Title : New competitive electrochemical aptasensor for the detection of cancer biomarker using 2D WSe_2/MAX phase (Ti_3AlC_2) nanocomposite modified screen printed carbon electrode

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ABSTRACT

Ovarian cancer is one of the most lethal gynecological malignancies, with the majority ofcases diagnosed at an advanced stage, significantly limiting treatment options and reducing survival rates. Therefore, early detection is crucial for improving patient outcomes. CA125 is a well-established tumor marker commonly used for the detection and monitoring of ovarian cancer progression. This study aims to develop a highly sensitive competitive electrochemical aptasensor for the detection of CA125. A 2D WSe_2/MAX phase (75:25 %w/w) nanocomposite was utilized to modify the surface of a screen-printed carbon electrode (SPCE), enhancing the electroactive surface area to improve electron transfer and providing a specific site for protein immobilization. Thymol blue (TMB) was deposited onto the modified SPCE, serving as an internal redox probe. Subsequently, the CA125 antigen was immobilized on the electrode surface, followed by blocking nonspecific binding sites with BSA, to obtain a BSA/CA125/TB/2D WSe_2/MAX phase/SPCE sensing platform. The detection process began with the pre-incubation of a specific CA125 aptamer with the target solution to form an aptamer-antigen complex. Subsequently, the remaining unbound aptamers were introduced onto the sensing platform, enabling the indirect quantification of CA125. Under optimal conditions, the proposed aptasensor exhibited a good linear relationship between the electrochemical response and the logarithmic concentration of CA125 across a wide range (0.10 – 100.0 ng/mL). These findings highlight the potential of the developed aptasensor for accurate and rapid CA125 detection. Furthermore, the selectivity, stability, reproducibility, and real-sample analysis will be further investigated to validate its practical applicability.

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