Supplementary Material

A selective electrochemical sensing platform for simultaneous detection of ascorbic acid, dopamine and uric acid based on AuNPs/carboxylated COFs/Poly (Fuchsin basic) film

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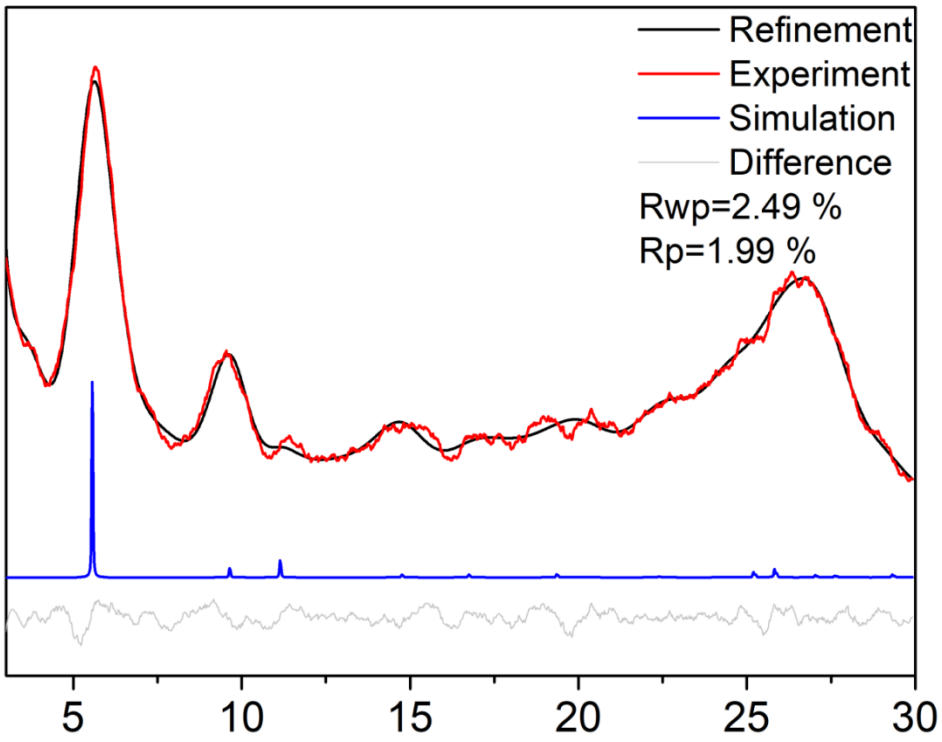


Figure S1. Experimental, Pawley refined and simulated XRD patterns of COF-TaTp.

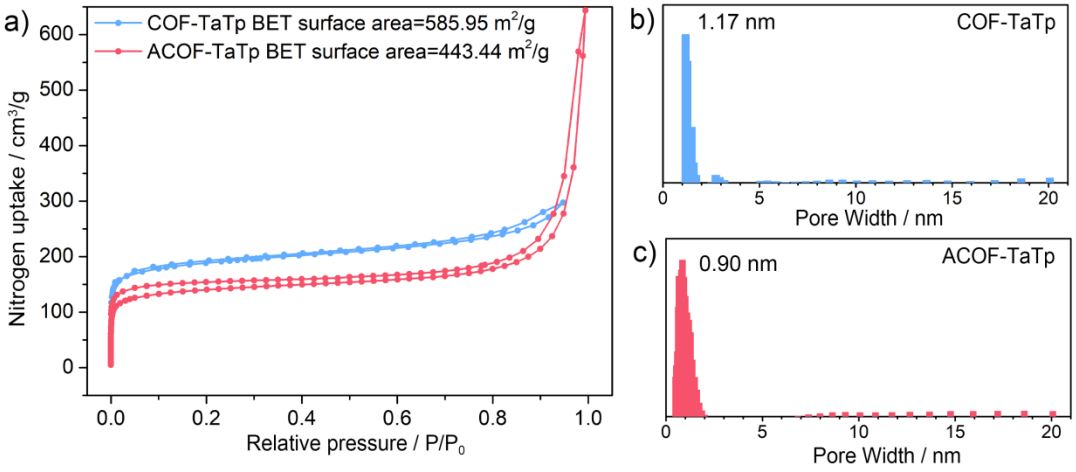


Figure S2 N_2 adsorption-desorption curves (a) and pore size distribution (b) of COF-TaTp and ACOF-TaTp

