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Prussian blue nanocubes with open framework structure coated with polyoxometalates as a highly sensitive platform for ascorbic acid detection in drinks / human urine

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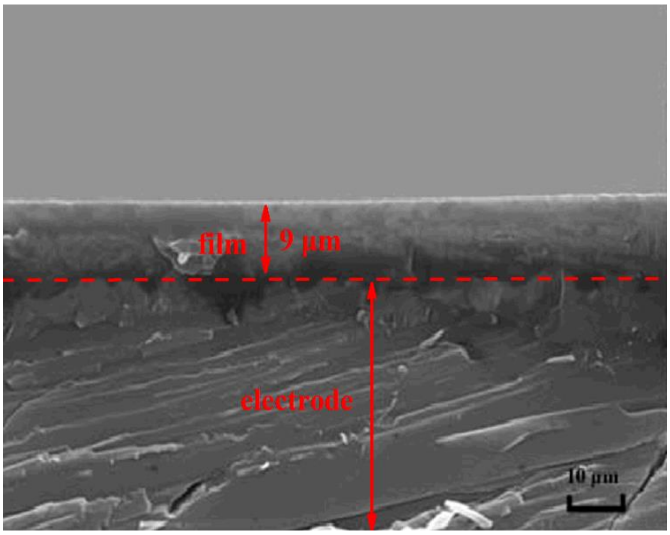

Fig. S1 The cross section of the PB NCs@POMs nanocomposite electrode.

Fig. S2 describes the effect of the different scan rate for 5 μM AA oxidation at the PB NCs@POMs nanocomposite in 0.1 M PBS (pH 7.0) at scan rates range from 20 to 200 mV/s. As Fig. S2(a) reveals, a linear dependence of peak currents vs. scan rate is shown by the consequences, indicating a surface adsorption control progress of the electron transfer response. The linear correlation equation of the I_{Pa} (μA) vs. v (mV s^{-1}) is:

$$I_{Pa} = 0.0161v + 1.09 \quad (R^2 = 0.992) \tag{1}$$

Besides, the linear relation of AA's oxidation peak potential (E_{pa}) vs. the natural logarithm of scan rates (log$v$) is revealed by Fig. S2(b). The linear relationship is expressed as:

$$E_{Pa} = 0.181 \log v + 0.0633 \quad (R^2 = 0.996) \tag{2}$$

According to the Laviron theory for an adsorption controlled and totally irreversible electrode process [1,2,3], E_{Pa} is defined by the following equation.

$$E_{Pa} = E_0 - \left(\frac{2.3RT}{\alpha nF}\right)\left[\log \frac{RTKs}{\alpha nF} - \log v\right] \tag{3}$$

where α is the transfer coefficient, Ks is the heterogeneous electrontransfer rate constant, n is the number of electrons transferred, v is the scan rate, and E_0 is the formal standard potential. Other symbols have their usual meanings. Thus, the value of αn can be easily calculated from the slope of E_{Pa} vs. log v. In this system, the slope was found to be 0.181, taking T = 298 K, R = 8.314 J/K mol, and F = 96,485 C/mol, the αn was calculated to be 0.327. The α value can be determined from the following equation [4,5,6]:

$$E_{pa} - E_{pa/2} = \frac{1.857RT}{\alpha F} = \frac{47.7}{\alpha} \text{mV} \quad (4)$$

where E_{Pa} and $E_{Pa/2}$ refers to the peak potential and the half-height, respectively. From this, the value of α is estimated to be 0.209. Based on this result, the electron transfer number of AA oxidation on PB NCs@POMs nanocomposite is calculated to be 1.56 approximately which is close to two electrons' transfer progress.

