Supplementary Information

Enhanced Electro-peroxymonosulfate Activation by Carbon Nanotube Filter with Functionalized Polyelectrolyte

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Supplementary Materials: 4 Test and 13 Figures

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Test S1. Specific information of tap water and lake water.

Samples	pH	DO (mM)	TOC (mg/L)	Conductivity (μs/cm)
Tap water	7.61	0.21	1.75	515.69
Lake water	7.83	0.19	88.90	675.25

Test S2. Experimental processes of several pollutants.

The prepared PDDA-CNT nanohybrid filter was installed to serve as a cathode, meanwhile a perforated titanium plate was made as an anode. The voltage used in experiments was provided by the DC power (DH1766A-1, China). The flow rate was controlled by an Ismatec ISM833C peristaltic pump (Switzerland). 50 mL of 10 mg/L four typical organic compounds dissolution including 1.5 mM PMS passed through PDDA-CNT nanohybrid filter and then returned, respectively. Effluent samples (3 mL), include congo red, methylene blue and tetracycline were collected and analyzed at given time intervals by UV-vis spectrophotometer (UV-2600, Japan), respectively. Bisphenol A was detected using high-performance liquid chromatography (HPLC, Thermofisher, USA).

Test S3. Energy consumption.

The electric energy consumption (kWh/m^3) was calculated using the equation:

$$Energy\ consumption = \frac{applied\ voltage\ (V) \times current\ (A) \times retention\ time\ (h)}{solution\ volume\ (m^3)}$$

Test S4. Comparison of the performance of proposed system with reported electrocatalytic filtration systems.

Materials	**Pollutants**	**Operating parameters**			**Removal efficiency**	**Energy consumption**	**References**
		Voltage (V)	**Residence time (min)**	**pH**			
Molecular imprinting-TiO_2@SnO_2-Sb (A)	2,4-dichlorophenoxyacetic acid (1 mg/L)	3 V	240	7.0	62.4%	0.58 Wh/L	[1]
Sb-SnO_2/carbon membrane (A)	Tetracycline (50 mg/L)	3 V	480	7.0	96.5%	-	[2]
CNT-polyvinyl alcohol (A)	Cr (VI) (1 mg/L)	7 V	360	6.0	86.5%	1.48 kWh/m³	[3]
Nanoparticulate zero-valent iron/CNT	Betablocker metoprolol (0.2 μmol/L)	1 V	0.1	-	97.0%	-	[4]
PDDA-CNT (C)	**Congo red (10 mg/L)**	**-1 V**	**40**	**7.0**	**100%**	**0.026 kWh/m³**	**This work**

Note: A: anode C: cathode.

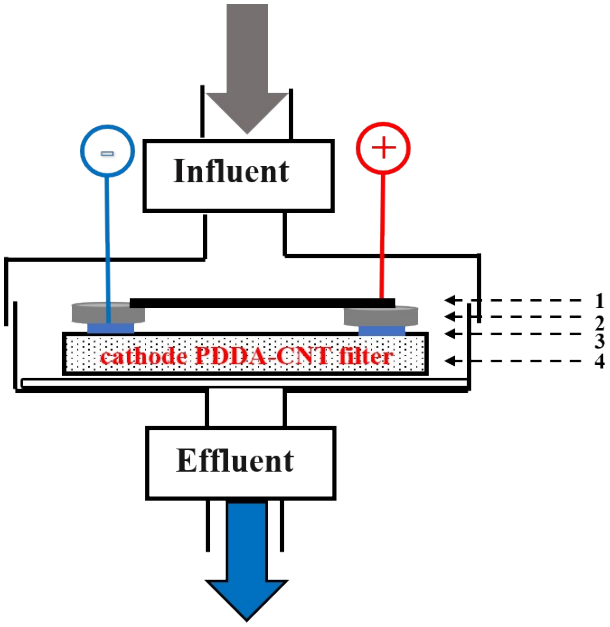

Fig. S1. Schematic diagram of continuous-flow electrochemical PMS activation device. (1) titanium ring, (2) a PDDA-CNT cathode filter, (3) an insulating silicone rubber separator seal, (4) a perforated titanium sheet.