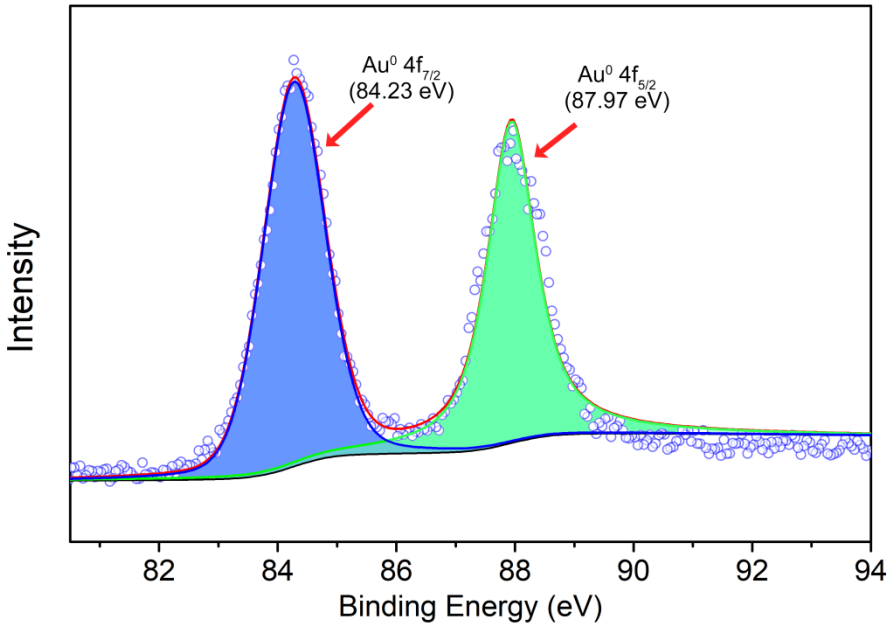


Figure S3. XPS spectrum of high-resolution Au 4f region.

