Support information for

Water decontamination under high salinity via TiO_2 NTs/PbO_2-Cu electro-chemical oxidation system: kinetics mechanism and DFT studies

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Text S1 Preparation of TiO_2 NTS/PbO_2 electrode

The TiO_2 NTs substrate was made via anodization method, and the main steps are listed below [1-3]: 1) Polished Ti sheet through abrasive papers was successively washed by twice-distilled water, ethanol, 0.1M hydrochloric acid, and twice-distilled water respectively in an ultrasonic cleaner (KH5200B, Kunshan Hechuang, China). 2) The anodization experiment was performed in a two electrodes system where earlier obtained Ti sheet served as anode which is parallel to Cu sheet cathode with a distance of 2.5cm. The electrolyte consisted of NaF (0.8 wt%), Na_2SO_4 (0.8 wt%), ethylene glycol (42 wt%), twice-distilled water (56.4 wt%), and the voltage was fixed at 25V using a DC power supply (PS-303D, Long Wei, Shenzhen, China). The anodization experiment was carried out at room temperature for 2 hours in a magnetic stirrer (DF-101S, Shanghai Yukang, China). After anodization, the obtained TiO_2 NTs sheet was ultrasonic cleaned with two-distilled water and then dried in an oven. 3) The as-formed TiO_2 NTs sheet was calcined at 500℃ at ambient atmosphere for 2 hours in a muffle furnace (KSL-1200X, Hefei Kejing, China). The heating and cooling rate were set at 2℃/min and 1℃/min, respectively. The finally annealed TiO_2 NTs sheet was denoted as TiO_2 NTs substrate.

The PbO_2 layer was coated on TiO_2 NTs substrate through variable current electro-deposition method as introduced below [4, 5]: The as-made TiO_2 NTs electrode was used as anode and graphite sheet was used as cathode in an electrolytic cell where the temperature set at 60℃. The deposition was performed in electrolyte containing 0.1M HNO_3, 0.5M $Pb(NO_3)_2$, 0.5g NaF, under two-stage currents where 25mA/cm^2 was applied first and 10mA/cm^2 was applied last. The obtained PbO_2 coated TiO_2 NTs electrode was then successively ultrasonic cleaned in ethanol, twice-distilled water and finally dried at 50℃ for use.

Text S2 The calculation for service life of electrode:

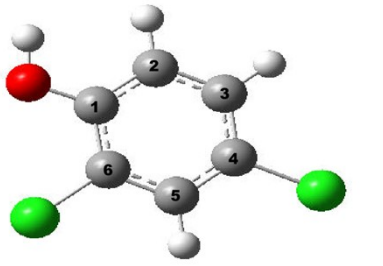
The empirical equation is according to the study of Hoffmann, as follows:[6]

$T_1 \times i_1^n = T_2 \times i_2^n$

Where T_1 is the lifetime obtained from current density i_1, T_2 is the lifetime obtained from current density i_2, n is the coefficient. In our study, T_1 = 6.45h at current density 100mA/cm^2 and T_2 = 34.27h at 50mA/cm2 were used to calculate the lifetime of electrode at current density 10mA/cm^2.

Table S1 Results of TOC removal, MCE (%), EEO in different salts solution. Condition: current density 10mA/cm^2, pH 5.5.

Solutions with different salts	TOC removal (mg/L, the initial concentration was 3.8mg/L)	MCE (%)	EEO
0.1M Na_2SO_4	2.85	4.24	2.32 x 10^{-3}
0.1M NaCl	1.69	2.52	8.48 x 10^{-5}
0.1M Na_2SO_4 + 0.1M NaCl + 0.1M $NaNO_3$	1.79	2.67	0.82 x 10^{-4}



Optimized structure of 2,4-DCP, and the number 1 to 6 represent carbon atoms C1 to C6.

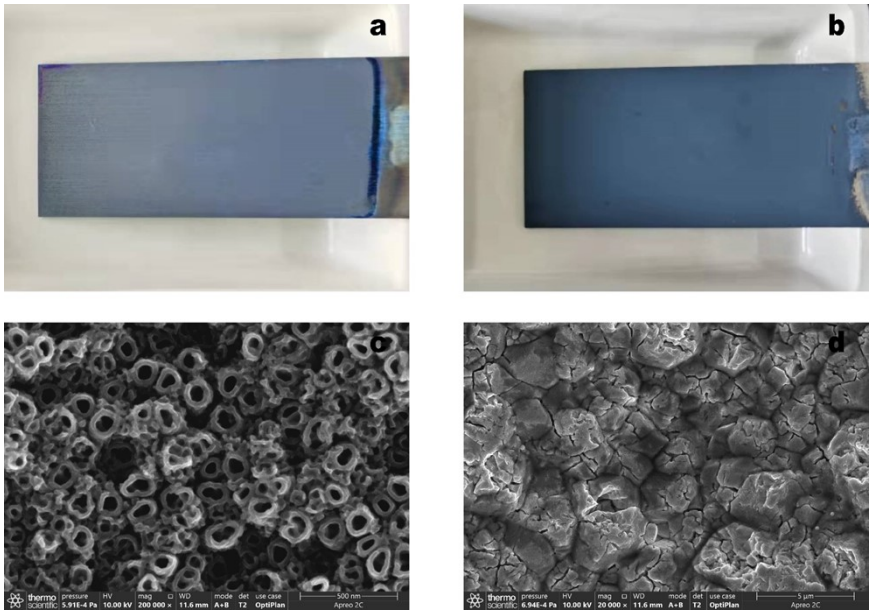


Figure. S1 Digital picture of TiO_2 NTs electrode (a); Digital picture of PbO_2 coated TiO_2 NTs electrode (b); SEM images of TiO_2 NTs electrode (c); SEM images of PbO_2 coated TiO_2 NTs electrode (d).

