes a specific analyte and the “sensor” element transduces the change in the biomolecule into an electrical signal. The bio element is very specific to the analyte to which it is sensitive. It does not recognize other analytes.



A Schematic Representation of Biosensors

Overview of Biosensor System





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graph TD; A[Biosensors Types] --> B[Resonant Biosensor]; A --> C[Optical-Detection Biosensor]; A --> D[Thermal-Detection Biosensor]; A --> E[Ion-sensitive FET (ISFET) Biosensor]; A --> F[Electrichemical Biosensor];
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Biosensors Types

**Resonant
Biosensor**

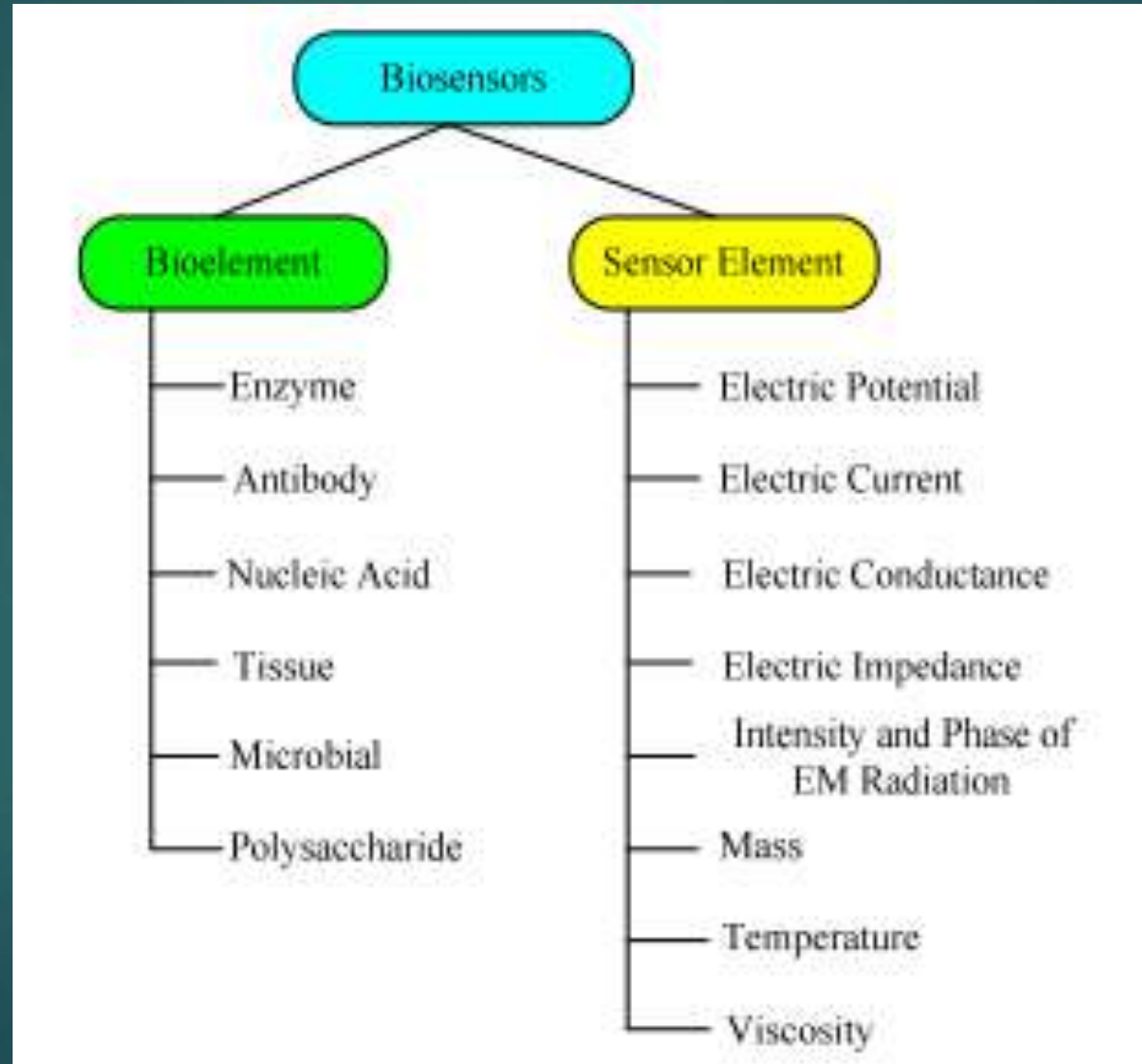
**Optical-
Detection
Biosensor**

**Thermal-
Detection
Biosensor**

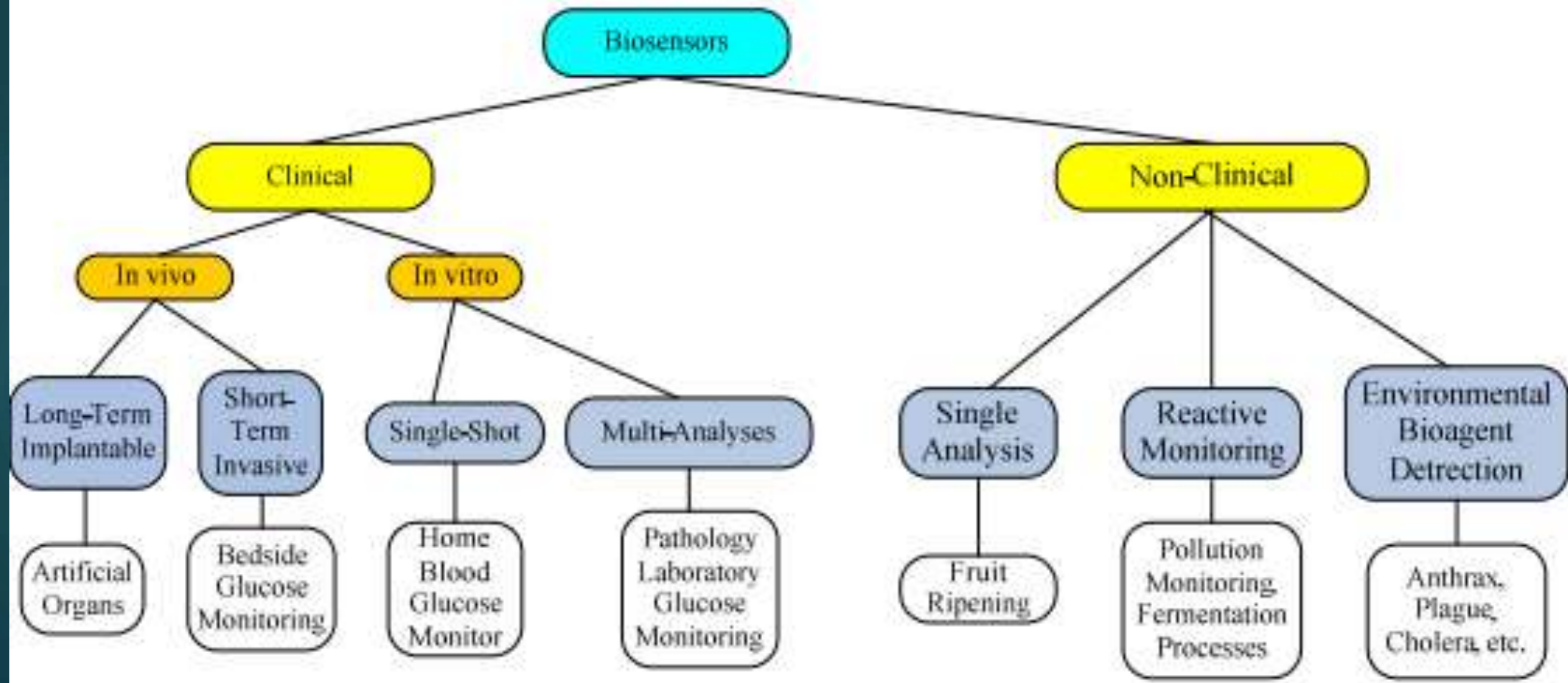
**Ion-sensitive
FET (ISFET)
Biosensor**

**Electrichemical
Biosensor**

