

Chapter 7

Biosensors for Environmental Monitoring in the Smart Agriculture Sector

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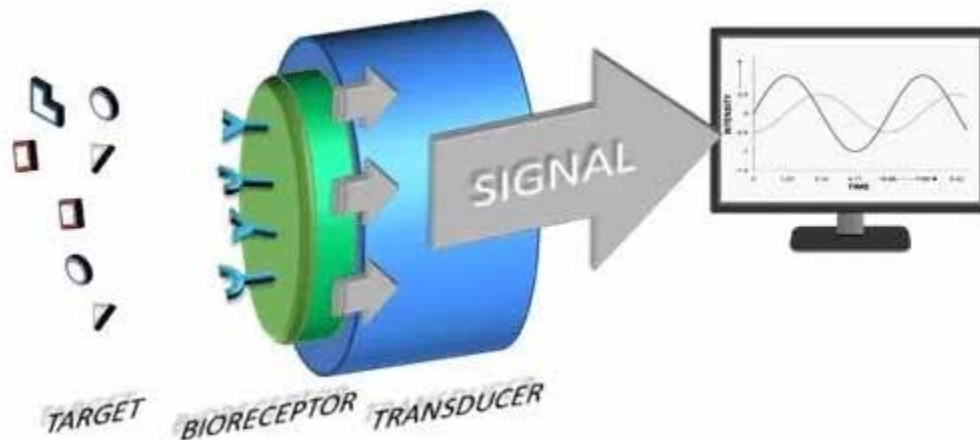
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ABSTRACT

Biosensors are of paramount importance in the field of environmental monitoring owing to their capacity to identify and measure distinct biological or chemical entities. Environmental monitoring instruments are crucial tools utilized for the evaluation and control of air, water, and soil conditions. These instruments find wide-ranging applications in the assessment of water quality, air quality, and soil quality in the smart agriculture sector. The field of biosensor technology has witnessed significant progress in recent years, particularly in the areas of miniaturization, mobility, and integration with nanomaterials. The chapter additionally emphasizes the significance of biosensors in influencing environmental laws and regulations, as evidenced by case studies that underscore the necessity of collaborative efforts among governmental bodies, industry, and academic institutions. In general, biosensors exhibit considerable promise in contributing to the advancement of a sustainable and improved environment, owing to their capacity for enhanced integration with state-of-the-art technology.

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Figure 1. Biosensor structure and transducing mechanism



1. INTRODUCTION

1.1 Definition and Significance of Biosensors

Biosensors integrate biological and physicochemical detectors. The bioreceptor identifies and binds to the target analyte, the chemical being measured. The transducer, or physicochemical detector, turns the binding event into an electrical, optical, or mechanical signal.

1.2 Significance of Biosensors

Biosensors have significantly transformed multiple domains, encompassing healthcare, environmental monitoring, and food safety. Their importance arises from their distinct benefits:

- **High Specificity:** Biosensors can discern and quantify analytes within intricate combinations, hence reducing the impact of interference from other chemicals.
- **Sensitivity:** Biosensors possess the ability to identify analytes at exceedingly low levels, rendering them indispensable for the early identification of diseases and the monitoring of the environment.
- **Rapid Response:** Biosensors offer instantaneous or nearly instantaneous outcomes, facilitating quick decision-making and intervention.
- **Portability:** Biosensors have the capability to be scaled down in size and incorporated into portable devices, which enables convenient testing at the point of care and distant monitoring.

Biosensors are advanced analytical instruments that integrate biological components with transducers to identify and measure precise biochemical compounds. These devices are essential in multiple domains, such as healthcare, environmental monitoring, and food safety. A biosensor typically comprises a biological recognition element, such as enzymes, antibodies, or nucleic acids, that selectively interacts

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