

# Zensor<sup>R&D</sup> NEWS

## Reference Papers 2018

Zensor  
R&D

For Internal Use Only

Sensing Good Life



Contents lists available at ScienceDirect

## Electrochimica Acta

journal homepage: [www.elsevier.com/locate/electacta](http://www.elsevier.com/locate/electacta)



# A disposable non-enzymatic histamine sensor based on the naftion-coated copper phosphate electrodes for estimation of fish freshness

Ming-Yuan Lee <sup>a</sup>, Ching-Chou Wu <sup>a, b, \*</sup>, Megawati Intan Sari <sup>a</sup>, Yu-Han Hsieh <sup>a</sup>

<sup>a</sup> Department of Bio-industrial Mechatronics Engineering, National Chung Hsing University, Taichung City, 402, Taiwan, ROC

<sup>b</sup> Innovation and Development Center of Sustainable Agriculture, National Chung Hsing University, Taichung City, 402, Taiwan, ROC



### ARTICLE INFO

#### Article history:

Received 13 March 2018  
Received in revised form  
21 May 2018  
Accepted 23 May 2018  
Available online 24 May 2018

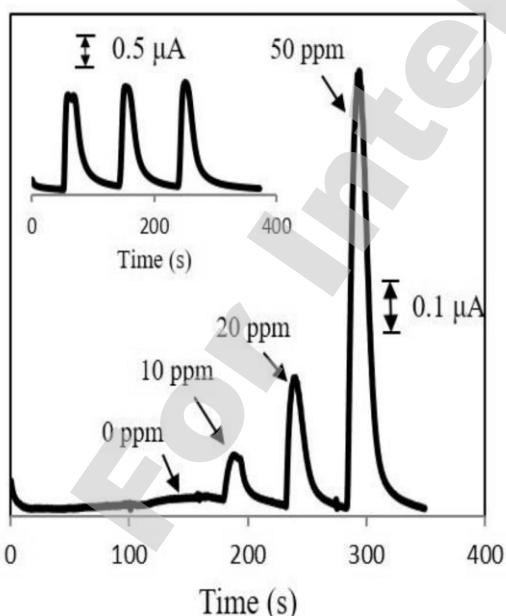
#### Keywords:

Histamine  
Copper phosphate  
Nafion coating  
Freshness

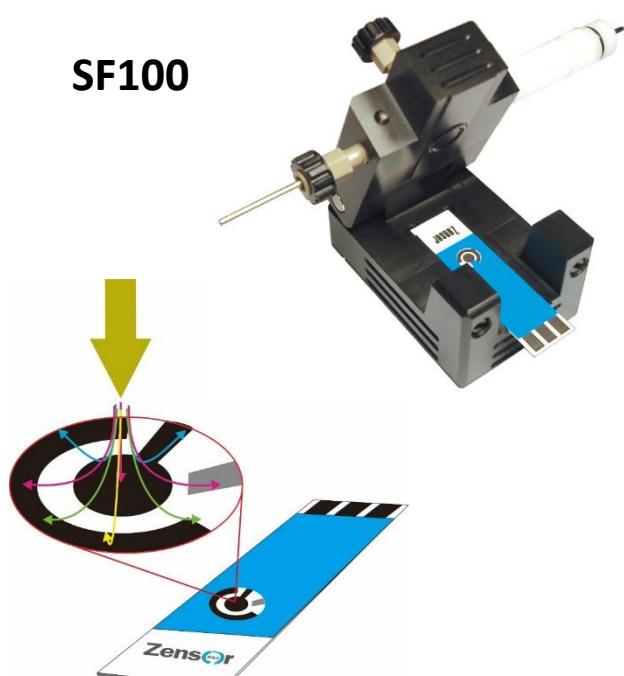
### ABSTRACT

Histamine is an important index for the estimation of allergic reaction and food freshness. This study develops a single-step dipping and coating method to fast produce an electrochemical histamine sensor based on a nafion-coated copper phosphate ( $\text{Cu}_3(\text{PO}_4)_2$ )-dominated electrode. The flake-like  $\text{Cu}_3(\text{PO}_4)_2$  nanostructures can be fast formed on Cu-electrodeposited screen printed carbon electrodes (SPCEs) within 20 min. Moreover, the 1% nafion-coated  $\text{Cu}_3(\text{PO}_4)_2$ /SPCEs presented good selectivity for the detection of histamine in the pH 8.5 solution. The nafion/ $\text{Cu}_3(\text{PO}_4)_2$ /SPCEs can be integrated with a flow-injection device for the detection of histamine with a good correlation coefficient ( $R = 0.999$ ) in the range of 5–500 ppm. The calculated limit of detection was 3.0 ppm. Moreover, the histamine concentration of 45 h-rotten fish samples detected by the nafion/ $\text{Cu}_3(\text{PO}_4)_2$ /SPCEs had a less than 10% deviation from that measured by the commercialized liquid chromatography-mass spectroscopy. The nafion/ $\text{Cu}_3(\text{PO}_4)_2$ /SPCEs have great promise for estimating the freshness of fish meat without expensive separation equipment and labor-intensive labeling procedures.

