

## Supporting Information

# **Enhanced visible light photocatalytic activity of polyaniline-crystalline TiO<sub>2</sub>-halloysite composite nanotubes by tuning the acid dopant in the preparation**

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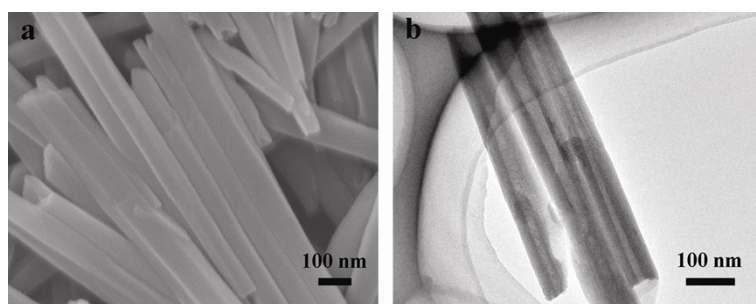


Fig. S1 SEM (a) and TEM (b) images of the halloysite (HA) minerals.

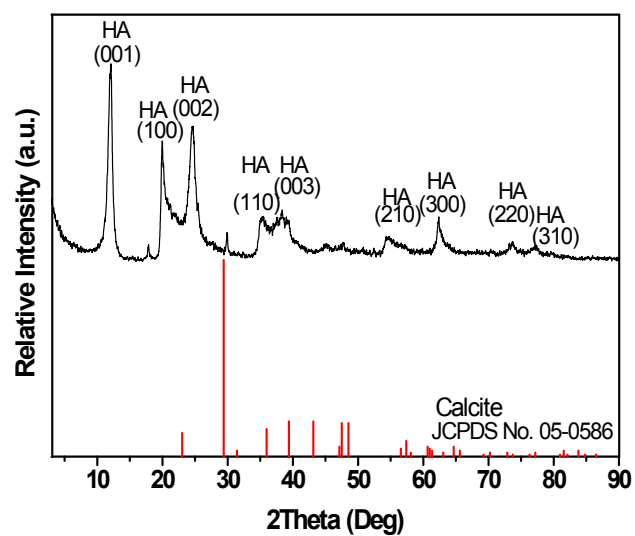


Fig. S2 XRD of the halloysite (HA) minerals and the standard XRD of calcite.

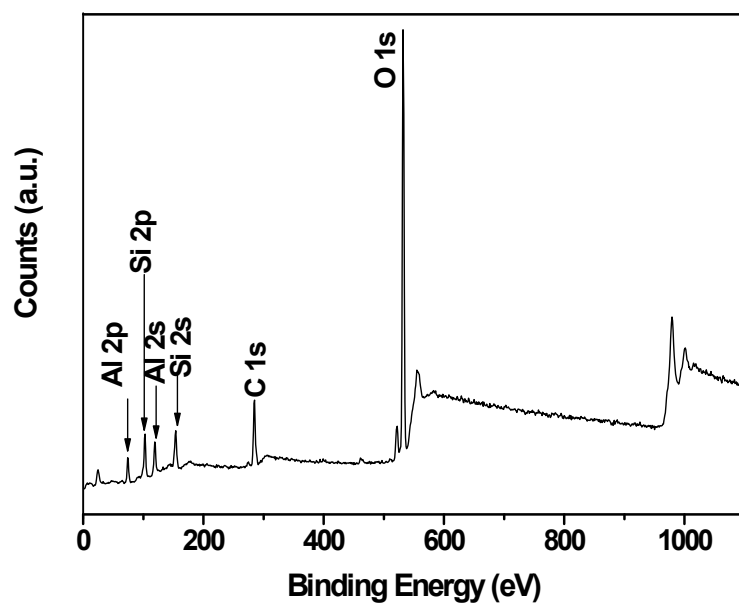
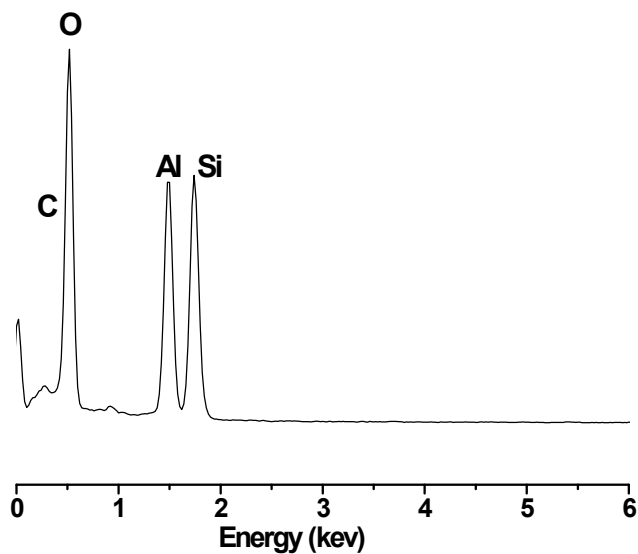
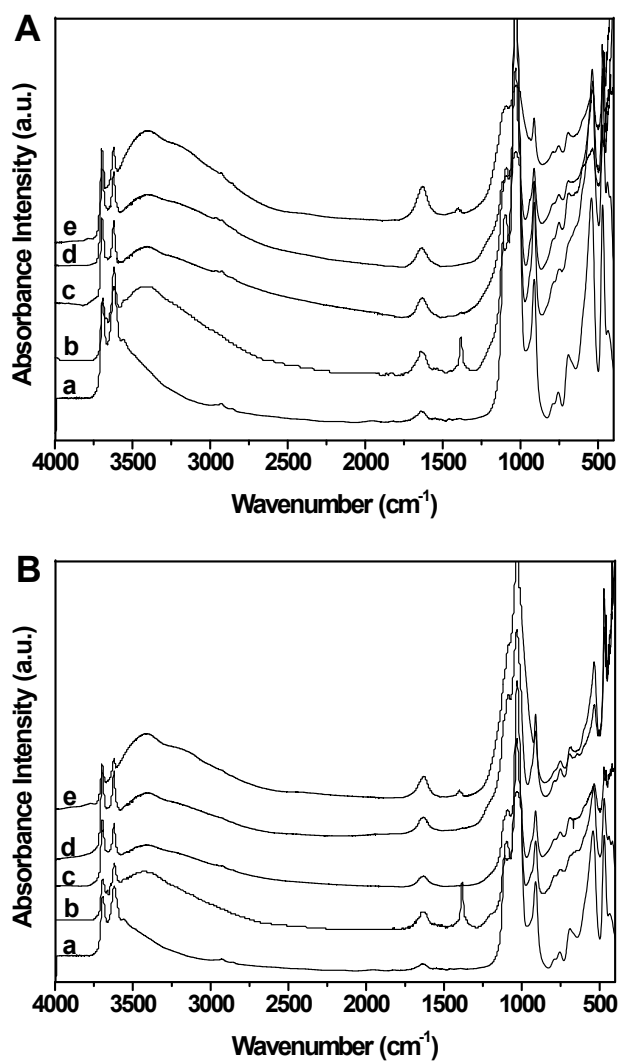


