Electronic Supplementary Information

Efficient adsorption/photodegradation of organic pollutants from aqueous systems using Cu_2O nanocrystals as a novel integrated photocatalytic adsorbent

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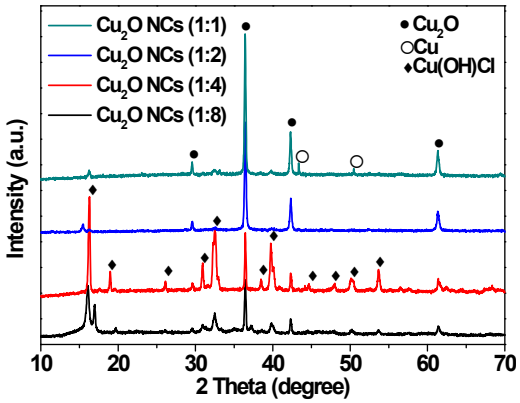

Fig. S1 XRD patterns of the samples obtained with different molar ratios of Cu and $CuCl_2$ reactants.

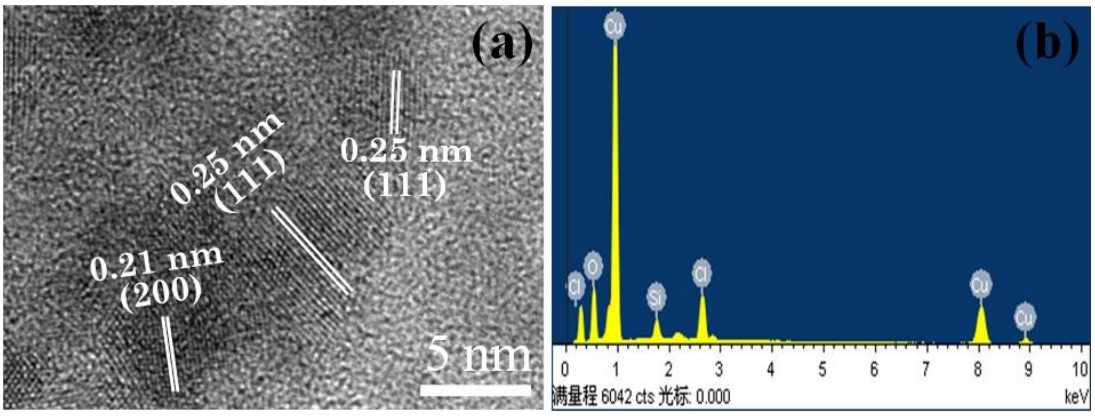

Fig. S2. HRTEM (a) image and EDS (b) spectrum of Cu_2O NCs.

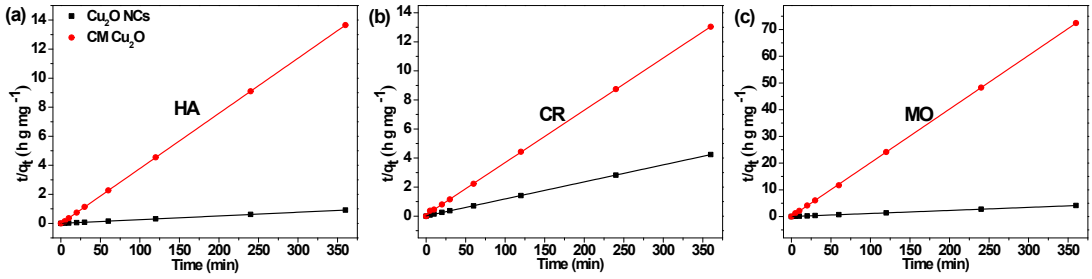

Fig. S3. Linear fit of experimental data obtained using pseudo-second-order kinetic model at different organic pollutants, pH = 5.0±0.1, m/V = 0.1 g/L.

Table S1. The experimental and calculated q_e values, pseudo-second-order rate constants, k_2, and correlation coefficient values, R_2.