© 2018 Elsevier Ltd. All rights reserved.



**Fig. 5.** FIA responses of histamine (0, 10, 20, 50 ppm)-spiked fresh fish sample measured with the 410  $\mu\text{L}/\text{min}$  flow rate at the nafion/ $\text{Cu}_3(\text{PO}_4)_2$ /SPCE at +0.12 V vs. Ag/AgCl. The insert shows the current response of the fish sample rotted at room temperature for 45 h measured with three repetitions.





ELSEVIER

Contents lists available at ScienceDirect

Talanta



journal homepage: [www.elsevier.com/locate/talanta](http://www.elsevier.com/locate/talanta)



## A novel electroanalytical assay for sulfamethazine determination in food samples based on conducting polymer nanocomposite-modified electrodes

Ya-Ling Su, Shu-Hua Cheng\*

Department of Applied Chemistry, National Chi Nan University, Puli, Nantou Hsien 545, Taiwan

### ARTICLE INFO

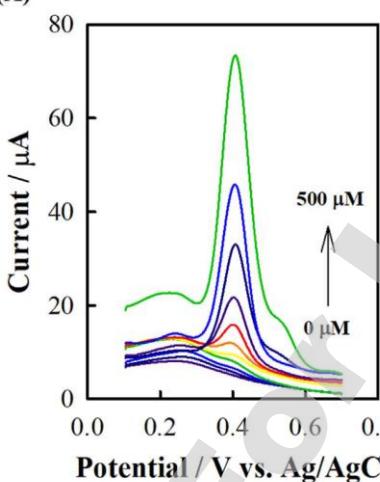
#### Keywords:

Poly(3,4-ethylenedioxythiophene)  
MnO<sub>2</sub> nanoparticles  
Nanocomposites  
Sulfamethazine  
Square wave voltammetry

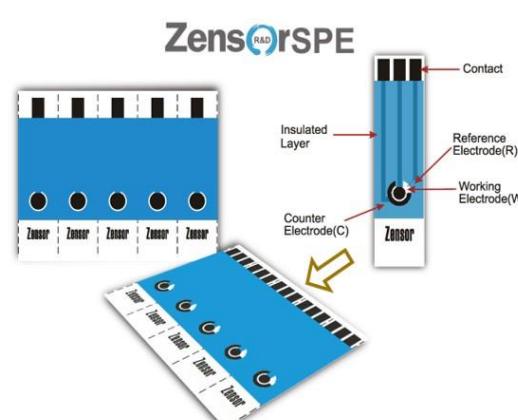
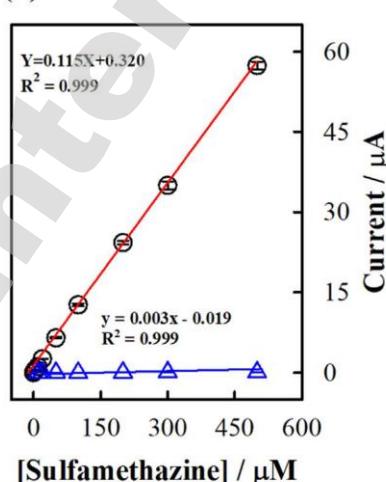
### ABSTRACT

The toxicity of sulfa drugs has attracted great attention, and the reported electrochemical methods for sulfa drugs usually employ a high oxidation potential. In this work, a one-pot synthesized conducting polymer nanocomposite containing poly(3,4-ethylenedioxythiophene) (PEDOT) and MnO<sub>2</sub> was cast on a screen-printed carbon electrode (SPCE), and the modified electrode showed superior electrochemical activity over a bare electrode for sulfamethazine (SMZ) determination. The SMZ detection was based on the electrochemical oxidation product, which showed an adsorptive property and exhibited a redox couple at 0.39 V in pH 3 phosphate buffer solutions (PBS). The electrode surfaces were well characterized by the water contact angle technique, Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), field emission scanning electron microscopy (FE-SEM), atomic force microscopy (AFM) and cyclic voltammetry. By the use of square wave voltammetry (SWV), a wide linear response to SMZ, from 1.0 μM to 500 μM, was obtained. The sensitivity and detection limits (S/N = 3) were 0.115 μA μM<sup>-1</sup> and 0.16 μM, respectively. The proposed method and a reference high-performance liquid chromatographic method (HPLC) were applied for the determination of SMZ in two real samples using the standard addition method, and satisfactory recoveries and good agreement were obtained.

(A)



(B)



**Fig. 7.** Electroanalytical performance of the proposed assay. (A) SWV responses for various concentrations of SMZ (0–500 μM) at SPCE/PEDOT/MnO<sub>2</sub> in pH 3 PBS (after CV scanning and SMZ dimers adsorption). Potential increment = 4 mV. Amplitude = 25 mV. Frequency = 15 Hz. (B) Plot of anodic peak current (I<sub>pa</sub>) vs. SMZ concentrations at SPCE/PEDOT/MnO<sub>2</sub> (○) and bare SPCE (△).



