

Fig. S1. PL spectra of the TA solution after reaction with H₂O₂ for 2 and 5 min over CuCo₂O₄/N-GQDs. (Reaction condition: similar to the degradation of MB, except that the MB aqueous solution was replaced by alkaline terephthalic acid (5×10^{-4} mol/L TA + 2×10^{-3} mol/L NaOH))

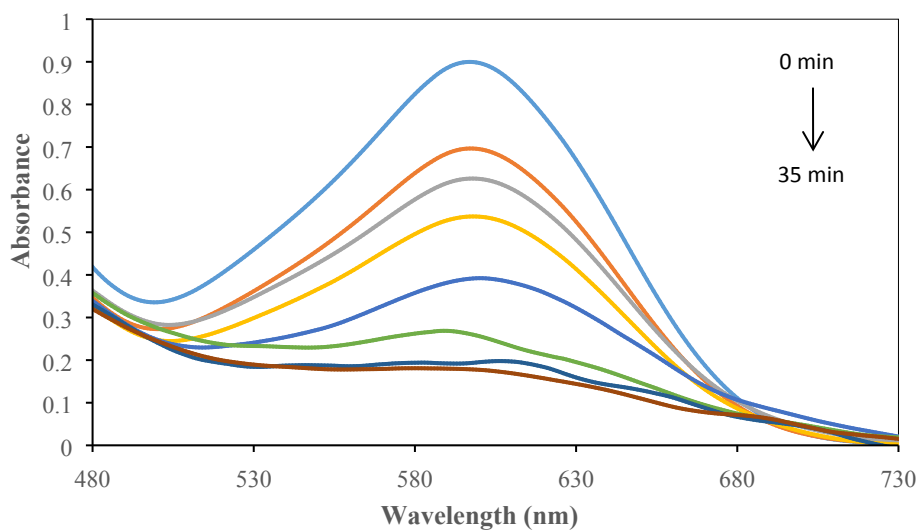
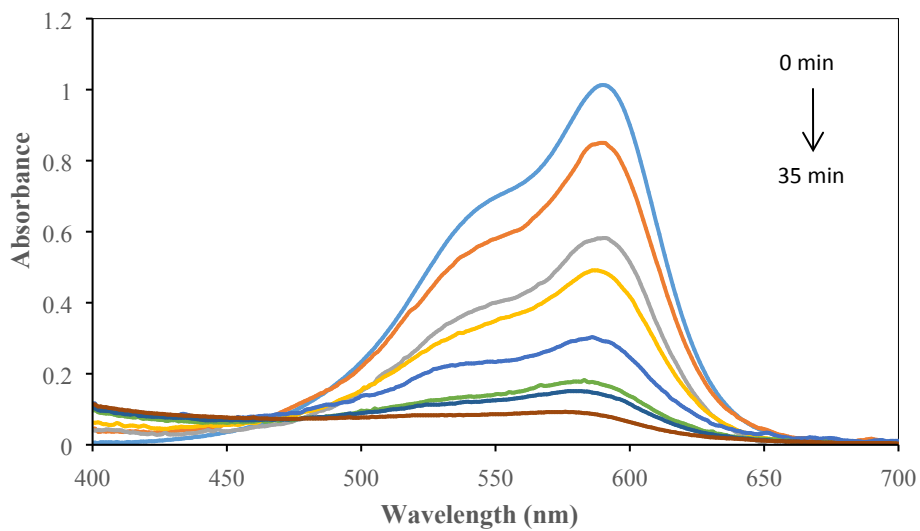


Fig. S2. Change in absorbance spectra of CV (a) and CR(b) at different time intervals in the presence of $\text{CuCo}_2\text{O}_4/\text{N-GQDs}$. (Reaction conditions: $C_{\text{CV}} = 5.0 \text{ mg/L}$, $C_{\text{CR}} = 20.0 \text{ mg/L}$, $C_{\text{H}_2\text{O}_2} = 0.1 \text{ mol/L}$, catalyst amount = 8 mg, pH = 7.0).

Table S1. The experimental variables and levels of the Box-Behnken design

Variables	Symbols		Levels		
	Uncoded	Coded	Low	Middle	High
pH	X_1	x_1	4.0	7.0	10.0
Catalyst mass (g)	X_2	x_2	0.002	0.005	0.008
H ₂ O ₂ Concentration (mol/L)	X_3	x_3	0.02	0.06	0.10

Table S2. Design matrix in the Box-Behnken model, observed and predicted values

Runs	Actual level of factors			Coded level of factors			k_{obs}	
	X_1	X_2	X_3	x_1	x_2	x_3	Observed	Predicted
1	7.0	0.005	0.06	0	0	0	0.035	0.036
2	4.0	0.002	0.06	-1	-1	0	0.005	0.001
3	4.0	0.005	0.1	-1	0	+1	0.012	0.012
4	4.0	0.008	0.06	-1	+1	0	0.018	0.020
5	7.0	0.008	0.02	0	+1	-1	0.034	0.031
6	7.0	0.008	0.1	0	+1	+1	0.099	0.096
7	7.0	0.002	0.1	0	-1	+1	0.020	0.023
8	7.0	0.005	0.06	0	0	0	0.033	0.036
9	10.0	0.002	0.06	+1	-1	0	0.026	0.024
10	10.0	0.008	0.06	+1	+1	0	0.093	0.096
11	10.0	0.005	0.1	+1	0	+1	0.099	0.097
12	7.0	0.005	0.06	0	0	0	0.041	0.036
13	7.0	0.002	0.02	0	-1	-1	0.010	0.012
14	4.0	0.005	0.02	-1	0	-1	0.008	0.009
15	10.0	0.005	0.02	+1	0	-1	0.023	0.023

Table S3. Analysis of variance (ANOVA) for Box-Benken design.

Source of variation	Df ^a	SS ^b	MS ^c	F value	P value ^d
Model	9	0.014947	0.001661	76.59	0.000
X ₁	1	0.004900	0.004900	226.00	0.000
X ₂	1	0.004186	0.004186	193.06	0.000
X ₃	1	0.003003	0.003003	138.50	0.000
X ₁ ²	1	0.000034	0.000034	1.58	0.265
X ₂ ²	1	0.000018	0.000018	0.83	0.404
X ₃ ²	1	0.000018	0.000018	0.83	0.404
X ₁ × X ₂	1	0.000729	0.000729	33.62	0.002
X ₁ × X ₃	1	0.001296	0.001296	59.77	0.001
X ₂ × X ₃	1	0.000756	0.000756	34.88	0.002
Lack-of-Fit	3	0.000074	0.000025	1.42	0.439
Pure Error	2	0.000035	0.000017		
Total	26	0.015055			

^a Degrees of freedom

^b Sum of square

^c Mean square

^d p Values <0.05 were considered to be significant.