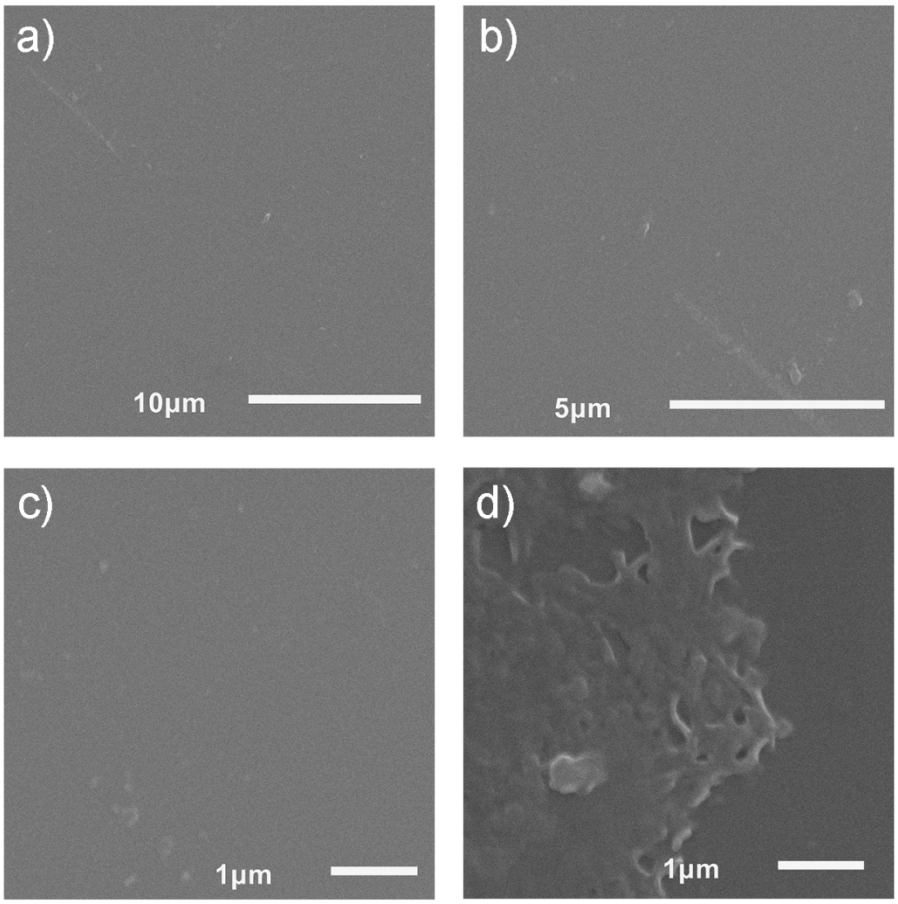


Figure S4 SEM images of poly-BFu film polymerized on the electrode under constant potential: a), b), c) dense poly-BFu film in different magnification; d) ledge place somewhere on the film.

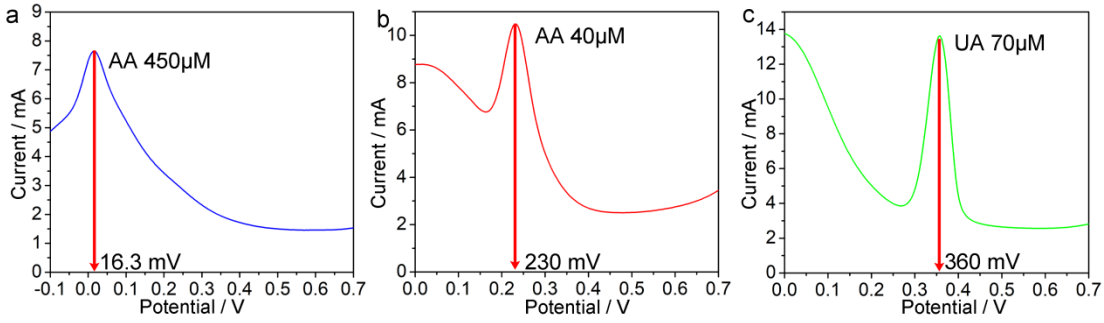


Figure S5. a), b), c) Individual DPV responses of the AA, DA, and UA, respectively, at pH 5.5 in 0.1M PBS solution.