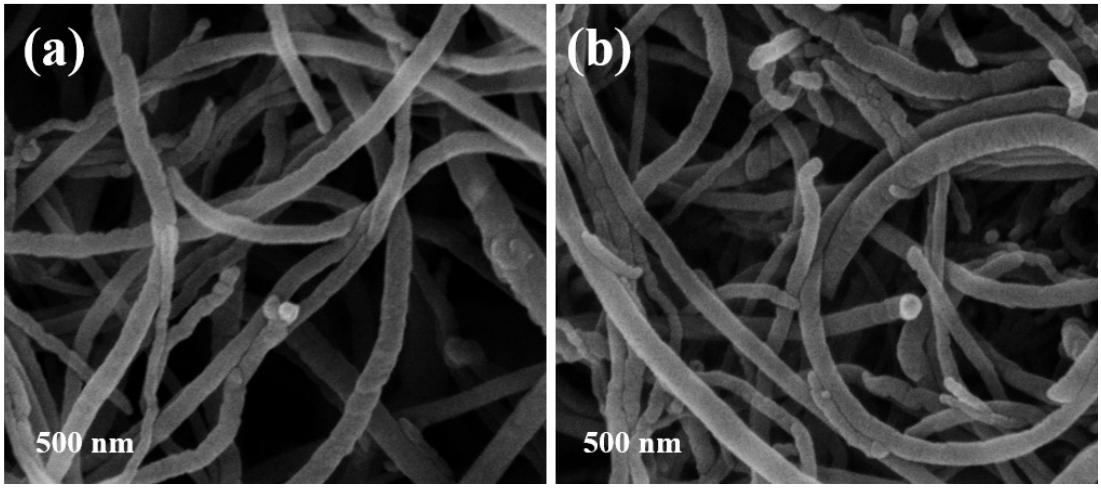

Fig. S2. FESEM images of (a) pristine CNT, (b) PDDA-CNT90 filter.

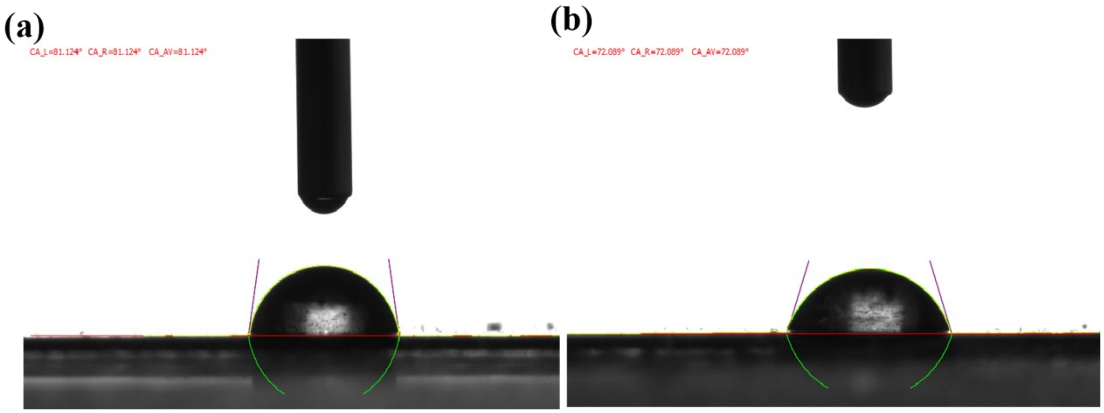

Fig. S3. Comparison of water contact angle of (a) CNT and (b) PDDA-CNT filter.

