

Electronic Supplementary Information

**Vertically aligned Pt/TiO<sub>2</sub> nanobelt films on Ti sheet for efficient degradation of refractory ethyl thionocarbamate collector**

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## 2.5 Analysis of byproducts by the SPE/GC–MS

The solid phase extraction procedures of byproducts were described as following: The SPE 24-port vacuum manifold system (Phenomenex, U.S.) was used to extract target byproducts from water. The Strata™-X (10 g, code: 8B-S029-MFF, Phenomenex) was employed as the SPE sorbent. Prior to extraction, the Strata™-X SPE cartridges were preconditioned with 2 mL of acetonitrile, followed by 1 mL of ultrapure water. The pH of water samples was adjusted to around 2.0 using 0.05 mol L<sup>-1</sup> HCl solution. 50 mL of acidified aqueous samples were loaded onto the cartridges and the aqueous solution passed directly through to waste bottle at a flow rate of 3 mL min<sup>-1</sup>. After sample percolation, the cartridges were rinsed with 5 mL ultrapure water. Afterwards, the cartridges were dried under vacuum for 10 min to removal residual water. The analytes were eluted with 3 mL of acetonitrile at the flow rate of 1 mL min<sup>-1</sup>. The organic extracts were transferred into 300 µL GC vials for analysis.

The SPE extracts were analyzed by the GC–MS (Shimadzu, GCMS–QP2010 SE, Japan), equipped with a capillary column (Zebron ZB–FFAP, 30 m×0.32 mm×0.25 µm, Phenomenex, U.S.). The GC–MS analysis procedures were given as following: the following oven temperature program was used: an initial oven temperature was 80 °C (held for 5 min), increased to 230 °C (held for 10 min) at 8 °C min<sup>-1</sup>, and then increased to 310 °C (held for 1 min) at 35 °C min<sup>-1</sup>. High purity He gas (purity≥99.999%) was used as carrier gas, and the column flow rate was 1 mL min<sup>-1</sup>. The ion source of mass spectra was operated in the electron impact mode (EI mode, electron energy 70 eV, 220 °C). Full-scan mass (m/z 40–500) were recorded for identification of byproducts. According to fragmentation rules of organic species under electron ionization conditions, byproducts were identified by comparing mass spectra with National Institute of Standards and Technology (NIST) mass spectral library data.

**Table S1** BET specific surface area of titanic acid, TiO<sub>2</sub> nanobelt and Pt/TiO<sub>2</sub> nanobelt films exfoliated from Ti sheet

Materials	BET specific surface area (m <sup>2</sup> g <sup>-1</sup> )
Titanic acid	127.96
TiO <sub>2</sub> nanobelts	95.48
Pt/TiO <sub>2</sub> nanobelts	93.35

**Table S2** Removal efficiency of ETC at 75 min and  $k_{\text{obs}}$  values in the photocatalytic degradation of ETC by Pt/TiO<sub>2</sub> nanobelt films with various Pt loadings

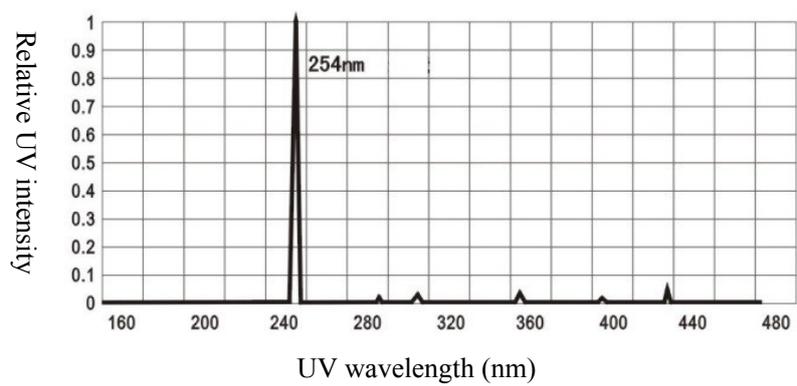
Pt loading (mg m <sup>-2</sup> )	Removal of ETC at 75 min (%)	$k_{\text{obs}}$ (min <sup>-1</sup> )	$R^2$
0	96.39	0.0299	0.991
7.2	97.46	0.0377	0.978
11.3	99.15	0.0458	0.988
41.5	99.78	0.0583	0.985
51.1	99.65	0.0516	0.993

