Supplementary information

The characteristics and mechanism of electrochemical peroxymonosulfate activation by Co-N@CF anode for pollutant removal

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Text S1

The electricity energy consumption was estimated by EE/O which was calculated according to following equation:

$$\frac{EE}{O} = \frac{1000P\text{t}}{60V\lg\frac{C_0}{C_t}}$$

Where P is the actual power of current generator (kW), t is the reaction time (min), V is the volume of reaction liquid (L), C_0 is the initial concentration of TC, C_t is the concentration of TC at selected reaction time.

Text S2

The activation energy of EC/Co-N@CF and Co-N@CF processes were calculated according Arrhenius formula:

$$\ln k = -\frac{Ea}{RT} + A$$

Where k is kinetic constants at different temperature, Ea was activation energy, R is gas constant which was 8.314 $Jmol^{-1}k^{-1}$, T was thermodynamic temperature, A is the temperature-independent factor.

Table S1 Element content comparison between Co-N@CF and bare CF.

Anodes	C	N	O	Co
Bare CF	48.55%	0	51.45%	0
Co-N@CF	57.71%	15.76%	19.2%	7.33%

Table S2 Comparison of electrochemical activation of PMS towards pollutants removal by different processes.

PMS activator	The pollutant and its initial concentration	Degradation efficiency	PMS (mM)	Current density/Voltage	EE/O ($kWh.m^{-3}$)	Reaction Time	Reference
Cathode: ACF	0.042 mM CBZ	100%	50	28.6 $mA.cm^{-2}$	1.89	40 min	[1]
Anode: BDD	0.005 mM SMX	84.67%	1	5.0 $mA.cm^{-2}$	6.16	30 min	[2]
Anode: Ti/SnO2-Sb	50 mg/L PFDA	92.7%	5	10.0 $mA.cm^{-2}$	37.46	90 min	[3]
Cathode: $NiCo_2O_4$	100 mg/L RhB	99.7%	32.5	10.0 $mA.cm^{-2}$	/	60 min	[4]
Anode: iron sheet	200 mg/L DNP	63.4%	5	4.0 $mA.cm^{-2}$	0.0336	15 min	[5]
Anode: Co-N@CF	44.4 mg/L TC	92.2%	0.4	1.0 $mA.cm^{-2}$	0.072	60 min	This work

Table S3 Scavenger reagents and reaction rate constants with various radicals.

	$OH^{\bullet}$	$SO_4^{\bullet-}$	$O_2^{\bullet-}$	$^1O_2$
TBA	6×10^{8} $M^{-1}S^{-1}$ [6]	7.6×10^{5} $M^{-1}S^{-1}$ [7]	Not available	1.8×10^{3} $M^{-1}S^{-1}$ [8]
L-Histidine	Not available	Not available	Not available	3.2×10^{8} $M^{-1}S^{-1}$ [9]
p-BQ	Not available	Not available	9.0×10^{8} $M^{-1}S^{-1}$ [10]	Not available
MeOH	9.7×10^{8} $M^{-1}S^{-1}$	2.7×10^{7} $M^{-1}S^{-1}$	Not available	Not available

Table S4 The kinetic constants and regression coefficients of TC degradation with various scavengers.

Quencher	Concentration(mM)	Kinetic constant (min^{-1})	R^2
TBA	0	0.11799	0.97593
	10	0.04799	0.96484
	50	0.02947	0.99194
	100	0.01533	0.99964
p-BQ	0	0.11799	0.97593
	0.1	0.03227	0.98850
	0.5	0.02184	0.99490
	1	0.01578	0.95264
	2	0.01993	0.96736
L-Histidine	0	0.11799	0.97593
	0.1	0.06721	0.95679
	0.5	0.05409	0.96546
	1	0.04264	0.93623
	5	0.04464	0.80583
$Na_2S_2O_3$	0	0.11799	0.97593
	0.05	0.05005	0.99575
	0.1	0.00961	0.99493
	0.5	0.00484	0.87008
	1	0.00331	0.98793
	2	0.00387	0.94419

