The Role of Paper-Based and Electrochemical Biosensors in Multiplexed Diagnostics

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Multiplexed testing systems are revolutionizing modern diagnostics by providing significant advancements in detection speed, sensitivity, and specificity. This presentation explores the forefront of these innovations, focusing on the development and application of paper-based and electrochemical biosensors. Paper-based diagnostic systems are increasingly recognized for their affordability and ease of deployment in point-of-care settings, especially in resource-constrained environments. [1, 4] These platforms utilize microfluidic technologies to simultaneously detect multiple analytes, thereby enhancing their utility in diverse diagnostic scenarios. [2] Additionally, the simplicity of their design allows for easy integration with various detection methods, including colorimetric and fluorescence-based assays, making them highly versatile tools in diagnostics. Electrochemical biosensors, on the other hand, offer exceptional sensitivity and the capability for real-time monitoring. By integrating advanced materials such as carbon-based nanostructures and metal-organic frameworks, these sensors have achieved remarkable specificity in detecting low-abundance biomarkers, enabling the simultaneous detection of multiple analytes, which is crucial for comprehensive disease diagnostics and monitoring. [3, 5] Moreover, their adaptation into multiplexed detection platforms expands their application in both clinical diagnostics and environmental monitoring, offering unparalleled precision and reliability. This lecture will provide a detailed evaluation of the current state and future directions of multiplexed testing systems, and the challenges faced in integrating these technologies, particularly highlighting how the convergence of paper-based and electrochemical biosensors is setting new standards in diagnostic accuracy and efficiency.

References

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