Comment [S]: The second affiliation was added in the article text for corresponding author.

# Electronic Supplementary Information

## Amplified electrochemical sensor employing a polymeric film and graphene quantum dots/multiwall carbon nanotubes in deep eutectic solvent for sensitive analysis of paracetamol and 4-aminophenol

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Comment [S]: The second affiliation was added in the article text for corresponding author.

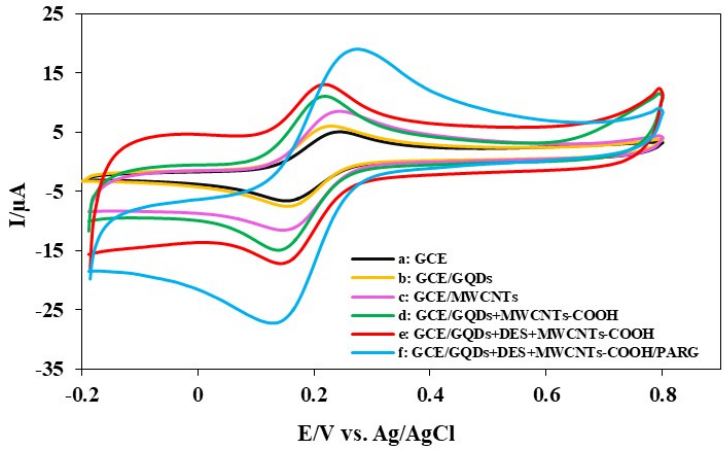


**Figure S1** Cyclic voltammograms of 1.0 mmol $L^{-1}$ of $K_3$ [Fe (CN) $_6$] containing 0.1 mol $L^{-1}$ KCl (scan rate: 0.1 V $s^{-1}$ ) recorded on bare GCE (a) GCE/GQDs (b), GCE/MWCNTs-COOH (c), GCE/GQDs+MWCNTs-COOH (d) GCE/GQDs+DES+MWCNTs-COOH (e) and GCE/GQDs+DES+MWCNTs-COOH/PARG (f).


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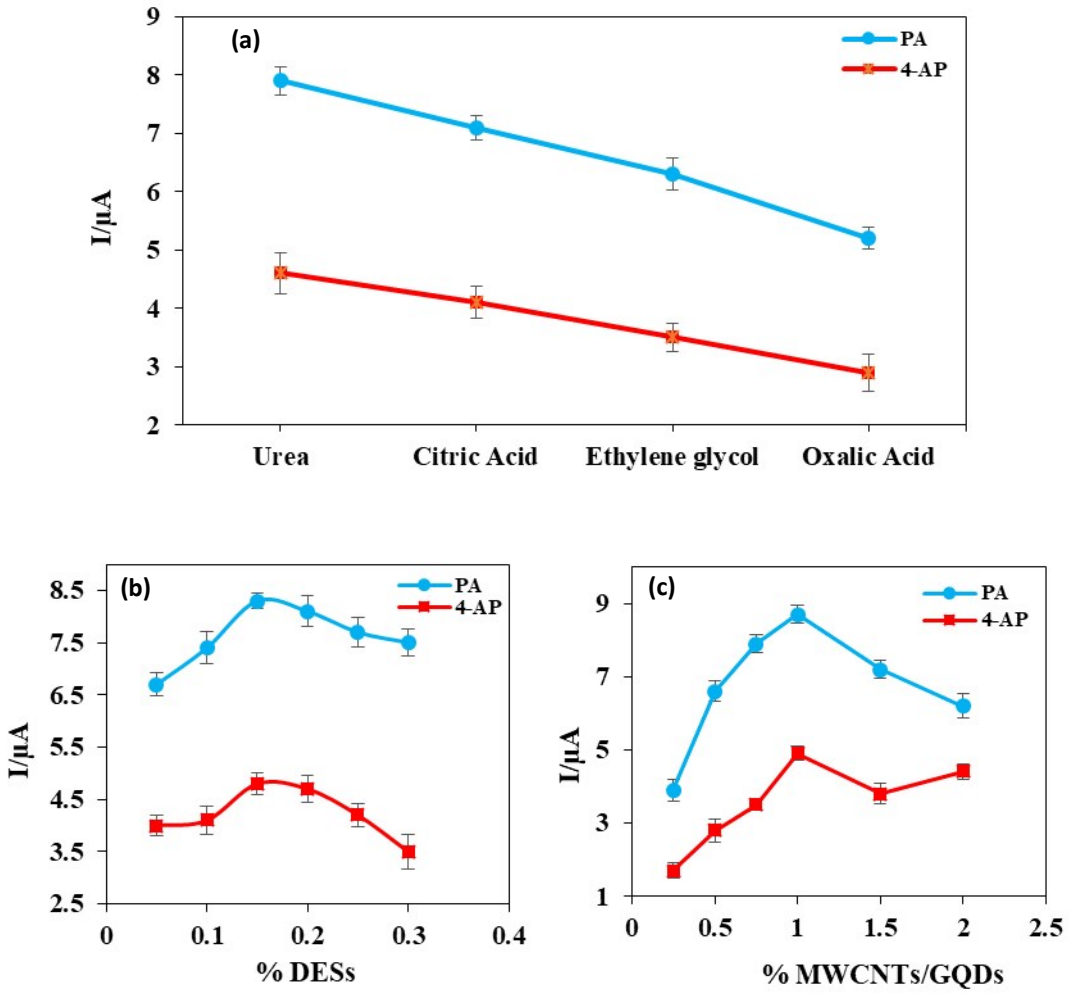


