Supplementary materials

Zirconium dioxide-decorated MWCNTs (ZrO_2@MWCNTs) nanocomposite as a high-performance electrochemical sensing platform for psychotropic drug analysis

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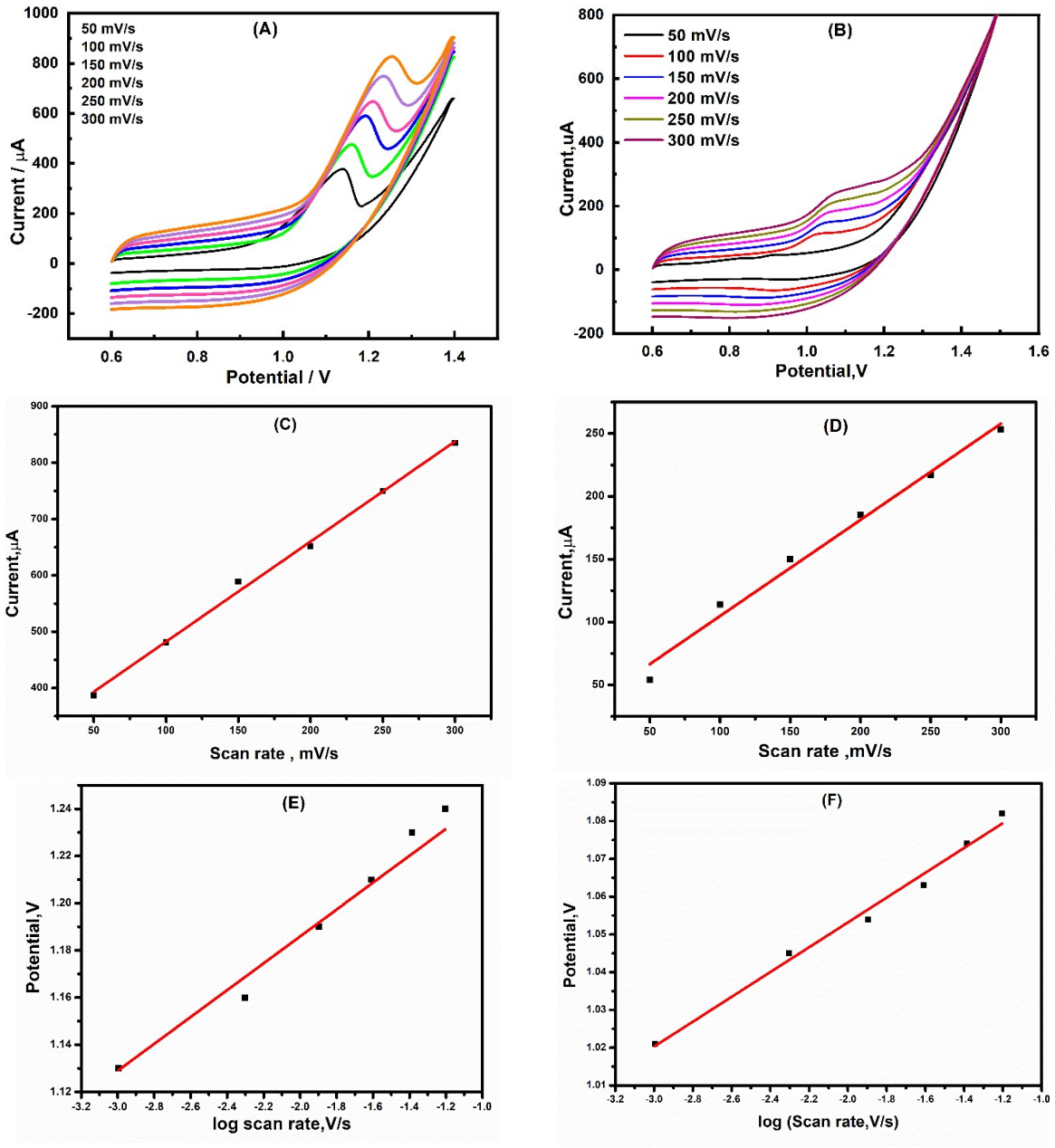

