Supplemental Information For

Three-dimensional activated graphene networks–sulfonate-terminated polymer nanocomposite as a new electrode material for sensitive determination of dopamine and heavy metal ions

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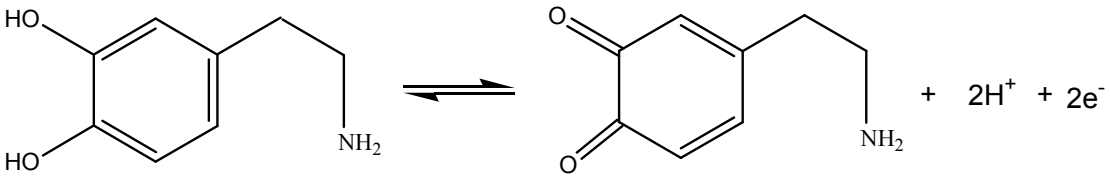
Scheme S1. Redox mechanism of DA.



dopamine (DA) dopaminequinone (DAQ)

Table S1. Comparison of the performance of 3DAGNs-STP/GCE with other electrodes for DA determination.

Electrodes	Limit of detection (μM)	Liner range (M)	Reference s
3DAGNs-STP/GCE	0.01	1.0×10^{-7}–3.2×10^{-5}	
Arrays of recessed ring disk	0.02	1.0×10^{-7}–1.0×10^{-3}	S1
Graphene modified GCE	2.64	4×10^{-6}–1×10^{-4}	S2
Nitrogen doped graphene modified electrode	0.25	5.0×10^{-6}–1.7×10^{-4}	S3
Silicon nanowire modified electrode	0.04	3.0×10^{-7}–2.0×10^{-4}	S4
Au nanoplates and reduced graphene oxide (RGO) modified GCE	1.4	6.8×10^{-6}–4.1×10^{-5}	S5
Gold nanoparticle-sheathed glass capillary nanoelectrode	0.01	2.0×10^{-8}–5.6×10^{-6}	S6
Graphene oxide-ferulic acid modified GCE	0.19	6.0×10^{-7}–1×10^{-3}	S7

Table S2. Determination of DA in real samples (*n*=3).

Sample	Added (μM)	Found (μM)	Recovery (%)	R. S. D (%)
Urine #1	20.00	19.52	97.6	2.90
Urine #2	20.00	18.42	92.1	4.45
Urine #3	20.00	21.03	105	5.27

Table S3. Cd^{2+} and Pb^{2+} detection limits by anodic stripping techniques at Bi film modified electrodes.

Modified electrodes	Detection limits		References
	Cd^{2+} (μg L^{-1})	Pb^{2+} (μg L^{-1})	
Bi/3DAGNs-STP/GCE	0.1	0.2	This work
Bi-coated carbon electrodes		0.3	S8
Bi nano-powder electrode	0.15	0.07	S9
Bi/poly(p-aminobenzene sulfonic acid) film electrode	0.63	0.8	S10
Nafion/2, 2-bipyridyl/bismuth composite film-coated glassy carbon electrode	0.12	0.077	S11
Photolithographically fabricated Bi sputtered electrode	1	0.5	S12
Bi-plated carbon paste mini-electrodes	0.1	0.2	S13
Bi-powder modified carbon paste electrode	1.2	0.9	S14
Bi-modified zeolite doped carbon paste electrode	0.08	0.1	S15
Bi-coated diamond-like carbon microelectrodes		4.4	S16

Table S4. Determination of Cd^{2+} and Pb^{2+} in real samples (n=3).

