

## Supplementary Information

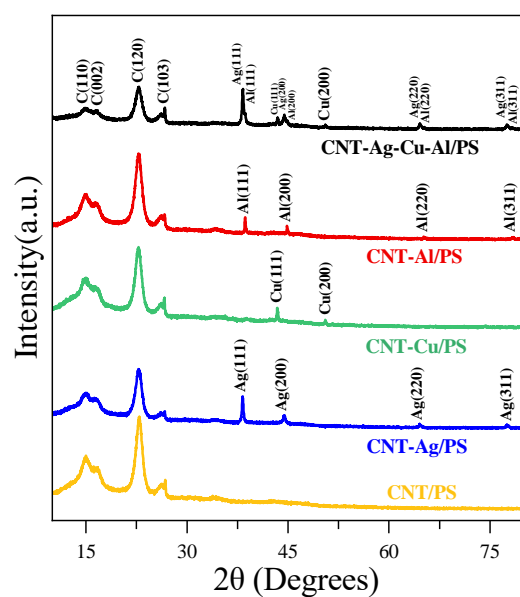
### **Development and Application of CNT-Ag-Cu-Al/PS-Based Paper Electrode for Detecting Diverse Analytes in Complex Matrices**

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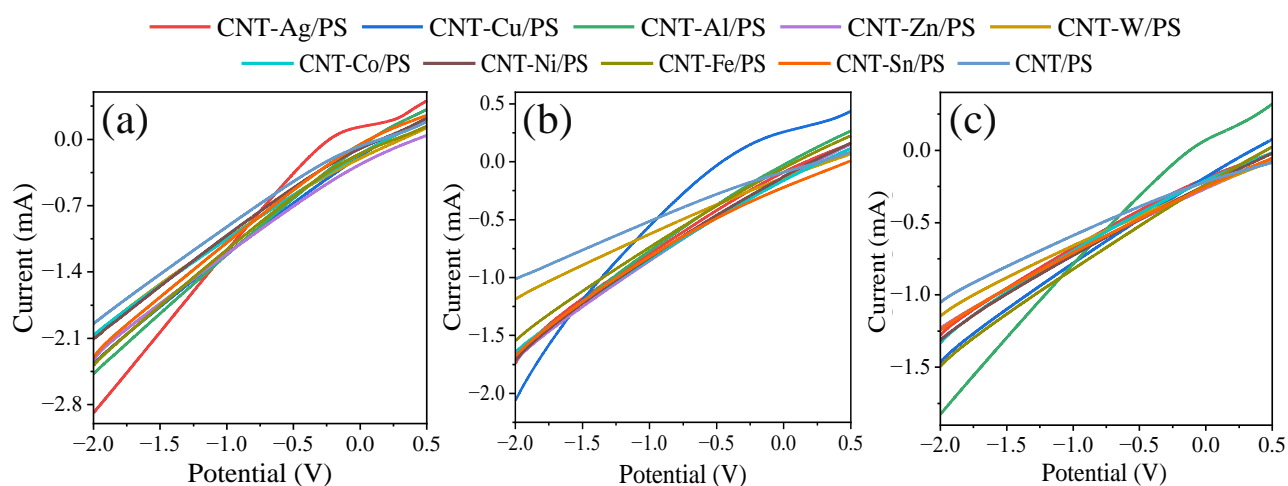
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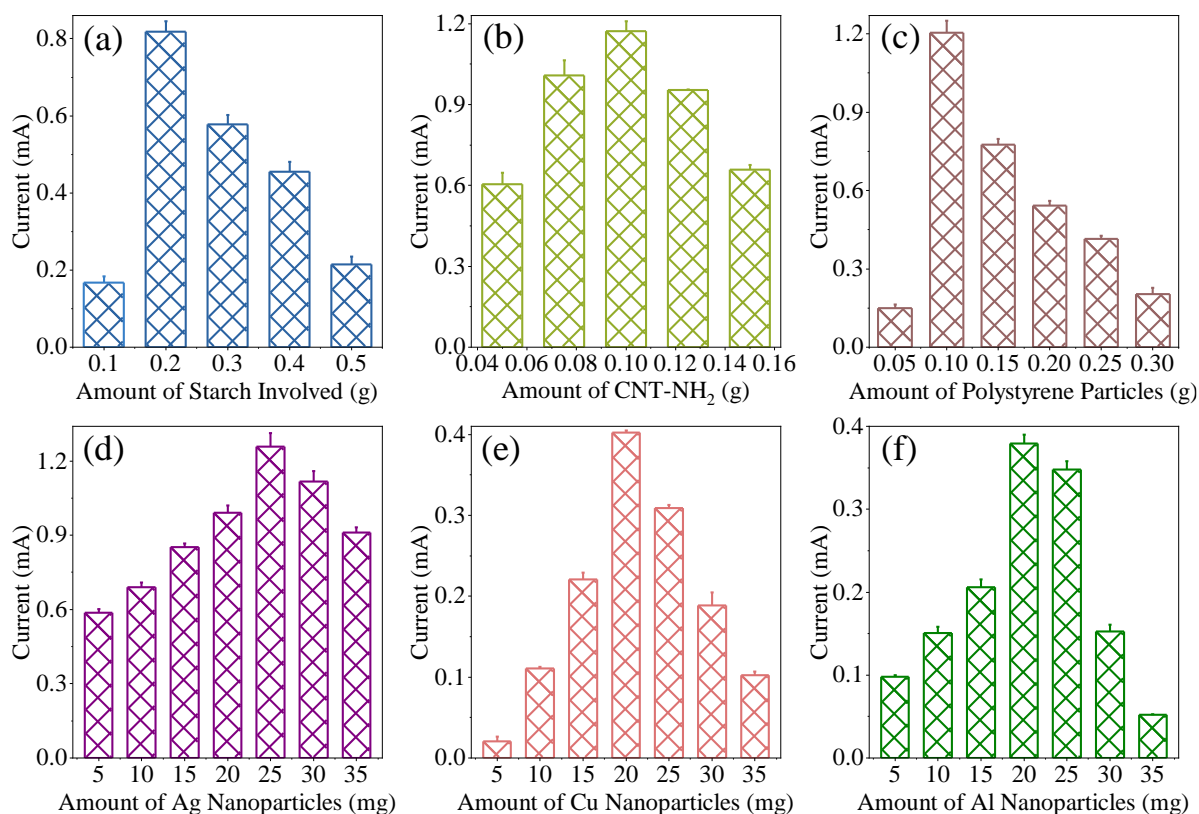
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**Fig. S1** XRD patterns of the different paper-based electrodes.



