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Review

Recent Advances of Guided Mode Resonant Sensors Applied to Cancer Biomarker Detection

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Abstract: Guided mode resonance (GMR)-based sensors have emerged as a promising technology for the early screening of cancer, offering advantages such as sensitivity, specificity, low cost, non-invasiveness, and portability. This review article provides a comprehensive overview of the latest advancements in GMR technology and its applications in biosensing, with a specific focus on cancer. The current state of cancer diagnosis and the critical need for point-of-care (POC) devices to address these challenges are discussed in detail. Furthermore, the review systematically explores various strategies employed in GMR-based cancer detection including design principles and the integration of advanced technologies. Additionally, it aims to provide researchers valuable insights for developing GMR sensors capable of detecting cancer biomarkers outside the laboratory environment.

Keywords: biosensor; guided mode resonance; cancer; biomarker; point of care

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1. Introduction

According to the World Health Organization (W.H.O.), cancer remains the leading cause of death globally. In 2022, an estimated 20 million new cancer cases were reported, resulting in 9.7 million deaths [1]. The most common cancers are lung, breast, colorectal, and prostate cancers [2]. Cancer research is significant since it contributes directly or indirectly to the well-being of individuals through early detection, better treatments, and enhanced quality of life. However, access to cancer care in low-income areas is challenging due to the need for specialized facilities. Developing POC solutions for the rapid screening and detection of cancer biomarkers can address this issue and facilitate early diagnosis [3]. For example, in the case of lung cancer, traditional imaging methods such as X-rays and CT scans are often inadequate for early detection due to their inherent limitations, such as low sensitivity, false positives or negatives, radiation exposure, and high cost. As an alternative, analyzing breath for volatile organic compounds (VOCs) related to lung cancer can reveal the body's biochemical status and offer early indications of the disease [4,5]. Therefore, cancer detection is a significant research field that encompasses various approaches including screening methods and diagnostic tools such as biopsies and imaging techniques [6].

Biosensing is a technique used to detect interactions of living entities with specific biorecognition elements such as antibodies, aptamers, DNA, and RNA [7,8], using sensors or detection systems [9,10]. These interactions generate a measurable signal indicating