†Electronic Supplementary Information

The Influence of Copper Addition on Electrical Conductivity and Charge Transfer Resistance of Reduced Graphene Oxide (rGO)

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Table S1. Calculated crystalline size (D) and interlayer spacing (d) values of the samples including of GO, rGO, and samples rGO with copper addition **A–E**.

Sample	2θ (°)	K	λ (nm)	β (°)	cos θ	D (nm)	d (nm)	Miller indices	Crystal
GO	9.69	0.940	0.154	1.39	0.99	5.73	0.91	0 0 2	GO
	42.12			0.79	0.93	10.73	0.21	1 0 0	GO
rGO	24.64			4.52	0.98	1.88	0.36	0 0 2	rGO
	42.34			2.42	0.90	3.79	0.18	1 0 0	rGO
Sample **A**	24.40			4.69	0.98	1.81	0.36	0 0 2	rGO
	42.56			2.41	0.93	3.69	0.21	1 0 0	rGO
	43.40			2.26	0.93	3.95	0.21	1 1 1	Cu
	49.02			0.51	0.91	17.87	0.19	-2 0 2	CuO
	50.93			0.76	0.90	12.09	0.18	2 0 0	Cu
	72.62			0.54	0.81	19.06	0.13	3 1 1	CuO
	77.82			0.76	0.78	14.03	0.12	2 2 2	Cu_2O
Sample **B**	24.45			4.59	0.98	1.85	0.36	0 0 2	rGO
	43.17			1.01	0.93	8.83	0.21	1 0 0	rGO
	43.36			1.87	0.93	4.77	0.21	1 1 1	Cu
	49.15			0.92	0.91	9.91	0.19	-2 0 2	CuO
	50.84			1.27	0.90	7.23	0.18	2 0 0	Cu
	72.62			0.52	0.81	19.79	0.13	3 1 1	CuO
	74.05			0.92	0.80	11.29	0.13	2 2 0	Cu

Sample **C**	24.34			6.60	0.98	1.29	0.37	0 0 2	rGO
	42.64			1.11	0.93	8.02	0.21	1 0 0	rGO
	43.23			0.44	0.93	20.39	0.21	1 1 1	Cu
	50.36			0.39	0.90	23.44	0.18	2 0 0	Cu
	74.08			3.40	0.94	2.60	0.23	2 2 0	Cu
	78.12			0.78	0.78	13.65	0.12	2 2 2	Cu_2O
Sample **D**	24.47			5.94	0.98	1.43	0.36	0 0 2	rGO
	42.59			0.70	0.93	12.72	0.21	1 0 0	rGO
	43.29			0.97	0.90	9.41	0.18	1 1 1	Cu
	50.43			0.59	0.90	15.53	0.18	2 0 0	Cu
	74.16			0.49	0.80	21.10	0.13	2 2 0	Cu
	78.05			0.62	0.78	17.29	0.12	2 2 2	Cu_2O
Sample **E**	24.31			5.27	0.98	1.61	0.37	0 0 2	rGO
	36.25			0.49	0.95	17.73	0.25	1 1 1	Cu_2O
	42.14			0.65	0.93	13.67	0.21	2 0 0	Cu_2O
	43.12			1.10	0.93	8.09	0.21	1 1 1	Cu
	49.12			2.17	0.91	4.20	0.19	-2 0 2	CuO
	50.33			1.00	0.91	9.13	0.18	2 0 0	Cu
	61.19			0.67	0.86	14.41	0.15	2 2 0	Cu_2O
	72.65			0.49	0.81	20.91	0.13	3 1 1	CuO
	73.76			0.20	0.80	50.83	0.13	3 1 1	Cu_2O
	77.84			0.71	0.78	15.05	0.12	2 2 2	Cu_2O