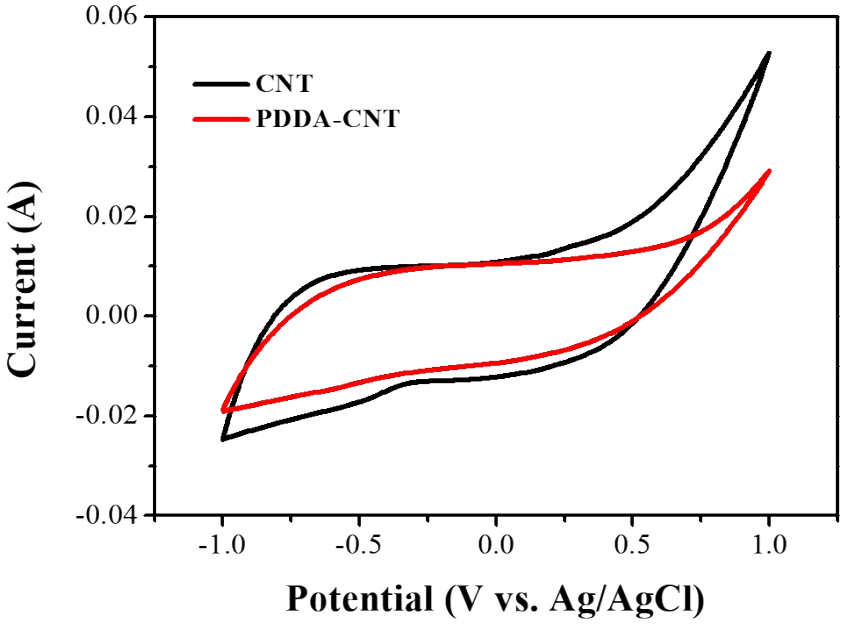

Fig. S4. CV data of CNT and PDDA-CNT filters in 0.1 M KOH at a scan rate of 50 mV s^{-1}.

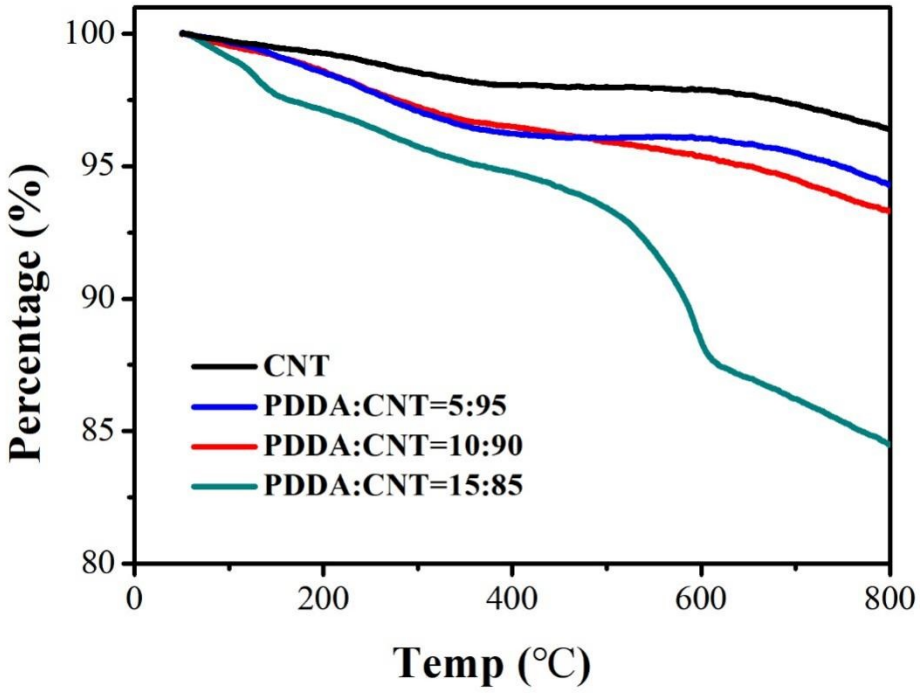

Fig. S5. TGA curves of CNT, and various PDDA-CNT samples.