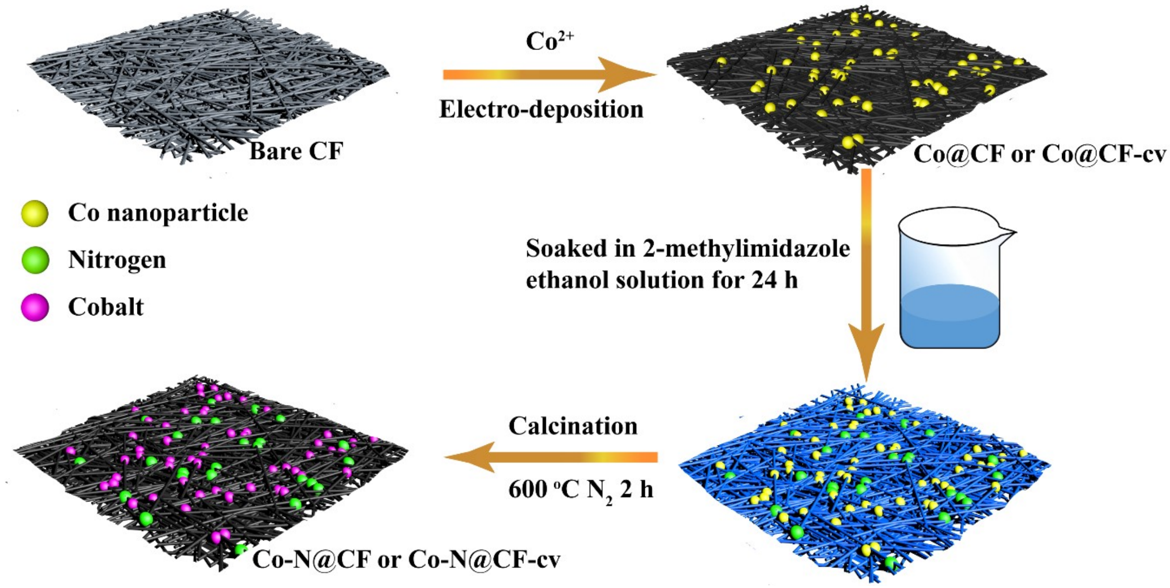

Fig. S1 Schematic illustration of the synthesis of the Co-N@CF anode.

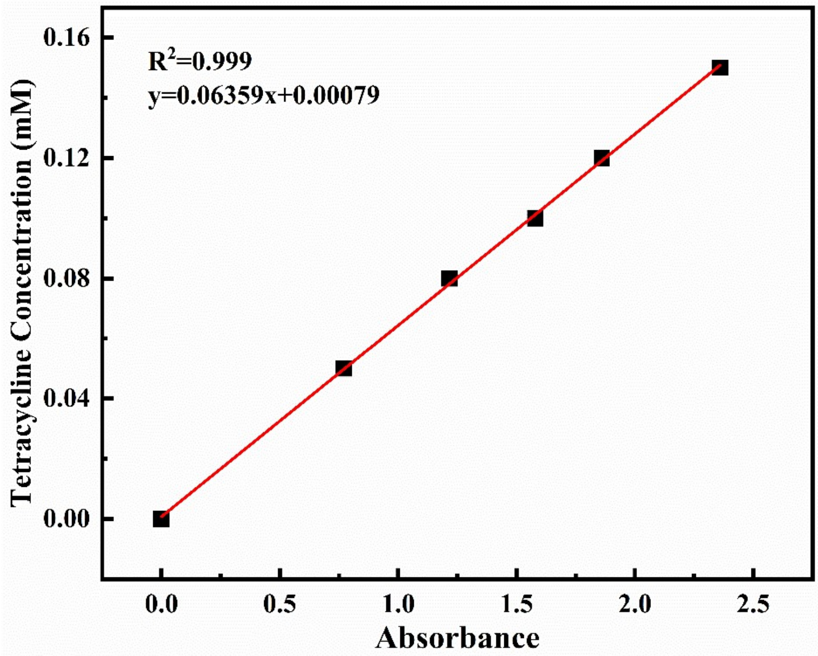

Fig. S2. The standard curve of concentration-absorbance of tetracycline.

