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Copper Nanoparticles/Polyaniline/Graphene Composite as a Highly Sensitive Electrochemical Glucose Sensor

Weiran Zheng, Liangsheng Hu, Lawrence Yoon Suk Lee,* and Kwok-Yin Wong*

Department of Applied Biology and Chemical Technology and the State Key Laboratory of Chirosciences, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China

**Corresponding authors: lawrence.ys.lee@polyu.edu.hk, kwok-yin.wong@polyu.edu.hk*

Abstract

A highly sensitive non-enzymatic glucose sensor based on Cu nanoparticles (CuNPs)/polyaniline (PANI)/graphene nanocomposite was fabricated *via* simple *in-situ* reduction of Cu precursor in polyaniline nanofibers under mild conditions followed by mechanical mixing with graphene suspension to form the composites with different graphene contents (0.5 %, 1 %, and 2 %). The properties of nanocomposites were characterized by SEM, TEM, XRD, UV-Vis, and XPS. The CuNPs (d = 2-4 nm) only slightly altered the ordered structure of PANI. It was found that CuNPs have direct electronic interaction with PANI *via* the N atoms on the polymer backbone, which enabled fast electrons transfer from electrode to CuNPs through graphene and PANI. The CuNPs/PANI/graphene nanocomposites were coated on a glassy carbon electrode for the investigation of their electrochemical properties. Both CuNPs/PANI and CuNPs/PANI/graphene showed high sensitivity towards glucose oxidation which occurred at ~ 0.5 V *vs* SCE. The best performance was achieved by the CuNPs/PANI/1% graphene-modified electrode which showed sensitivity of ~150 mA cm^{-2} M^{-1}, detection limit of 0.27 μM (S/N = 3), and response time of about 3 s. This system was also highly selective towards glucose oxidation that almost no signal was detected from interferents such as ascorbic acid and dopamine, demonstrating its great potential as a non-enzymatic glucose sensor.

Keywords: Copper nanoparticles, polyaniline, non-enzymatic sensor, glucose electrooxidation, graphene