**Figure S2** Effects of type of DESs (a) Effects of the amount of DESs (b), and effects of weight ratio of MWCNTs:GQDs (c) on the oxidation peak current of 20.0 µmol $L^{-1}$ PA and 4-AP in 0.1mol $L^{-1}$ PBS (pH 6.0) at GCE/GQDs+DES+MWCNTs-COOH/PARG, scan rate: 10 mV $s^{-1}$.

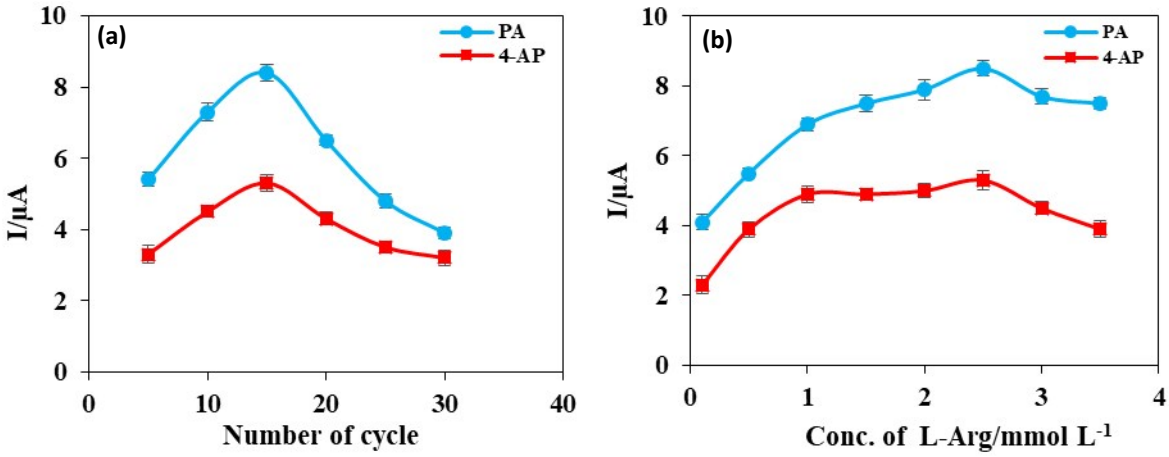


**Figure S3** Effects of number of cycles (a) and concentration of L-Arg (b) in the electropolymerization step on the oxidation peak current of 20.0 μmol $L^{-1}$ PA and 4-AP in 0.1mol $L^{-1}$ PBS (pH 6.0) at GCE/GQDs+DES+MWCNTs-COOH/PARG, scan rate: 100 mV $s^{-1}$.