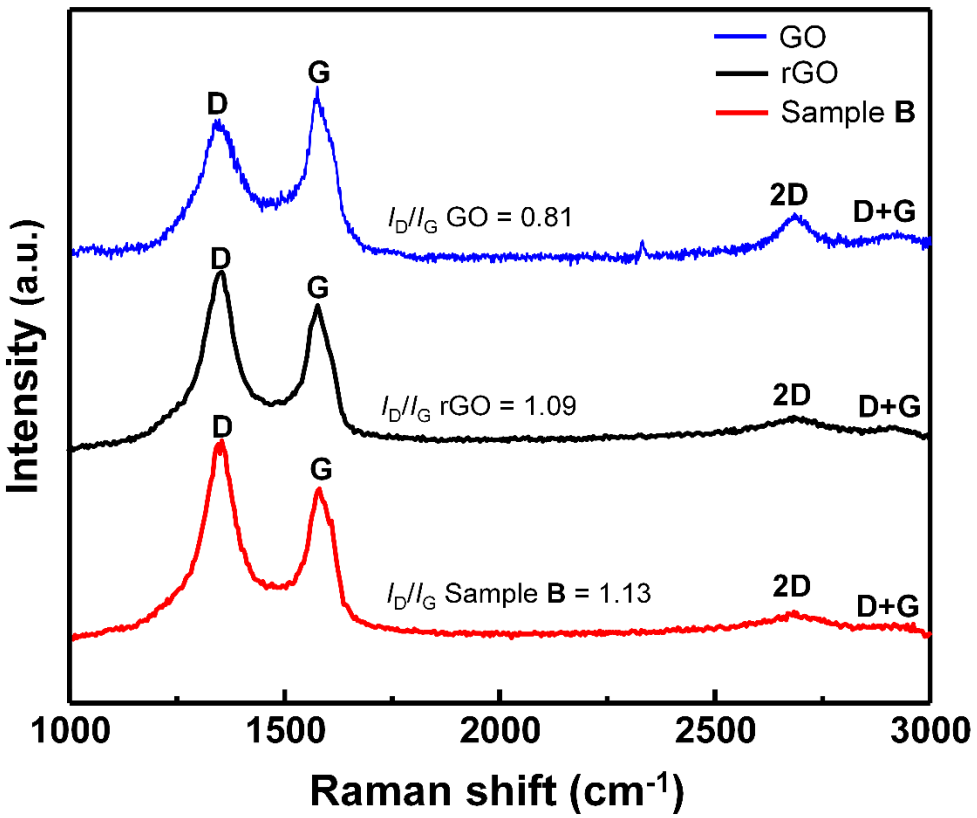

Fig S1 Raman spectra of GO, rGO, and sample **B**.

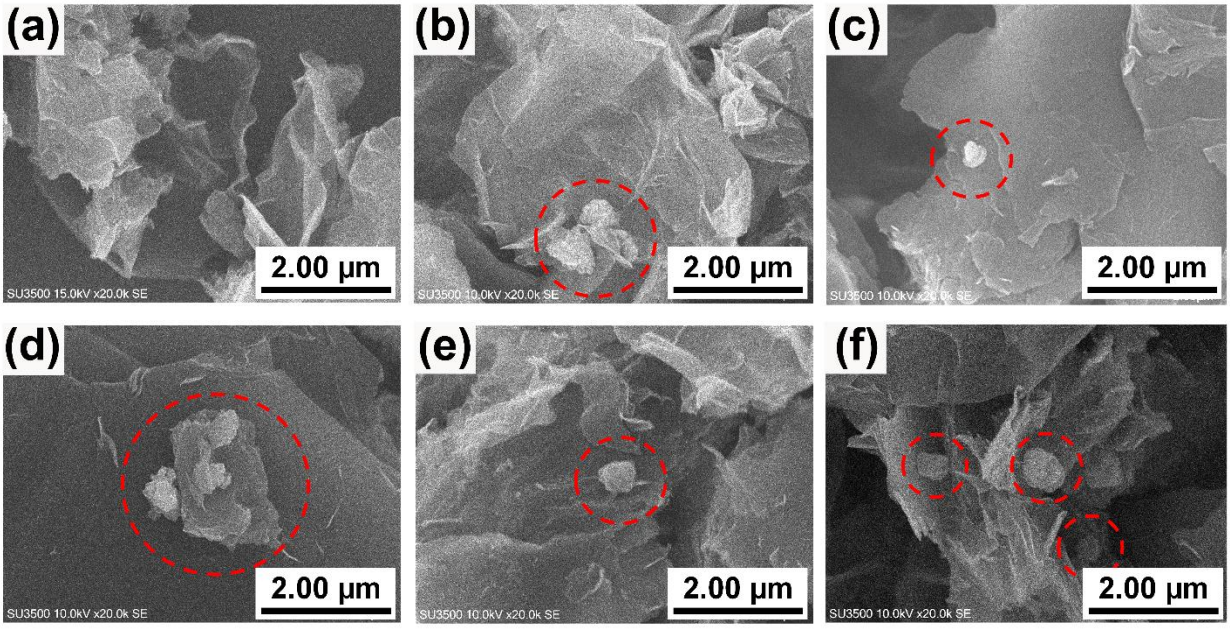

Fig. S2 SEM pictures of (a) rGO, (b) sample **A**, (c) sample **B**, (d) sample **C**, (e) sample **D**, and (f) sample **E**. The red dash lines indicated copper particle in the samples.