	Organic pollutants	Experimental values q_e (mg/g)	Calculated q_e (mg/g)	k_2 (g/(mg·min))	R^2
Cu_2O NCs	HA	345.22	344.83	0.00350	0.9997
	CR	84.88	90.91	0.00931	0.9998
	MO	87.53	87.72	0.00241	0.9999
CM Cu_2O	HA	26.37	26.39	0.0898	0.9999
	CR	27.61	27.78	0.01489	0.9994
	MO	4.97	4.98	1.13055	0.9996

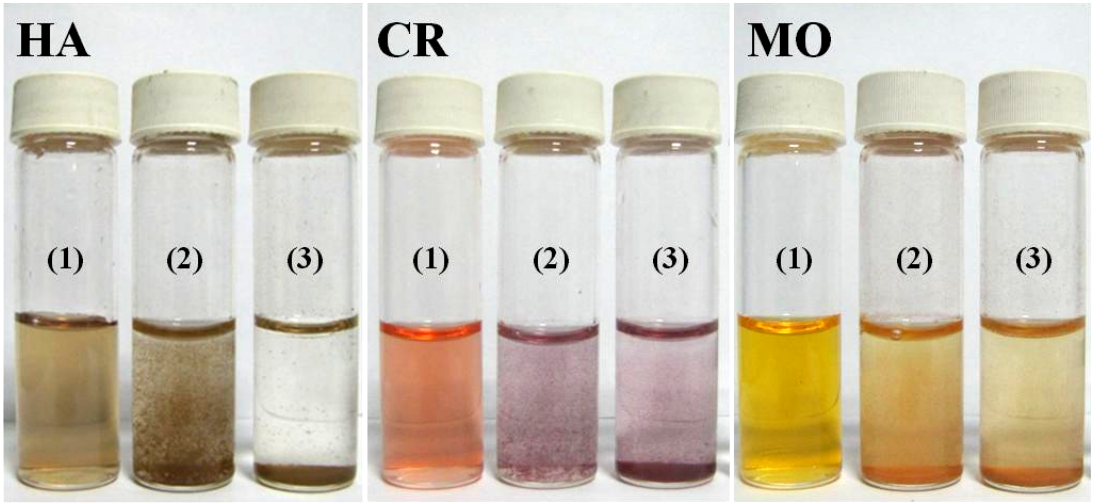

Fig. S4. Digital pictures of HA, CR and MO adsorption on as-prepared Cu_2O NCs sample. NO. 1 vials are corresponded to HA, CR and MO solution, respectively. NO. 2 and 3 vials are taken at adsorption time of 10 minutes and 30 minutes, respectively.

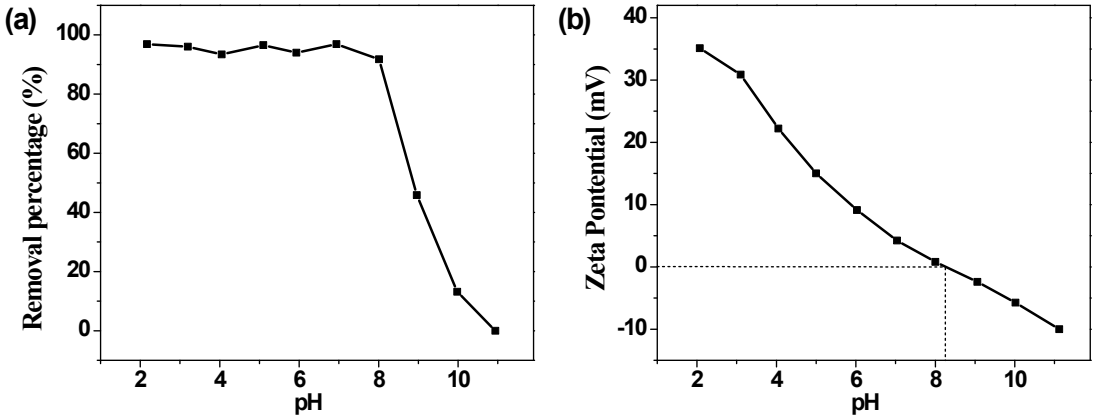

Fig. S5. (a) Effect of solution pH on the adsorption of HA by Cu_2O NCs and (b) Zeta-potential of Cu_2O NCs as a function of pH.

