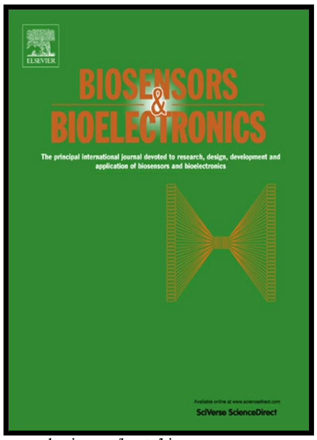

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A novel electrochemical sensor based on Cu@Ni/MWCNTs nanocomposite for simultaneous determination of guanine and adenine

Dongyang Wang [a, 1], Bintong Huang [c, 1], Jie Liu [c], Xia Guo [f], Guzailinur Abudukeyoumu [g], Yang Zhang [b, e,*], Bang-Ce Ye [a, d, *], Yingchun Li [b, c, *]

[a] *Key Laboratory for Green Processing of Chemical Engineering of Xinjiang Bingtuan, School of Chemistry and Chemical Engineering, Shihezi University, Shihezi 832003, China*

[b] *College of Science, Harbin Institute of Technology, Shenzhen, 518055, China*

[c] *Key Laboratory of Xinjiang Phytomedicine Resources for Ministry of Education, School of Pharmacy, Shihezi University, Shihezi, 832000, China*

[d] *State Key Laboratory of Bioreactor Engineering, East China University of Science and Technology, Shanghai, 200237, China*

[e] *Harbin Institute of Technology (Shenzhen), Shenzhen Key Laboratory of Organic Pollution Prevention and Control, Shenzhen, Guangdong, 518055, China*

f The Clinical Innovation & Research Center (CIRC), Shenzhen Hospital, Southern Medical University, Shenzhen, 518100, China

[g] *Department of pharmacy, Kashi Second People's Hospital, Kashi, Xinjiang, 844000, China*

[1] These authors contributed equally to this work.

*Corresponding authors.

1) Prof. Dr. Yingchun Li, tel: +86-755-86239466, e-mail address: liyingchun@hit.edu.cn.

2) Prof. Dr. Bang-Ce Ye, tel: +86-021-64252094, e-mail address: bcye@ecust.edu.cn.

3) Dr. Yang Zhang, e-mail address: zhangyang07@hit.edu.cn.

Abstract: A novel electrochemical sensing platform based on combination of multi-walled carbon nanotubes and copper-nickel hybrid nanoparticles (Cu@Ni/MWCNTs) was developed for simultaneous detection of guanine (G) and adenine (A). The Ni/MWCNTs and Cu@Ni/MWCNTs nanocomposites were characterized by transmission electron microscopy (TEM) and energy-dispersive X-ray spectroscopy (EDS). The electrochemical behaviors of G and A on the modified electrode were explored by cyclic voltammetry (CV) and differential pulse voltammetry (DPV) in phosphate buffer with pH 3.0. Under the optimal conditions, electrical signals were linear over the concentration ranges from 5.0 to 180 μM and 8.0 to 150 μM for simultaneous determination G and A with the detection limit as low as 0.35 μM and 0.56 μM (S/N=3), respectively. Furthermore, linear concentration ranges in individual determination are 1.0~180 μM and 2.0~150 μM with detection limits of 0.17 μM and 0.33 μM (S/N=3) for G and A, respectively. The sensor was successfully used to quantify G and A in real samples. The Cu@Ni/MWCNTs composite presented here can serve as a promising candidate for developing electrochemical sensor devices and plays an important role in widespread fields.

Keywords: *Multi-walled carbon nanotubes; Copper nickel nanoparticles; Guanine; Adenine; Electrocatalytic oxidation; Synergistic effect*

1. Introduction

Guanine (G) and adenine (A) are important purine bases in deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). Purine bases are crucial biomolecules which play various roles in cell proliferation (Burnstock 2002), coronary blood flow regulation (Burnstock 1997), cardiovascular system (Ralevic et al. 1991), etc. Abnormal changes in purine content and metabolism may affect immune function and cause various diseases including cancer, epilepsy (Cekan and Sigurdsson 2009; Pietrzyk et al. 2010), lupus erythematous, renal calculi and anemia (Fox 1981; Nyhan 2005). Hence, accurately monitoring G and A in biosamples is of great meaning for assessment of health status and early warning of several diseases. Analytical approaches that have been reported for detecting G and A include liquid chromatography (Gill and Indyk 2007), calorimetry (Heisler et al. 2002), capillary zone electrophoresis (Yeh and Jiang 2002) and mass spectrometry (Huang and Chang 2007). However, most of them suffer from disadvantages such as consumption of a large amount of organic reagents, expensive equipment and time-consuming procedures. In comparison, electrochemical sensor for the determination (Hui et al. 2015; Lynge et al. 2011; Sun et al. 2008; Yari and Derki 2016; Yari and Saidikhah 2016) of G and A can be very attractive since it allows developing a sensitive, fast, simple and cost-effective assay, especially suitable for complex and low concentration biological samples without complicated pre-treatment.

To developing a sensor, sensitivity and selectivity are always key issues for practical application (Yin et al. 2015). To improve the sensitivity, various modifiers like carbon nanotubes (CNTs), graphene, precious and transition metals, semiconductors and artificial polymers (Dan et al. 2015; Jiang and Zhang 2010; Wang et al. 2006; Wang et al. 2009) have been utilized to decorate electrodes. Recently, studies of bimetallic nanoparticles as catalysts have