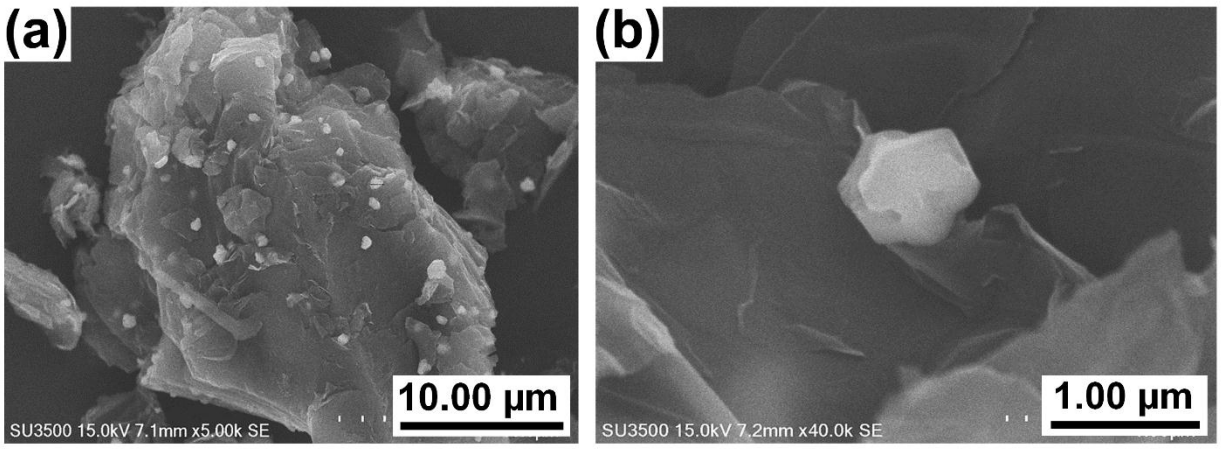

Fig. S3 SEM pictures of sample **E** (a) surface of rGO and (b) the edge of graphene sheets with Cu or Cu_2O particle.