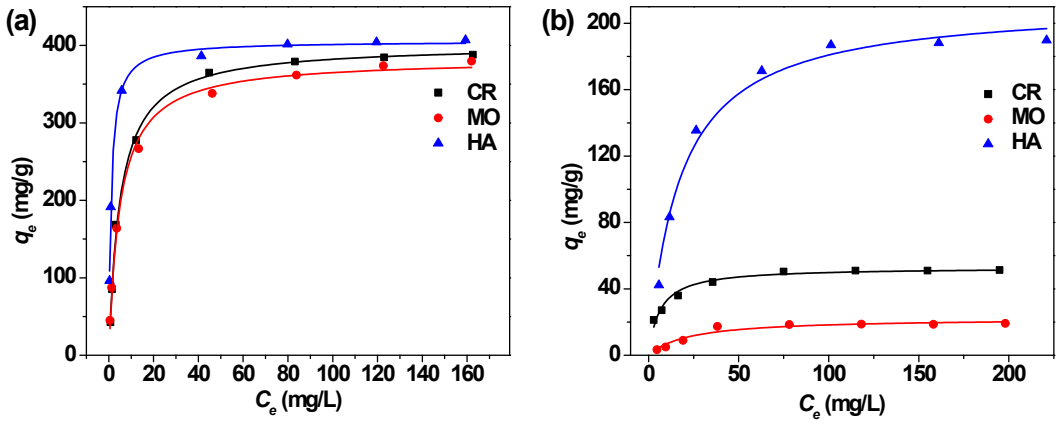

Fig. S6. Adsorption isotherms of CR, MO and HA on Cu_2O NCs (a) and CM Cu_2O (b).

Table S2. Parameters of the Langmuir and Freundlich isotherm model for organic pollutants on Cu_2O NCs and CM Cu_2O

Samples	Organic pollutants	Langmuir			Freundlich		
		q_{max} (mg/g)	b (L/mg)	R^2	k	n	R^2
Cu_2O NCs	HA	405.5	0.935	0.992	199.86	6.449	0.814
	CR	401.4	0.203	0.996	116.12	3.883	0.878
	MO	382.9	0.198	0.995	113.15	3.926	0.921
CM Cu_2O	HA	212.3	0.0576	0.983	45.62	3.521	0.833
	CR	52.9	0.164	0.963	20.23	5.250	0.911
	MO	22.4	0.044	0.934	3.59	2.955	0.798

Table S3. Comparison of maximum adsorption capacity of organic pollutants adsorption on Cu_2O NCs with other different adsorbents.

Adsorbents	*Adsorption capacity (mg·g^{-1})*	*Ref.*
	HA	
Activated carbon	2.15	1
Fly ash	72	2
Coal fly	16.6	3
Mesoporous silica	120	4
Aminopropyl functionalized SBA-15	117	5
Cu_2O NCs	405.5	This study
	CR	
Activated carbon	52-189	6
waste Fe(III)/Cr(III) hydroxide	44.00	7
waste Orange peel	22.44	8
waste banana pith	20.29	9
Cu_2O NCs	401.4	This study
	MO	
Activated carbon	9.94	10
Orange peels	20.50	11
Hyper-cross-linked polymer	70.92	12
Cu_2O NCs	382.9	This study

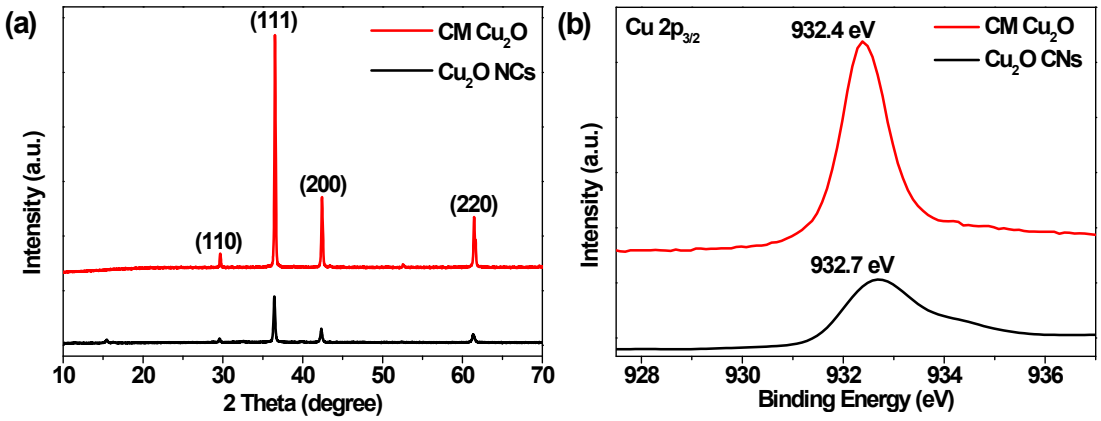

Fig. S7 XRD patterns (a) and Cu $2p_{3/2}$ XPS spectra (b) of CM Cu_2O and Cu_2O NCs.