**Table S3** GC retention time and special characteristics of identified byproducts in the photocatalytic degradation of ETC at 30 min

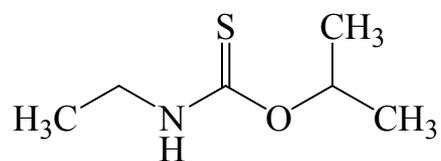
Peak No.	Molecular formula	Compound name	Retention time (min)	Similarity (%)	Peak area (%)	Characteristic ions ( $m/z$ )
1	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	2,3-dihydroxy-2-methylpentanoic acid	4.567	71	15.36	72,88,90,116
2	C <sub>5</sub> H <sub>11</sub> NO <sub>2</sub>	dimethylethoxyformamide	4.615	70	32.61	59,72,88,90
3	C <sub>6</sub> H <sub>13</sub> NO <sub>2</sub>	<i>L</i> -valine methyl ester	4.872	74	1.04	72,74,88,90
4	C <sub>4</sub> H <sub>9</sub> NO <sub>2</sub>	isopropyl carbamate	6.975	99	37.1	59,62,88
5	C <sub>2</sub> H <sub>5</sub> NO	acetamide	8.081	100	6.57	59
6	C <sub>6</sub> H <sub>14</sub> O <sub>3</sub>	2,2'-dihydroxydipropyl ether	9.048	69	1.45	59,70,89,116
7	C <sub>4</sub> H <sub>5</sub> NO <sub>2</sub>	succinimide	10.113	82	1.06	56,99,127
8	C <sub>12</sub> H <sub>14</sub> O <sub>4</sub>	diethyl phthalate	15.163	92	1.81	65,105,149,177

**Table S4** GC retention time and special characteristics of identified byproducts in the photocatalytic degradation of ETC at 90 min

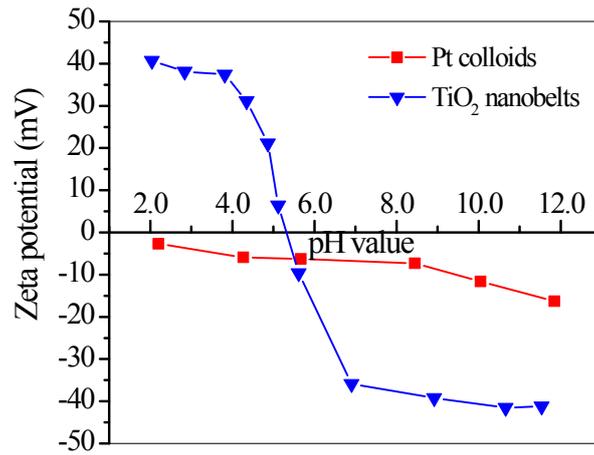
Peak No.	Molecular formula	Compound name	Retention time (min)	Similarity (%)	Peak area (%)	Characteristic ions ( <i>m/z</i> )
9	C <sub>10</sub> H <sub>20</sub> O	2-isopropyl-5-methylcyclohexanol	6.319	85	29.2	71,81,95,123
4	C <sub>4</sub> H <sub>9</sub> NO <sub>2</sub>	isopropyl carbamate	6.98	90	1.92	59,62,88
10	C <sub>6</sub> H <sub>9</sub> N	2-ethylpyrrole	7.097	100	4.12	95
5	C <sub>2</sub> H <sub>5</sub> NO	acetamide	8.081	99	8.51	59
11	C <sub>8</sub> H <sub>11</sub> N	2-ethyl-6-methylpyridine	8.143	86	20.49	65,92,120,152
12	C <sub>3</sub> H <sub>7</sub> N	<i>N</i> -ethyl- <i>N</i> -methyleneamine	12.051	98	1.45	57
8	C <sub>12</sub> H <sub>14</sub> O <sub>4</sub>	diethyl phthalate	15.157	93	24.43	65,105,149,177