Fig. 3 XPS survey spectra of the halloysite minerals (C peak from the adventitious elemental carbon).



**Fig. S4** The energy-dispersive X-ray spectroscopy (EDX) of the halloysite minerals. The EDX shows that the halloysite minerals are composed of the elements Al, Si and O (C peak from the carbon-coated copper grids).



**Fig. S5** FT-IR spectra of heterogeneous PANI-TiO<sub>2</sub>-HA nanotubes prepared by one-pot with 1%

volume ratio of ANI to TTIP at pH 1.5 (A) and 0.5 (B) of the starting sols: a) HA; the pH of the starting sols is tuned by b) HNO<sub>3</sub>, c) HCl, d) H<sub>2</sub>SO<sub>4</sub> and e) H<sub>3</sub>PO<sub>4</sub>, respectively.

**Table S1.** Mass ratio of PANI to TiO<sub>2</sub> and the conductivity of heterogeneous PANI-TiO<sub>2</sub>-HA nanotubes prepared by one-pot with 1% volume ratio of ANI to TTIP (P-TH/X/1%-Z).

Sample	The acidity tuned by	Mass ratio of PANI to TiO <sub>2</sub>	Conductivity (S/cm <sup>-1</sup> )
TH/0.5-HCl	HCl	-	1.44 × 10 <sup>-8</sup>
TH/1.5-HCl	HCl	-	9.33 × 10 <sup>-9</sup>
P-TH/0.5/1%-HNO <sub>3</sub>	HNO <sub>3</sub>	2.22%	1.02 × 10 <sup>-8</sup>
P-TH/1.5/1%-HNO <sub>3</sub>	HNO <sub>3</sub>	1.82%	7.14 × 10 <sup>-9</sup>
P-TH/0.5/1%-HCl	HCl	1.48%	2.48 × 10 <sup>-8</sup>
P-TH/1.5/1%-HCl	HCl	10.00%	7.79 × 10 <sup>-9</sup>
P-TH/0.5/1%-H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	5.62%	1.23 × 10 <sup>-8</sup>
P-TH/1.5/1%-H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	5.64%	5.61 × 10 <sup>-9</sup>
P-TH/0.5/1%-H <sub>3</sub> PO <sub>4</sub>	H <sub>3</sub> PO <sub>4</sub>	19.84%	6.94 × 10 <sup>-9</sup>
P-TH/1.5/1%-H <sub>3</sub> PO <sub>4</sub>	H <sub>3</sub> PO <sub>4</sub>	9.76%	2.95 × 10 <sup>-9</sup>
PANI/1.5-HCl	HCl	-	1.06 × 10 <sup>-6</sup>
PANI/0.5-HCl	HCl	-	1.23 × 10 <sup>-5</sup>
PANI/0.5 M HCl	HCl	-	1.76 × 10 <sup>-5</sup>
PANI/1 M HCl	HCl	-	2.89 × 10 <sup>-5</sup>
PANI/2 M HCl	HCl	-	4.66 × 10 <sup>-5</sup>