Contents lists available at ScienceDirect

## Composites Part B

journal homepage: [www.elsevier.com/locate/compositesb](http://www.elsevier.com/locate/compositesb)



# Microwave-assisted synthesis of $\text{Bi}_2\text{WO}_6$ flowers decorated graphene nanoribbon composite for electrocatalytic sensing of hazardous dihydroxybenzene isomers

Umamaheswari Rajaji<sup>a</sup>, Mani Govindasamy<sup>a</sup>, Shen-Ming Chen<sup>a,\*</sup>, Tse-Wei Chen<sup>a,d</sup>, Xiaoheng Liu<sup>b,\*\*</sup>, Sathishkumar Chinnapaiyan<sup>c</sup>

<sup>a</sup> Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, No.1, Section 3, Chung-Hsiao East Road, Taipei 106, Taiwan

<sup>b</sup> Key Laboratory of Education Ministry for Soft Chemistry and Functional Materials, Nanjing University of Science and Technology, Nanjing, 210094, PR China

<sup>c</sup> International Master Program in Mechanical and Automation Engineering, National Taipei University of Technology, No.1, Section 3, Chung Hsiao East Road, Taipei 106, Taiwan

<sup>d</sup> Research and Development Center for Smart Textile Technology, National Taipei University of Technology, Taipei, Taiwan

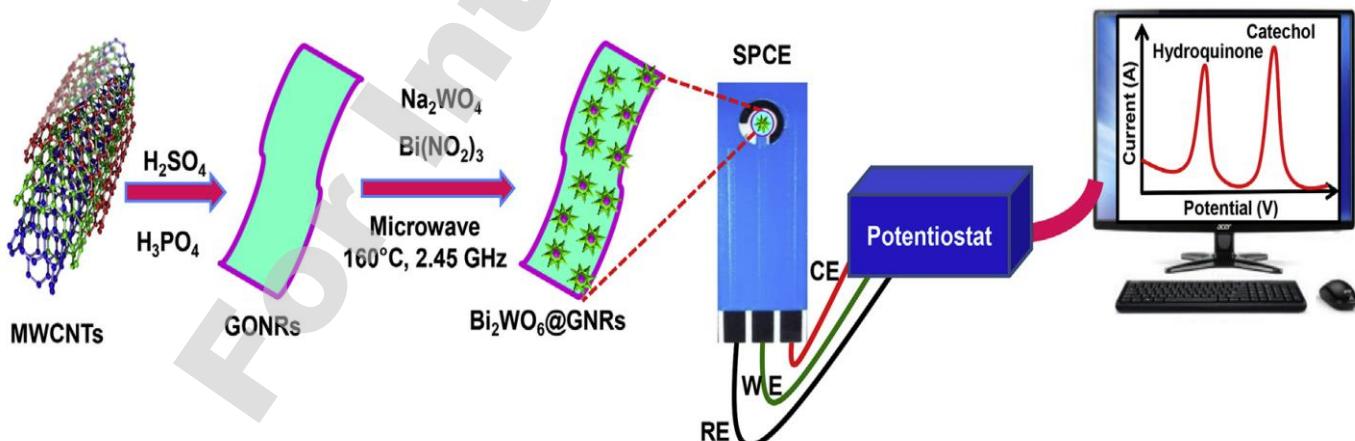
## ARTICLE INFO

### Keywords:

Layered transition metal oxides  
Microwave synthesis  
Non-enzymatic biosensor  
Electrocatalysis  
Biological toxicity  
Modified electrodes  
Electrochemical sensors

## ABSTRACT

A microwave-assisted synthesis is described for the preparation of bismuth tungstate/graphene nanoribbons ( $\text{Bi}_2\text{WO}_6@\text{GNRs}$ ) nanocomposite as cost-effective alternative to existing hydrothermal method. HR-TEM, XRD, XPS, EDX, BET and Raman characterizations reveal the incorporation of  $\text{Bi}_2\text{WO}_6$  flowers on GNRs. The electrochemical and interfacial properties of the composite were probed by voltammetry and impedance studies. The electrocatalytic ability of the composite was assessed by studying the redox reactions of hazardous dihydroxybenzene isomers.  $\text{Bi}_2\text{WO}_6@\text{GNRs}$  modified screen-printed electrode was found to distinguish the voltammetric signals of catechol and hydroquinone (separation gap of 140 mV, vs.  $\text{Ag}|\text{AgCl}$ ), minimizes reaction overpotentials, and amplifies the electrochemical current signal. The effects of concentration scan rate and cross-reactivity are studied.  $\text{Bi}_2\text{WO}_6@\text{GNRs}$  incorporated sensor displayed detection limits of 5.31 nM and 7.24 nM for catechol and hydroquinone, respectively. The method was found to be practically applicable in the determination of catechol and hydroquinone in water samples and face cream sample, respectively.



**Scheme 1.** Schematic illustration for the preparation of  $\text{Bi}_2\text{WO}_6@\text{GNRs}$  nanocomposite for sensing dihydroxybenzene isomers in water samples and face cream sample. WE = Working electrode, RE = Reference electrode, CE = Counter electrode.



