Electrochemical Sensor Based on ZrP/Cu-β-CD/MWCNTs Composite for Accurate Epinephrine Determination in Serum with High Recovery

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Section 1 Additional Experimental Section

I. Characterization and Electrochemical Testing Methods

The structure of the synthesized products was investigated using Scanning Electron Microscopy (SEM) (JEM-2100) and Transmission Electron Microscopy (TEM) (JEOL, JEM-2010200 kV). FT-IR absorption spectroscopy characterization was performed using a Bruker Tensor II spectrometer (Bruker, Germany). The measurement of electrochemical resonance peaks was conducted using a CHI760E electrochemical workstation in a standard three-electrode configuration, with a platinum wire serving as the counter electrode and Ag/AgCl as the reference electrode.

II. Chemicals and Materials

All reagents utilized for synthesis were procured commercially and are suitable for use without further purification. Zirconium oxychloride octahydrate ($ZrOCl_2{\cdot}8H_2O$) was obtained from RHAWN, phosphoric acid (H_3PO_4), MWCNTs, glucose (Glu), L-tyrosine (L-Tyr), L-tryptophan (L-Try), D-trypttophan （D-Try), D-alanine (D-Ala), sodium chloride (NaCl), uric acid (UA), EP and sodium hydroxide (NaOH) were sourced from Aladdin, copper (II) sulfate pentahydrate ($CuSO_4{\cdot}5H_2O$) was acquired from Leyan Reagent Company, beta-cyclodextrin (β-CD) was purchased from Tianjin Guangfu Fine Chemical Research Institute, anhydrous ethanol (C_2H_6O) was obtained from Tianjin Jiayu Fine Chemical Co., Ltd., and zinc acetate ($(CH_3COO)_2Zn$) was sourced from Acros, magnesium chloride ($MgCl_2$) purchased from Yuanye Biotechnology,

potassium chloride (KCl) purchased from Tianjin Kemio Chemical Reagent Co., Ltd, zinc chlorid ($ZnCl_2$) and urea purchased from Ron's reagent, sodium dihydrogen phosphate purchased from Tianjin Opsheng Chemical Co., Ltd, sodium dihydrogen phosphate was purchased from Tianjin Kaitong Chemical Reagent Co., Ltd, potassium ferrocyanide purchased from Tianjin Hengxing Chemical Reagent Co., Ltd, potassium ferrocyanide purchased from Tianjin Zhiyuan Chemical Reagent Co., Ltd, nafion purchased from Sigma Aldrich.

III. Atomic Interaction Model Method

All calculations were carried out using the Gaussian 16 program. The obtained results were analyzed and visualized with Multiwfn and VMD. The B3LYP functional in combination with the 6-31G basis set was applied throughout the computations.

Section 2 Structure Characteristics

I. The FT-IR spectra of ZrP, Cu-*β*-CD, and ZrP/Cu-*β*-CD/MWCNTs.

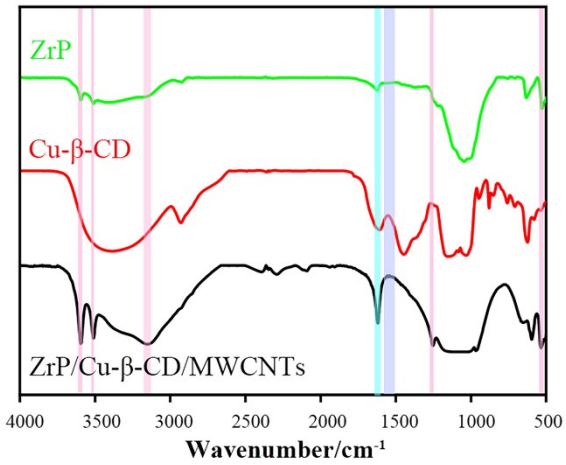

Fig. S1 FT-IR plot of ZrP, Cu-*β*-CD, and ZrP/Cu-*β*-CD/MWCNTs.

II. PXRD plots of ZrP, Cu-*β*-CD, MWCNTs, and ZrP/Cu-β-CD/MWCNTs

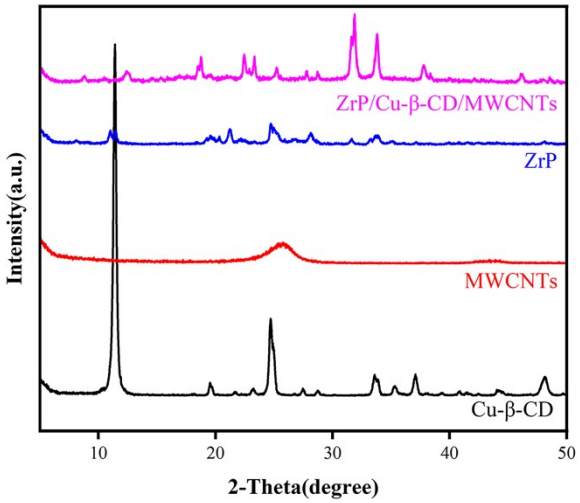

Fig. S2 PXRD plots of ZrP, Cu-*β*-CD, MWCNTs, and ZrP/Cu-*β*-CD/MWCNTs

Section 3 optimization experiments

I. The impact of changes in component ratios

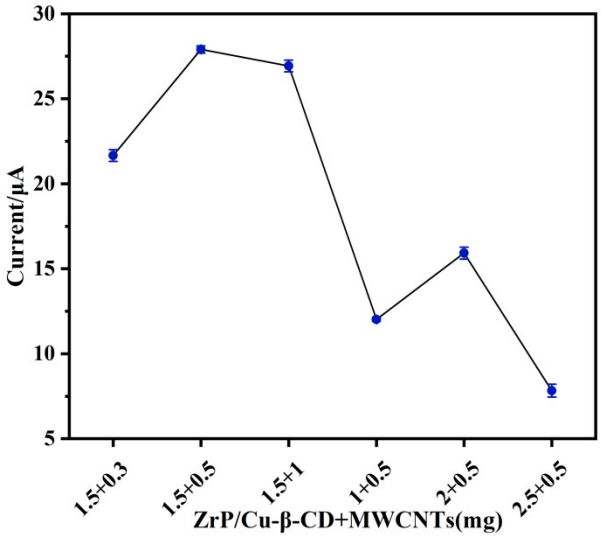

Fig. S3 The Influence of Component Ratio Changes on Peak Response Current. Data are presented as mean ± SD (n = 5).

II. The influence of drip coating amount

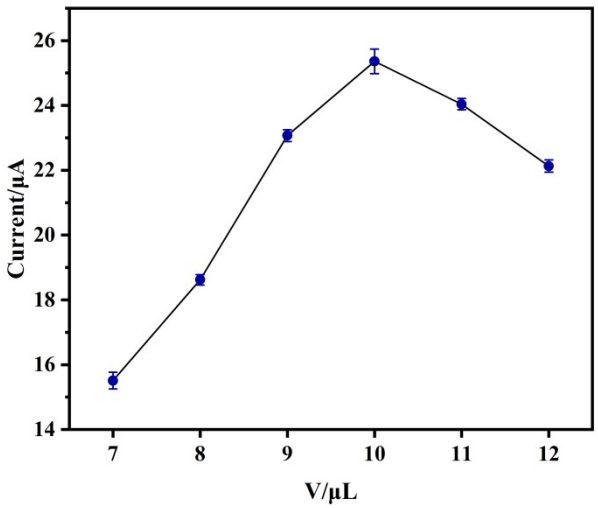

Fig. S4 The influence of droplet coating amount on peak response current. Data are presented as mean ± SD (n = 5).