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Target-Triggered, Dual Amplification Strategy for Sensitive Electrochemical Detection of a Lymphoma-associated MicroRNA

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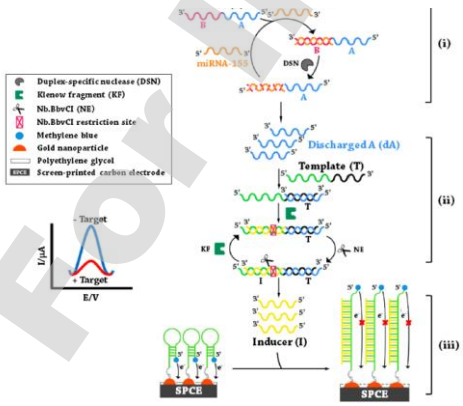
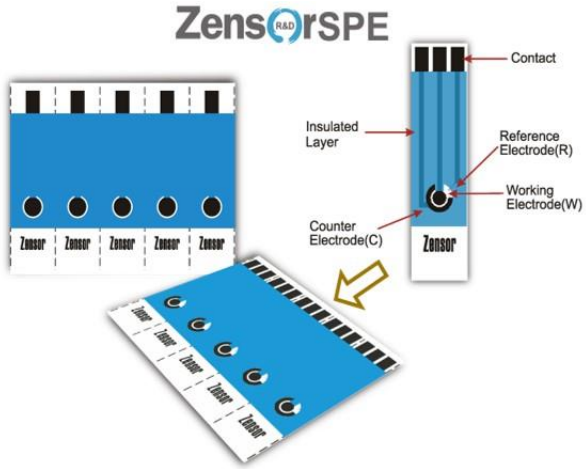
A B S T R A C T

DNA technology, through rational design of sequence, has led to a series of DNA-based nanomachines and logic circuits that have emerged as nano-implements to achieve autonomous and programmable systems. In particular, DNA circuits have proven to be versatile functional units for integration. In this study, we developed a DNA amplification, circuitry-integrated, electrochemical biosensor for the detection of diffuse, large B-cell lymphoma (DLBCL)-associated microRNA, miR-155. The nucleic acid amplification circuitry in the upstream included the incorporation of a nuclease-assisted amplification reaction as a switch to initiate a one-to-many recognition event for the recycling of target miR-155. The subsequent release of a single strand (discharge A, dA) launched a strand displacement reaction as a secondary amplification process for the multiplied production of inducer (I) (a DNA fragment) in the downstream. This was encountered subsequently with a signal processor, a methylene blue-tagged hairpin, sensitized-electrode, which resulted in signal translation from a DNA recognition event to an electrochemical signal readout for the quantification of miR-155 that was present in the sample. This electrochemical biosensor offers an ultrasensitive detection, with a LOD calculated at 3.57 fM. The precision of this biosensor has an acceptable CV (coefficient of variation) value of 14.92%. The recovery of 89.43 ± 8.83% obtained from the analysis of a spiked sample was satisfactory, which demonstrated that this biosensor meets the analytical requirements for clinical samples. The distinctive DNA circuitry, in conjunction with the universal, electrochemical sensing platform, provides a promising application for the detection of miR-155 or other disease-related oligonucleotide; this circuitry can be extended further to clinical diagnosis of liquid biopsy samples for patients with mammalian lymphoma.





Scheme 1. Schematic illustration of a miR-155-triggered, two-step DNA amplification circuitry with a universal, electrochemical signal translator for the detection of DLBCL-associated microRNA.

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Portable amperometric immunosensor for histamine detection using Prussian blue-chitosan-gold nanoparticle nanocomposite films

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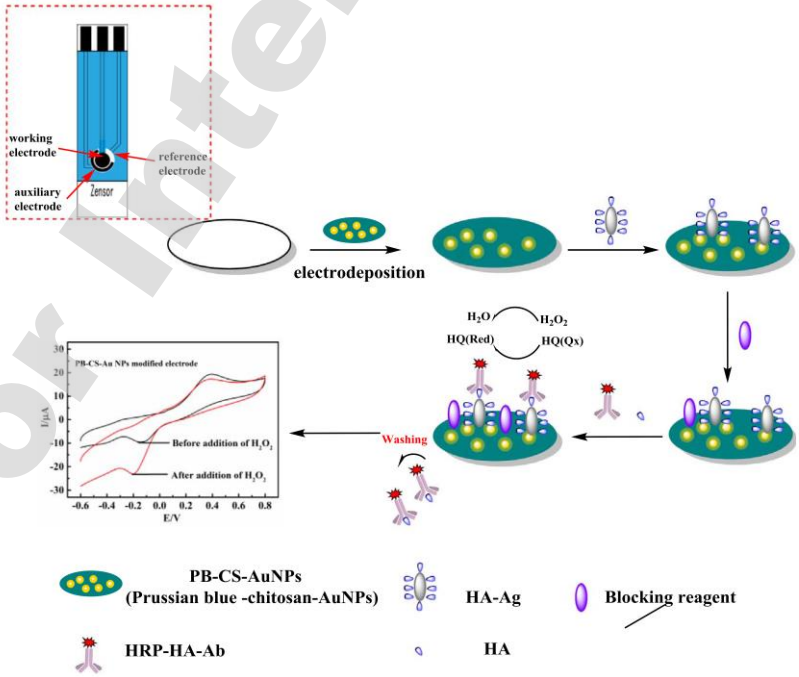
ABSTRACT