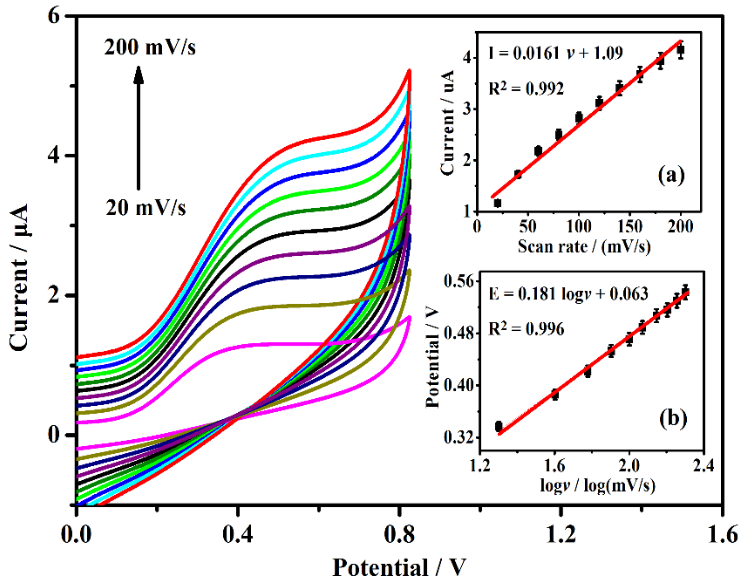

Fig. S2 CVs of 5 μM AA on the surface of PB NCs@POMs nanocomposite at various scan rates range from 20 to 200 mV s^{-1} in 0.1 M PBS (pH 7.0). (a) Dependence of the oxidation peak current on scan rate. (b) Calibration plot of E_P *vs.* log$v$.

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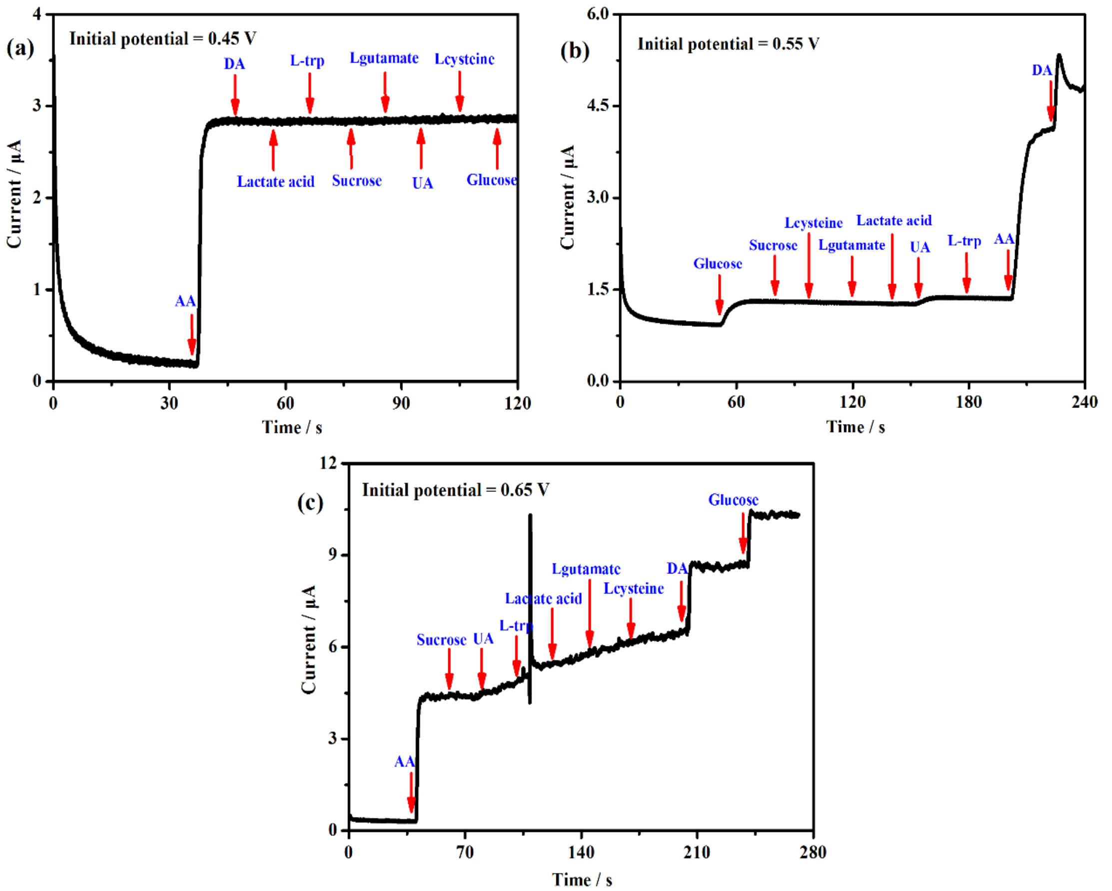