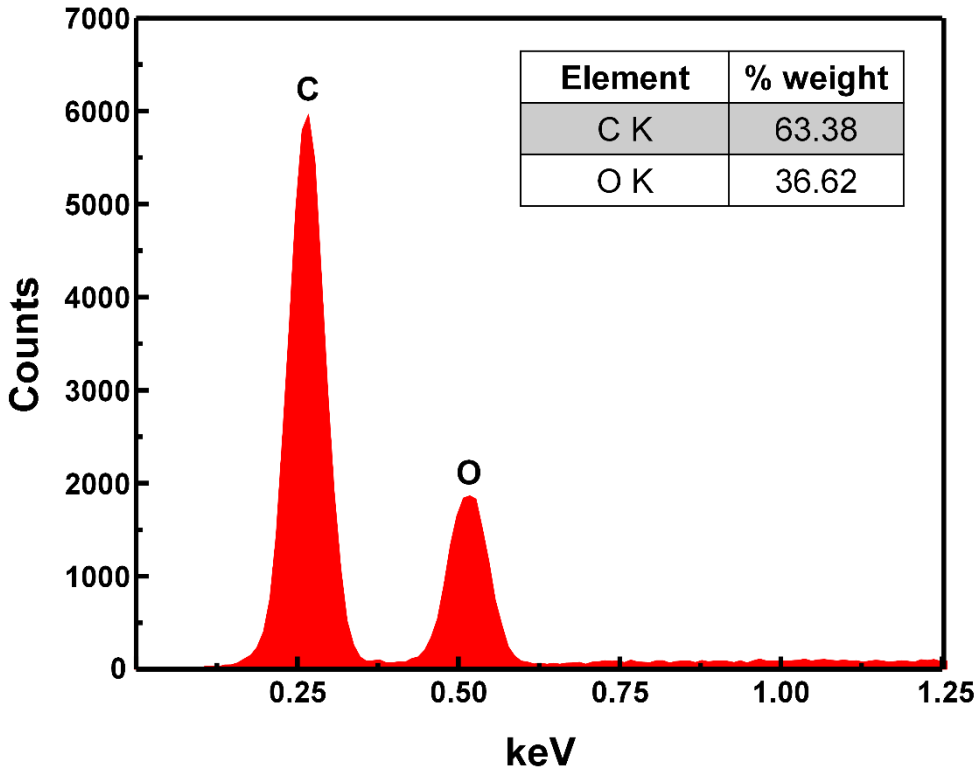

Fig. S4 EDX result of graphene oxide.

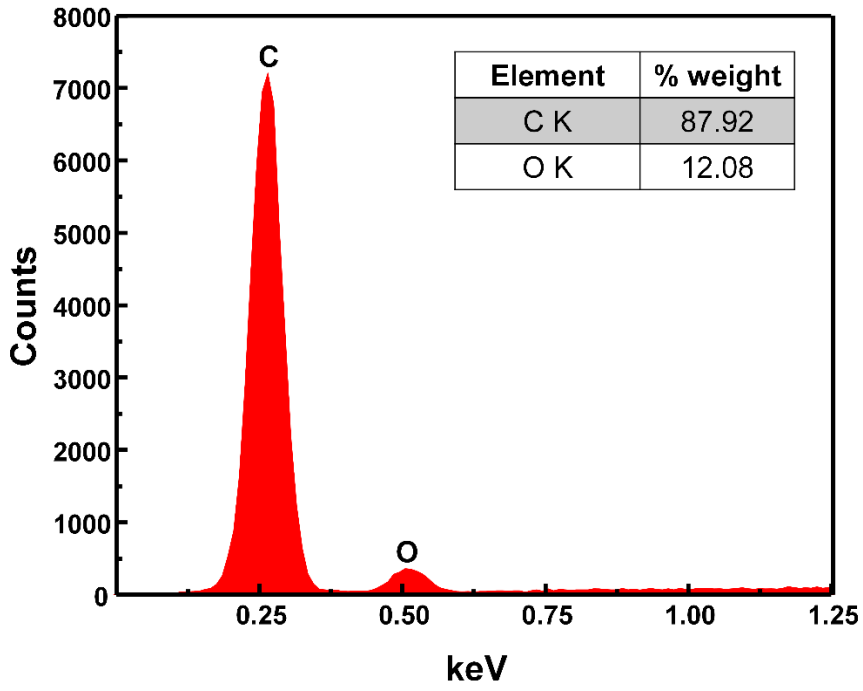

Fig. S5 EDX result of reduced graphene oxide.