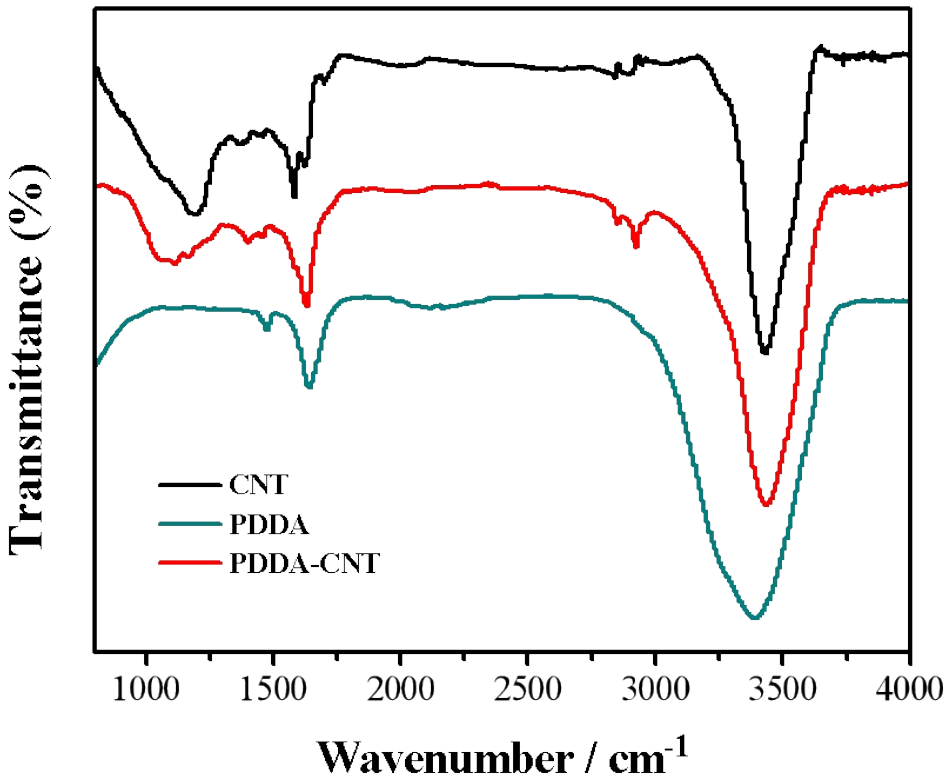

Fig. S6. FT-IR spectra of PDDA, CNT and PDDA-CNT filters.