ELSEVIER

Contents lists available at ScienceDirect

## Food Chemistry

journal homepage: [www.elsevier.com/locate/foodchem](http://www.elsevier.com/locate/foodchem)



# An electrooxidative technique to fast fabricate copper phosphate electrodes capable of integrating high performance liquid chromatography for the label-free detection of fish freshness

Yu-Han Hsieh<sup>a</sup>, Ming-Yuan Lee<sup>a</sup>, Ching-Chou Wu<sup>a,b,\*</sup>

<sup>a</sup> Department of Bio-industrial Mechatronics Engineering, National Chung Hsing University, Taichung City 402, Taiwan, ROC

<sup>b</sup> Innovation and Development Center of Sustainable Agriculture, National Chung Hsing University, Taichung City 402, Taiwan, ROC

### ARTICLE INFO

#### Keywords:

Electrooxidation  
Histamine  
Copper phosphate  
Fish freshness

### ABSTRACT

A simple and fast one-step electrooxidative method has been developed to monolithically produce a copper phosphate ( $\text{Cu}_3(\text{PO}_4)_2$ ) compound on a disposable copper tape, which can be integrated with high performance liquid chromatography (HPLC) for the estimation of fish freshness. The  $\text{Cu}_3(\text{PO}_4)_2$  compound of flake-like nanostructures was formed by applying a first anodic peak potential at the copper tape for 10 min in a 1 M sodium dihydrogen phosphate ( $\text{NaH}_2\text{PO}_4$ ) (pH 5.0) solution. The  $\text{Cu}_3(\text{PO}_4)_2$  electrodes can detect the oxidative reaction of histidine and histamine in 20 mM  $\text{NaH}_2\text{PO}_4$  solutions with pH 5.0–8.5. When integrating the electrodes with a flow injection system, the linear range and the calculated detection limit of histamine were respectively 2.5–250 ppm and 0.15 ppm. The electrodes integrated to HPLC can specifically detect the histamine concentrations in fish samples in the pH 7.5  $\text{NaH}_2\text{PO}_4$  solution, achieving an accuracy rate of 95.3% and a recovery rate of 101.1%.

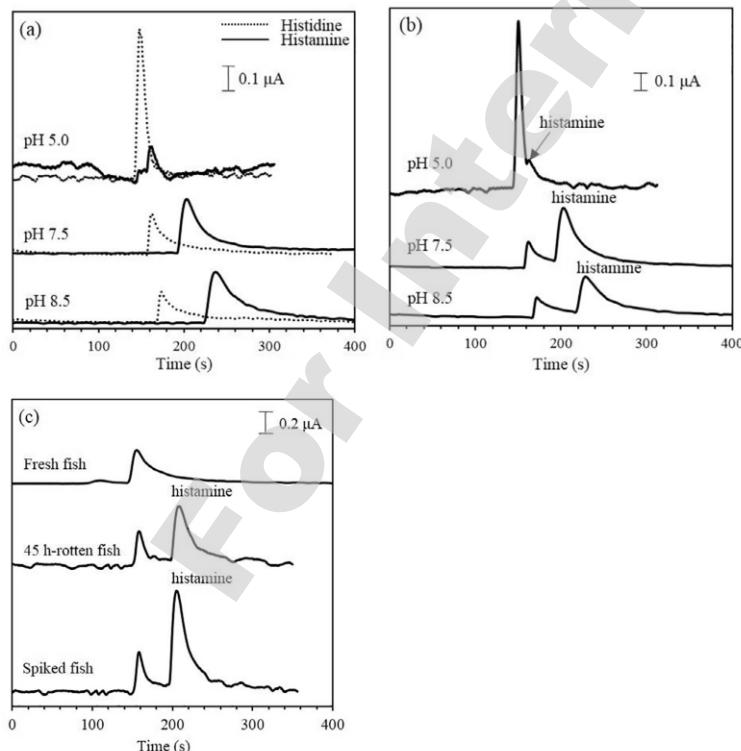
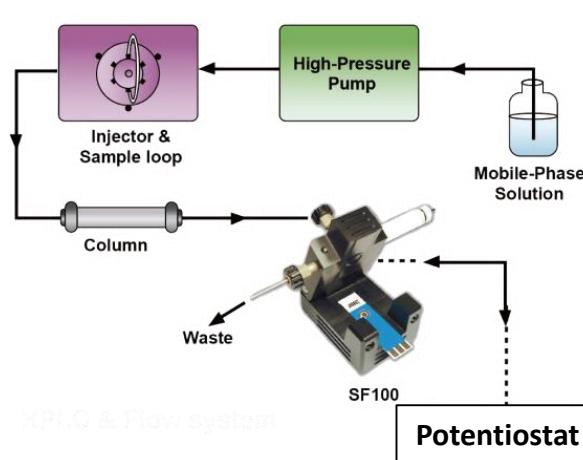


Fig. 5. HPLC chromatograms of separate 100 ppm histamine (solid line) and histidine (dashed line) samples prepared and performed in the 20 mM  $\text{NaH}_2\text{PO}_4$  solutions of pH 5.0, 7.5 and 8.5 (a), the mixture of 100 ppm histidine and 100 ppm histamine (b) and fresh, 45 h-rotten and 50 ppm histamine-spiked 45 h-rotten mackerel samples performed in the 20 mM  $\text{NaH}_2\text{PO}_4$  solutions of pH 7.5 (c). Applied potential: +0.12 V vs. Ag/AgCl; flow rate: 1.0 mL/min; sample loop: 20  $\mu\text{L}$ .