Histamine (HA) is a biogenic amine that can accumulate to high concentration levels in food as a result of microbial activity and can cause toxic effects in consumers. In this work, a portable electrochemical immunosensor capable of detecting HA with high sensitivity and selectivity was developed. Prussian blue-chitosan-gold nanoparticle (PB-CS-AuNP) nanocomposite films with excellent biocompatibility were synthesized and characterized by scanning electron microscopy and energy dispersive X-ray analysis. The PB-CS-AuNP were coated onto a screen-printed electrode by one-step electrodeposition and used to conjugate the HA ovalbumin conjugate (HA-Ag). HA was determined by a competition between the coating HA-Ag and the HRP labeled HA antibody (HRP-HA-Ab). After careful optimization of assay conditions and Box-Behnken analysis, the developed immunosensor showed a linear range from 0.01 to 100 μg/mL for HA in fish samples. The average recoveries from spiked samples ranged from 97.25% to 105%. The biosensor also showed good specificity, reproducibility, and stability, indicating its potential application in monitoring HA in a simple and low cost manner.



Scheme 1. Schematic representation of the HA immunosensor with a one-step electrodeposition of PB-CS-AuNP nanocomposite film using HRP-HA-Ab as the label with the aid of the electron mediator (HQ) and H_2O_2.

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Detection of Amphipathic Viral Peptide on Screen-Printed Electrodes by Liposome Rupture Impact Voltammetry

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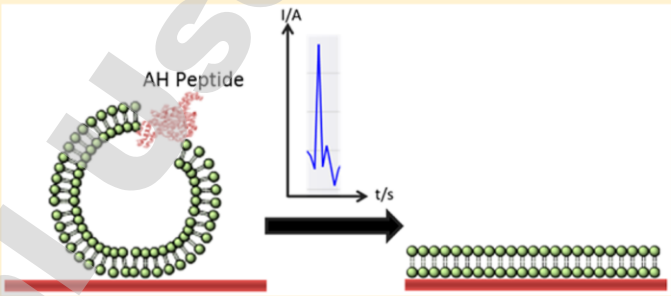
ABSTRACT: Detection of infectious viruses and disease biomarkers is of utmost importance in clinical screening for effective identification and treatment of diseases. We demonstrate here the use of liposome rupture impact voltammetry for the qualitative detection of model amphipathic viral peptide on a screen-printed electrode. This novel, proof-of-concept method was proposed for the quick and reliable detection of viruses by nonfaradaic liposome rupture impact voltammetry with the aid of 1,2-dioleoyl-*sn*-glycero-3-phosphocholine liposomes. This provides an avenue for the development of future on-site, point-of-care detection devices for medical and biological applications.



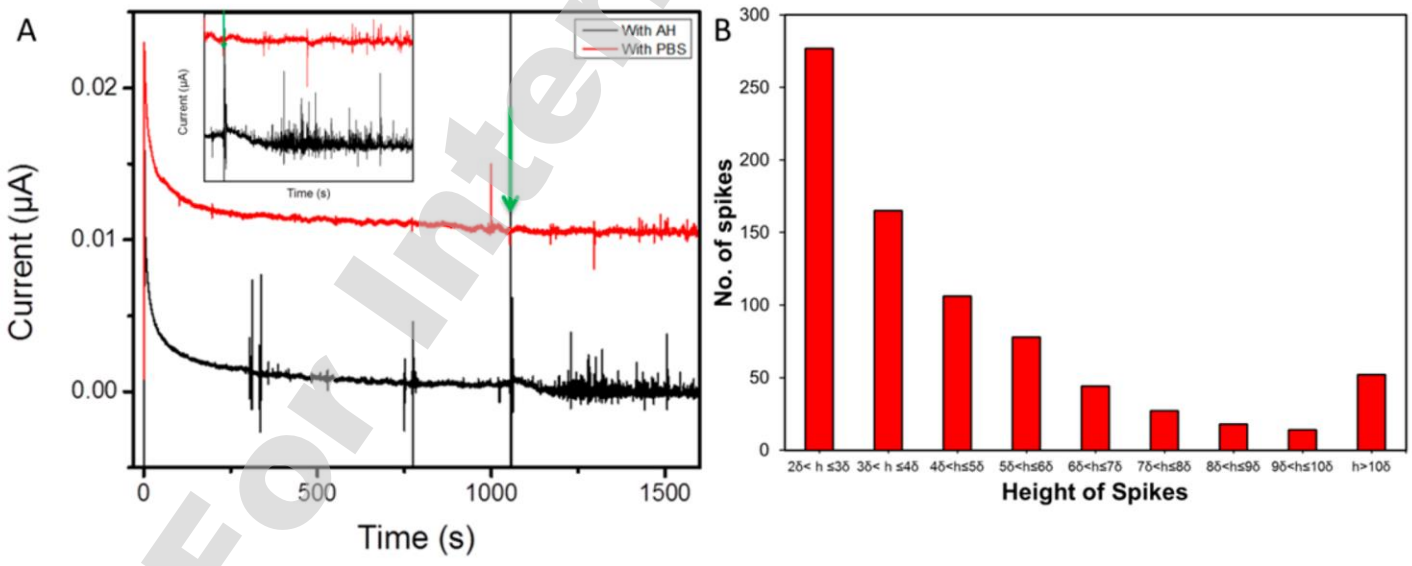


Figure 4. (A) Chronoamperometric measurements of the signals obtained. Inset shows enlarged view of spikes obtained. The scans are offset for clarity. Arrows indicate the point of injection of PBS and AH peptide accordingly. (B) Summary of spike count of liposome ruptures upon addition of AH peptide.