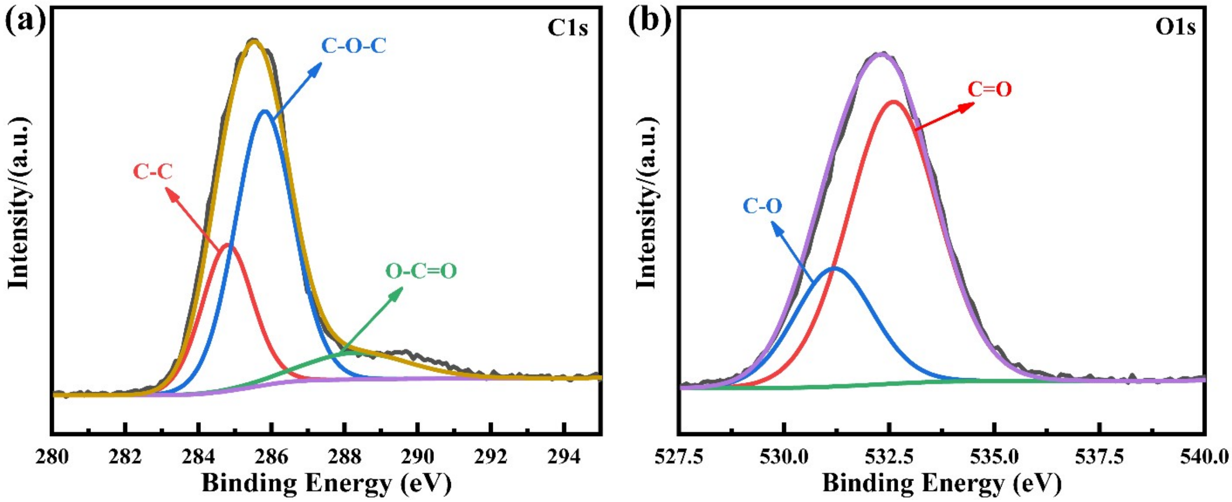

Fig. S3. The high XPS resolution spectrum of C 1s (a) and O 1s (b) of bare CF.

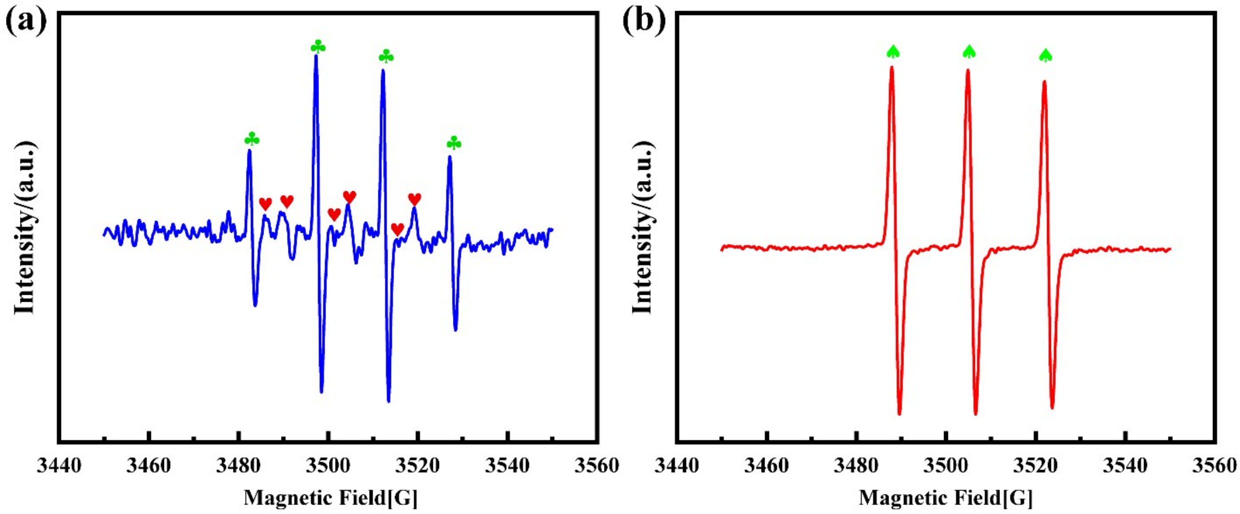

Fig. S4. EPR spectra of DMPO-OH$^{\bullet}$ (♣), DMPO-$SO_4^{\bullet -}$ (♥) (a) and TMP-$^1O_2$ (♠) (b) generated in EC/Co-N@CF process.