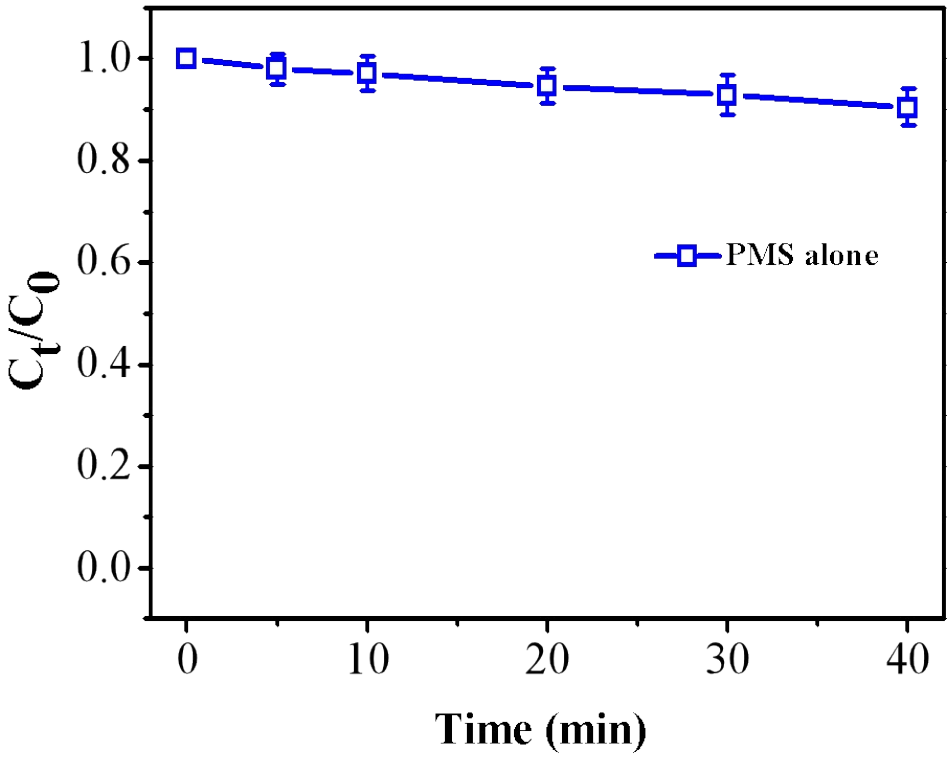

Fig. S7. Effect of PMS alone on the CR degradation performance in PDDA-CNT/PMS system. Experiment conditions: J = 5 mL/min, $[CR]_0$ = 10 mg/L, $[PMS]_0$ = 1.5 mM, PDDA: CNT = 10: 90, pH = 7.0 ± 0.5, V = -1 V.

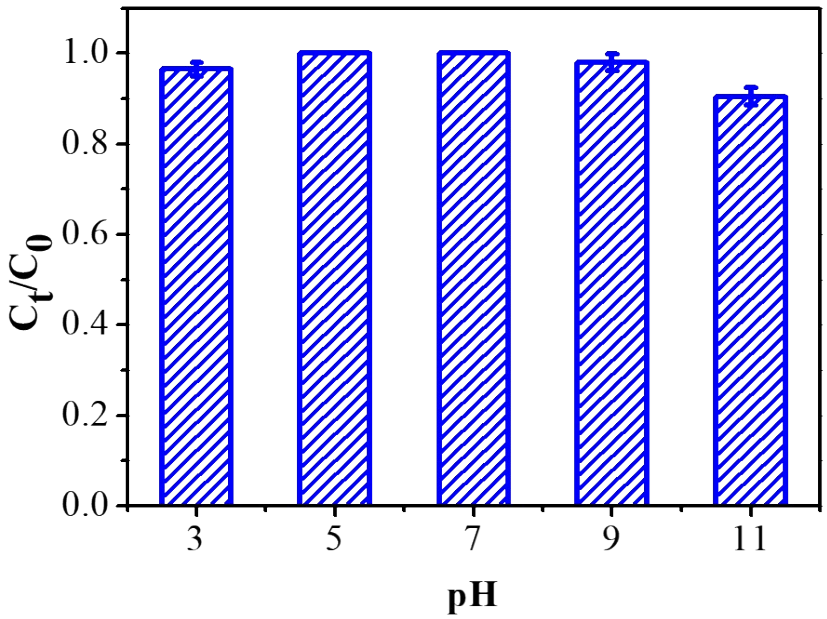

Fig. S8. of the degradation efficiency of CR with different initial pH. Experiment conditions: J = 5 mL/min, $[CR]_0$ = 10 mg/L, $[PMS]_0$ = 1.5 mM, PDDA: CNT = 10: 90, V = -1 V.