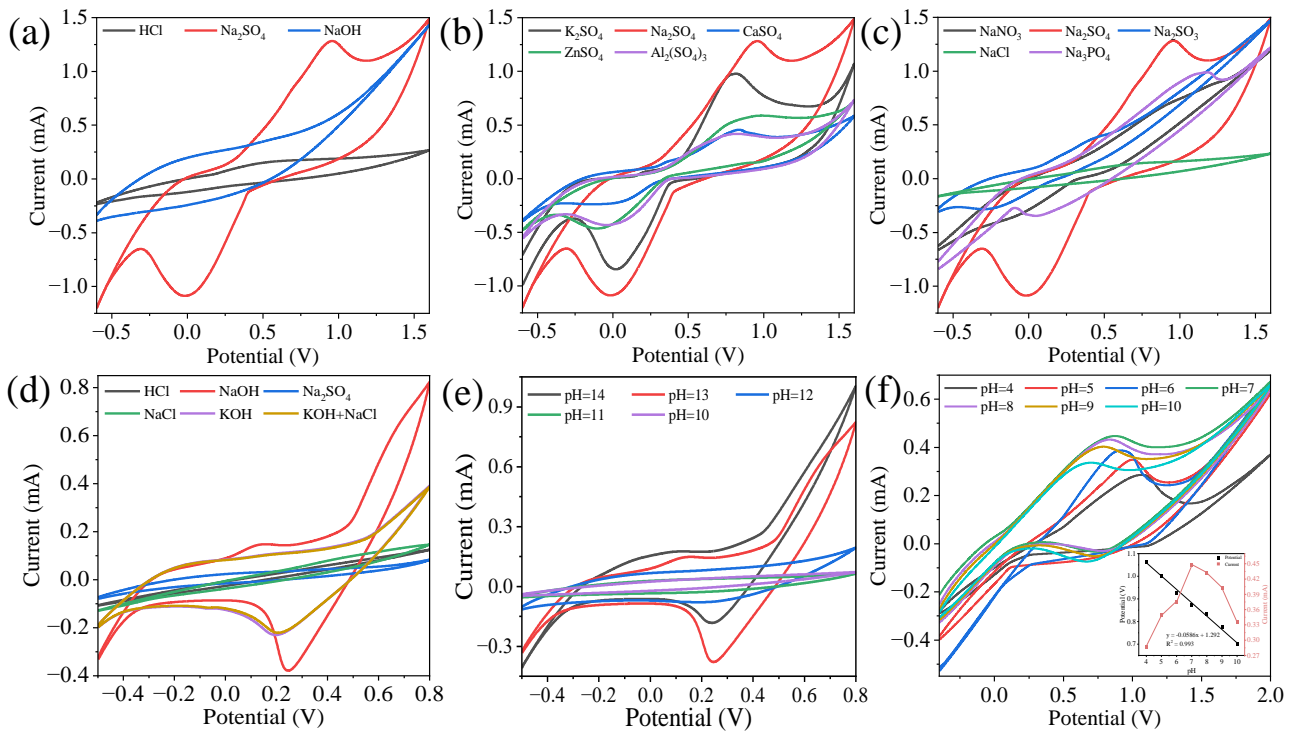
**Fig. S2** Comparison of the LSV curves of different types of metallic paper electrodes for the detection of 100  $\mu\text{M}$  Glc in 0.1 M  $\text{Na}_2\text{SO}_4$  (a), 10  $\mu\text{M}$  OTC in 0.1 M  $\text{NaOH}$  (b), and 20  $\mu\text{M}$  HQ in 0.1 M PBS buffer (c), with all test sweeps at 50  $\text{mV s}^{-1}$ .