HPLC & Flow system



Contents lists available at ScienceDirect

## Sensors and Actuators B: Chemical

journal homepage: [www.elsevier.com/locate/snb](http://www.elsevier.com/locate/snb)



# Selective amperometric and flow injection analysis of 1,2-dihydroxy benzene isomer in presence of 1,3- and 1,4-dihydroxy benzene isomers using palladium nanoparticles-chitosan modified ITO electrode

Subramanian Nellaippan<sup>a</sup>, Annamalai Senthil Kumar<sup>a,b,\*</sup>

<sup>a</sup> Nano and Bioelectrochemistry Research Lab, Department of Chemistry, School of Advanced Sciences, Vellore Institute of Technology University, Vellore, 632 014, India

<sup>b</sup> Carbon dioxide Research and Green Technology Centre, Vellore Institute of Technology University, Vellore, 632 014, India

### ARTICLE INFO

#### Article history:

Received 4 March 2017

Received in revised form 22 July 2017

Accepted 25 July 2017

Available online 26 July 2017

#### Keywords:

Isomers of dihydroxy benzene

Selective detection of 1,2-dihydroxy benzene

Palladium nanoparticles-Chitosan composite

Indium tin oxide electrode

Flow injection analysis

### ABSTRACT

Amongst various isomers of dihydroxy benzene, 1,2-dihydroxy benzene (Catechol, CA) isomer and its derivative based natural compounds are considered to be the key functional group for various health benefits. In electrochemistry, pulse voltammetric techniques combined with chemically modified electrodes (CMEs) have been often reported for simultaneous detection of 1,2- (CA); 1,3- (Resorcinol, RE) and 1,4-dihydroxy benzene (hydroquinone, HQ) isomers at discrete potentials, ~0.1, ~0.2 and ~0.4 V vs Ag/AgCl, respectively, in a neutral pH condition. Indeed, the above technique and the reported CMEs were not suitable for selective amperometric i-t based detection of CA without interference from HQ and RE. In fact, at CA detection potential, ~0.2 V, HQ also got co-detected. Herein, we report a palladium nanoparticles-Chitosan indium tin oxide modified electrode (ITO/CHIT@Pd<sub>nano</sub>) as a selective amperometric sensor system for CA isomer detection without any interference of HQ and RE. A specific interaction between Pd<sup>2+</sup> and CA as {Pd<sup>2+</sup>-CA complex} is proposed as a key factor for the selectivity achieved in this work. As a proof of concept, flow injection analysis of CA functional group in wine and tea real samples was demonstrated.

© 2017 Elsevier B.V. All rights reserved.

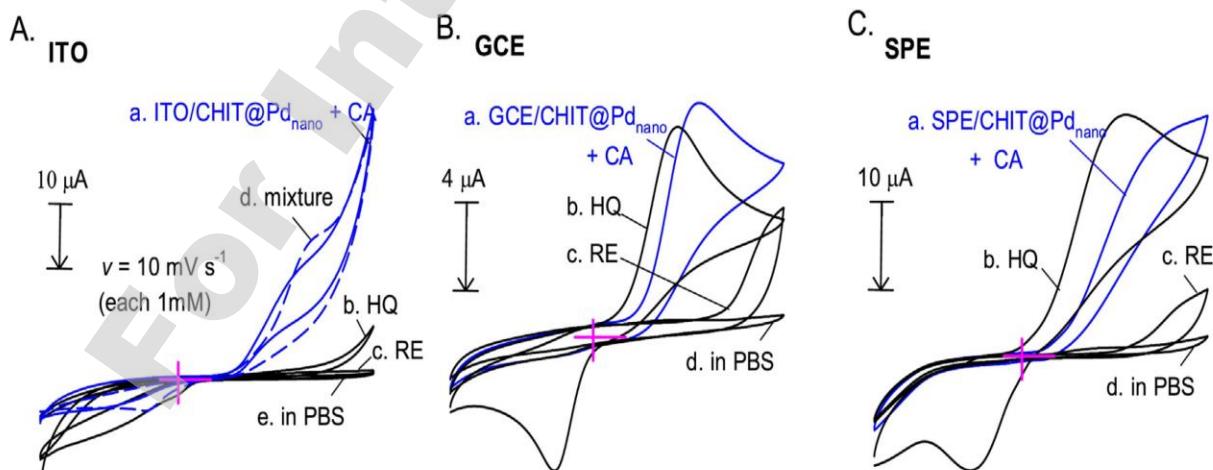


Fig. 1. Cyclic voltammetric responses of ITO/CHIT@Pd<sub>nano</sub> (A), GCE/CHIT@Pd<sub>nano</sub> (B) and SPE/CHIT@Pd<sub>nano</sub> (C) modified and bare ITO (D), GCE (E) and SPE (F)-unmodified electrodes in presence of 1 mM (each) 1,2-dihydroxy benzene (CA), 1,3-dihydroxy benzene (RE) and 1,4-dihydroxy benzene (HQ) isomers at  $v = 10 \text{ mV s}^{-1}$  in pH 7 PBS.



