Facile Preparation of Copper oxide Nanoleaves decorated Multi-walled Carbon Nanotube Composite for Non-enzymatic Sensing of Glucose

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Experimental Section

Chemicals:

All reagents used in this study were of analytical grade. $CuSO_4 \cdot 5H_2O$, sodium hydroxide, sodium dodecyl sulphate were purchased from Beijing Chemical Works, Multiple walled carbon nanotubes(MWCNTs, OD>50 nm, length 10-20 μm) was purchased from Beijing Nachen S&T Ltd, Dopamine(DA), Glucose, Uric acid (UA), Ascorbic acid (AA) was purchased from Alfa Aesar. Deionized water (>18.4 $M\Omega cm^{-1}$) was prepared with Milli-Q machine.

Preparation of copper oxide (CuONL) decorated multiple-walled carbon nanotubes (MWCNTs) composites:

In a typical reaction process, 0.6 g (20 mM) sodium dodecyl sulphate(SDS) was dissolved in 100 mL deionized water with magnetic stirring at 60 ℃. 0.01 g MWCNTs were ultrasonically dispersed in 5 mL dimethyl formamide (DMF), then the MWCNTs/DMF solution were added to the SDS solution, and ultrasonically dispersed for another 10 min to make SDS thoroughly adsorb onto MWCNTs. 0.5 g $CuSO_4 \cdot 5H_2O$ were added to the above solution, and the solution was ultrasonic dispersed for 10 min. Then 20 mL NaOH solution (0.5 M) was slowly dropped into the mixture and subsequently stirred for 10 min. Finally, the precipitation was separated by centrifugation and dried at 60 ℃.

Characterization:

The nanocomposite was characterized by scanning electron microscope (SEM), transmission electron microscope (TEM) and X-ray diffraction (XRD). The electrocatalytical activity of the nanocomposite modified electrodes towards glucose oxidation was investigated by cyclic voltammetry (CV) and chronoamperometry.

Electrochemical experiments were carried out on a CHI 660C electrochemical workstation (Shanghai Chenhua, China) with a conventional three-electrode system, with CuONL/MWCNTs as working electrode, an SCE electrode and a platinum wire as reference electrode and counter electrode. The CuONL/MWCNTs was characterized by X-ray diffraction (XRD, X' Pert PRO MPD) with an area detector operating under a voltage of 40 kV and a current of 40 mA using Cu Kα radiation (λ = 0.15418 nm). The morphology of the sample was observed by a scanning electron microscope (SEM, QUANTA FEG 250) and a transmission electron microscope (TEM, FEI Tecnai G2 T20).

Glucose sensing characteristics:

The glass carbon electrode (GCE, 3 mm in diameter) was carefully polished with alpha alumina powder(1.0, 0.3 micronmeter) and gamma alumina powder(0.05 micronmeter), then rinsed with distilled water and ethanol, and then dried under ambient temperature. Then, 1.0 g prepared CuONL/MWCNTs nanocomposites was fully ultrasonically dispersed in 1 mL DMF to obtain a uniform suspension. Finaly, 5 μL suspensions was dropped onto the GCE and dried in air. Thus CuONL/MWCNTs modified GCE was obtained.

Table 1 Comparison of the present CuONL/MWCNTs electrode with other nonenzymatic glucose sensors

Electrode	Sensitivity (μAmmol^{-1}cm^{-2})	Linear range(up to, mmolL^{-1})	Detection limit (μmolL^{-1})	E(V)	Ref
Au nanoplates	49.5	20	200	0.65	1
		10		-0.2	1
NiO–Au hybrid nanobelts	48.35	4.55	1.32	0.6	2
	23.88	2.79	0.65	0.2	2
Fe_2O_3 nanowire arrays	726.9	8	6	0.521	3
Cobalt oxide acicular nanorods	571.8	3.5	0.058	0.5	4
Cu_2O	190	1.1	47.2	0.5	5
Cu_2O/MWCNTs	6.53	0.01	0.05	-0.2	6
CuO@C	1200	0.06	1	-0.2	7

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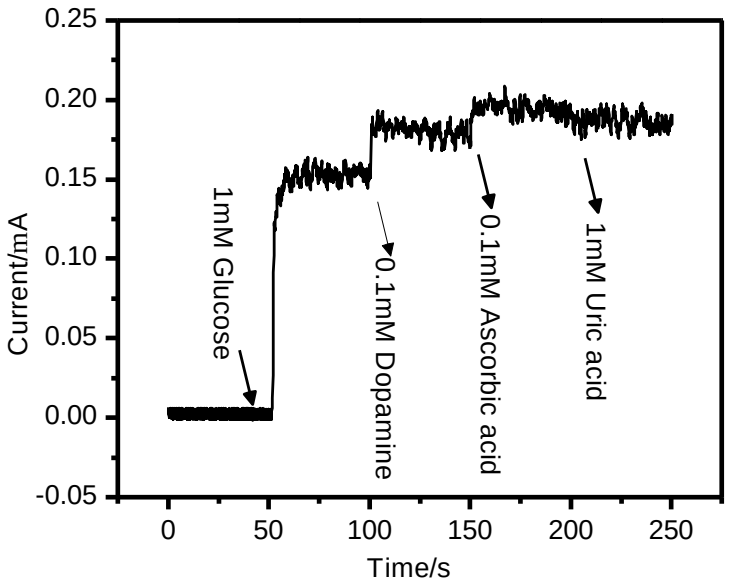

Fig. 3 Amperometric response to injection of 1 mM glucose, 0.1 mM dopamine, 0.1 mM ascorbic acid and 1 mM uric acid