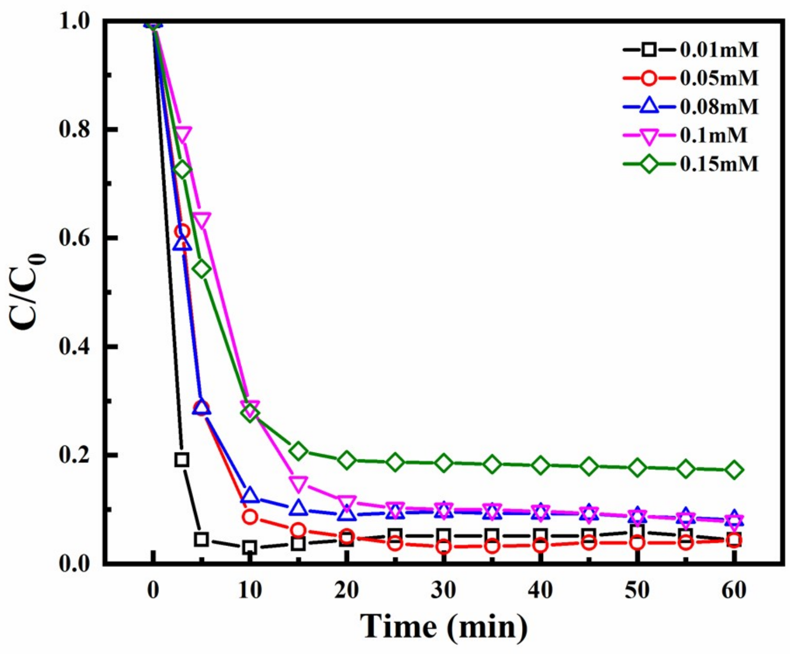

Fig. S5. Degradation efficiency of TC with effect of initial TC concentration.

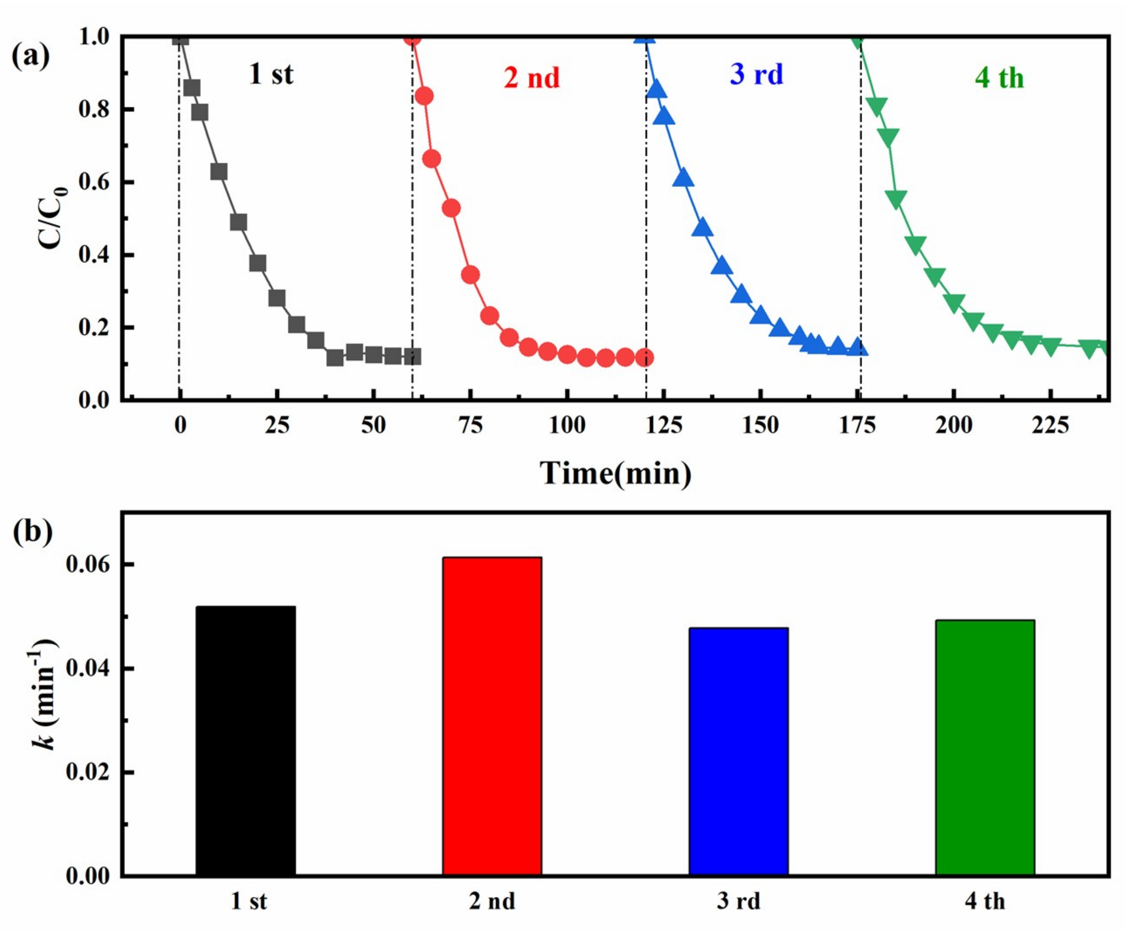

Fig. S6. The recyclability (a) and *k* (b) of Co-N@CF anode.

