

## Supplementary information

### 1 Experimental Section

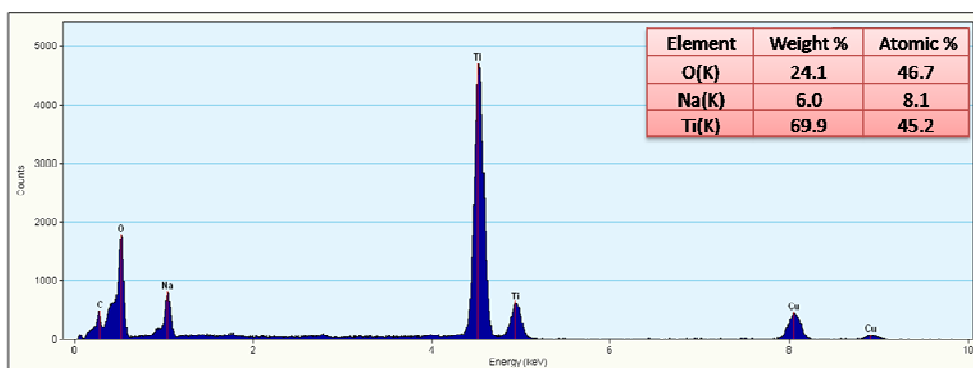
Materials: P25 (Beijing Entrepreneur Science & Trading Co., Ltd), NaOH (Beijing Chemicals, purity > 96.0%), Terephthalic acid (Acros, purity >99%), and Deionized water was purified by a Milli Q system with an electrical resistance of 18.4 M $\Omega$ -cm.

Synthesis of titanate nanotubes: 2g P25 was put into 80mL of 10M NaOH aqueous solution, then transferred to a 100mL Teflon-lined stainless steel autoclave, and sealed. The autoclave was put into an oven, heated at 120<sup>0</sup>C for 24h, and cooled naturally in air, producing white Na-titanates precipitates. These white precipitates were isolated from solution by centrifugation and subsequently washed with deionized water, the step was repeated for several times until the pH of solution was about 10.5. Then the Na-titanates were isolated by centrifugation at 10000r/min for 5min.

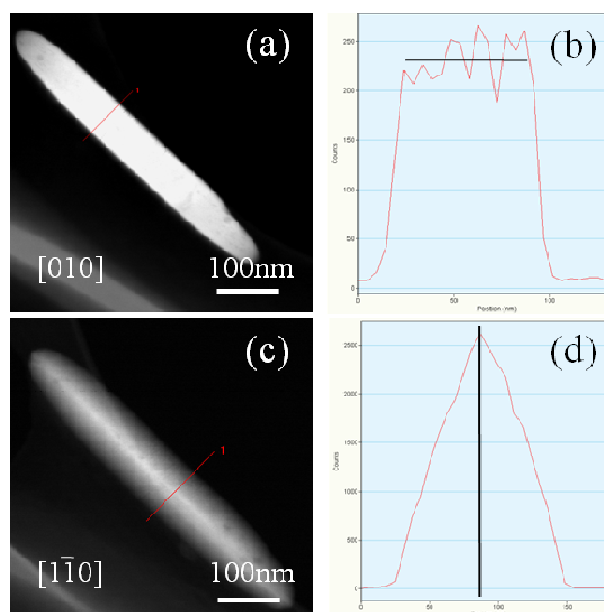
Synthesis of tetragonal faceted-nanorods (TFNR) anatase TiO<sub>2</sub>: 1g Na-titanates (wet, isolated by centrifugation without drying) were dispersed into 40mL deionized water solution, then transferred to a 50mL Teflon-lined stainless steel autoclave, and sealed. The autoclave was put into an oven, heated at 200<sup>0</sup>C for 24h, and cooled naturally in air, producing white tetragonal faceted-nanorods (TFNR) precipitates. These white precipitates were isolated from solution by centrifugation and subsequently washed with deionized water, and finally dried at 60<sup>0</sup>C in vacuum for 10 h.

Characterization: Crystallographic phases of the samples were characterized by a powder X-ray diffractometry (XRD, D/MAX-PC 2500 with Cu K $\alpha$  radiation). The sizes and morphologies of the prepared products were measured by scanning electron microscopy (SEM, Hatachi S 4800, 10kv), transmission electron microscopy (TEM), scanning transmission electron microscopy (STEM), higher-resolution transmission electron microscopy (HRTEM) and energy dispersive X-ray spectroscopy (EDS) were character by FEI Tecnai F30 with 300 kV. Surface area was determined using BET method based on N<sub>2</sub> adsorption with a Micromeritics ASAP 2010 Analyze. Fluorescence spectra were recorded on the HITACHI F-4500 FL Spectrophotometer.