Figure S1: Influence of varying scan rates (ranging from 0.05 to 0.3 V/s) on the redox responses of (A) carbamazepine (CBZ) and (B) quetiapine (QTP), each at a fixed concentration of 1×10^{-3} M, recorded using a ZrO_2@MWCNT-modified glassy carbon electrode (GCE). A linear correlation between oxidation peak current and scan rate is observed for (C) CBZ and (D) QTP, suggesting diffusion-controlled electrochemical behavior. The relationship between peak potential and the logarithm of scan rate is shown for (E) CBZ and (F) QTP

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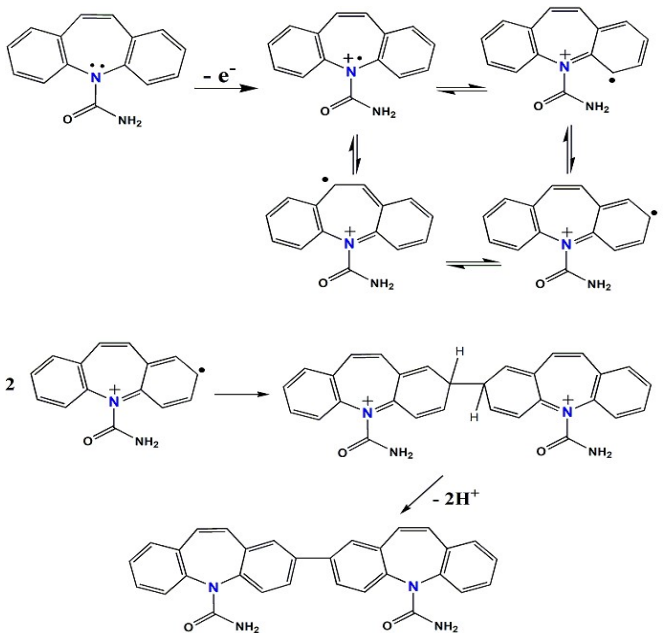
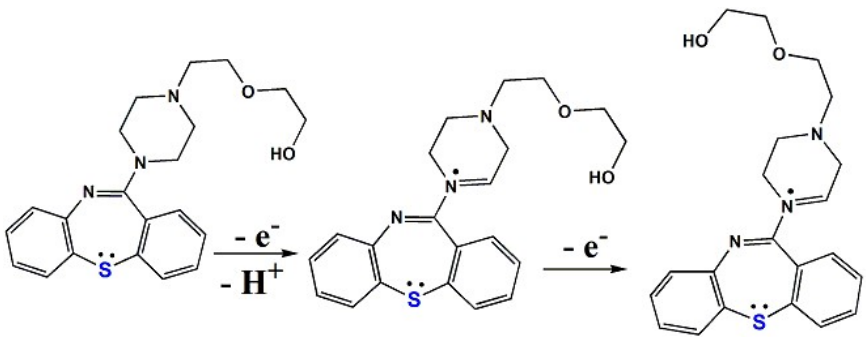
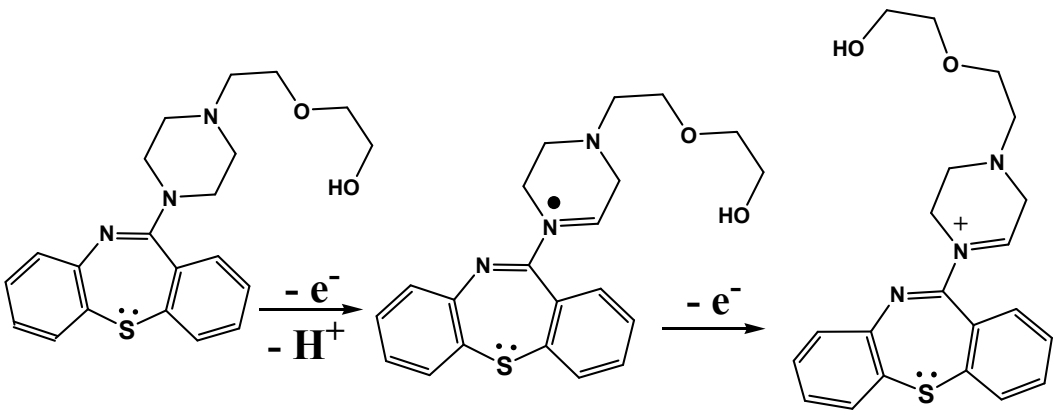


(A)



(B)

QTP oxidation reaction:



Scheme 1: The oxidation mechanism of (A) CBZ and (B) QTP, involving a one electron transfer for CBZ and two-electron transfer process for QTP.