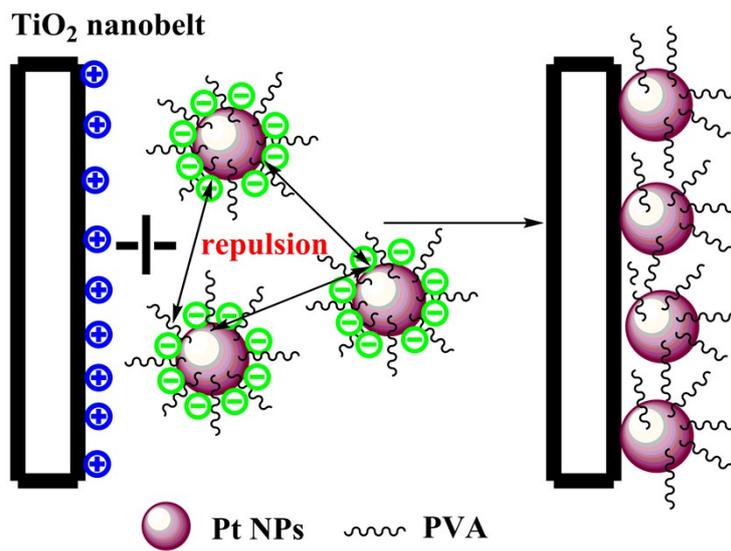
**Fig. S1** Distribution of UV irradiation emitted from the UV lamp



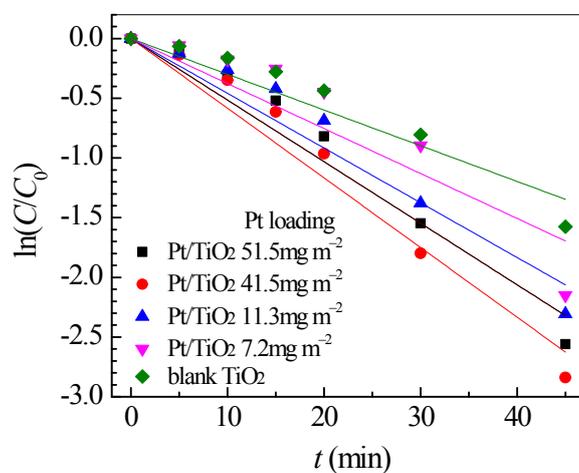
**Fig. S2** Molecular structure of ethyl thionocarbamate (ETC) flotation collector



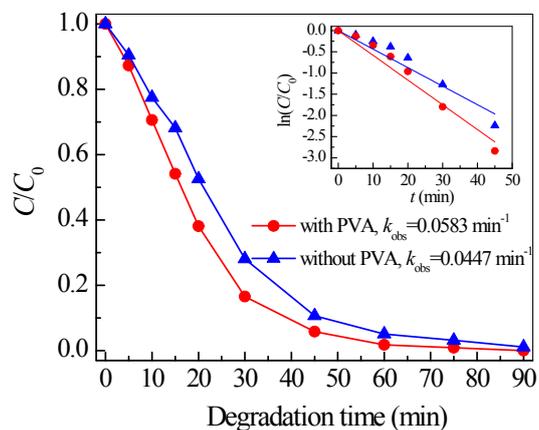
**Fig. S3** The variations of zeta potentials of Pt colloids and exfoliated TiO<sub>2</sub> nanobelts with pH value