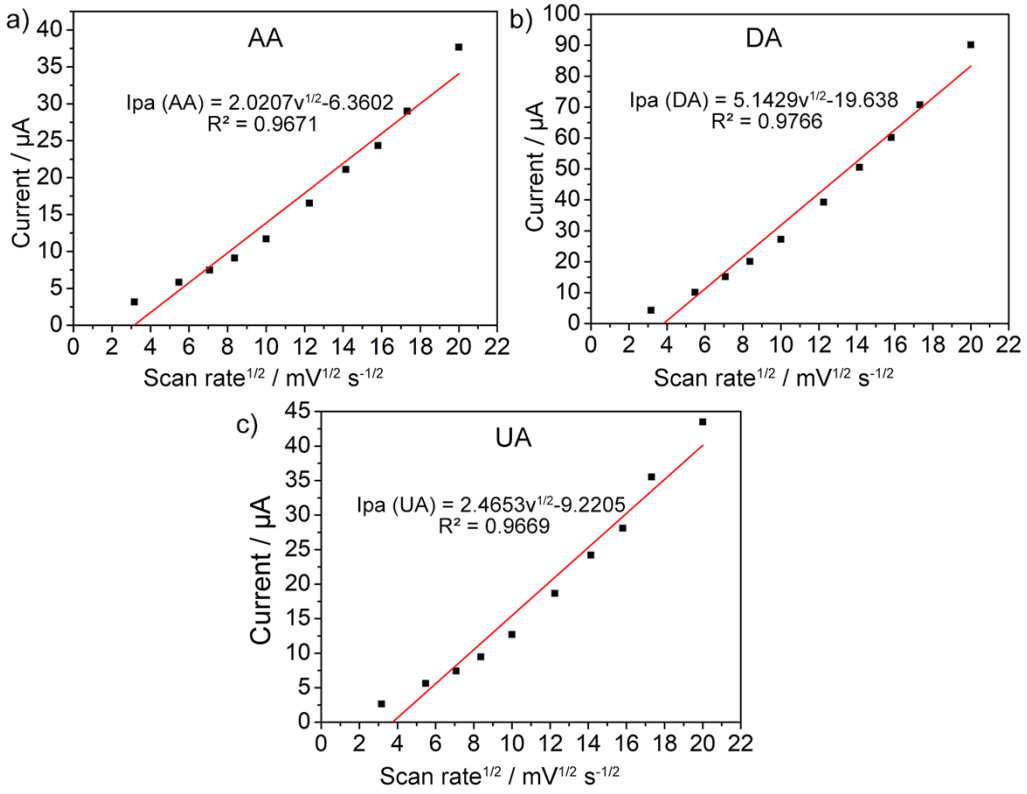


Figure S6. a) The relationship of AA's peak current with the square root of scan rate (mV/s). b) The relationship of DA's peak current with the square root of scan rate (mV/s). (c) The relationship of UA's peak current with the square root of scan rate (mV/s). (Concentration: 300 μM AA, 10 μM DA and 30 μM UA).

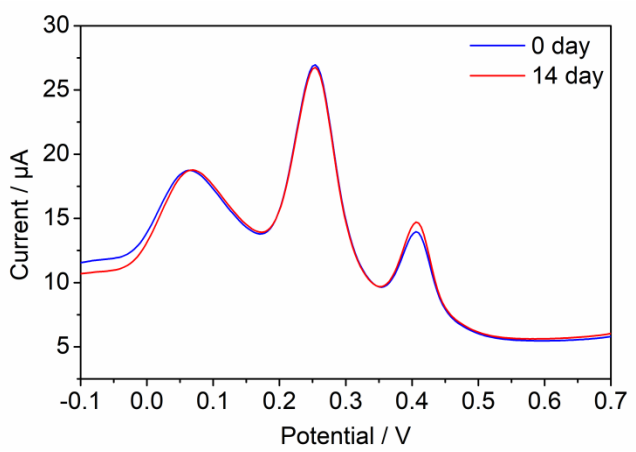


Figure S7. The DPV curves obtained on the prepared AuNPs@ACOF/p-BFu/GCE for stability test. The electrode was sealed and kept at 15-25ºC with the humidity of 50%-80% for two weeks before test.

Table S1. Peak energy of XPS survey spectra

Name	Peak BE (eV)	FWHM (eV)	Area (P) CPS. eV	Atomic (%)
COF-TaTp				
C1s	284.81	1.55	169899.51	74.48
O1s	399.79	2.97	53641.41	14.55
N1s	531.44	2.5	66265.22	10.97
ACOF-TaTp				
C1s	284.39	2.61	21955.3	78.19
O1s	398.72	3.08	5385.84	11.86
N1s	532.29	3.87	7391.33	9.95
AuNPs/ACOF-TaTp				
C1s	284.8	1.76	20805.78	71.54
O1s	399.02	2.89	6723.11	14.3
N1s	532.08	3.45	10468.03	13.6
Au4f	84.31	1.19	3623.1	0.57

Table S2. The comparison in peak-to-peak separation potential of AA, DA, and UA

with other reports in literature.