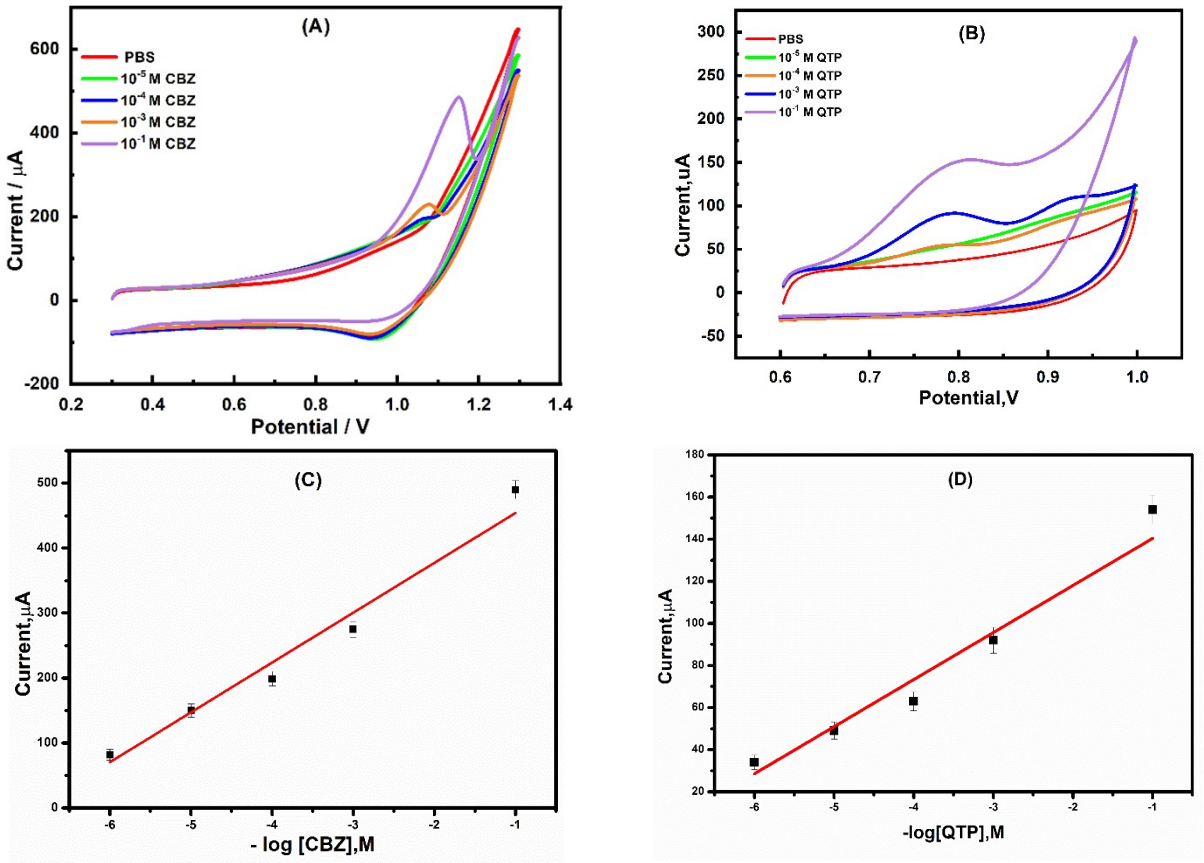
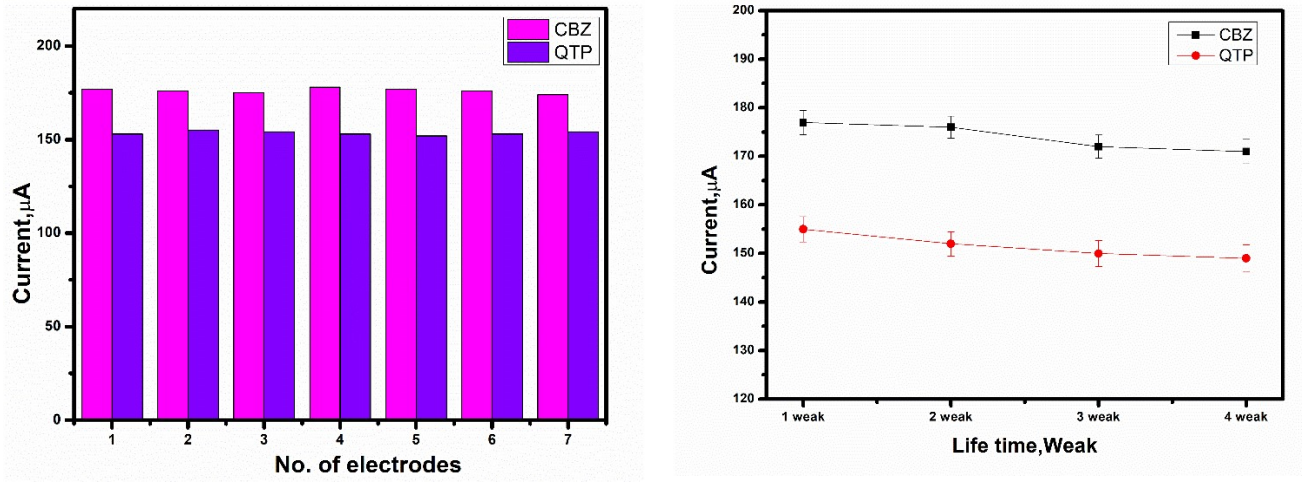