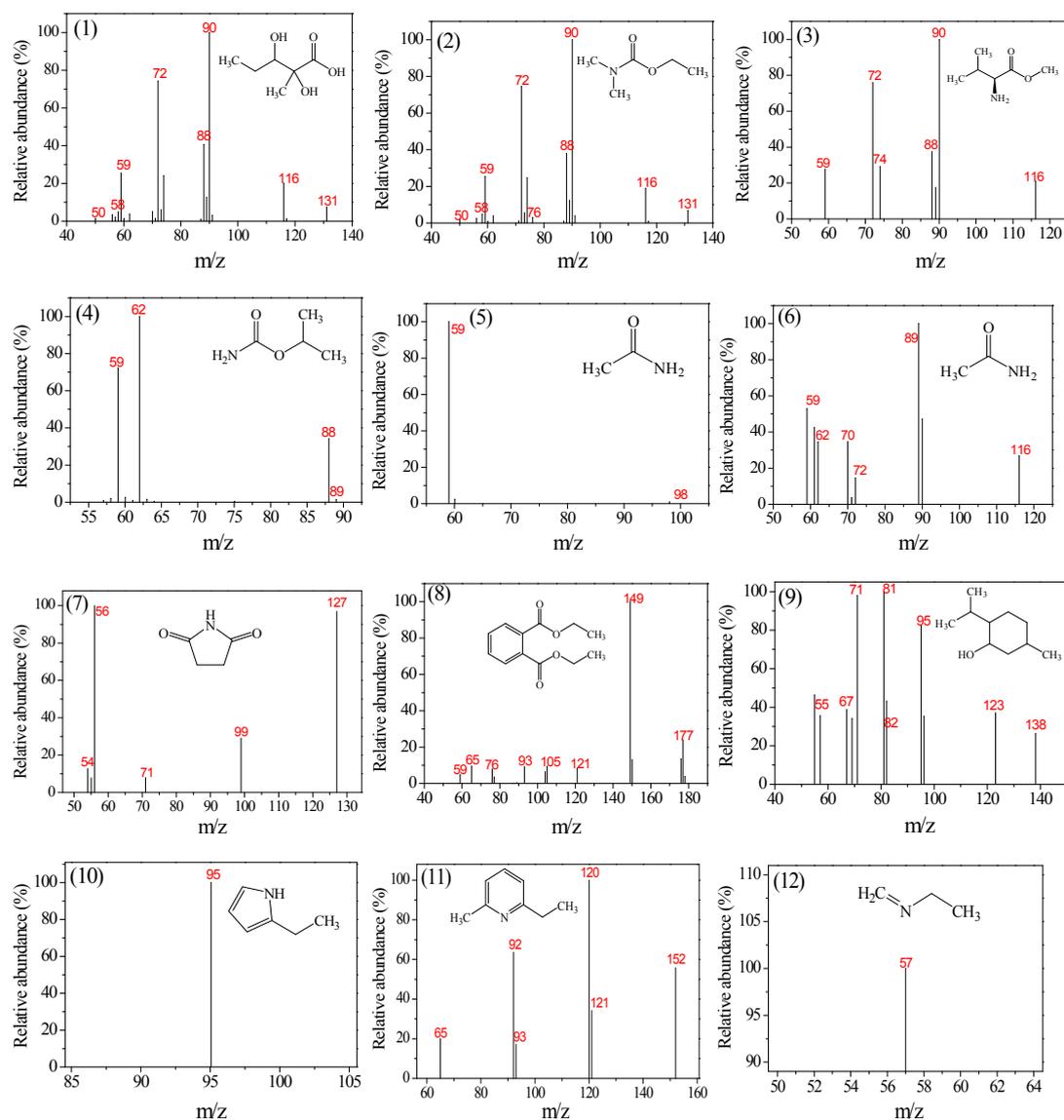
**Fig. S4** The schematic diagram of loading Pt NPs on TiO<sub>2</sub> nanobelts via the electrostatic self-assembly



**Fig. S5** Linear fitting of  $\ln(C/C_0)$  versus  $t$  in the photocatalytic degradation of ETC collector.



**Fig. S6** Comparison of photocatalytic degradation of ETC collector by Pt/TiO<sub>2</sub> nanobelt films (41.5 mg m<sup>-2</sup>) with and without PVA capping.



**Fig. S7** Mass spectra of byproducts generated in the photocatalytic degradation of ETC collector by the Pt/TNFs, (1) 2,3-dihydroxy-2-methylpentanoic acid; (2) dimethylethoxyformamide; (3) *L*-valine methyl ester; (4) isopropyl carbamate; (5) acetamide; (6) 2,2'-dihydroxydipropyl ether; (7) succinimide; (8) diethyl phthalate; (9) 2-isopropyl-5-Methylcyclohexanol; (10) 2-ethylpyrrole; (11) 2-ethyl-6-methylpyridine; (12) *N*-ethyl-*N*-methylethanimine.