Sample	Original Cd^{2+} ($\mu g\ L^{-1}$)	Original Pb^{2+} ($\mu g\ L^{-1}$)	Added Cd^{2+} ($\mu g\ L^{-1}$)	Added Pb^{2+} ($\mu g\ L^{-1}$)	Cd^{2+}			Pb^{2+}		
					Found ($\mu g\ L^{-1}$)	Recovery (%)	R.S.D. (%)	Found ($\mu g\ L^{-1}$)	Recovery (%)	R.S.D. (%)
Tap water	-	1.82	10.00	10.00	10.30	103	3.08	11.20	94.8	4.21
River water #1	1.50	4.23	10.00	10.00	11.2	97.3	4.16	13.39	94.1	3.35
River water #2	2.25	4.97	10.00	10.00	11.84	96.7	4.13	15.21	102	2.97

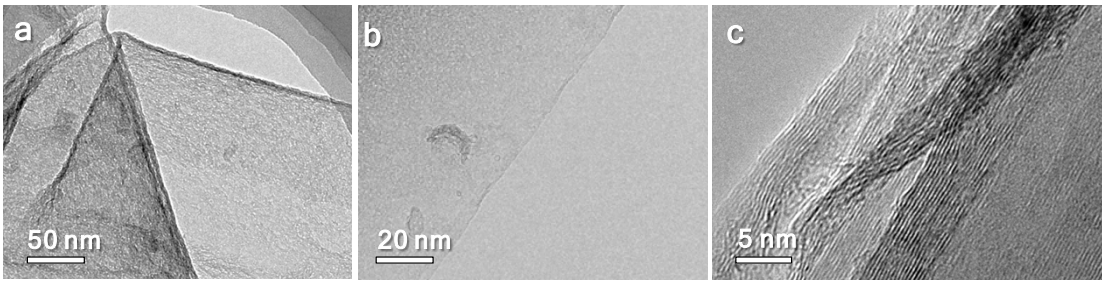


Fig. S1 TEM images of 3DAGNs.

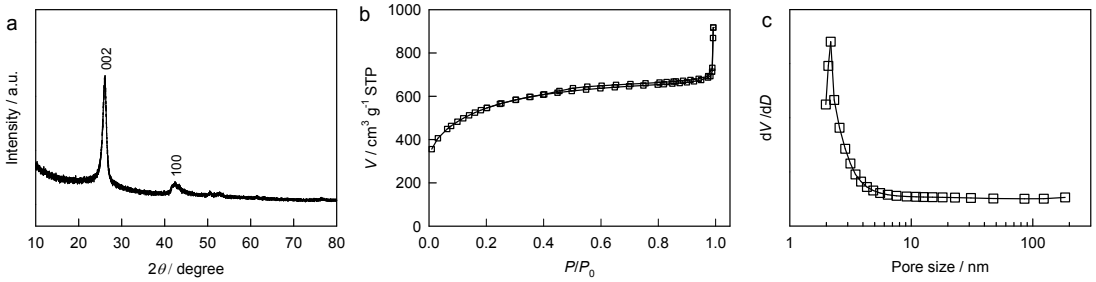


Fig. S2 XRD pattern (a), nitrogen adsorption/desorption isotherm (b), and pore distribution (c) of 3DAGNs.

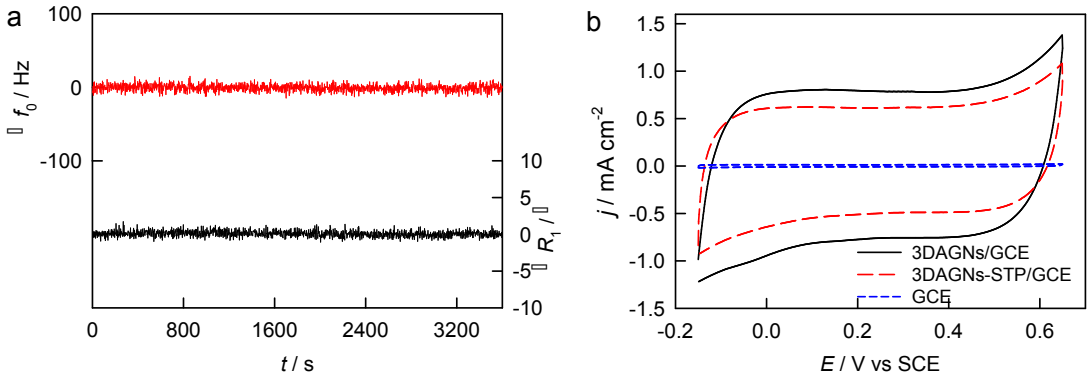


Fig. S3 (a) Time-dependent responses of resonant frequency shift (Δf_0) and motional resistance change (ΔR_1) for a 3DAGNs-STP modified PQC in stirred PBS (pH 7.0). (b) Cyclic voltammograms of 3DAGNs-STP/GCE, 3DAGNs/GCE, and bare GCE in 0.1 M PBS (pH 7.0). Scan rate: 50 mV s^{-1}.