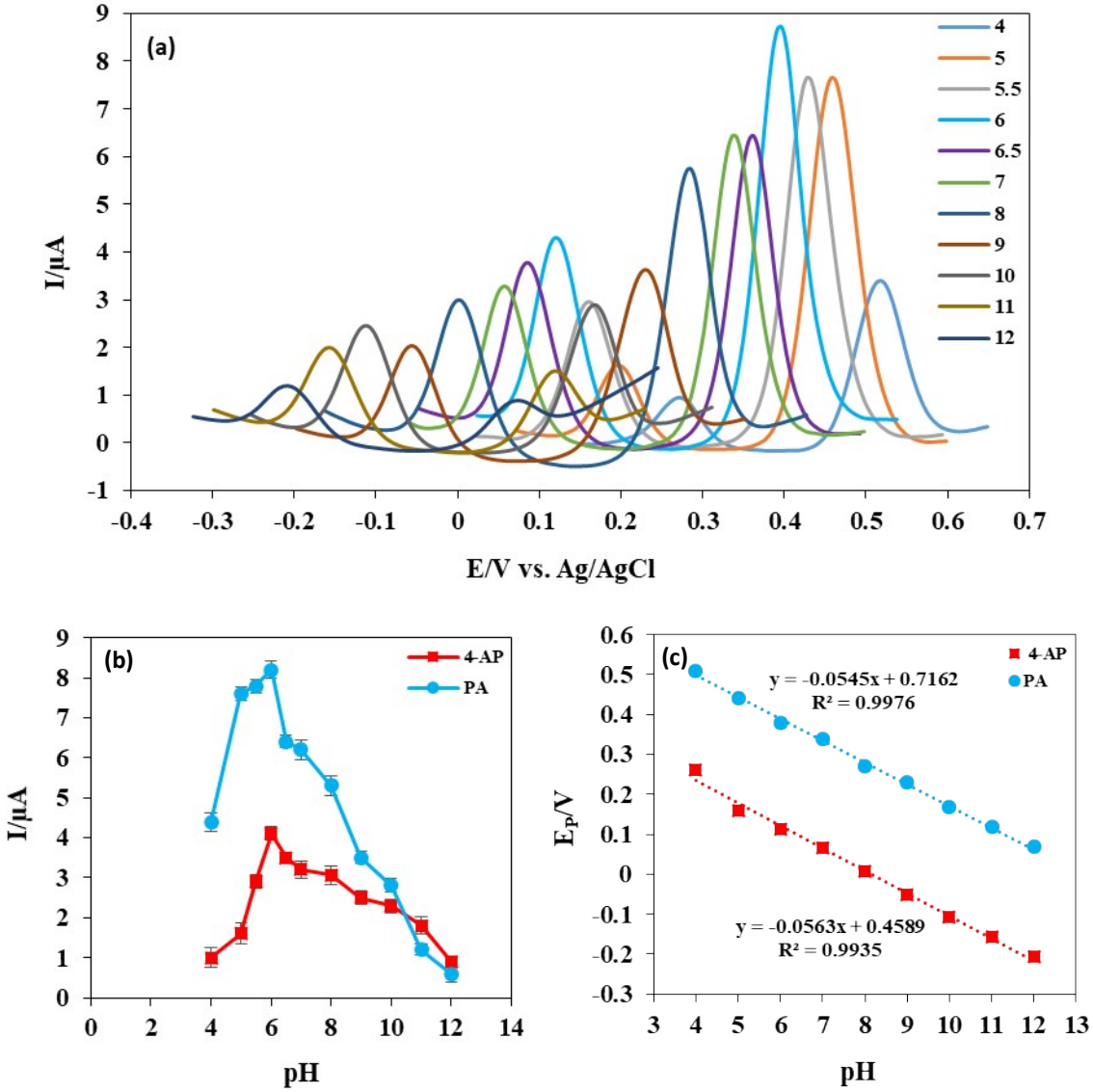


**Figure S4** DPV curves of 20.0 µmol $L^{-1}$ PA and 4-AP on GCE/GQDs+DES+MWCNTs-COOH/PARG at different pH values (from 4.0 to 12.0), Scan rate: 0.01 V $s^{-1}$ (a). Dependence of the oxidation peak current of PA and 4-AP to the solution pH (b). Dependence of the oxidation peak potential of PA and 4-AP to the solution pH.

