

Electronic Supplementary Information

In Situ Reduction and Functionalization of Graphene Oxide with L-Cysteine for Simultaneous Electrochemical Determination of Cadmium (II), Lead (II), Copper (II), and Mercury(II) ions

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Name	Peak B.E. eV	Functionality	FWHM / eV	Area / cps.eV	Atomic / %
S2p ^{3/2} (1) (1/2) Doublet	168.88	[SO ₄] ²⁻	1.93	1697.35	0.26
S2p ^{1/2} (1) (2/2) Doublet	169.94	-	1.93	861.45	-
Cl2p ^{3/2} (1/2 Doublet)	199.15	Impurity (Cl ⁻ salt?)	3.08	2126.57	0.22
Cl2p ^{1/2} (2/2 Doublet)	200.85	Impurity (Cl ⁻ salt?)	3.08	1091.45	-
C1s (1)	284.64	C-H and C-C (sp ² /sp ³)	1.42	28324.95	10.98
C1s (2)	285.34	C-OH	1.41	65908.68	25.57
C1s (3)	287.28	C=O	1.55	74265.26	29.71
C1s (4)	289.07	HO-C=O	1.81	14318.45	5.57
N1s (1)	401.4	[NH ₄] ⁺ X ⁻	3.52	3267.22	0.75
O1s (1)	532.19	C-OH	1.89	23369.4	3.55
O1s (2)	533.15	C-O-C	1.98	153818.97	23.39

Table. 1 Atomic percentage composition of C1s, O1s, N1s, S2p and Cl2p of GO.

Name	Peak B.E. eV	Functionality	FWHM / eV	Area / cps.eV	Atomic / %
S2p ^{3/2} (1) (1/2 Doublet)	164.02	S-H	3.17	530.77	0.21
S2p ^{1/2} (1) (2/2 Doublet)	165.28	-	3.17	269.86	-
S2p ^{3/2} (2) (1/2 Doublet)	167.81	S-S	1.66	331.75	0.12
S2p ^{1/2} (2) (2/2 Doublet)	168.93	-	1.66	169.35	-
Cl2p ^{3/2} (1/2 Doublet)	199.94	Impurity (Cl ⁻ salt?)	1.11	304.44	0.11
Cl2p ^{1/2} (2/2 Doublet)	201.44	-	1.11	156.25	-
C1s (1)	284.65	C-H and C-C (sp ² /sp ³)	1.22	98876.39	41.98
C1s (2)	286	C-OH	2.07	60358.9	25.64
C1s (3)	288.4	C=O	2.46	18436.5	7.84
C1s (4)	291.99	HO-C=O	1.78	3563.26	1.52
N1s (1)	398.46	R-NH ₂	1.41	5282.64	1.32
N1s (2)	399.9	(R) ₂ -N-H	1.7	27195.85	6.81
O1s (1)	531.09	C=O and HO-C=O	2.03	29478.92	4.9
O1s (2)	532.43	C-OH	2.33	56837.27	9.46

Table. 2 Atomic percentage composition of C1s, O1s, N1s, S2p and Cl2p of L-Cys-rGO.

Name	Peak B.E. eV	Functionality	FWHM / eV	Area / cps.eV	Atomic / %
S2p ^{3/2} (1) (1/2 Doublet)	168.39	S-S	2.19	509.99	0.23
S2p ^{1/2} (1) (2/2 Doublet)	169.45	-	2.19	260.03	-
Cl2p ^{3/2} (1/2 Doublet)	199.68	Impurity (Cl ⁻ salt?)	2.86	574.56	0.20
Cl2p ^{1/2} (2/2 Doublet)	201.18	-	2.86	294.85	-
C1s (1)	284.35	C-C (sp ² /sp ³)	0.9	50328.11	17.86
C1s (2)	284.91	C-H	1.02	77861.06	27.63
C1s (3)	286.06	C-OH	1.97	67730.94	24.05
C1s (4)	288.34	C=O	2.41	23518.36	8.36
C1s (5)	290.88	HO-C=O	2.78	4384.07	1.56
N1s (1)	399.57	R-NH ₂	2.46	15766.66	3.3
N1s (2)	401.93	[NH ₄] ⁺ X ⁻	3.51	2697.46	0.57
O1s (1)	531.63	C=O and HO-C=O	2.15	57078.7	7.94
O1s (2)	532.97	C-OH	2.3	59623.34	8.3

Table. 3 Atomic percentage composition of C1s, O1s, N1s, S2p and Cl2p of rGO.