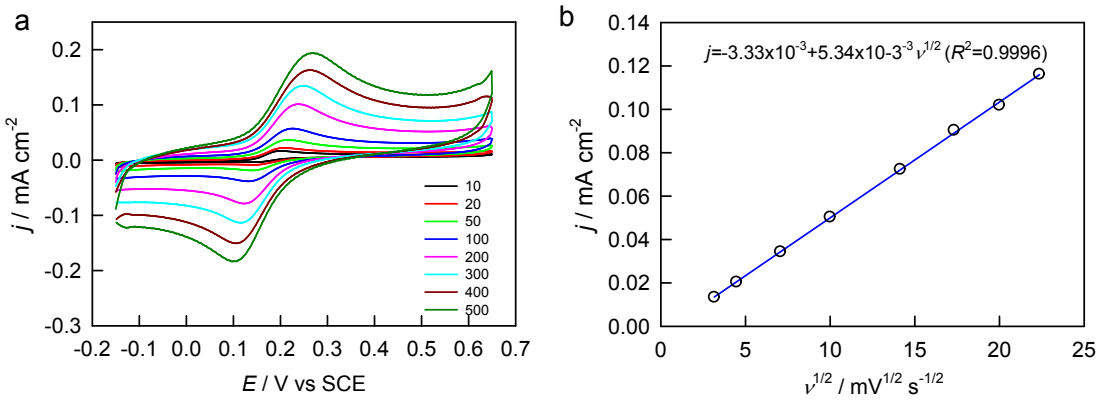


Fig. S4 Scan rate dependence of cyclic voltammograms (a) and anodic peak currents (b) of bare GCE in 0.1 M PBS (pH 7.0) containing 0.2 mM DA.

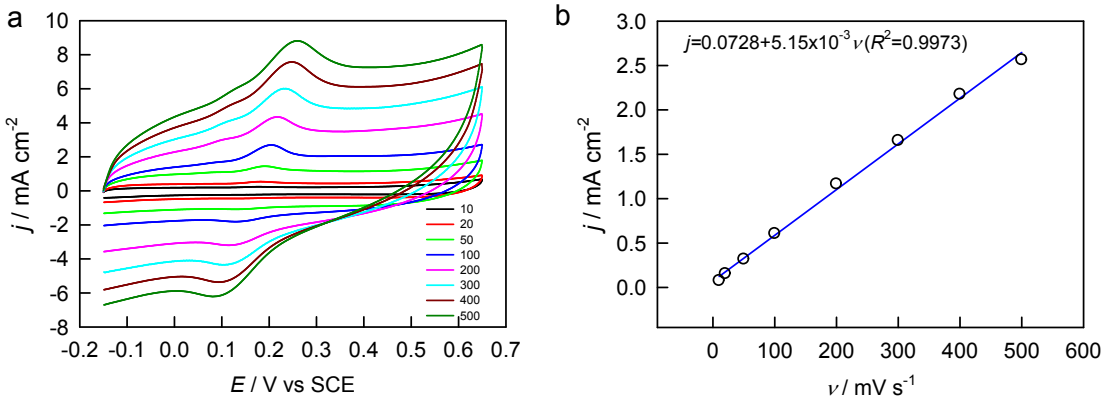


Fig. S5 Scan rate dependence of cyclic voltammograms (a) and anodic peak currents (b) of 3DAGNs/GCE in 0.1 M PBS (pH 7.0) containing 0.2 mM DA.

