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Advancements in Electrochemical Biosensors for Cancer Biomarker Detection

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Introduction

Cancer is the most common life-threatening disease, with the highest mortality rate worldwide. Cancer diagnosis at an early stage is critical for effective and successful treatment. Traditional cancer screening diagnostic methods are expensive, time-consuming, and impractical for repeated screenings. However, biomarker-based cancer diagnosis is emerging as one of the most promising strategies for early diagnosis, disease progression monitoring, and subsequent cancer treatment. This review discusses recent advances and improvements in electrochemical biosensors designed for detecting various cancer biomarkers using various signal transduction techniques and biological recognition strategies.

Cancer is one of the leading causes of premature death worldwide, accounting for 18.1 million reported cases and 9.6 million deaths in 2018. Cancer incidence and mortality are unexpectedly increasing in developing countries. Cancer is a group of diseases in which body cells begin to grow unexpectedly and cause genetic cellular changes in solid masses of tissue and, in some cases, non-solids of the blood path. Tumors are classified into two types: benign and malignant. Malignant types are the most dangerous, and once they begin to develop, they begin to divide and spread to other organs via the blood and lymphatic systems by alternating normal cells, causing the majority of cancer deaths. As a result, early detection of cancer is critical to ensuring its diagnosis before it becomes incurable [1].

Description

Furthermore, biomarkers that represent characteristics of four different lung cancers, namely AFP, CEA, CA125, and CA15-3, have been found in the blood or urine of affected patients. SOX2 (sex-determining region Y-box 2) is another potential CB that can be used for early detection of cancers such as prostate cancer, lung cancer, skin cancer, and breast cancer. As a result, there may be many more CB to be analysed, which has encouraged researchers worldwide to focus on the development of non-invasive techniques for cancer diagnosis [2].

The transducer converts biological signals generated by the interaction of the target biomarker and biorecognition molecules into measurable electrical or optical signals. Represents recently reported biosensing approaches for cancer biomarker detection. Cancer biosensors are classified into three types based on the type of transducer used or the nature of the biological response, as shown in the diagram. The designs of biosensors differ depending on the type of cancer biomarker. To detect nucleic acid, receptor, and secretary protein biomarkers, for example, biorecognition molecules such as complementary nucleic acid probes, specific ligands, and specific antibodies are used [3-5].

Conclusion

There is a high demand for efficient biosensors for rapid analysis of cellular alterations to detect related biomarkers in order to ultimately improve cancer prognosis and treatment strategies. This review discusses various types of recently reported electrochemical biosensors, as well as their operating principles and designs for detecting cancer biomarkers. However, new approaches such as nanofabrication and clinical applications are required for the development of low-cost lab-on-chips and next-generation novel biosensors. Surprisingly, electrochemical biosensors are the most commonly reported sensing method for cancer biomarker detection. Nanostructured materials and nanocomposites are crucial in the fabrication and design of various electrochemical biosensors and will be used more in future research.

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Conflict of Interest

There are no conflicts of interest by author.

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