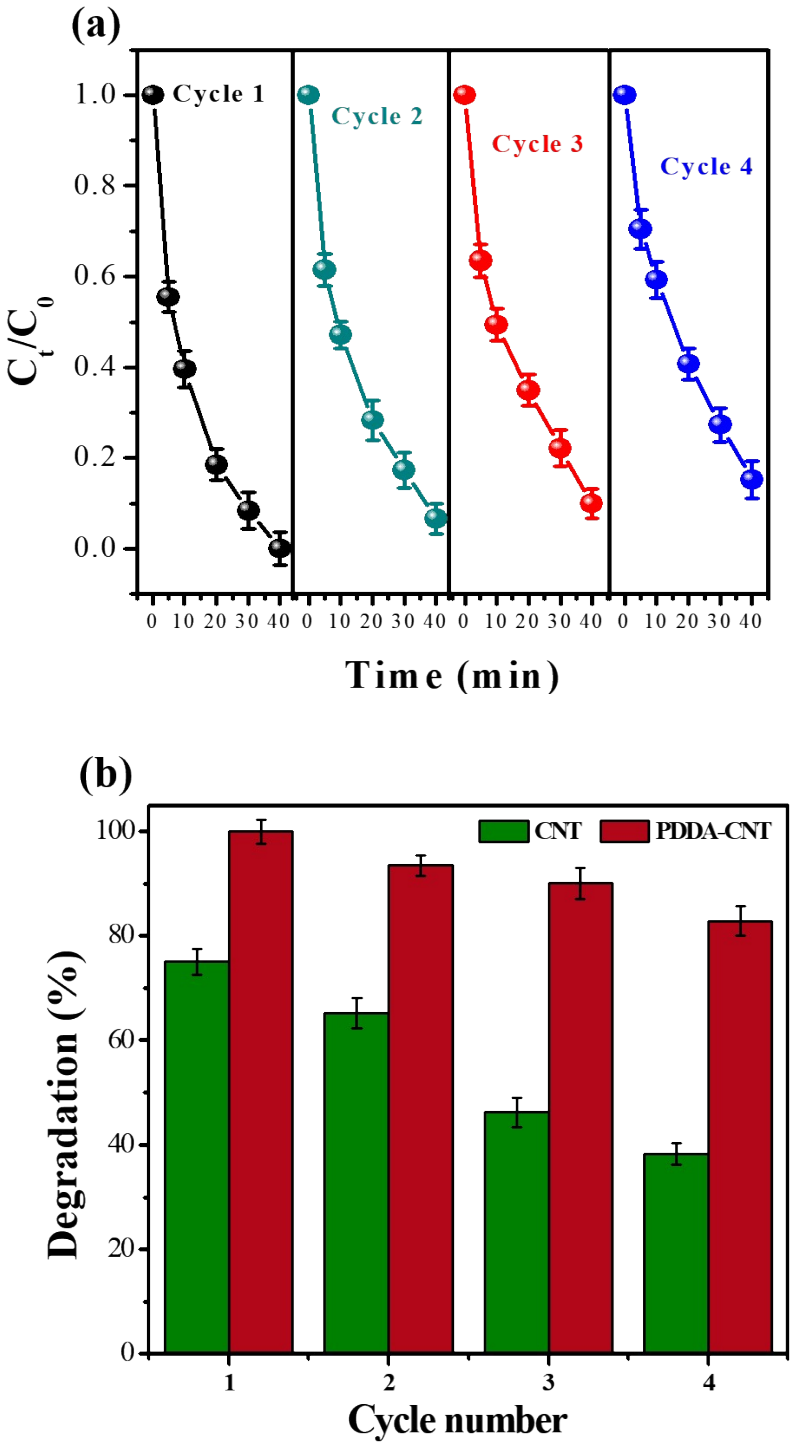

Fig. S9. (a) Degradation of CR after four cycles in PDDA-CNT/PMS system and (b) comparison of CR degradation efficiency in CNT/PMS system and PDDA-CNT/PMS system. Experiment conditions: J = 5 mL/min, $[CR]_0$ = 10 mg/L, $[PMS]_0$ = 1.5 mM, PDDA: CNT = 10:90, pH = 7.0 ± 0.5, V = -1 V.