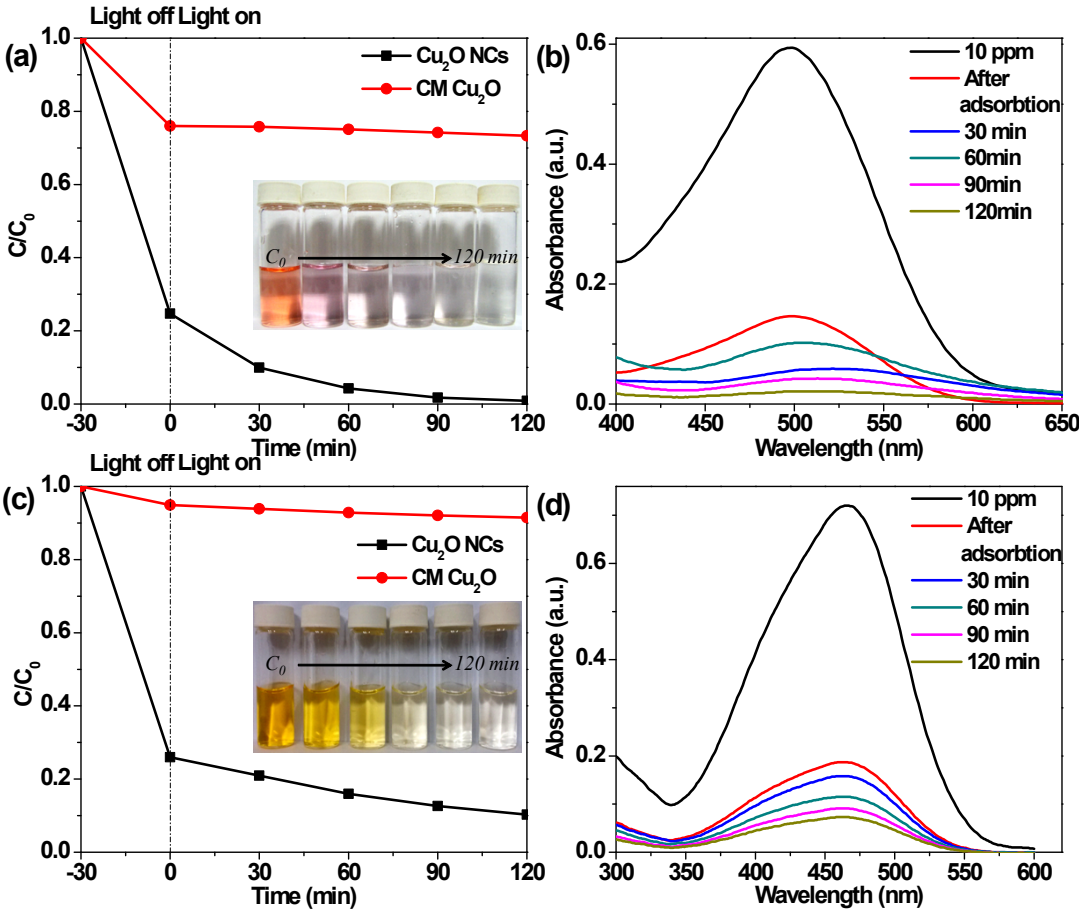

Fig. S8. Photodegradation of CR (a) and MO (c) over Cu_2O NCs and CM Cu_2O under visible light irradiation, respectively. UV−Vis spectra of CR (b) and MO (d) in aqueous Cu_2O NCs dispersions as a function of irradiation time with visible light irradiation ($\lambda \geq 400$ nm).

