Development of a DNA-based Electrochemical Biosensor for Rapid Thrombin Detection Using Nanostructured Gold Electrodes

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Early diagnosis of hemostatic disorders, such as thrombosis and hemophilia, relies on the rapid and accurate detection of biomarkers like thrombin. [1] Electrochemical biosensors, capable of converting biomolecular interactions into electrical signals, are powerful tools for detecting biomarkers. Their high sensitivity and specificity enable precise quantification, facilitating early diagnosis of blood coagulation imbalances and effective treatment monitoring. [2,3] In this work, we developed an electrochemical biosensor for the precise quantification of thrombin in biological samples. The sensing platform is based on nanostructured gold electrodes, fabricated using a combination of inkjet printing [4] and click-sintering techniques, [5] resulting in a high surface area and optimized electrochemical properties. This nanostructuration significantly increases the sensor's sensitivity, enabling the detection of ultra-low concentrations. Here, we propose as biorecognition element a thrombin structure-switching aptamer, modified with one extremity with a redox tag, and presenting a portion that is displaced only in the presence of the target. When the target is present, the displaced portion can bind a capture sequence immobilized on the electrode, giving a current signal. This current is directly proportional to the thrombin concentration in the sample. [6] Ongoing research aimed at optimizing experimental conditions will further enhance the biosensor's performance, making it a valuable tool for early disease detection. This analytical platform has the potential to be applied in various fields, such as clinical diagnosis, monitoring of anticoagulant therapies, and biomedical research.

References

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