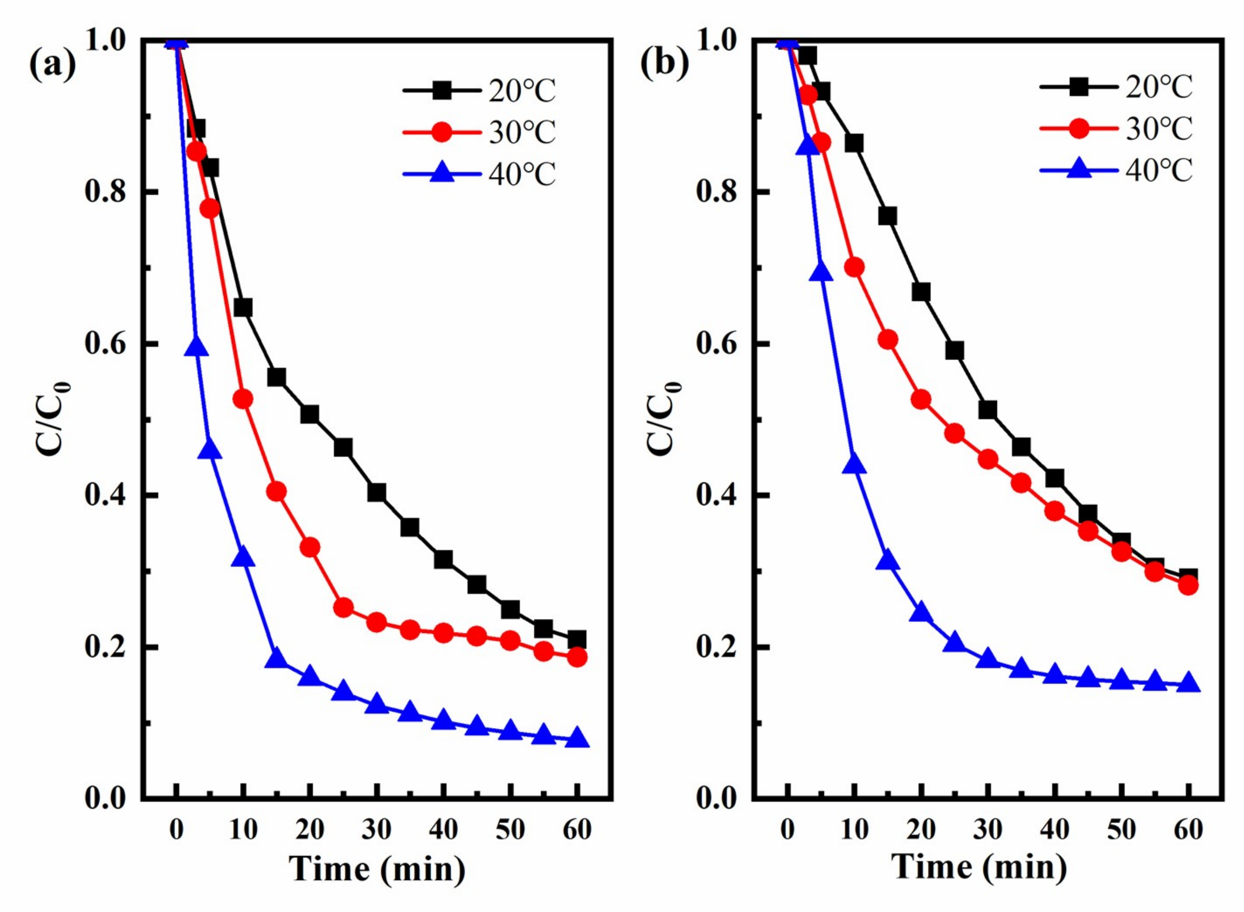

Fig. S7 The linear fitted curve of the degradation results of EC/Co-N@CF (a) and Co-N@CF (b) processes at various temperature.

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