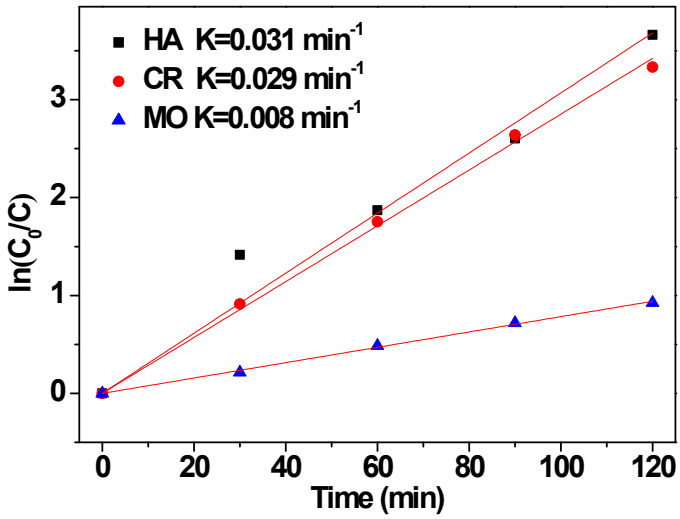

Fig. S9. Photocatalytic degradation reaction kinetics of HA, CR and MO over Cu_2O NCs, respectively.

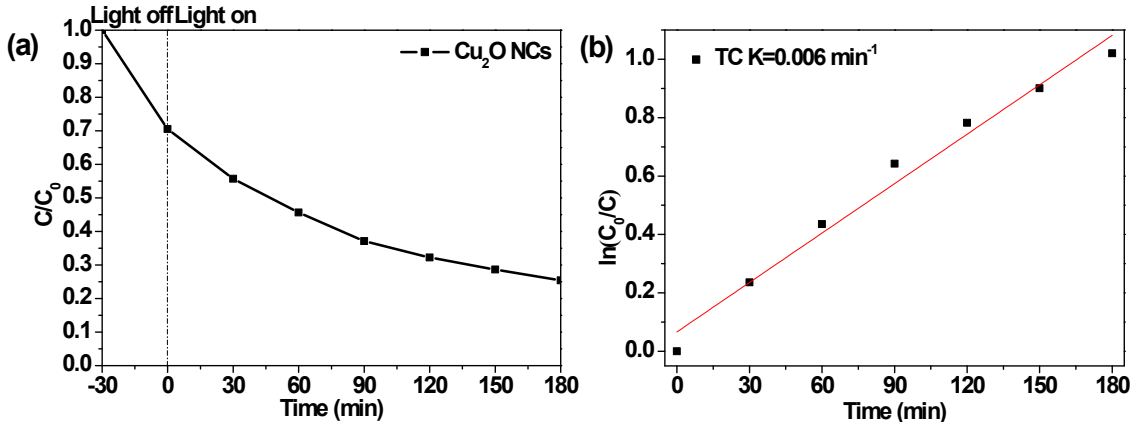

Fig. S10. Photodegradation (a) and photocatalytic degradation reaction kinetics (b) of TC over Cu_2O NCs under visible light irradiation.

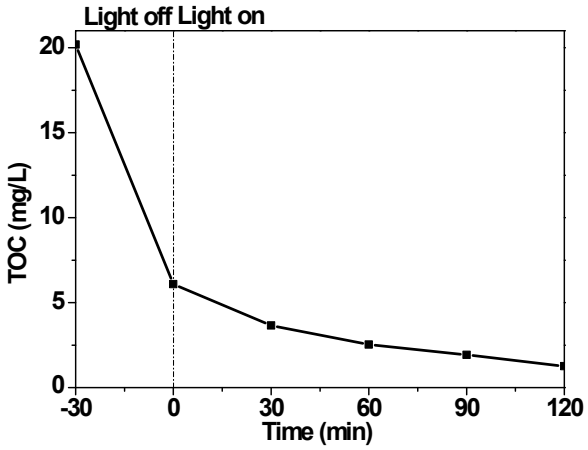

Fig. S11 The TOC removal curve of HA photocatalytic degradation by Cu_2O NCs.