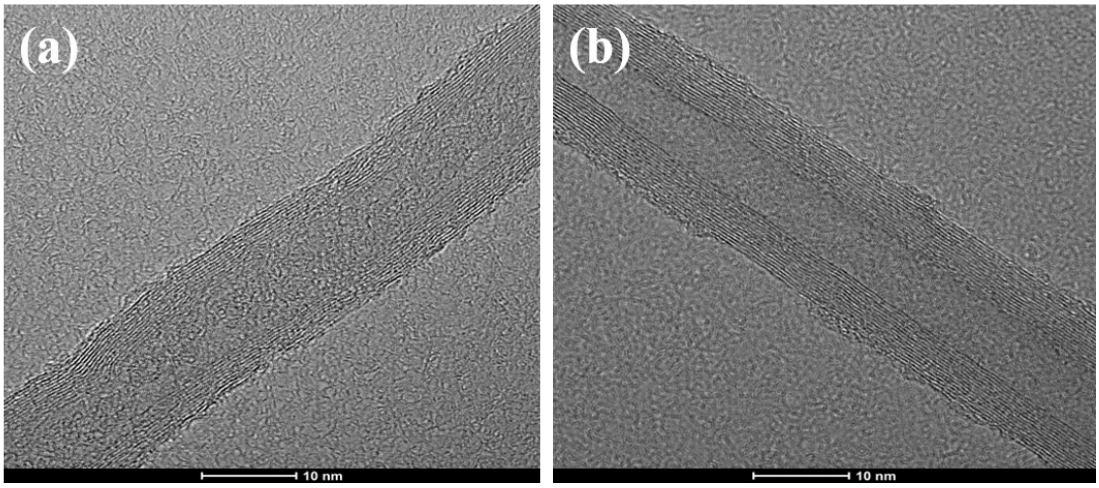

Fig. S10. FETEM of PDDA-CNT filter (a) before, and (b) after catalysis.

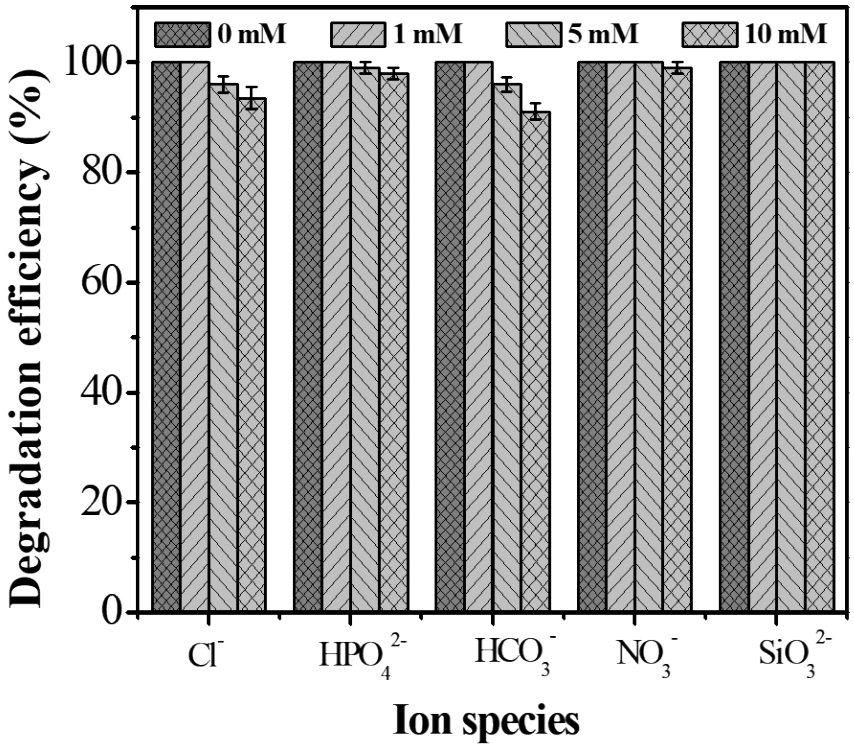

Fig. S11. Effect of coexisting ions in PDDA-CNT/PMS system. Experiment conditions: J = 5 mL/min, $[CR]_0$ = 10 mg/L, $[PMS]_0$ = 1.5 mM, PDDA: CNT = 10: 90, pH = 7.0 ± 0.5, V = -1 V.

