# Self-Powered Photoelectrochemistry Biosensor for Ascorbic Acid Determination in Beverage Samples Based on Perylene Material

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## Experiment

### Chemicals

3,4,9,10-perylenetetracarboxylic dianhydride(PDA) was purchased from TCI-SCT(Shanghai, China). Glycine(Gly), histidine(His), serine(Ser), threonine(Thr), lysine(Lys), alanine(Ala), methionine(Met), leucine(Leu), glutathione(GSH), glucose(Glu) and fructose(Fru) was purchased from Aladdin Biochemical Technology Co., Ltd.(Shanghai, China). O-Phenylenediamine(OPD) was purchased from Macklin Biochemical Co., Ltd.(Shanghai, China). Other chemicals was analytical reagent. Ultrapure water (> 18 MΩ) from a Milli-Q Plus system (Millipore) was used to prepare aqueous solutions.

## Instrument

PEC experiments were performed on a PLS-LED 100B High power LED light source (PerfectLight Technology Co., Ltd., China) with electrochemical workstation CHI 660B (Shanghai CHI Instruments Co., Ltd., China). The working electrode was glassy carbon electrode(GCE) (3-mm diameter), reference electrode be Ag/AgCl (KCl-saturated) and counter electrode be platinum wire. The supporting electrolyte was 0.1 M phosphate buffer saline (PBS, pH 7.4). Scanning electron microscopy (SEM) was performed on a Zeiss Supra-40 scanning electron microscope (accelerating voltage: 5 kV). Lambda 750 spectrophotometer of Perkin Elmer in USA were used to measure the ultraviolet–visible (UV–Vis) absorption spectra. Fluorescent(FL) spectrum of OPD and AA mixture solution was recorded on F-7000(HITACHI Ltd., Japan). The infrared spectra of the PDA was recorded by NICOLET 5700 Fourier infrared spectrometer. SK type ultrasonic cleaning machine (Shanghai Keguo Ultrasonic instrument Co., Ltd), pHS-3C meter (Shanghai second analysis instrument factory), dry type thermostat (Hangzhou Aomori Instrument Co., Ltd). In PEC experiment, the applied voltage was at 0 V vs. Ag/AgCl.

### The preparation of PDA self-assembly material modified GCE

5.88 mg PDA powder was added to 5 mL of ultrapure water and sonicated for 1 h. The PDA solution was then allowed to self-assemble for 12 h at 20 ℃. Thereafter, the resulting PDA solution was stored at 4 ℃ for use. Finally, 6 μL PDA solution was dropped on the polished GCE surface and dried at room temperature for use.

### Standard OPD-based fluorescence method

1 mM OPD in 50 mM tris-HCl(pH=9.0) was mixed with different concentrations of AA solution and incubated at 37 ℃ for 120 min, which produced fluorescence quinoxaline in situ and exhibited blue fluorescence emission wavelength at 425 nm. The excitation wavelength($\lambda_{ex}$) was set at 360 nm and the fluorescence intensity at 425 nm was recorded.

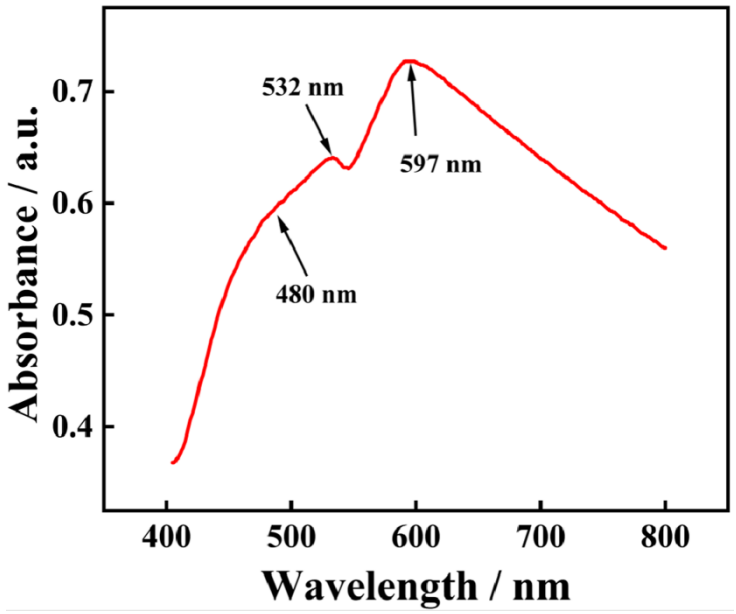



**Figure S1.** The UV-vis absorption spectra of PDA aqueous solution.

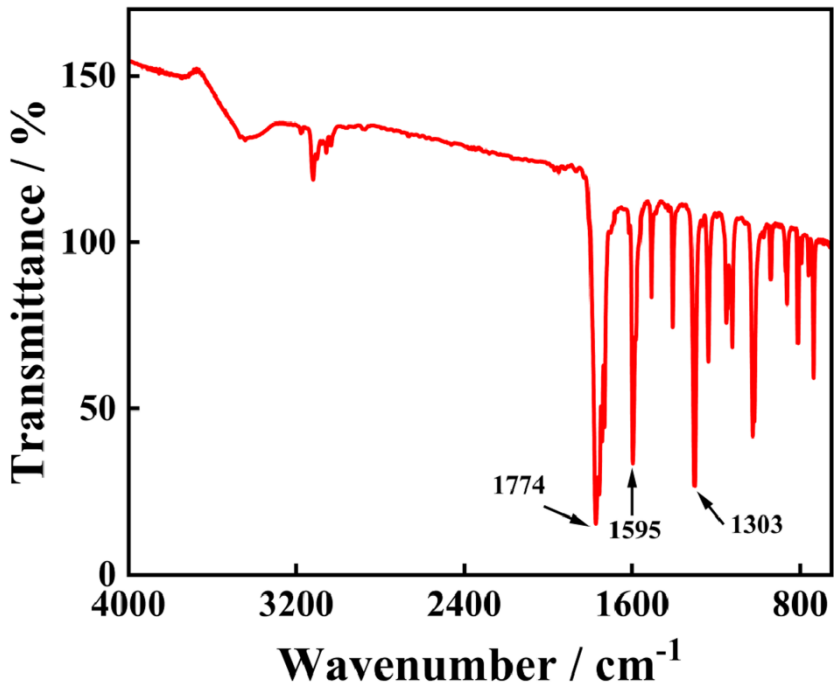



**Figure S2.** The FT-IR spectrum of PDA

**Table S1.** The IR characteristic peaks of the PDA.

| | υ(C=O)/cm$^{-1}$ | υ(C=Cin aromatic ring )/cm$^{-1}$ | υ(O=C-O-C=O)/cm$^{-1}$ |
|---|---|---|---|
| PDA | 1774 | 1600-1400 | 1303 |

**Table S2** The comparison of different AA biosensors.

| Method | Linear range (μM) | LOD (μM) | Refs |
|---|---|---|---|
| Fluorescence | 10-100 | 1.8 | 1 |
| Electrochemistry | 10-50 | 4.7 | 2 |
| Colorimetry | 0.25-50 | 0.079 | 3 |
| Colorimetry | 0.5-30 | 0.28 | 4 |
| PEC | 1000 - 5000 | 1000 | 5 |
| PEC | 5-300 | 1 | 6 |
| PEC | 5-400 | 4.1 | This work |

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