

Title : Competitive electrochemical aptasensor based on gold nano particle and 2D boron nitride nanocomposite for detection of breast cancer biomarker.

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ABSTRACT

This study presents the development of a competitive aptasensor based on gold nanoparticles (AuNPs) and 2-dimensional boron nitride (BN) nanocomposite-modified screen-printed carbon electrodes (SPCEs) for detecting cancer antigen 15-3 (CA 15-3), a key biomarker for breast cancer. To optimize the sensing platform, various parameters, including concentration and incubation time of CA 15-3, concentration of aptamer specific to CA 15-3, as well as the bio-interaction time, were systematically evaluated. Electrochemical impedance spectroscopy and cyclic voltammetry were used to characterize the modified electrodes in 0.010 M phosphate-buffered saline (pH 7.4) containing 5 mM ferri/ferrocyanide as a redox probe. The SPCE/BN/AuNPs demonstrated an improvement of conductivity, significantly enhancing the sensor's sensitivity. Impedance changes due to specific bio-interactions confirmed successful protein immobilization and the formation of bio-complex layers at the electrode surface. Under optimized conditions, the sensor exhibited a strong linear relationship between the electrochemical response and the logarithmic concentration of CA 15-3 across a wide range (0.10 – 100.0 U/mL). This method offers enhanced sensitivity, rapid analysis, and cost-effectiveness. The selectivity, stability, reproducibility, and real-sample analysis will be further investigated to validate its practical applicability.

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