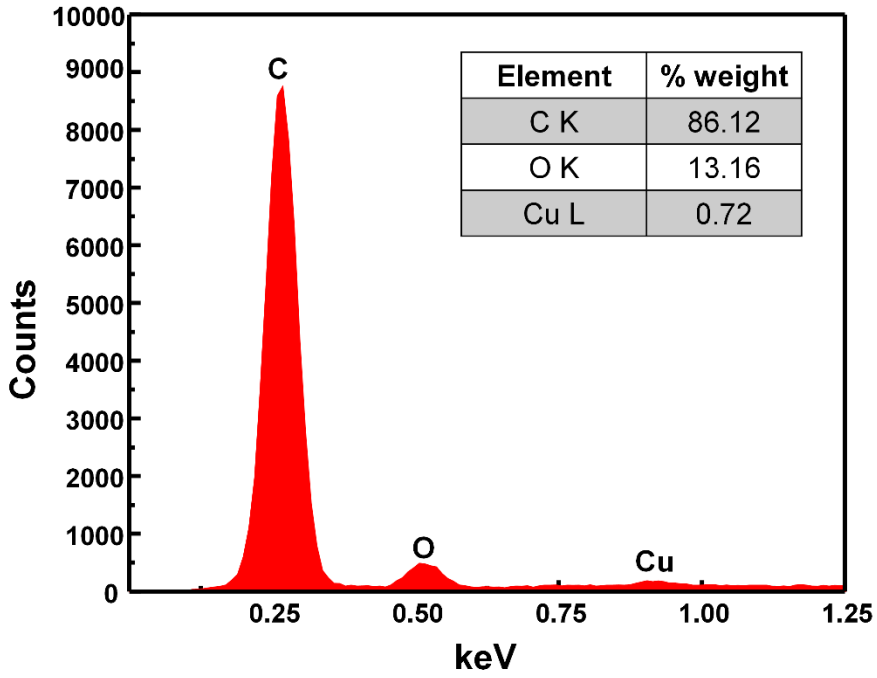

Fig. S6 EDX result of sample **A**

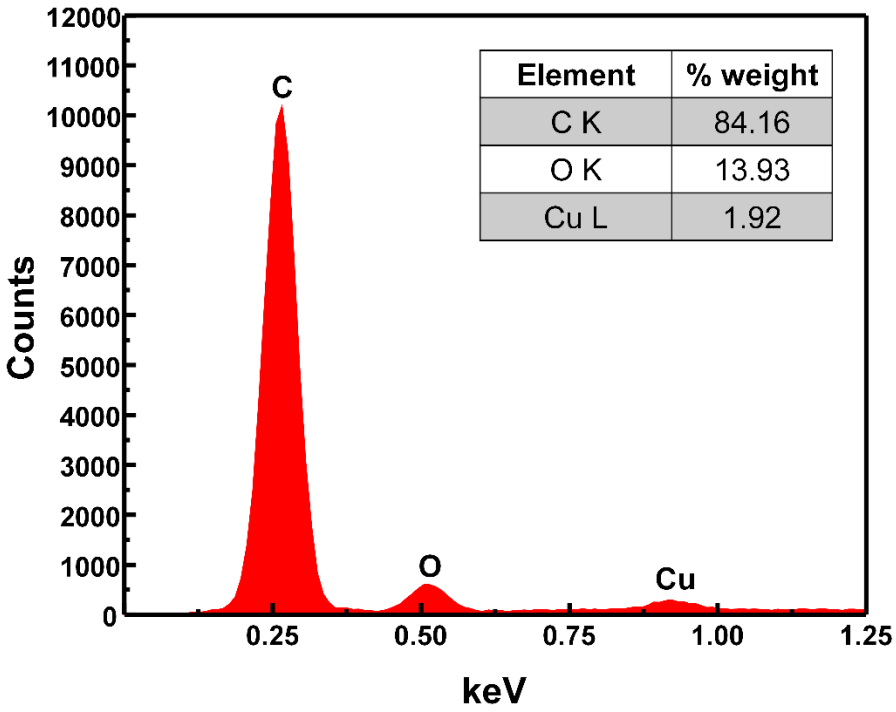

Fig. S7 EDX result of sample **C**.