Number	AA (mV)	DA (mV)	UA (mV)	AA-DA* (mV)	DA-UA* (mV)	Reference
1	40	253	390	213	137	[S1]
2	37	188	339	151	151	[S2]
3	67	210	360	143	150	[S3]
4	8	201	341	193	140	[S4]
5	114	294	409	180	115	[S5]
6	48	216	372	168	156	This work

* The peak-to-peak separation potential

[S1] Q. Zhu, J. Bao, D. Huo, M. Yang, C. Hou, J. Guo, M. Chen, H. Fa, X. Lu, Y. Ma, 3D Graphene hydrogel-gold nanoparticles nanocomposite modified glassy carbon electrode for the simultaneous determination of ascorbic acid, dopamine and uric acid, Sens. Actuators B: Chem., 2017, 238, 1316-1323. https://doi.org/10.1016/j.snb.2016.09.116.

[S2] H. Yang, J. Zhao, M. Qiu, P. Sun, D. Han, L. Niu, G. Cui, Hierarchical bi-continuous Pt decorated nanoporous Au-Sn alloy on carbon fiber paper for ascorbic acid, dopamine and uric acid simultaneous sensing, Biosens. Bioelectron., 2019, 124-125, 191-198. https://doi.org/10.1016/j.bios.2018.10.012.

[S3] J. Feng, Q. Li, J. Cai, T. Yang, X. Hou, Electrochemical detection mechanism of dopamine and uric acid on titanium nitride-reduced graphene oxide composite with and without ascorbic acid, Sens. Actuators B Chem., 2019, 298, 126872. https://doi.org/10.1016/j.snb.2019.126872.

[S4] W. Cai, J. Lai, T. Lai, H. Xie, J. Ye, J. Controlled functionalization of flexible graphene fibers for the simultaneous determination of ascorbic acid, dopamine and uric acid, Sens. Actuators B: Chem., 2016, 224, 225-232. https://doi.org/10.1016/j.snb.2015.09.079.

[S5] Q. Li, C. Huo, K. Yi, L. Zhoub, L. Su, X. Hou, Preparation of flake hexagonal BN and its application in electrochemical detection of ascorbic acid, dopamine and uric acid, Sens. Actuators B: Chem., 2018, 260, 346-356. https://doi.org/10.1016/j.snb.2017.12.208.

Table S3. Five samples of mixture of 150 μM AA, 5 μM AA and 25 μM UA were

determined with the same electrode

Samples serial number	AA Current µA	RSD %	DA Current µA	RSD %	UA Current µA	RSD %
1	6.772		6.572		11.68	
2	6.837		6.723		11.53	
3	6.695	1.79	6.635	1.24	11.77	1.86
4	6.562		6.597		11.24	
5	6.579		6.765		11.39	

Table S4. Five times of mixture of 150 µM AA, 5 µM AA and 25 µM UA were determined with the same sample

Samples serial number	AA Current µA	RSD %	DA Current µA	RSD %	UA Current µA	RSD %
1	6.372		6.519		11.91	
2	6.569		6.383		11.09	
3	6.7883	2.39	6.505	2.63	11.68	3.01
4	6.538		6.837		11.98	
5	6.687		6.655		11.62	

Table S5. Effect of various substances on the determination of AA, DA and UA*

Substance	Amount (mM)	Relative error (%) AA	Relative error (%) DA	Relative error (%) UA
citric acid	50	0.3%	0.1%	-0.1%
glucose	20	0.2%	-0.3%	-0.2%
L-cysteine	20	0.5%	0.3%	-0.1%
NaCl	500	0.1%	0.0%	0.0%
KCl	100	0.0%	0.0%	-0.1%
NaH_2PO_4	100	0.2%	0.1%	0.1%
Na_2HPO_4	100	0.0%	-0.1%	0.0%
$CaCl_2$	100	0.7%	0.6%	0.3%
$MgCl_2$	100	1.1%	0.4%	0.5%

* The concentration: AA (640 μM), DA (5.8 μM) and UA (30 μM).