Elements of Biosensors



Potential Applications of Biosensors



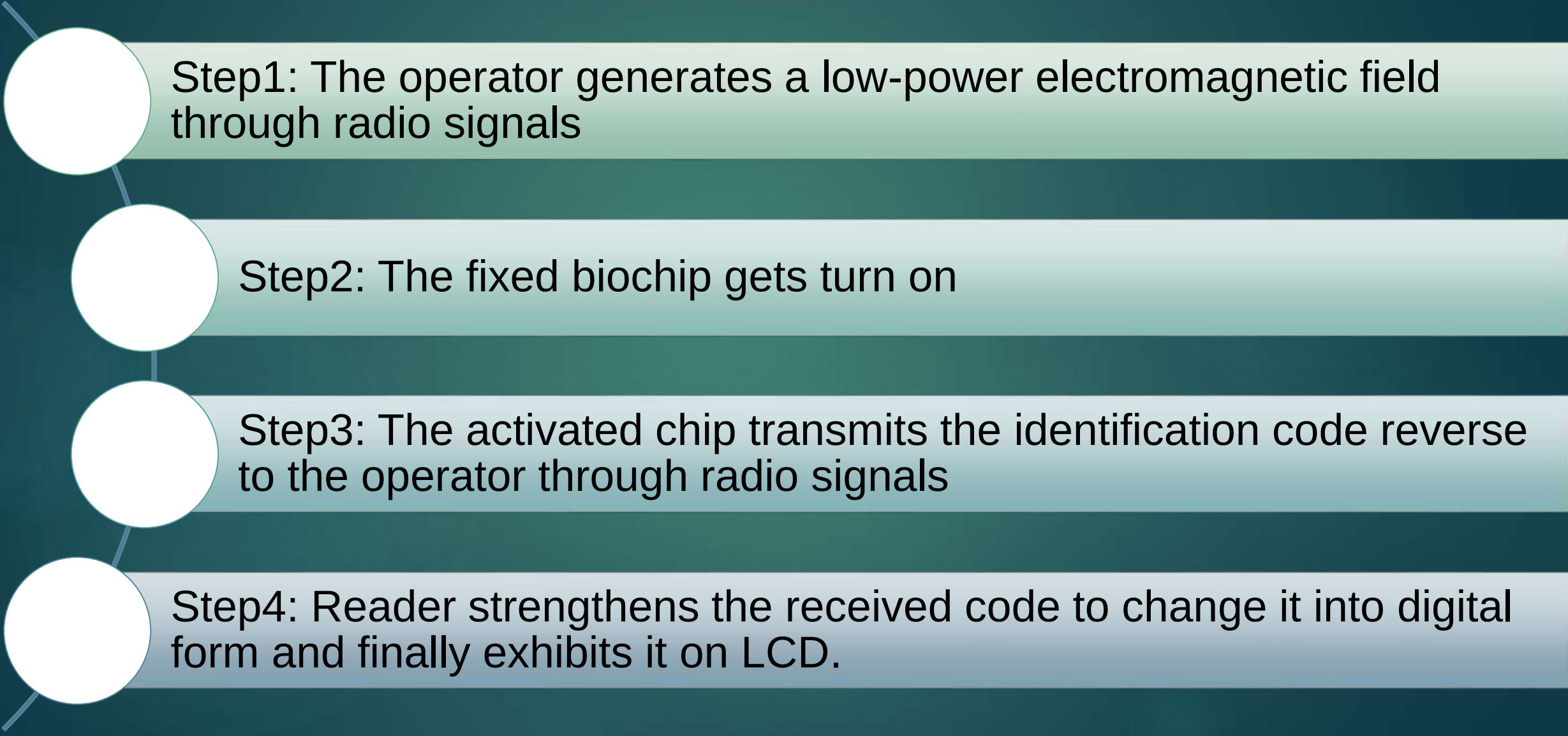
What is a BIOCHIP?

- Biochips can be defined as ‘microelectronic-inspired devices that are used for delivery, processing, analysis, or detection of biological molecules and species’



These devices are used to detect cells, microorganisms, viruses, proteins, DNA and related nucleic acids, and small molecules of biochemical importance and interest.