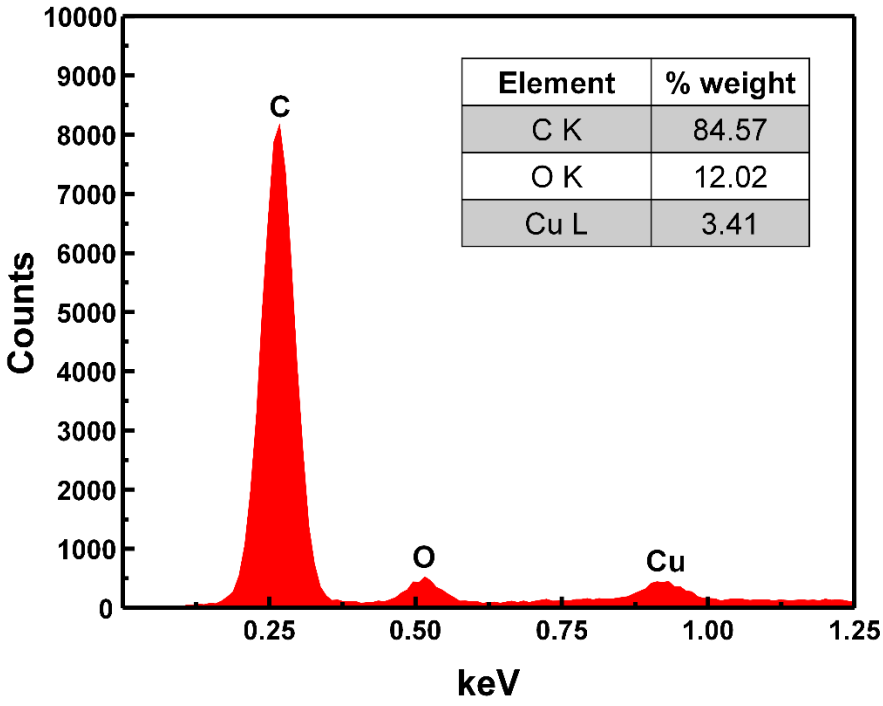

Fig. S8 EDX result of sample **D**

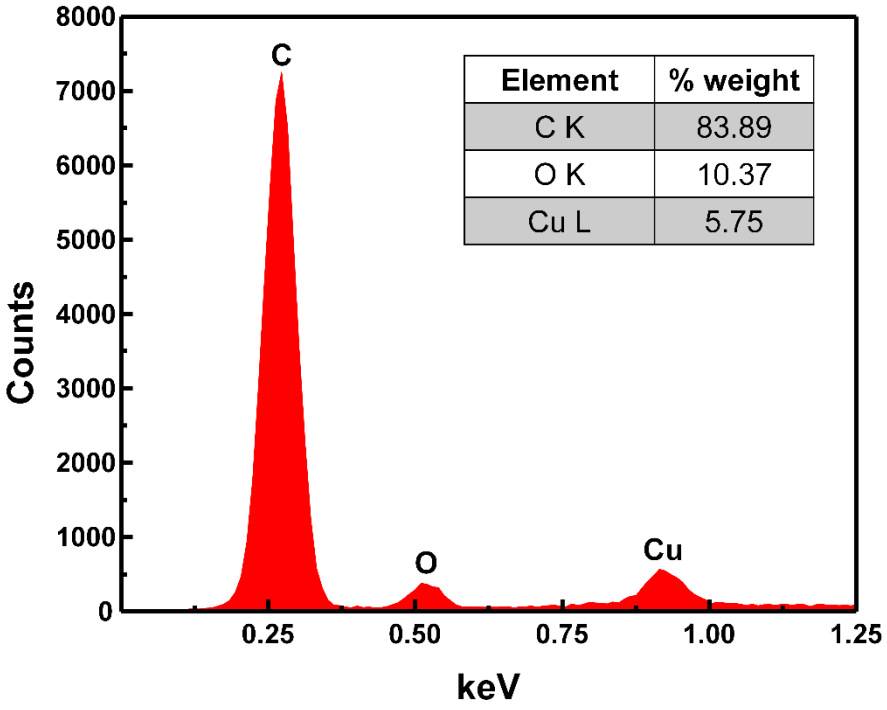

Fig. S9 EDX result of sample **E**

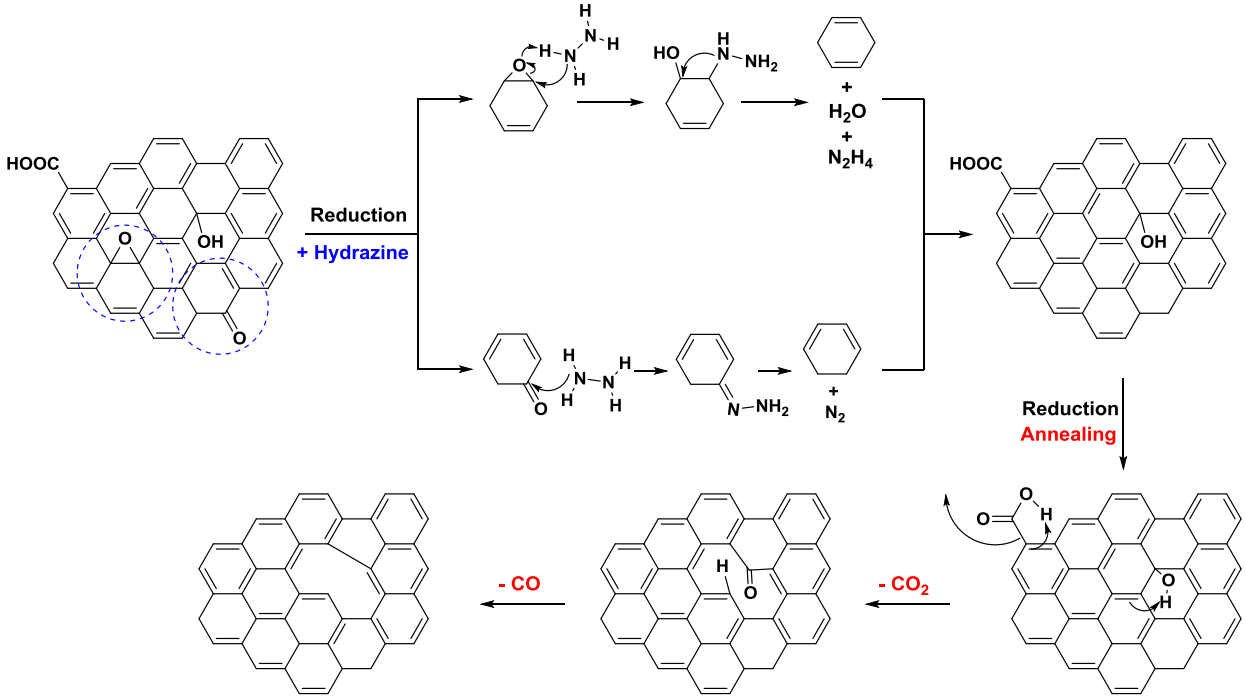

Fig. S10 Possible mechanism reaction of reduction