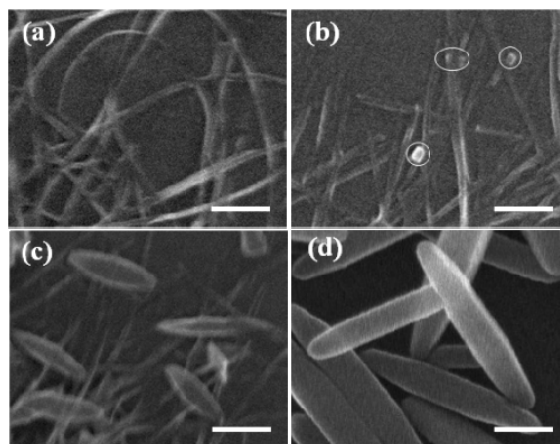
Photoreactivity measurement: Photocatalysts including TFNR anatase TiO<sub>2</sub> and commercially available anatase powders (20 mg) were suspended in 80 mL of aqueous solution containing 0.01 M NaOH and 3.0 mM terephthalic acid under UV irradiation. Before exposure to UV light irradiation, the suspension was stirred in the dark for 30 min. Then, 5.0 mL of solution was taken out every 20 min, and the TiO<sub>2</sub> was separated from the solution with a centrifugation method. The remaining clear liquid was used for fluorescence spectrum measurements. During the photoreactions, no oxygen was bubbled into suspension. The employed excitation light in recording fluorescence spectra is 320 nm. The light source employed in photoreactions is a 8 W U-type UV lamp with a maximum emission at 254 nm.



**Fig. S1** Energy dispersive X-ray spectroscopy (EDS) data taken from Na-titanate nanotubes, the inset was the corresponding elements content.

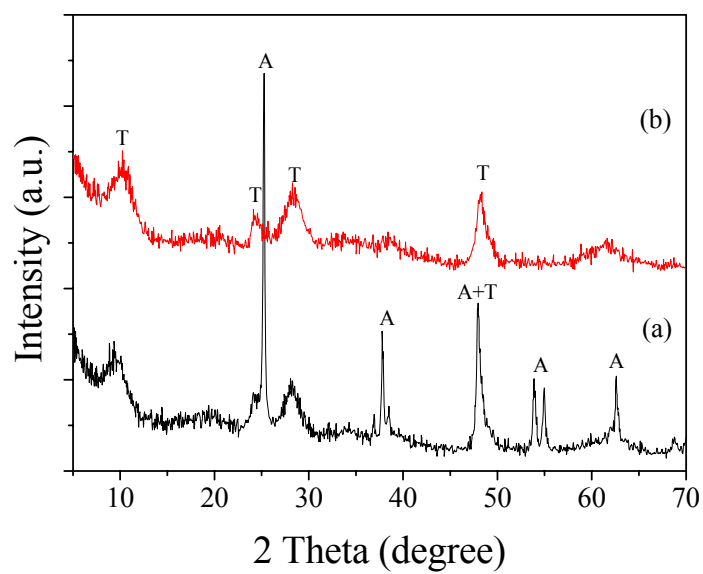


**Fig. S2** (a) STEM image of individual tetragonal faceted-nanorods (TFNR) anatase TiO<sub>2</sub> viewed along the [010] direction. (b) The records of titanium content when scanning across the plane, indicated by red wire in (a). The titanium content keeps constant, which means the thickness of the rod viewed along the [010] direction was constant. (c) TEM image of the same TFNR anatase TiO<sub>2</sub> viewed along the [110] direction. (d) The records of titanium content when scanning across the plane, indicated by red wire in (c). The titanium content shows a symmetric sharp peak, which means, viewed along the [110] direction, the middle was thickest and the rod was faceted with sharp edge instead of round.



**Fig. S3** SEM image of (a) Na-titanate nanotubes and the intermediates of anatase TiO<sub>2</sub> with different hydrothermal reaction time: (b) 0.5 h, (c) 1 h and (d) 10 h.

Scale bars: 100 nm.



**Fig. S4** X-ray diffraction patterns of (a) Na-titanate nanotubes hydrothermal reaction at  $200^{\circ}\text{C}$  for 1h; (b) Na-titanate nanotubes was treated in the ethanol bath at  $200^{\circ}\text{C}$  for 24h.