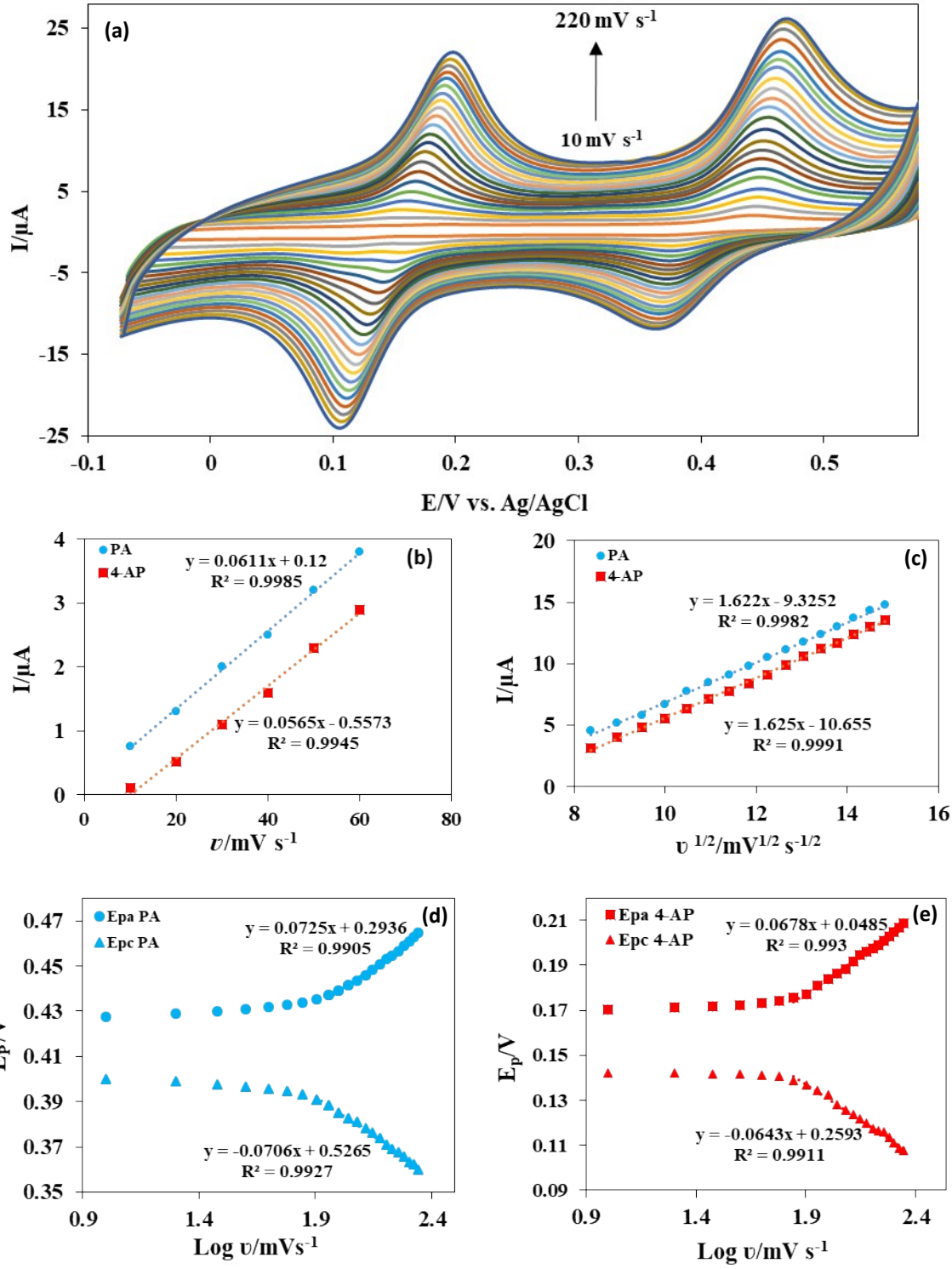
(a)
220 mV s-1
10 mV s-1
I/µA
E/V vs. Ag/AgCl
(b)
PA
4-AP
y = 0.0611x + 0.12
R² = 0.9985
y = 0.0565x - 0.5573
R² = 0.9945
I/µA
υ/mV s-1
(c)
PA
4-AP
y = 1.622x - 9.3252
R² = 0.9982
y = 1.625x - 10.655
R² = 0.9991
I/µA
υ 1/2/mV1/2 s-1/2
(d)
Epa PA
Epc PA
y = 0.0725x + 0.2936
R² = 0.9905
y = -0.0706x + 0.5265
R² = 0.9927
Ep/V
Log υ/mVs-1
(e)
Epa 4-AP
Epc 4-AP
y = 0.0678x + 0.0485
R² = 0.993
y = -0.0643x + 0.2593
R² = 0.9911
Ep/V
Log υ/mV s-1