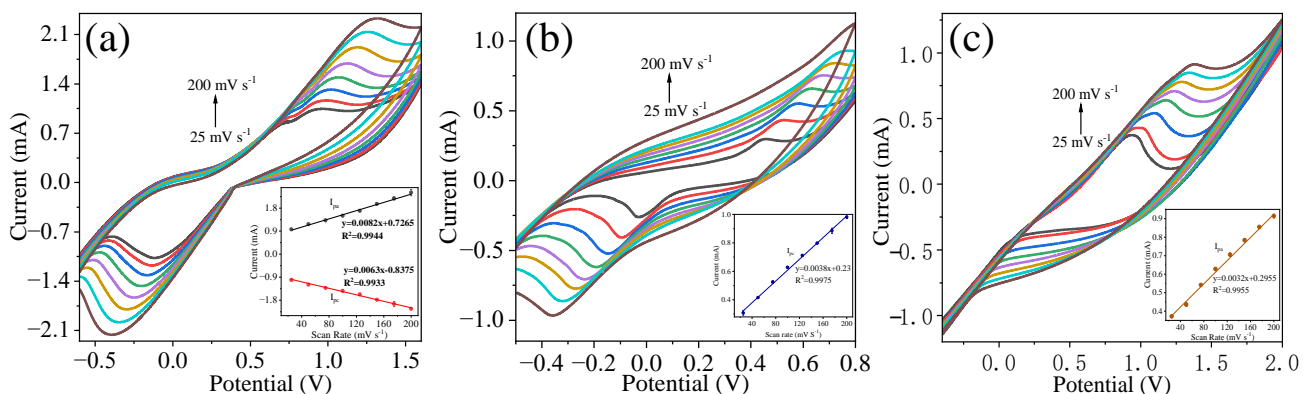
**Fig. S3** Effects of different experimental parameters on the electrochemical performance of CNT-Ag-Cu-Al/PS paper electrode: (a) amount of starch involved, (b) amount of CNT-NH<sub>2</sub> particles, (c) amount of PS particles involved, (d) amount of AgNPs, (e) amount of CuNPs, and (f) amount of AlNPs.

**Table S1** Fitting equivalent circuit parameters of different fabricated electrodes immersed in 0.1 M KCl, 5.0 mM K<sub>3</sub>[Fe (CN)<sub>6</sub>], and 5.0 mM K<sub>4</sub>[Fe(CN)<sub>6</sub>].