**Table S2.** The adsorption ratio of P-TH/X/1%-Z for RB after 24 h adsorption-desorption equilibrium in the dark.

Sample	Adsorption ratio (%)	Sample	Adsorption ratio (%)
TH/0.5/-HCl	22.2	TH/1.5-HCl	28.6
P-TH/0.5/1%-HNO <sub>3</sub>	30.7	P-TH/1.5/1%-HNO <sub>3</sub>	41.2
P-TH/0.5/1%-HCl	26.1	P-TH/1.5/1%-HCl	34.0
P-TH/0.5/5%-HCl	39.3	P-TH/1.5/5%-HCl	46.1
P-TH/0.5/100%-HCl	54.9	P-TH/1.5/100%-HCl	71.5
P-TH/0.5/1%-H <sub>2</sub> SO <sub>4</sub>	33.1	P-TH/1.5/1%-H <sub>2</sub> SO <sub>4</sub>	31.9
P-TH/0.5/1%-H <sub>3</sub> PO <sub>4</sub>	37.8	P-TH/1.5/1%-H <sub>3</sub> PO <sub>4</sub>	38.2
PANI/1.5-HCl	53.9	PANI/0.5-HCl	44.3
PANI/0.5 M HCl	32.9	PANI/1 M HCl	54.5
PANI/2 M HCl	37.8	P25	8.2

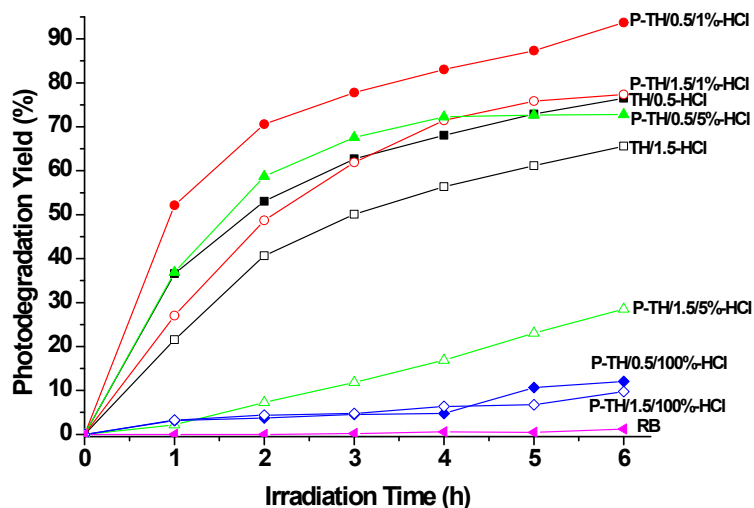


Fig. S6 Comparison of photodegradation yield of P-TH/X/Y-HCl for degradation of RB under visible light irradiation.

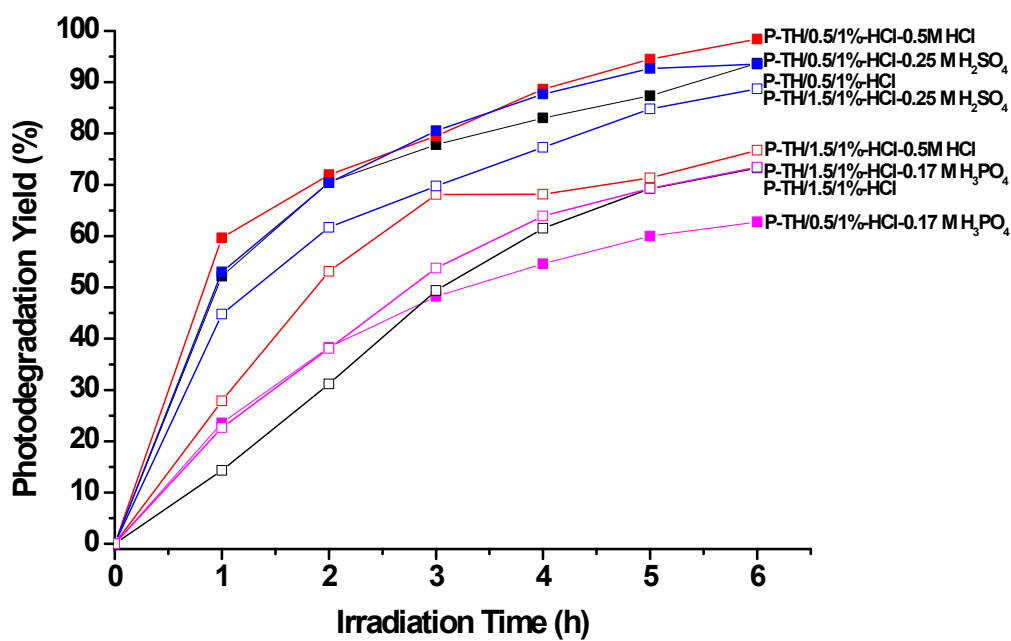


Fig. S7 Comparison of photodegradation yield of P-TH/X/1%-HCl after being doped with 0.5 M HCl, 0.25 M H<sub>2</sub>SO<sub>4</sub> and 0.17 M H<sub>3</sub>PO<sub>4</sub> solution for degradation of RB under visible light irradiation.