process of GO using hydrazine and further reduction of rGO due to annealing process.

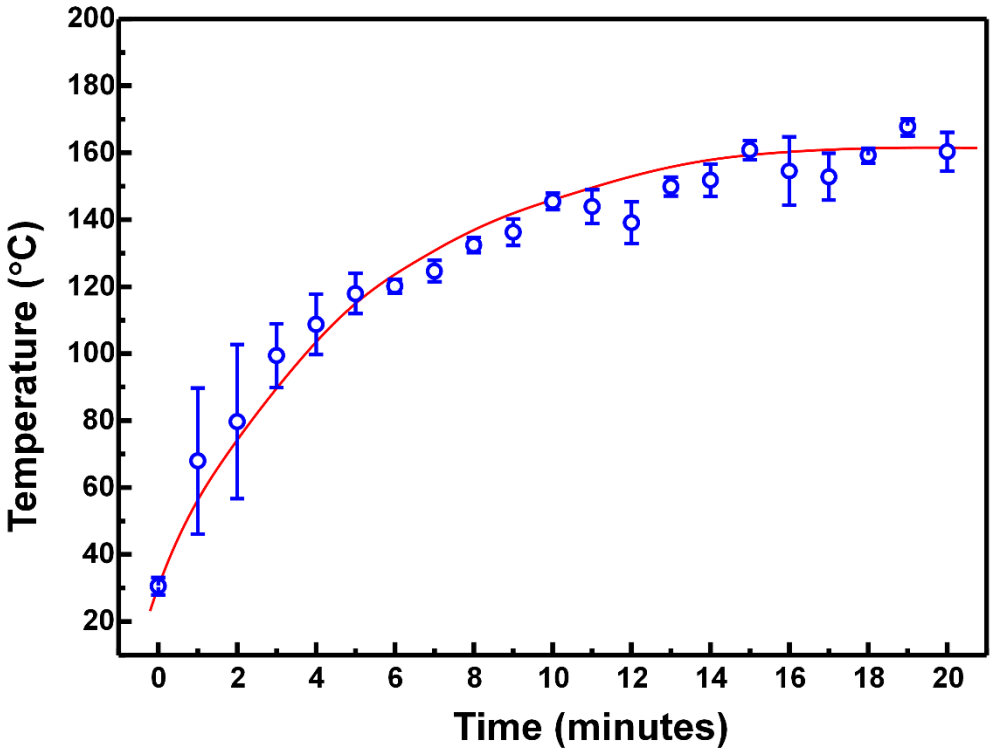

Fig. S11 The influence of temperature per minute under microwave irradiation conditions during reduction process of GO.