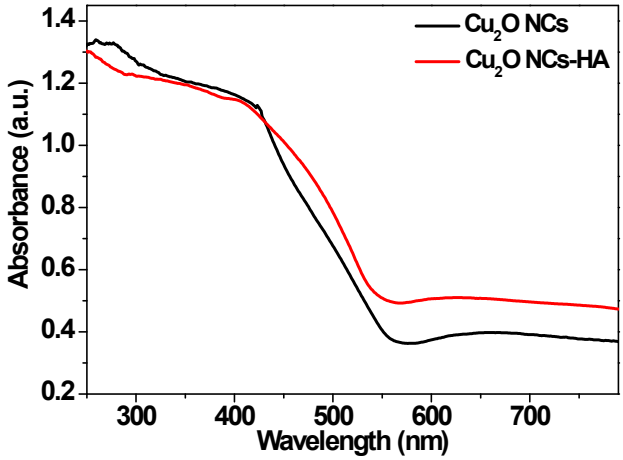

Fig. S12 The UV–Vis diffuse reflectance spectra of Cu_2O NCs and after HA adsorption.

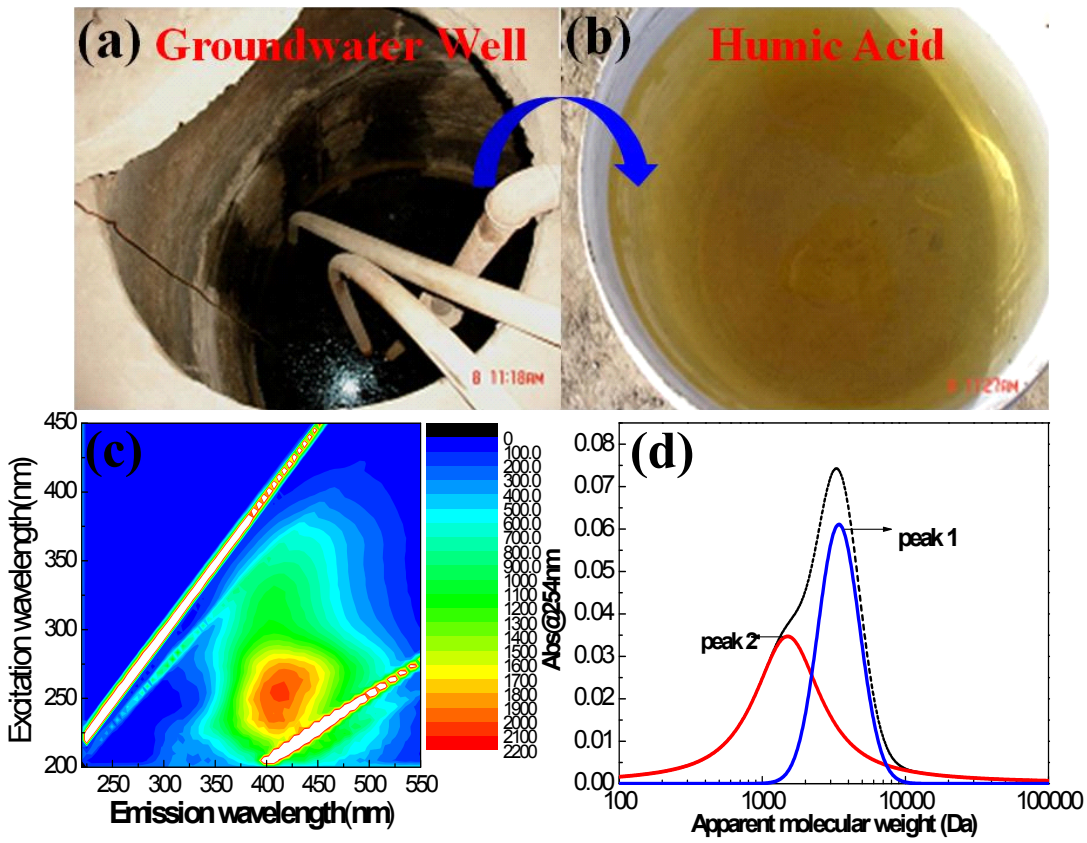

Fig. S13. (a) Digital pictures of the natural groundwater well; (b) the color of the groundwater sample; (c) the characterization of NOM by excitation emission matrix fluorescence spectroscopy and (d) by high performance size exclusion chromatography.

References

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