Contents lists available at ScienceDirect



## Biosensors and Bioelectronics

journal homepage: [www.elsevier.com/locate/bios](http://www.elsevier.com/locate/bios)



# Multiplexed aptasensor based on metal ions labels for simultaneous detection of multiple antibiotic residues in milk

Falan Li<sup>a</sup>, Yemin Guo<sup>b</sup>, Xiangyou Wang<sup>a,b,\*</sup>, Xia Sun<sup>b,\*\*</sup>

<sup>a</sup> School of Engineering, Northeast Agricultural University, No. 59 Mucai Street Xiangfang District, Harbin 150000, Heilongjiang Province, PR China

<sup>b</sup> School of Agricultural Engineering and Food Science, Shandong University of Technology, No. 12 Zhangzhou Road, Zibo 255049, Shandong Province, PR China

### ARTICLE INFO

#### Keywords:

Multiplexed aptasensor  
Simultaneous detection  
Metal ions labels  
Multiple antibiotic residues

### ABSTRACT

A dual-target electrochemical aptasensor was developed for the simultaneous detection of multiple antibiotics based on metal ions as signal tracers and nanocomposites as signal amplification strategy. Metal ions such as Cd<sup>2+</sup> and Pb<sup>2+</sup> could generate distinct differential pulse voltammetry (DPV) peaks. When targets were present, kanamycin (KAN) and streptomycin (STR) as models, the KAN aptamer (KAP) and STR aptamer (STP) were released from their complementary strands, with more change of Cd<sup>2+</sup> and Pb<sup>2+</sup> corresponding to peak currents. At the same time, complementary strand of KAP (cKAP) and STP (cSTP) were linked with the poly (A) structure (cSTP-PolyA-cKAP) to increase their conformational freedom. Graphitized multi-walled carbon nanotubes (MWCNT<sub>Gr</sub>) and carbon nanofibers-gold nanoparticles (CNFs-AuNPs) as a biosensor platform enhanced the surface area to capture a large amount of cSTP-PolyA-cKAP, thus amplifying the detection response. Under the optimal conditions, the aptasensor could detect KAN and STR as low as 74.50 pM and 36.45 pM respectively with the range from 0.1 to 100 nM and exhibited excellent selectively. Moreover, this aptasensor showed promising applications for the detection of other analytes by changing corresponding aptamers.

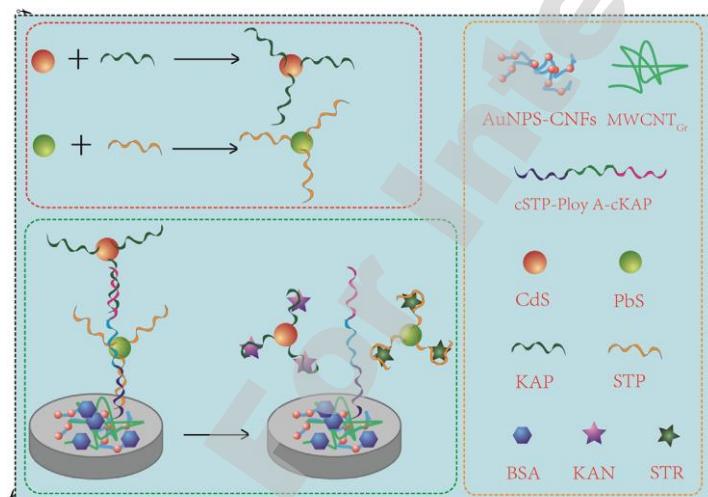
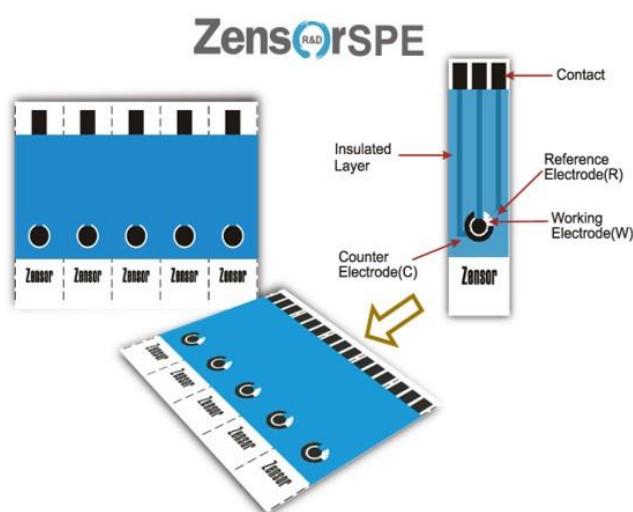


Fig. 1. Schematic illustration of the preparation process for the aptasensor.