Working Principal of BIOCHIP



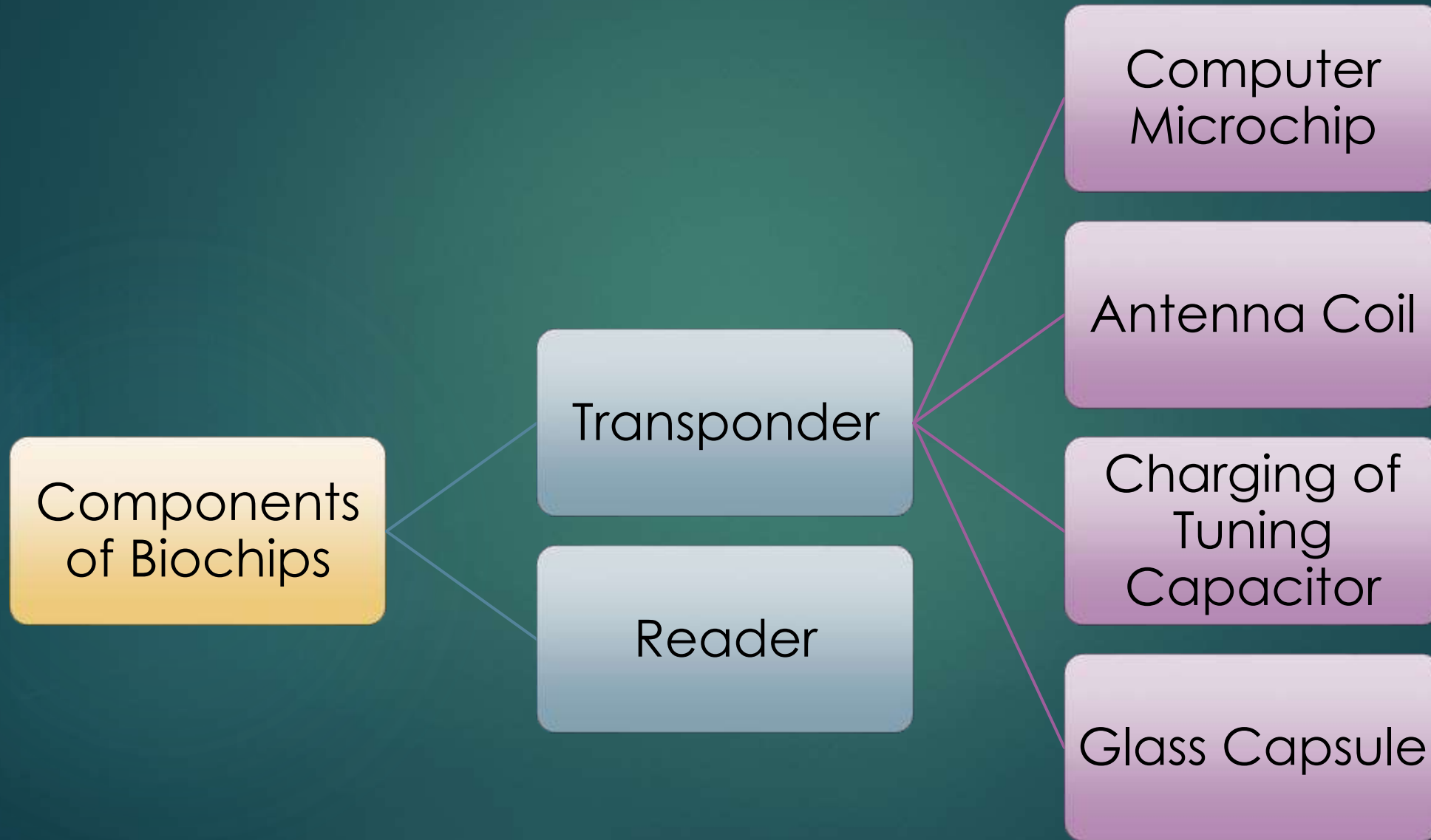
Step1: The operator generates a low-power electromagnetic field through radio signals

Step2: The fixed biochip gets turn on

Step3: The activated chip transmits the identification code reverse to the operator through radio signals

Step4: Reader strengthens the received code to change it into digital form and finally exhibits it on LCD.

Components of BIOCHIP



Transponder

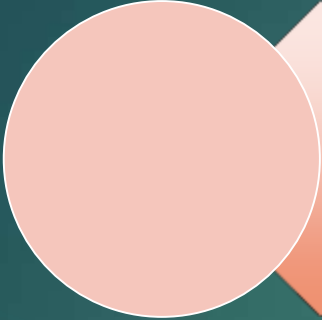
Transponders are two types' namely active transponder and passive transponder. This is a passive transponder which means that it doesn't contain any of its own energy or battery whereas in passive, it is not active until the operator activates it by giving it a low electrical charge. This transponder consists of four parts such as antenna coil, computer microchip, glass capsule, and a tuning capacitor.

