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Aptamer Pseudoknot-Functionalized Electronic Sensor for Reagentless and Single-Step Detection of Immunoglobulin E in Human Serum

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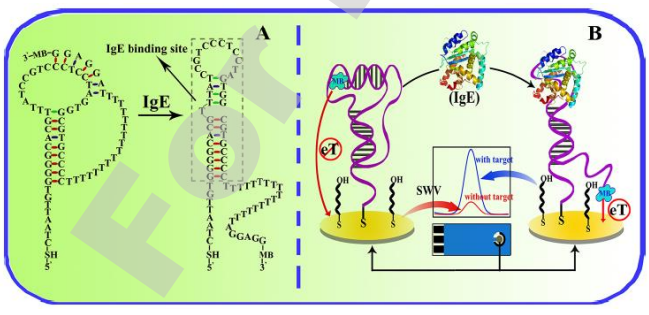
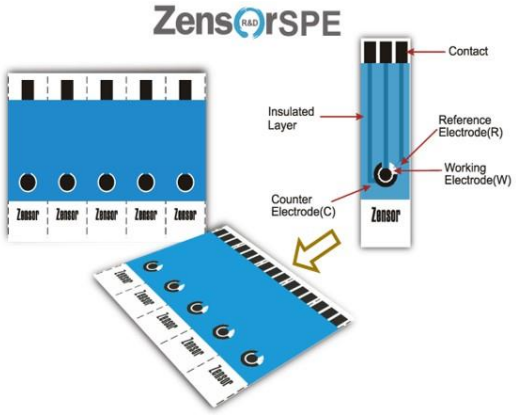
Supporting Information

ABSTRACT: The development of electronic sensors with minimized usage of reagents and washing steps in the sensing protocols will significantly facilitate the detection of biomolecules. In this work, by using a new pseudoknot design of the aptamer probes, the construction of an electronic sensor for reagentless and singlestep detection of immunoglobulin E (IgE) in human serum is described. The pseudoknot aptamer probes are self-assembled on the disposable electrode surface. The association of IgE with the aptamer probes leads to conformational changes of the pseudoknot aptamer structures and brings the redox-tags in close proximity to the electrode, resulting in amplified current response for monitoring IgE. The effects of the pseudoknot structure and the immobilization concentration of the aptamer probes on the sensor performance are evaluated. Under optimal conditions, the detection limit for IgE is estimated to be 60 pM. The sensor is also selective and can be employed to detect IgE in human serum samples. The developed sensor can achieve reagentless, washing-free and low-cost (with the disposable electrode) electrochemical detection of proteins, making this device a convenient sensing platform for the monitoring of different biomarkers when coupled with the appropriate aptamer probes.





Scheme 1. (A) Conformational Change of the Pseudoknot Structure of the SH-IgE-BA Aptamer upon binding to IgE. (B) Illustration of the Reagentless and Single-Step Electronic Detection of IgE on the SPCE Sensor

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Anodic stripping voltammetry of anti-Vi antibody functionalized CdTe quantum dots for the specific monitoring of *Salmonella enterica* serovar Typhi†

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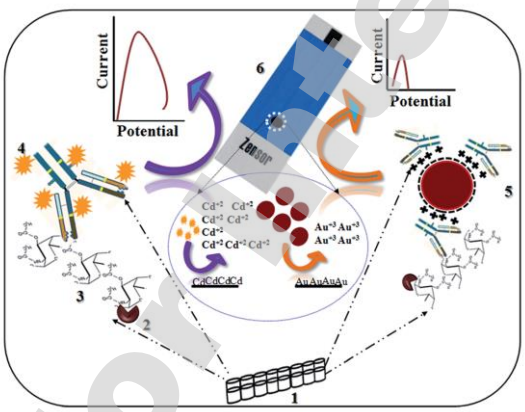
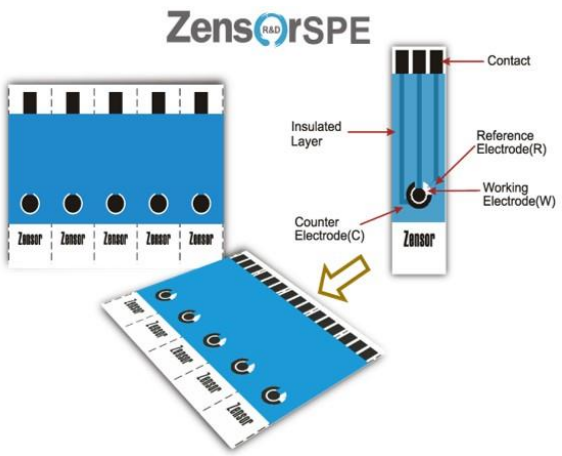
Recent trends in electrochemical immunoassays have paved the way for metal nanoparticles bursting as a very promising technique for sensitive evaluation. In this work, we report the competence of bioconjugated CdTe quantum dot (QD) and gold nanoparticle (GNP) for the detection of Vi capsular polysaccharide antigen of *Salmonella* Typhi. The QD and GNP were bioconjugated with anti-Vi antibody and characterized to quantify the loading of respective nanoparticles. Cadmium chloride and gold chloride reference standards were used for the evaluation of the respective metal atoms in the nanobioprobes. The bursting of QD and GNP released 6.91 nmol of cadmium and 83.21 nmol of gold ions in 1 μL each, whereas, the anti-Vi nanobioprobe bursting resulted in the release of 17.29 nmol of cadmium and ~34.75 nmol of gold atoms per 1 μg of antibody. The results are indicative of conjugation of multiple QDs per antibody molecule in marked contrast to the GNPs which can interact and bind with many antibodies owing to its larger size. CdTe–IgG nanobioprobe was, therefore, made use for developing a new sandwich type stripping voltammetry immunoassay in the presence of polymyxin B, a cationic receptor molecule, as a capture molecule. The stripping response observed was much convincing in the range 1 ng to 625 ng of Vi antigen indicating feasibility and reliability of the QD based stripping assay. The results provided an insight into the governing factors of immunostripping inferring the potency of biofunctionalized semiconductor/inorganic nanodots for electroanalytical applications.





Scheme 1 Schematic presentation of anodic stripping voltammetry (ASV) based electro-immunoassay. The immunoassay was realised in a microtitre plate followed by bursting of the nanoparticles. The bursted solution was analyzed by ASV in a screen printed electrode. (1) Microtiter plate, (2) polymyxin B, (3) Vi capsular polysaccharide, (4) QD–anti-Vi IgG conjugate, (5) GNP–anti-Vi IgG conjugate, (6) Screen Printed Electrode (SPE).

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