From Enzymes to Aptamers: The Power of Immobilized Biomaterials in Next-Gen Biosensors

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Electrochemical biosensors incorporating biocomponents such as enzymes, aptamers, antibodies, and nucleic acids have emerged as highly effective analytical tools due to their specificity, sensitivity, and versatility. A fundamental aspect that influences the performance and commercial feasibility of these biosensors is the immobilization of the biocomponent onto the sensor surface. Immobilization techniques offer a stable interface between the biological recognition element and the transducer, enabling enhanced signal transduction, reproducibility, and long-term stability.

The use of immobilized biocomponents not only preserves their biological activity but also improves their resistance to environmental fluctuations, making biosensors more suitable for real-world applications. This is especially important in sensing mechanisms that involve inhibition or modulation of biomolecular activity, such as drug screening, toxin detection, or clinical diagnostics. By strategically immobilizing enzymes or aptamers, biosensors can be tailored to selectively detect inhibitors or target molecules with high precision and low detection limits [1].

A prominent example is the electrochemical biosensing of tyrosinase activity, where the immobilized enzyme (or its mimetic aptamer-based counterparts) is used to monitor drug-induced inhibition. These platforms have been optimized for enhanced analytical performance and are increasingly used in pharmaceutical research, cosmetic testing, and environmental safety monitoring.

Overall, the immobilization of biomaterials plays a central role in advancing biosensor technology by ensuring that biorecognition elements function reliably and efficiently under various conditions. As the field moves toward multi-analyte and wearable platforms, robust immobilization strategies will be essential in realizing the next generation of high-performance, bio-inspired sensing systems [2].

References

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