The calculation for relative error: Relative error = (C'-C) /C*100%

Where C' is the measured concentration, obtained by the calibration curve. C is the concentration of the prepared solution.

For example: For AA, after adding 20 mM glucose, the obtained Ip of AA is 18.76 μA. The measured concentration (C') for AA is calculated by the calibration curve, *Ip* (AA) = $0.0128C_{AA}$ + 10.541 (R^2 = 0.9991). The calculated concentration is 641.3 μM. Therefore, the relative error = (641.3-640)/640*100% = 0.2 %.

For DA, after adding 20 mM glucose, the obtained Ip of DA is 26.86 μA. The measured concentration (C') for DA is calculated by the calibration curve, *Ip* (DA1) = $1.9792C_{DA}$ + 15.42 (R^2 = 0.9941). The calculated concentration is 5.78 μM. Therefore, the relative error = (5.78-5.8)/5.8*100% = -0.3 %.

For UA, after adding 20 mM glucose, the obtained Ip of UA is 14.67 μA. The measured concentration (C') for UA is calculated by the calibration curve, *Ip* (UA1) = $0.3262C_{UA}$ + 4.9079 (R^2 = 0.9966). The calculated concentration is 29.94 μM. Therefore, the relative error = (29.94-30)/30*100% = -0.2 %.