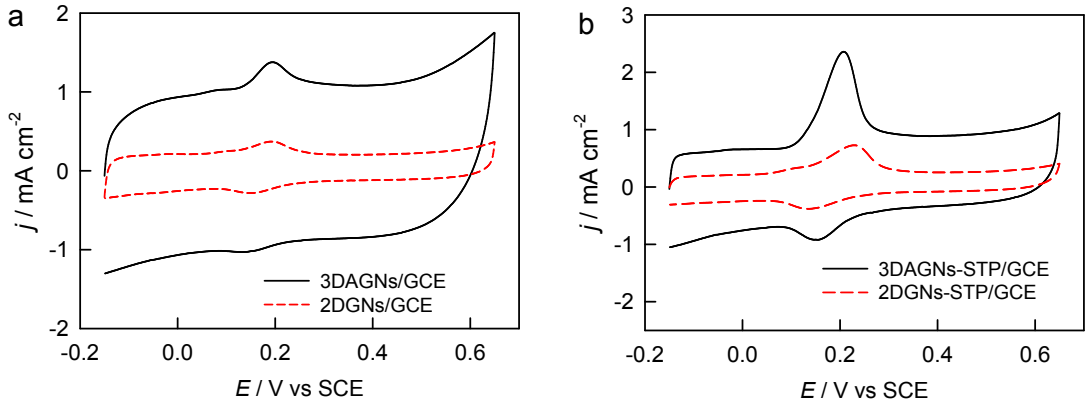


Fig. S6 (a) Cyclic voltammograms of 3DAGNs/GCE and 2DGNs/GCE in 0.1 M PBS (pH 7.0) containing 0.2 mM DA. (b) Cyclic voltammograms of 3DAGNs-STP/GCE and 2DGNs-STP/GCE in 0.1 M PBS (pH 7.0) containing 0.2 mM DA. Scan rate: 50 mV s^{-1}.

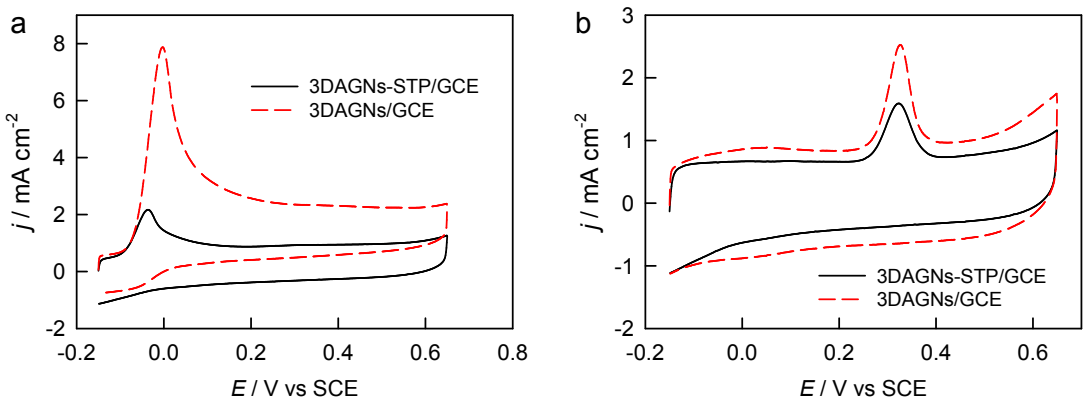


Fig. S7 (a) Cyclic voltammograms of 3DAGNs-STP/GCE and 3DAGNs/GCE in 0.1 M PBS (pH 7.0) containing 2 mM AA. (b) Cyclic voltammograms of 3DAGNs-STP/GCE and 3DAGNs/GCE in 0.1 M PBS (pH 7.0) containing 0.5 mM UA. Scan rate: 50 mV s^{-1}.

