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Nanobiosensors

LECTURE NO: 15



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15.1 Nanobiosensors

- Nanobiosensor is a modified version of a biosensor which may be defined as a compact analytical device/ unit incorporating a biological or biologically derived sensitized element linked to a physico-chemical transducer
- Nanosensors with immobilized bioreceptor probes that are selective for target analyte molecules are called nanobiosensors.



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15.2 Characteristics of ideal biosensor:

- Highly specific for the purpose of the analyses i.e. a sensor must be able to distinguish between analyte and any ‘other’ material.
- Stable under normal storage conditions.
- Specific interaction between analytes should be independent of any physical parameters such as stirring, pH and temperature.
- Reaction time should be minimal.



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15.3 Constituents of Nanobiosensors:

- A typical nanobiosensor comprises of 3 components; biologically sensitized elements (probe), transducer and detector
- The biologically sensitized elements (probe) including receptors, enzymes, antibodies, nucleic acids, molecular imprints, lectins, tissue, microorganisms, organelles etc., which are either a biologically derived material or bio-mimic component that receives signals from the analytes (sample) of interest and transmits it to transducer. And such nano-receptor may play a vital role in the development of future nanobiosensors.



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- The transducer acts as an interface, measuring the physical change that occurs with the reaction at the bioreceptor/sensitive biological element then transforming that energy into measurable electrical output.
- The detector element traps the signals from the transducer, which are then passed to a microprocessor where they are amplified and analyzed; the data is then transferred to user friendly output and displayed/stored.



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15.5 Types of Nanobiosensors:

- **Mechanical Nanobiosensors:** Nanoscale mechanical forces between biomolecules provide an exciting ground to measure the biomolecular interaction. This helps in the development of minute, sensitive and label free biosensors
- **Optical Nanobiosensors:** Optical biosensors are based on the arrangement of optics where beam of light is circulated in a closed path and the change is recorded in resonant frequency when the analyte binds to the resonator.



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- **Nanowire Biosensors:** Nanowire biosensor is a hybrid of two molecules that are extremely sensitive to outside signals.
- **Ion Channel Switch Biosensor Technologies:** The Ion Channel Switch (ICS) is based on a synthetic self-assembling membrane that acts as a biological switch for detecting the signals i.e. the presence of specific molecules by triggering an electrical current.



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- **Electronic Nanobiosensors:** Electronic nanobiosensors work by electronically detecting the binding of a target DNA that actually forms a bridge between two electrically separated wires on a microchip
- **Viral nanobiosensors:** Virus particles are essentially biological nanoparticles. Herpes simplex virus (HSV) and adenovirus have been used to trigger the assembly of magnetic nanobeads as a nanosensor for clinically relevant viruses.



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- **Nanoshell Biosensors:** Positioning gold nanoshells are used in a rapid immunoassay for detecting analytes within complex biological media without any sample preparation
- **PEBBLE Nanobiosensors:** Probes Encapsulated by Biologically Localized Embedding (PEBBLE) nanobiosensors consist of sensor molecules entrapped in a chemically inert matrix by a microemulsion polymerization process that produces spherical sensors in the size range of 20 to 200 nm.



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15.9 Role of Biosensors in Agriculture:

- Presently, nanomaterial-based biosensors exhibit fascinating prospects over traditional biosensors. Nanobiosensors have marked advantages such as enhanced detection sensitivity/ specificity and possess great potential for its applications in different fields including environmental and bioprocess control, quality control of food, agriculture, bio defence, and, particularly, medical applications. But here we are concerned with the role of nano biosensor in agriculture and agro-products.



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- Some of the potential applications of nanobiosensors are listed below:
- As Diagnostic Tool for Soil Quality and Disease Assessment
- As an Agent to Promote Sustainable Agriculture
- As a Device to Detect Contaminants and Other Molecule
- As Tool for Effective Detection of DNA and Protein
- As a Tool for Analysis in Food Products



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