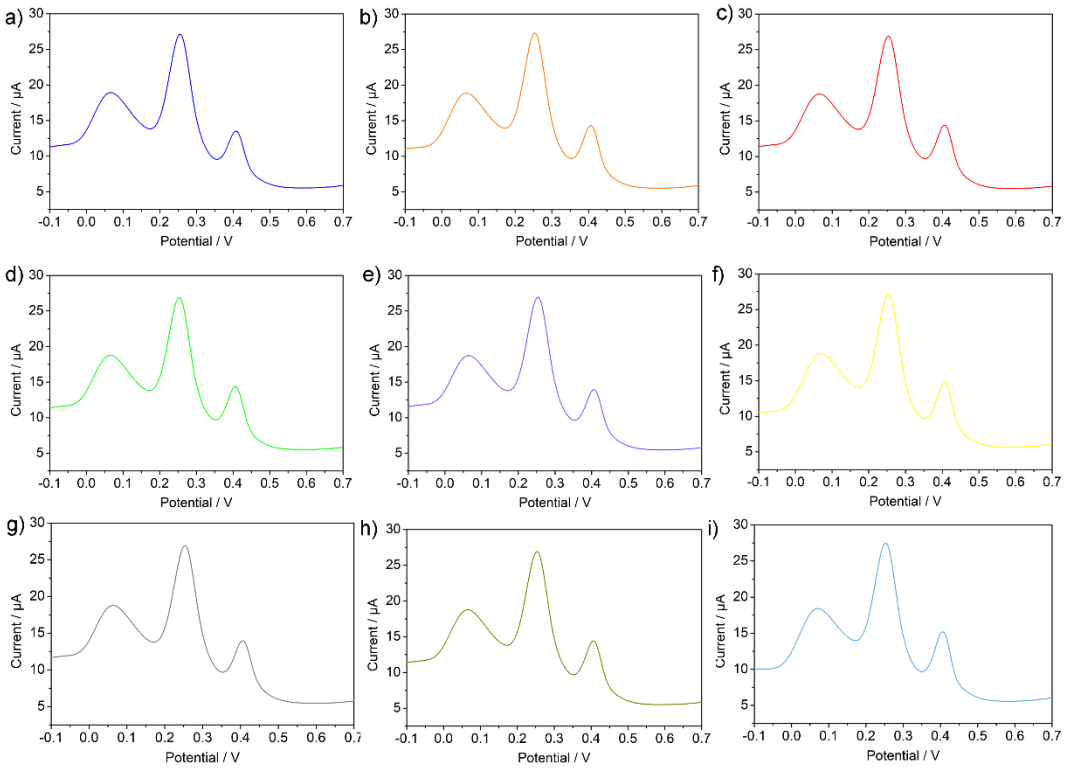


Figure S8. DPVs of AA (640 μM), DA (5.8 μM) and UA (30 μM) on AuNPs@ACOF/p-BFu/GCE in the PBS solution at pH 5.5 after adding 20 mM glucose (a), 100 mM $CaCl_2$ (b), 20 mM L-cysteine (c), 50 mM citric acid (d), 500 mM NaCl (e), 100 mM KCl (g), 100mM Na_2HPO_4 (h), 100 mM NaH_2PO_4 (f), 100 mM $MgCl_2$ (i).

Table S6. Results of AA determination in Vitamin C tablet[a] and DA determination in Dopamine injection[b]

Real sample	Labeled amount[c]	Found amount[d] (mg)	% Error	RSD (%)
Vitamin C tablet	100 mg	105.2	3.97	0.94
		103.9		
		102.8		
Dopamine injection	20 mg	18.6	-5.33	1.51
		18.9		
		19.3		

[a] Vitamin C tablet: HuaZhong Pharmaceutical CO., LTD., 100 mg, was diluted to 1 L with 0.1 M PBS; [b] Dopamine injection: Guilin Pharmaceutical Co., Ltd., 2 mL : 20 mg, was diluted to 2.5 L with 0.1 M PBS. [c] The labeled amount was directly used as the actual amount for comparison.

[d] Found amount = C·V·Mr

C (mM): The concentration of the sample diluted with PBS.

V (L): Liquid volume after dilution.

Mr (mg/mmol): AA = 176.13, DA (Hydrochloride) = 189.64, UA = 168.11.

Example for the calculation: For AA, the obtained Ip (AA) = 7.986 μA. Its concentration is calculated by the calibration curve, Ip (AA2) = $0.00240C_{AA}$+ 5.6781 (R2 = 0.9997). The calculated concentration is 586.7 μM = 0.5865 mM. Therefore, the found amount = C_{AA}·V·Mr = 0.5865 mM x 1 L x 176.13 mg/mmol = 105.2 mg.

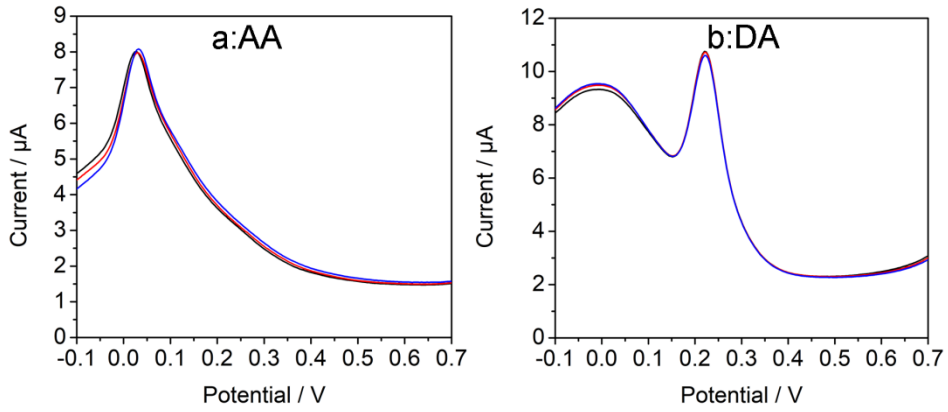


Figure S9. DPV curves obtained on the prepared AuNPs@ACOF/p-BFu/GCE for AA determination in Vitamin C tablet (a) and DA determination in Dopamine injection (b). The specific results are shown in Table S6