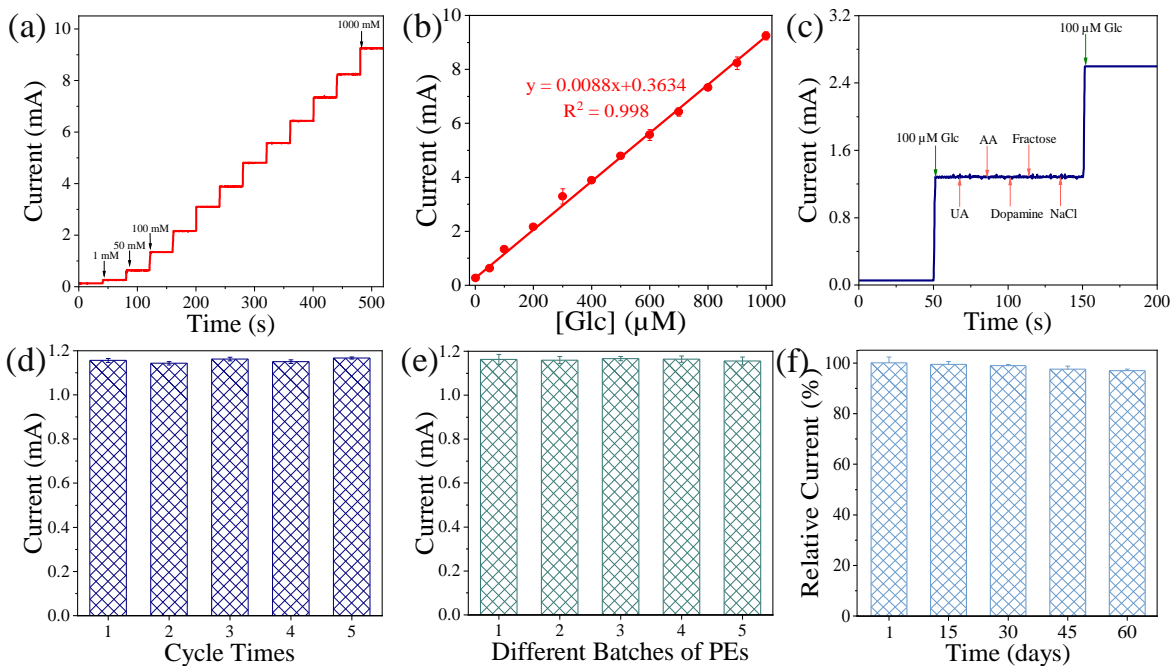
Electrode type	Electrode name	R <sub>s</sub> (Ω)	R <sub>ct1</sub> (Ω)	R <sub>ct2</sub> (Ω)	CPE1 (μF)	CPE2 (μF)
1	CNT-Ag-Cu-Al/PS	19.9	441.0	445.9	0.971	0.453
2	CNT-Ag/PS	26.0	477.0	487.8	0.986	0.429
3	CNT-Cu/PS	25.8	509.3	545.8	0.964	0.648
4	CNT-Al/PS	33.1	567.6	606.7	1.100	0.729
5	CNT-Zn/PS	116.4	698.8	827.4	1.029	0.570
6	CNT-W/PS	117.7	708.0	828.8	1.021	0.572
7	CNT-Co/PS	94.8	757.7	897.1	0.988	0.636
8	CNT-Ni/PS	13.4	787.7	804.1	0.963	0.374
9	CNT-Fe/PS	92.1	790.7	714.7	0.964	0.143
10	CNT-Sn/PS	151.6	880.7	1056.0	1.027	0.618
11	CNT/PS	66.8	969.4	1064.0	0.988	0.299