Fig. S3 The i-t curves of the PB NCs@POMs nanocomposite containing 25 μM of ascorbic acid, dopamine, glucose, uric acid, lactate acid, sucrose, l-gutamate, l-cysteine and l-tryptophan in 0.1 M PBS (pH 7.0) at different initial potentials of (a) 0.45V, (b) 0.55V, (c) 0.65V.

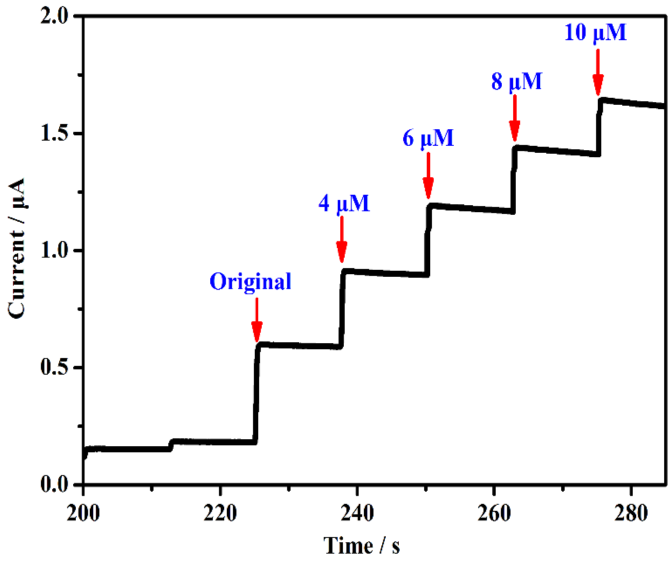

Fig. S4 The i-t curve of the PB NCs@POMs nanocomposite for AA detection in drinks of orange juice.

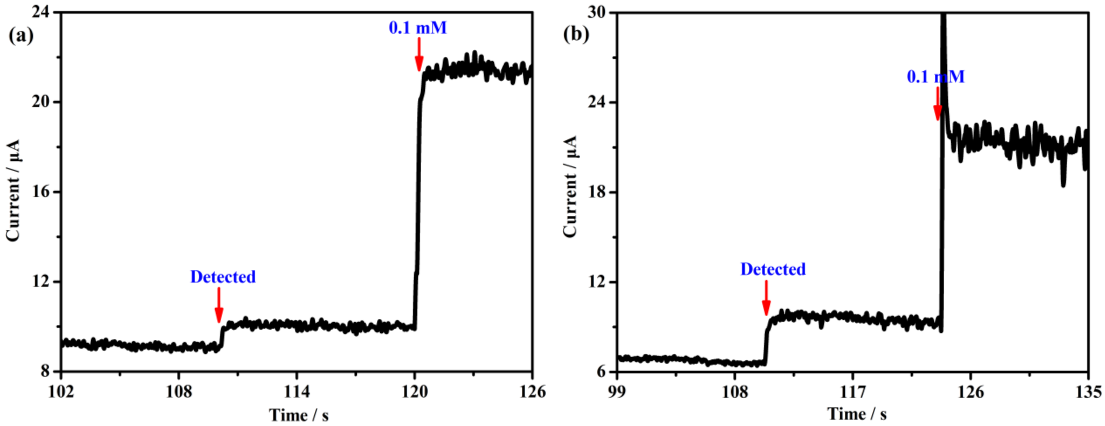

Fig. S5 The i-t curve of the PB NCs@POMs nanocomposite for AA detection in human urine of (a) the first volunteer, and (b) the second volunteer.