- The computer microchip stores a unique identification (UID) number that ranges from 10 digits to 15 digits long.
- The antenna coil is very small, primitive and this type of antenna is used to send and receive the signals from the scanner or reader.
- The charging of the tuning capacitor can be done with the small signal i.e., 1/1000 of a watt which is sent by the operator.
- The glass capsule holds the antenna coil, capacitor, and microchip, and it is made with a biocompatible material namely soda lime glass

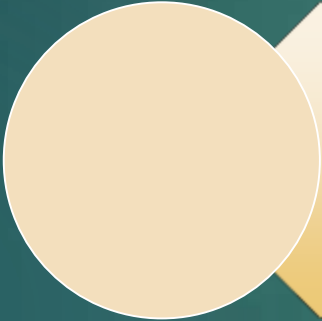
Reader

The reader comprises of a coil namely “exciter” and it forms an electromagnetic field through radio signals. It offers the required energy ($<1/1000$ of a watt) to activate the biochip. The reader carries a receiving coil for receiving the ID number or transmitted code sent back from the excited implanted biochip.

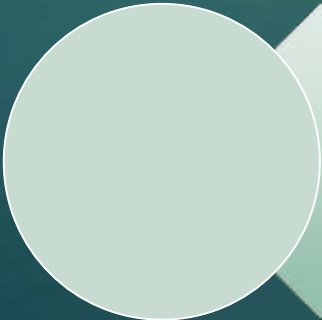
Types of BIOCHIP



DNA microarray



Microfluidic chip



Protein microarray

DNA Microarray

A DNA microarray or DNA biochip is a set of tiny DNA spots fixed to a strong surface. A researcher utilizes to calculate the expression levels for a large number of genes. Every DNA mark comprises picomoles of particular genes which are termed as probes. These can be a short segment of a genetic material under high rigidity situations. Usually, probe-target hybridization is noticed and counted by recognition of fluorophore or chemiluminescence labeled targets to decide the relative quantity of nucleic acid series in the target. Innovative arrays of nucleic acid were macro arrays about 9 cm X 12 cm and the initially automated icon based analysis was published in the year 1981.

Microfluidic Chip

Microfluidic biochips or lab-on-a-chip are a choice to usual biochemical laboratories and are transforming several applications like DNA analysis, molecular biology procedures, proteomics which is known as the study of proteins and diagnostic of diseases (clinical pathology). These chips are becoming more complex by using 1000's of components, but those components are designed physically called as bottom-up full-custom plan, which is a very large workforce.

Protein Microarray

A protein microarray or protein chip method is used to follow the actions as well as connections of proteins, and to find out their function on a large scale. The main advantage of protein microarray is that we can track a large number of proteins in parallel. This protein chip comprises of a surface for supporting like microtitre plate or bead, nitrocellulose membrane, the glass slide. These are automated, rapid, economical, very sensitive, consumes less quantity of samples. The first methodology of protein chips was introduced in antibody microarrays of scientific publication in the year 1983. The technology behind this chip was quite easy to develop for DNA microarrays, which have turned into the most generally used microarrays.

Advantages of BIOCHIP

- The biochip is used to rescue the sick

Very small in size, powerful and faster.

Biochips are useful in finding the lost people

Biochips can be used to identify the persons individually

Biochips perform thousands of biological reactions in a few seconds.

Disadvantages of BIOCHIP

- Biochips are expensive
- Biochip raises dangerous problems of individual privacy.
- Biochip marks the end of human being liberty and self-respect.
- There will be a chance of turning every person into a controlled person
- Biochips can be fixed into the human's body without their interference.

Applications of BIOCHIP



- By using this chip we can trace a person or animal anywhere in the world

This chip is used to store and update the information of a person like medical financial and demographics

A biochip leads to safe E-commerce systems

These chips are effective in restoring the records of medical, cash, passport, etc

The biochip can be applicable in the medical field as a BP sensor, glucose detector, and oxygen sensor.