Figure S2: The cyclic voltammetry of the ZrO_2@MWCNTs modified GCE with different concentration of (A) CBZ and (B) QTP in phosphate buffer pH 7.0. The linear calibration curves of (C) CBZ and (D) QTP, the log concentration plotted vs. the oxidation current.



(A) **(B)**

Figure S3: (A) Reproducibility and (B) lifetime of the ZrO_2@MWCNTs modified GCE toward CBZ and QTP detection.

Table S1: CV and EIS data evaluated from experimental data of Figure 2A&B.

	E_{ox} V	E_{red} V	$\Delta E_{1/2}$ V	I_{ox} µA	I_{red} µA	R_s Ω	R_{ct} Ω	CPE µF	ω Ω
Bare GCE	0.430	0.024	0.227	21.4	-20.2	38.5	5968	44.4	98.6
ZrO_2@GCE	0.223	0.029	0.120	32.6	-33.6	33.2	35.5	278.1	59.7
NiO@GCE	0.289	-0.036	0.126	27.7	-28.5	32.5	3248	52.5	81.6
La_2O_3@GCE	0.230	0.003	0.127	30.0	-28.404	31.2	100.2	215.9	64.3
Sb_2O_3@GCE	0.384	-0.178	0.117	14.6	-16.0	37.9	7254.3	31.2	115.8
TiO_2@GCE	0.323	-0.076	0.103	29.779	-30.492	35.4	1210.3	73.8	72.6
V_2O_5@GCE	0.340	-0.104	0.124	28.317	-30.788	34.8	2510	68.9	74.5

Table S2: CV and EIS data of evaluated from experimental of Figure 2C&D of the unmodified and modified GCE with different metal oxides**.**

	E_{ox} v	E_{red} v	ΔE v	I_{ox} µA	I_{red} µA	R_s Ω	R_{ct} Ω	CPE µF	ω Ω
MWCNTs	0.286	-0.030	0.128	113.347	-118.775	15.3	340.2	78.9	72.3
ZrO_2@MWCNTs	0.206	0.068	0.137	188.942	-185.443	5.8	9.2	115.4	62.1
TiO_2@MWCNTs	0.196	0.075	0.136	143.468	-152.613	7.5	86.5	103.6	65.5
La_2O_3@MWCNTs	0.208	0.112	0.160	181.661	-182.248	12.8	79.3	104.6	66.4

Table S3: Determination of CBZ and QTP in Tegretol® 200 mg, Tegretol® 400 mg, Seroquel® 25 mg, and Quitapex 25 mg samples.

Drug	Added	Found ± SD	RSD (%)	% recovery
Tegretol® CR	200 mg	199.2 ± 1.6	1.1	99.6
Tegretol® CR	400 mg	401.2 ± 2.3	2.3	100.3
Seroquel®	25 mg	24.8 ± 1.2	3.1	99.2
Quitapex	25 mg	25.05 ± 1.3	1.4	100.2