**Figure S5** Cyclic voltammograms of 20.0 µmol $L^{-1}$ PA and 4-AP in 0.1mol $L^{-1}$ PBS (pH 6.0) on GCE/GQDs+DES+MWCNTs-COOH/PARG at different scan rate (from 10 to 220 mV $s^{-1}$) (a). Dependence of the oxidation peak currents of PA and 4-AP with scan rate (b). Dependence of the oxidation peak currents of PA and 4-AP with square root of scan rate (c). Dependence of the peak potential of PA with log scan rate (d). Dependence of the peak potential of 4-AP with log scan rate (e).

Table S1: Comparison of the characteristics of reported electrochemical methods for simultaneous determination of PA and 4-AP.

| Electrode | LDR (µmol $L^{-1}$) | | LOD (µmol $L^{-1}$) | | Sensitivity (µA. µmol$^{-1}$L ) | | [Ref.] |
|---|---|---|---|---|---|---|---|
| | PA | 4-Ap | PA | 4-AP | PA | 4-AP | |
| Co,Ni-$MoO_2$/MoC/GCE | 0.05-200.0 | 0.05-140.0 | 0.013 | 0.012 | 0.1530 | 0. 2633 | [1] |
| CuO-Au/MWCNT/GCE | 0.2-6.0 | 0.5-1.6 | 0.016 | 0.1 | 0.049 | 35.02 | [[2] |
| $MoS_2$@NHCSs/GCE | 0.05-20 | 0.05-20 | 0.02 | 0.013 | 0.2712 | 0.1978 | [[3] |
| CS/Au/Pd/Rgo/GCE | 1.0-250 | 1.0-300 | 0.3 | 0.12 | 0.052 | 0.1342 | [[4] |
| AuNPs/SDS-LDH/GCE | 1.0-400.0 | 0.5- 200.0 | 0.13 | - | 0.02 | 0.03 | [[5] |
| CILE | 2.0-2200 | 0.3-1000 | 0.5 | 0.1 | - | - | [[6] |
| PEDOT/GCE | 1.0-100.0 | 4.0-320.0 | 0.4 | 1.2 | 0.284 | 0.094 | [[7] |
| CdSe/GCE | 0.5-800.0 | 1.0- 900.0 | 0.1 | - | 0.025 | 0.0147 | [[8] |
| Cr-SBC/GCE | 0.008-0.125 | 0.008-0.133 | 0.0068 | 0.0056 | 0.0000411 | 0.000045 | [[9] |
| Poly(PE)Bis-8(hq)/GCE | 0.5-200 | 0.3-150 | 0.07 | 0.45 | 0.0431 | 0.096 | [[10] |
| Paper based devices | 50.0-2000 | 50.0-2000 | 25.0 | 10.0 | - | - | [[11] |
| RGO-TiN/GCE | 0.06-660 | 0.05-520 | 0.02 | 0.013 | 0.1304 | 0.2102 | [12] |
| CoTATPAPc/GCE | 0.02-0.34 | 0.02-0.34 | 0.0063 | 0.0 | 248.2 | 278.1 | [13] |
| GCE/GQDs+DES+MWCNTs-COOH/PARG | 0.030-110 | 0.050-100 | 0.010 | 0.016 | 0.2788 | 0.2511 | This work |

MoC: molybdenum carbide; rGO: reduced grapheme oxide. NHCS: nitrogen-doped hollow carbon spheres, SDS: sodium dodecyl sulfate; LDH: layered double hydroxide. CILE: carbon ionic liquid electrode; PEDOT: poly (3, 4-ethylenedioxythiophene); Cr-SBC: chromium schiff base complex; poly (PE) bis-8(hq): Poly (2, 2′-(1 4-phenylenedivinylene) bis-8-hydroxyquinaldine); TiN: titanium nitride; CoTATPAPc: cobalt (II) tetra 2-amino-3-(thio)propanoic acid phthalocyanine complex.

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