Contents lists available at ScienceDirect

## Journal of the Taiwan Institute of Chemical Engineers

journal homepage: [www.elsevier.com/locate/jtice](http://www.elsevier.com/locate/jtice)



# Reduced graphene oxide supported raspberry-like SrWO<sub>4</sub> for sensitive detection of catechol in green tea and drinking water samples

Shaktivel Manavalan<sup>a</sup>, Mani Govindasamy<sup>a</sup>, Shen-Ming Chen<sup>a,\*</sup>, Umamaheswari Rajaji<sup>a</sup>, Tse-Wei Chen<sup>a</sup>, M. Ajmal Ali<sup>b</sup>, Fahad M.A. Al-Hemaid<sup>b</sup>, M.S. Elshikh<sup>b</sup>, M. Abul Farah<sup>c</sup>

<sup>a</sup> Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, No.1, Section 3, Chung-Hsiao East Road, Taipei 106, Taiwan

<sup>b</sup> Department of Botany and Microbiology, College of Science, King Saud University, Riyadh - 11451, Saudi Arabia

<sup>c</sup> Department of Zoology, College of Science, King Saud University, Riyadh - 11451, Saudi Arabia

### ARTICLE INFO

#### Article history:

Received 6 January 2018

Revised 21 April 2018

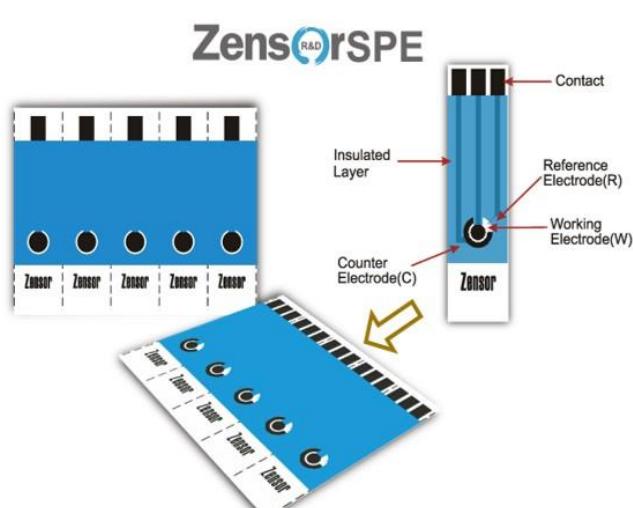
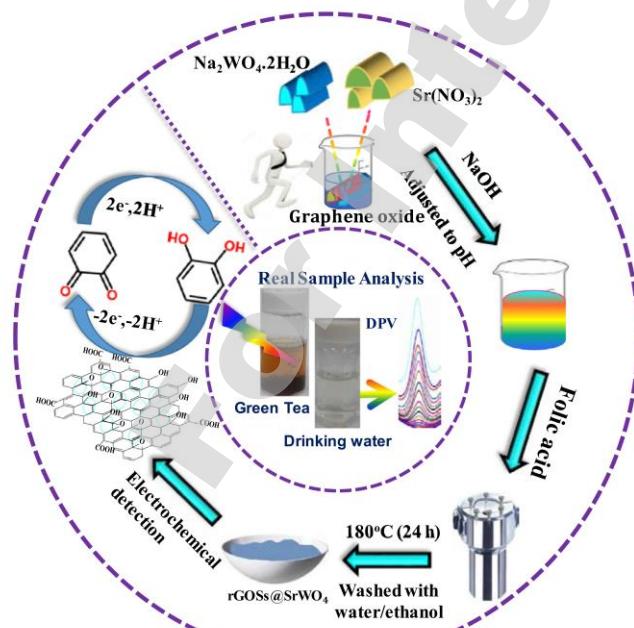
Accepted 3 May 2018

Available online 29 May 2018

### ABSTRACT

The raspberry-like strontium tungstate microspheres supported on reduced graphene oxide nanosheets (rGOSs@SrWO<sub>4</sub>) were prepared by a hydrothermal method and it was applied to the electrocatalytic sensing of catechol. The as-prepared rGOSs@SrWO<sub>4</sub> composite was characterized by XRD, Raman, FESEM, EDX, EIS, and voltammetric techniques. Morphology studies reveal the uniform wrapping of raspberry-like SrWO<sub>4</sub> microstructure by thin sheets of rGOSs and the composite possesses large surface area and abundant catalytic active sites. The rGOSs@SrWO<sub>4</sub> composite modified screen-printed multi-conventional electrode (SPME) was fabricated which was found to exhibit extraordinary electrocatalytic activity and excellent selectivity towards the detection of catechol. The rGOSs@SrWO<sub>4</sub>/SPME displayed a linear range of 0.034–672.64 μM and detection limit of 7.34 nM using differential pulse voltammetry as signal read-out. Furthermore, the electrode was durable, reproducible and repeatable. The practical utility of the method was demonstrated in green tea and drinking water samples.