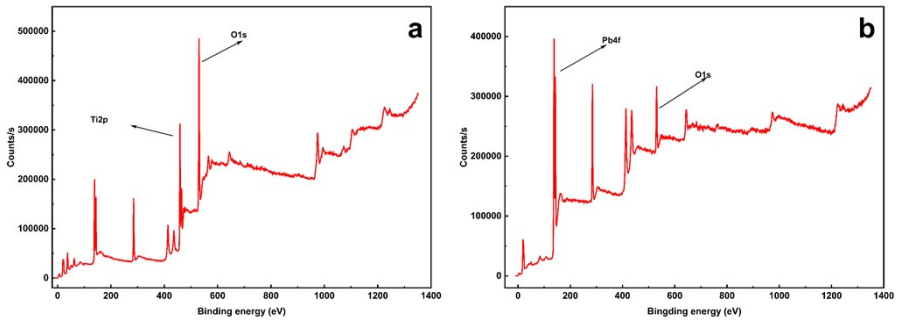


Figure. S2 XPS spectra of TiO_2 nanotube substrate(a); PbO_2 coated layer (b).

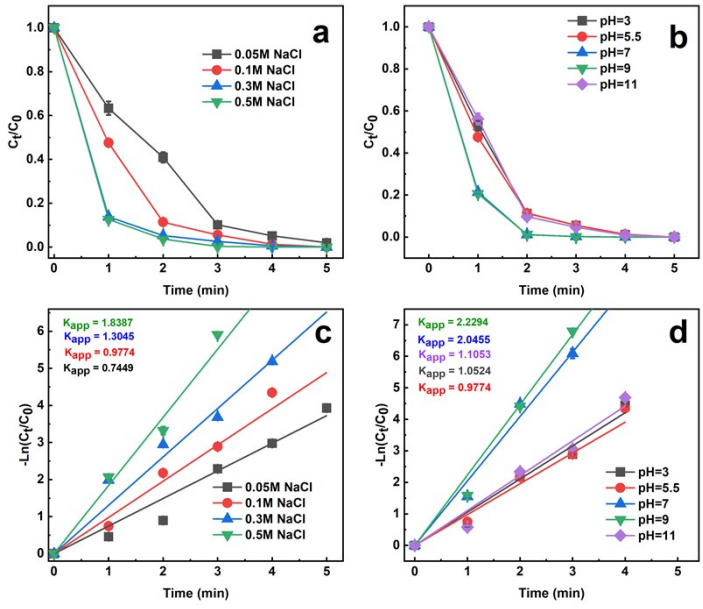


Figure. S3 Degradation of 2,4-DCP and kinetics performance NaCl solution (0.05mM 2,4-DCP): the effect of NaCl concentration, current density 10mA/cm^2, pH 5.5 (a, c); the effect of pH, current density 10mA/cm^2, NaCl concentration 0.1M(b, d).

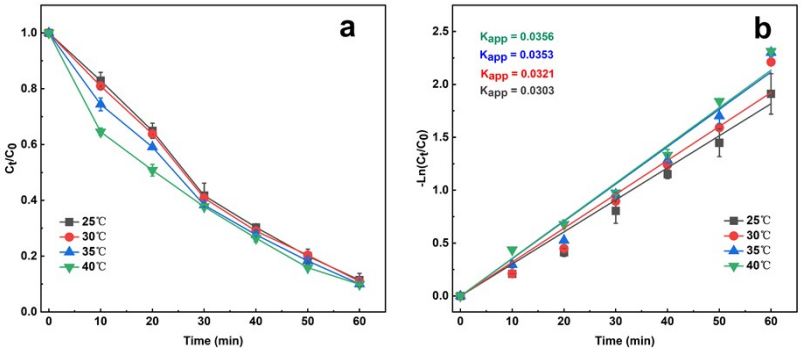


Figure. S4 degradation time course under different temperatures (a); degradation kinetics under different temperatures (b).

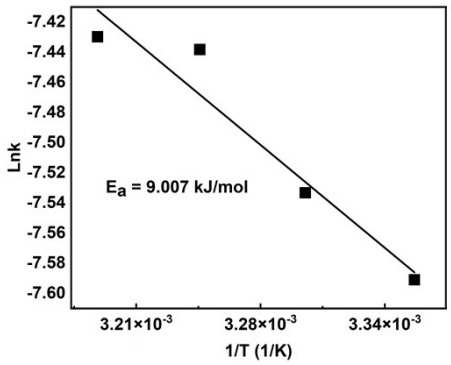


Figure. S5 Lnk-1/T plot for apparent activation energy calculation. Conditions: 2,4-DCP 0.05mM, current density 10mA/cm^2, pH 5.5, Na_2SO_4 concentration 0.5M.

References:

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