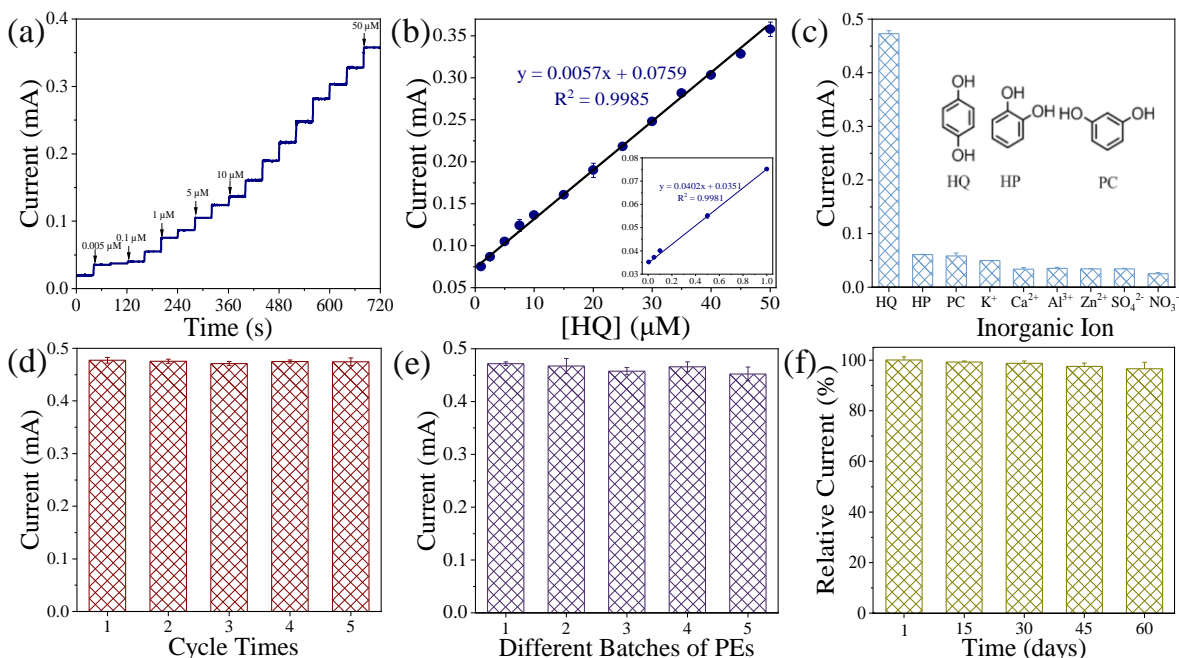
**Fig. S4** Comparison of CV curves of CNT-Ag-Cu-Al/PS paper electrodes for the detection of Glc in (a) acidic, neutral and alkaline, (b) metal salts containing various cations, and (c) metal salts containing various anions as electrolyte solutions; comparison of CV curves of CNT-Ag-Cu-Al/PS paper electrodes for the detection of OTC in (d) acidic, neutral and alkaline and (e) NaOH as an electrolyte solution at different pH, and (f) comparison of CV curves of CNT-Ag-Cu-Al/PS paper electrodes for the detection of HQ in PBS buffer solution at different pH.



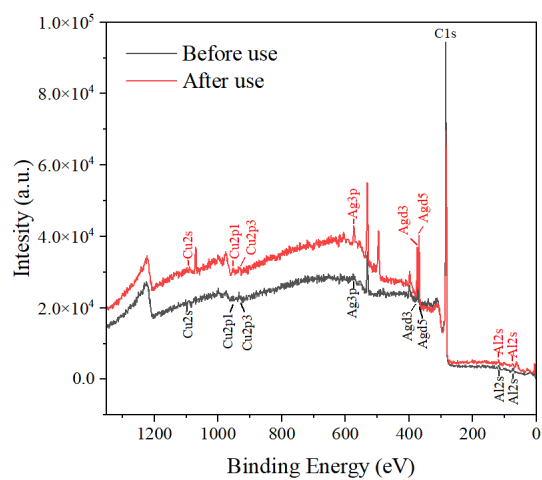
**Fig. S5** CV curves of Glc (a), OTC (b) and HQ (c) at CNT-Ag-Cu-Al/PS paper electrodes in the scanning range of 25-200 mV s<sup>-1</sup>, and their corresponding calibration plot of I<sub>p</sub> vs V



**Fig. S6** (a) steady-state current-time responses of Glc at the CNT-Ag-Cu-Al/PS paper electrode at +0.50 V in 0.1 M Na<sub>2</sub>SO<sub>4</sub>, and (b) calibration curve (current vs. concentration) of Glc (n=3); (c) add different interferers to explore the anti-interference of the detection process; (d) reproducibility and (e) response stability of different batches of the CNT-Ag-Cu-Al/PS paper electrode for Glc detection, and (f) long-term stability of the paper electrode.



**Fig. S7** (a) steady-state current-time responses of HQ at the CNT-Ag-Cu-Al/PS paper electrode at +0.50 V in 0.1 M PBS buffer, and (b) calibration curve (current vs concentration) of HQ (n=3); (c) add different interferers to explore the anti-interference of the detection process; (d) reproducibility and (e) response stability of different batches of the CNT-Ag-Cu-Al/PS paper electrode for HQ detection, and (f) long-term stability of the paper electrode.



**Fig. S8** XPS analysis of CNT-Ag-Cu-Al/PS paper electrode before and after use.