Table S7. Simultaneous determination of UA in urine samples (N=3)

Analytes	Determined (μM)	Added (μM)	Found (μM)	Recovery (%)	RSD (%)
UA	13.71	10	23.81	100.97	0.62
		50	66.26	105.11	0.94
		75	91.28	103.43	0.96

* The processed urine sample was diluted 300-fold with 0.1M PBS

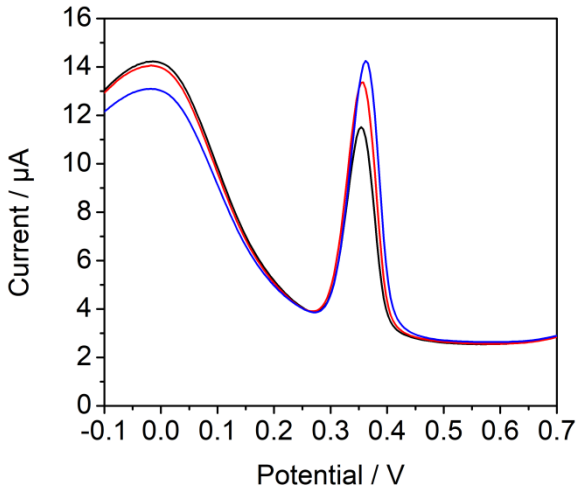
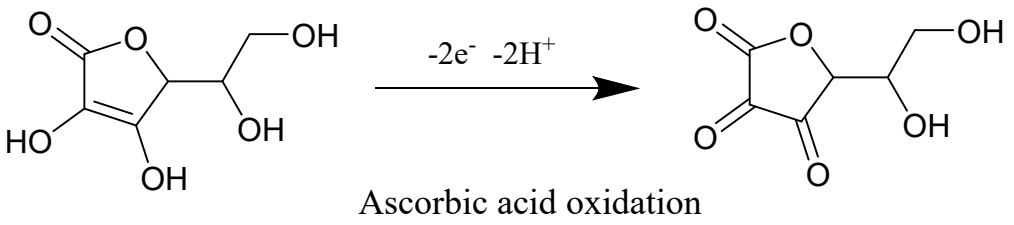
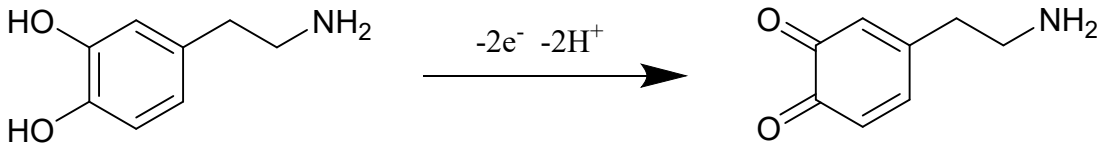


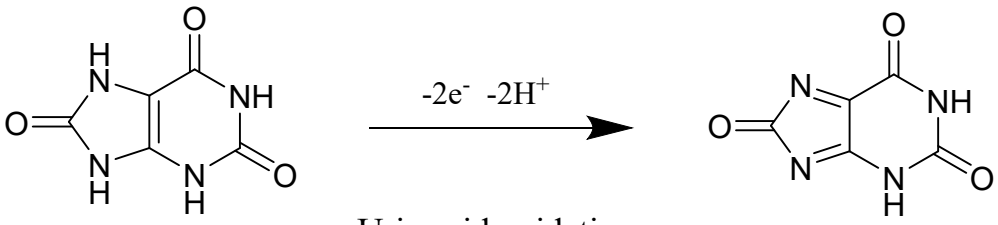
Figure S10. DPV curves obtained on the prepared AuNPs@ACOF/p-BFu/GCE for determination of UA in urine samples. The specific results are shown in Table S7



Ascorbic acid oxidation



Dopamine acid oxidation



Uric acid oxidation

Scheme S1. Oxidation of AA, UA, and DA on electrodes