© 2018 Taiwan Institute of Chemical Engineers. Published by Elsevier B.V. All rights reserved.



**Fig. 1.** Schematic representation for the hydrothermal synthesis of rGOSs@SrWO<sub>4</sub> and its electrochemical application to determining of catechol in green tea and water samples. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)



Cite this: *New J. Chem.*, 2018,  
 42, 14642

## Homogeneous electrochemical aptasensor based on a dual amplification strategy for sensitive detection of profenofos residues

Yancui Jiao,<sup>t,ab</sup> Jiayun Fu,<sup>t,ab</sup> Wenjie Hou,<sup>ab</sup> Zhaoqiang Shi,<sup>ab</sup> Yemin Guo,<sup>ID \*</sup><sup>ab</sup> Xia Sun,<sup>ab</sup> Qingqing Yang<sup>ab</sup> and Falan Li<sup>ab</sup>

A homogeneous type of electrochemical aptasensor was designed based upon the principle of target-induced and tool enzyme-assisted signal amplification, which was employed for the detection of profenofos residues. In this experiment, profenofos, a type of organophosphorus pesticide, was used as a model target. The electrochemical signals of the aptasensor were acquired via electrostatic adsorption of negatively charged screen-printed electrodes (SPEs) and positively charged ferrocene (Fc). The ingeniously designed hairpin structure of the probe was unfolded with profenofos bound to the aptamer sequences, and after this, the target profenofos and the complementary DNA sequences with hairpin probes (HP) were separately recycled with the help of Vent polymerase and T7 exonuclease (T7 Exo). At the same time, due to the employment of T7 Exo, the Fc labeled DNA duplex could be digested into mononucleotides, making the end-labeled Fc approach the electrode surface and generate an enhanced electrochemical response. Based on this strategy, an ultrasensitive electrochemical aptasensor was fabricated with a low detection limit (LOD) of  $0.01 \text{ ng mL}^{-1}$ . The developed method can be applied for the determination of profenofos residues in vegetables, and it produced satisfactory results.

Received 8th May 2018,  
 Accepted 12th July 2018

DOI: 10.1039/c8nj02262c

rsc.li/njc

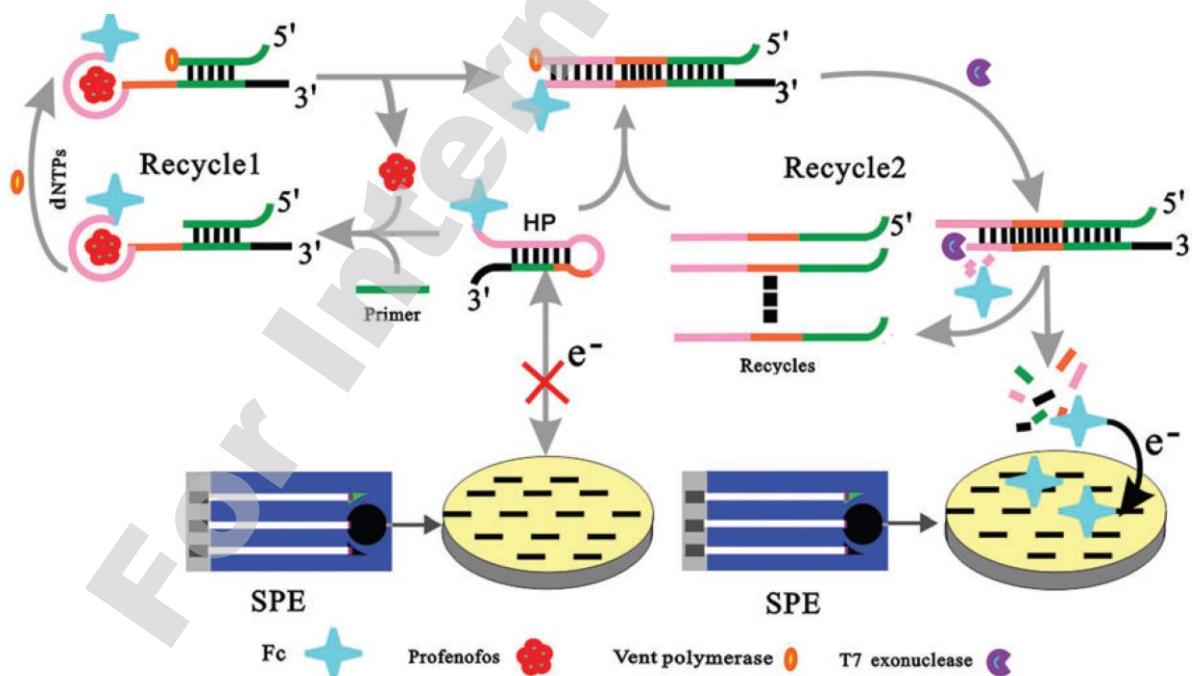


Fig. 2 Principle of the target-induced and T7 Exo-assisted recycling amplification strategy for profenofos detection.