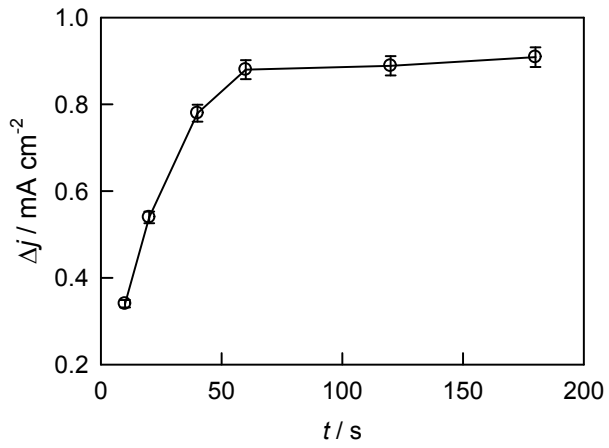


Fig. S8 The effect of pre-concentration time on the differential pulse stripping current for 20 μM DA at 3DAGNs-STP/GCE.

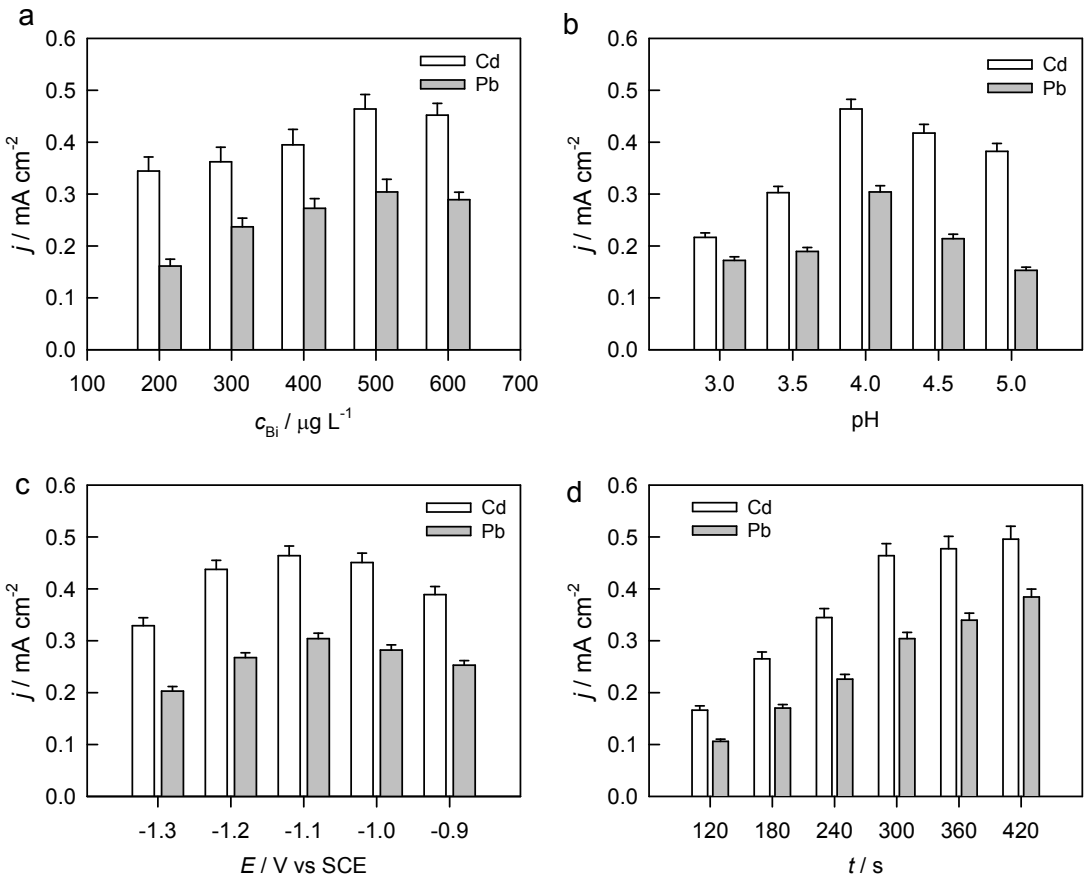


Fig. S9 The effect of Bi^{3+} concentration (a), solution pH (b), deposition potential (c), and deposition time (d) on the stripping current of Cd^{2+} and Pb^{2+} at 3DAGNs-STP/GCE in 0.1 M acetate buffer solution containing 50 μg L^{-1} each of Cd^{2+} and Pb^{2+}. Other experimental conditions are the same as in Fig. S9.