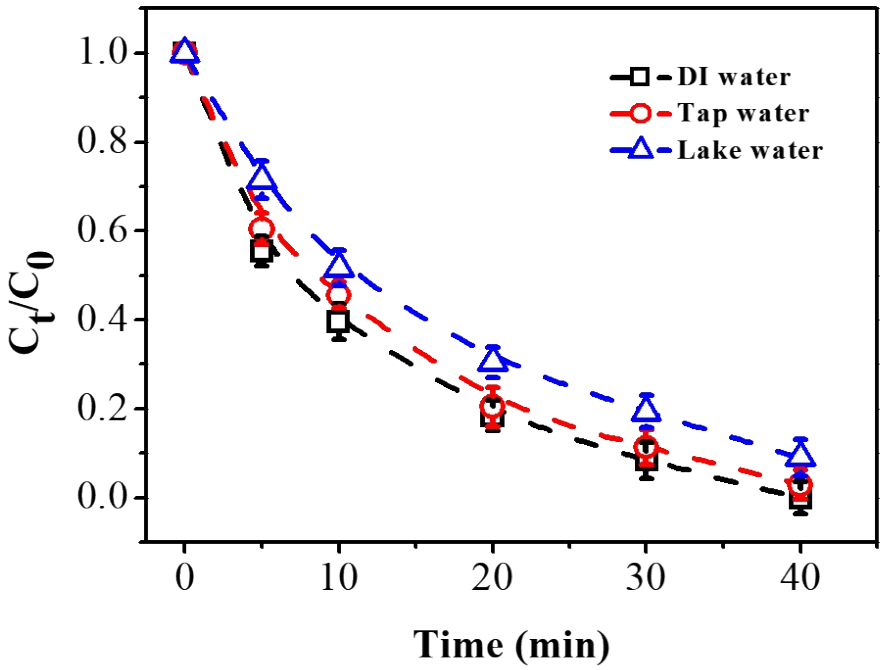

Fig. S12. The degradation efficiency of CR in different water matrixes in PDDA-CNT/PMS system. Experiment conditions: J = 5 mL/min, $[CR]_0$ = 10 mg/L, $[PMS]_0$ = 1.5 mM, PDDA: CNT = 10: 90, pH = 7.0 ± 0.5, V = -1 V.

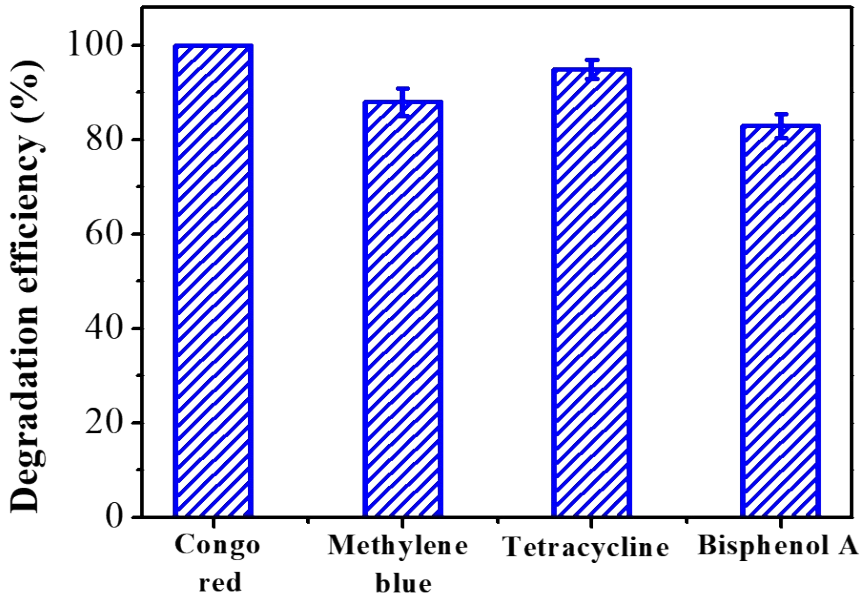

Fig. S13. Degradation efficiency of four typical organic compounds. Experiment conditions: J = 5 mL/min, $[CR]_0$ = 10 mg/L, $[PMS]_0$ = 1.5 mM, PDDA: CNT = 10:90, pH = 7.0 ± 0.5, V = -1 V.

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