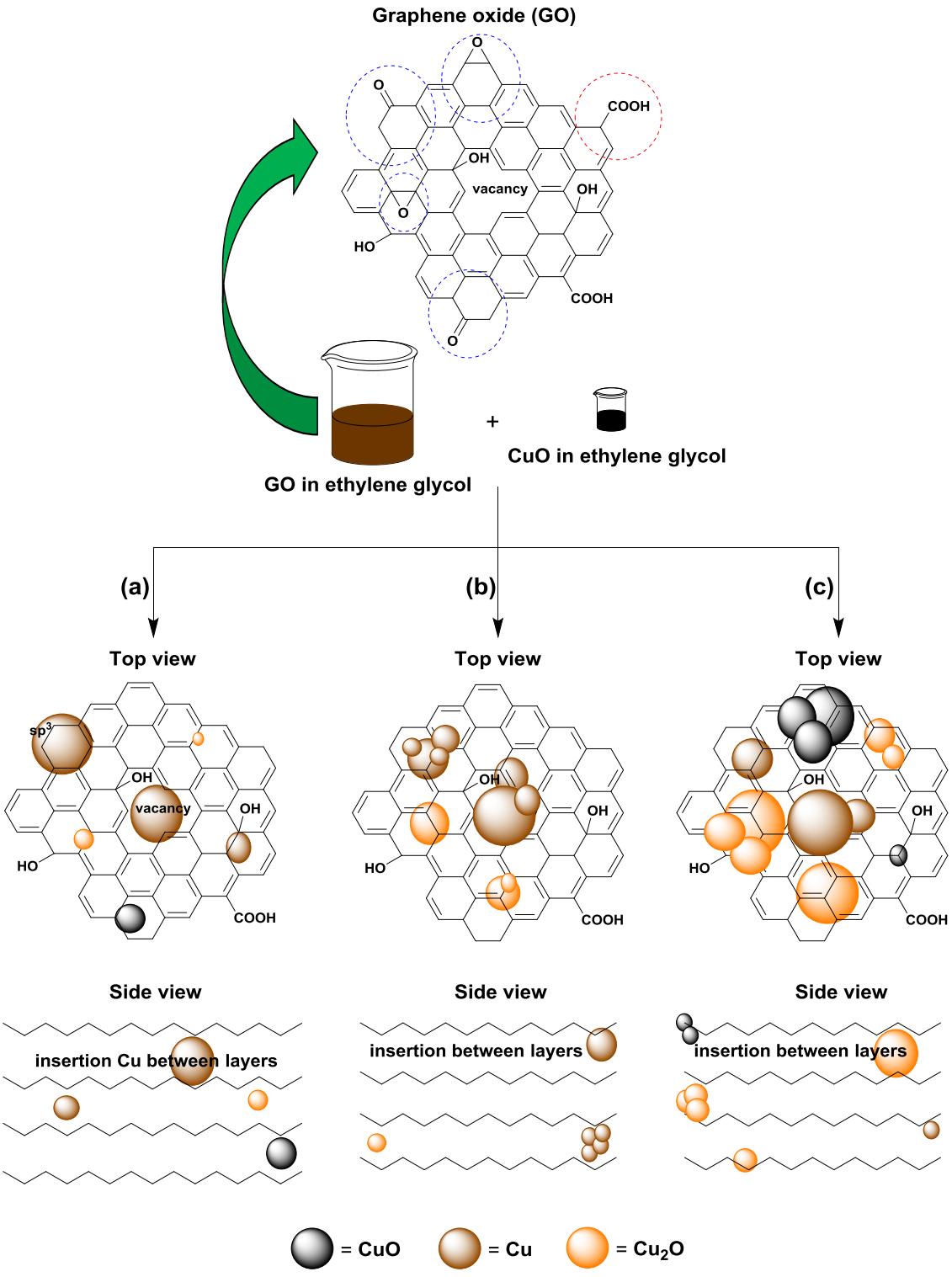

Fig. S12 The illustration on the possibility of Cu, CuO, or Cu_2O in the rGO (top view and side view) after the reduction of GO and CuO using hydrazine as the reducing agent under microwave irradiation conditions when the copper in the reaction mixture were (a) 1 wt%, (b) 2 and 3 wt%, and (c) 5 wt%.

Fig. S12 shows the illustration on the possibility of Cu, Cu_2O, or CuO after reduction process. There are blue and red circles on the graphene oxide are displayed in Fig. S12. The blue circles indicate the possible oxygen-containing functional groups to be reduced by hydrazine. The red circle represents the potential oxygen-containing group to be removed by microwave irradiation.[29] The defect from the vacancy in rGO sheets potentially occurred during oxidation or exfoliation process. This defect consequently disrupts the electron mobility on the graphene sheet, which led to the decrease of electrical conductivity.