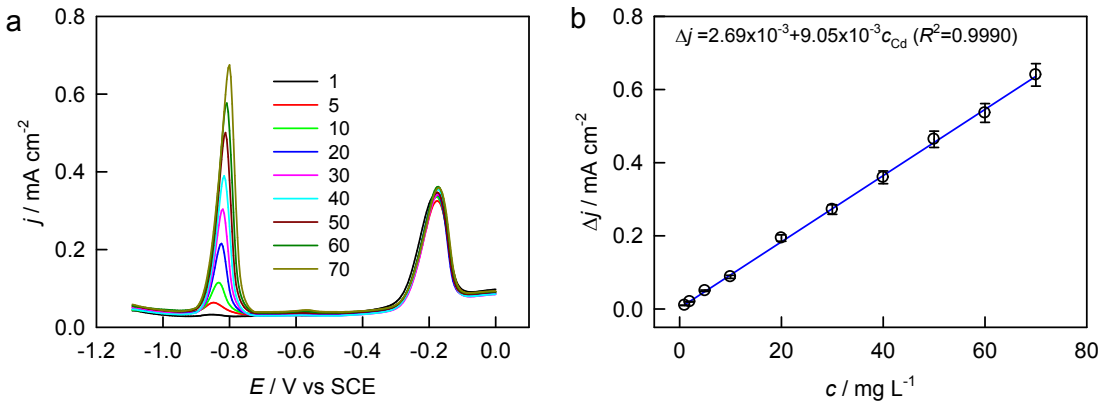


Fig. S10 Differential pulse stripping voltammograms (a) and calibration curve (b) 3DAGNs-STP/GCE for Cd^{2+} in 0.1M acetate buffer solution (pH 4.0) in the presence of 500 μg L^{-1} Bi^{3+}. Deposition potential: -1.1 V, deposition time: 300 s.

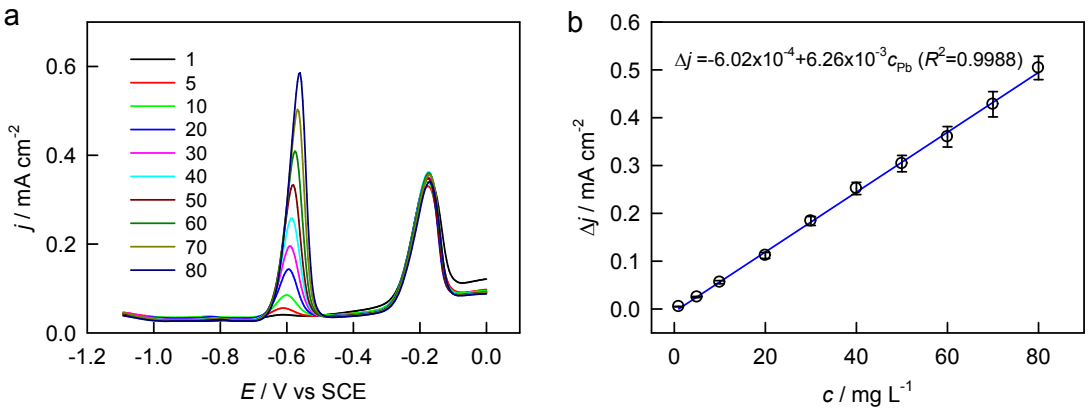


Fig. S11 Differential pulse stripping voltammograms (a) and calibration curve (b) 3DAGNs-STP/GCE for Pb^{2+} in 0.1M acetate buffer solution (pH 4.0) in the presence of 500 μg L^{-1} Bi^{3+}. Deposition potential: -1.1 V, deposition time: 300 s.

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