Supporting Information

Photocatalytic and dye-sensitized solar cell performances of {010}-faceted and [111]-faceted anatase TiO_2 nanocrystals synthesized from tetratitanate nanoribbons

Yi-en Du,[a,b] Qi Feng,*[b] Changdong Chen,[b] Yasuhiro Tanaka,[b] Xiaojing Yang*[a]

[a] Beijing Key Laboratory of Energy Conversion and Storage Materials, College of Chemistry, Beijing Normal University, Beijing, 100875, China.

[b] Department of Advanced Materials Science, Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu-shi, 761-0396, Japan.

Corresponding Authors

E-mail: yang.xiaojing@bnu.edu.cn

Email: feng@eng.kagawa-u.ac.jp

Fabrication of Dye-Sensitized Solar Cells (DSSCs). For preparation of the pastes, 0.5 g TiO_2 nanocrystals was added to the mixture of solution containing 2.5 g ethanol, 2.0 g α-Terpineol, and 1.4 g 10 wt% solutions of Wako-ethyl-cellulose 10 (8-14mPas) and 1.1 g 10wt% solutions of Wako-ethyl-cellulose 45 (45-65mPas), followed by ultrasonic treatment for 5 min, and finally grounded for 3 d by ball-milling at room temperature to yield the slurry. Fluorine-doped tin oxide (FTO) conducting glass plates (25 × 25 mm) were first cleaned with distilled water using an ultrasonic bath for 5 min, and then cleaned with alcohol for 5 min using the ultrasonic bath. The FTO glass substrates were immersed in a 0.1 M $Ti(OC_3O_7)_4$ solution for several seconds, and then sintered at 480 °C for 60 min in the high temperature furnace. Porous TiO_2 films were prepared by the doctor-blade technique, using TiO_2 nanocrystal paste on a FTO conducting glass plate. The films thickness was controlled by thickness of the adhesive tape used as the spacer. After being coated with the paste on the FTO glass plate, the TiO_2 film electrode was calcined at 315 °C for 15 min in high temperature furnace. Do such working several times to get desired thickness of TiO_2 layer, and then sintered it at 450 °C for 30 min in the high temperature furnace. The TiO_2 films were then treated with 0.1 M $Ti(OC_3O_7)_4$ solution as described above, and then calcined at 480 °C for 60 min in the high temperature furnace. When the temperature was cooled to 80 °C, the TiO_2 films were immersed into a 3×10^{-4} mol/L N719 dye solution in a mixed solvent of acetonitrile (super dehydrated) and tert-butyl alcohol (1 : 1 volume ratio), and kept for 24 h at room temperature to adsorb the dye onto the TiO_2 electrode. The TiO_2 electrode was subsequently washed with absolute ethanol to remove the unabsorbed dyes. The DSSC was comprised of the dye-sensitized TiO_2 electrode and a platinum-sputtered FTO glass counter electrode with an electrolyte solution between the electrodes. The electrolyte was injected between the two electrodes and driven by capillary force through the edges. The electrolyte solution was composed of 1-butyl-3-methylimidazolium iodide (0.60 mol/L), iodine (0.03 mol/L), guanidine thiocyanate (0.10 mol/L), and 4-tert-butylpyridine (0.50 mol/L) in a mixed solvent of acetonitrile (super dehydrated) and valeronitrile (85%:15% volume ratio).

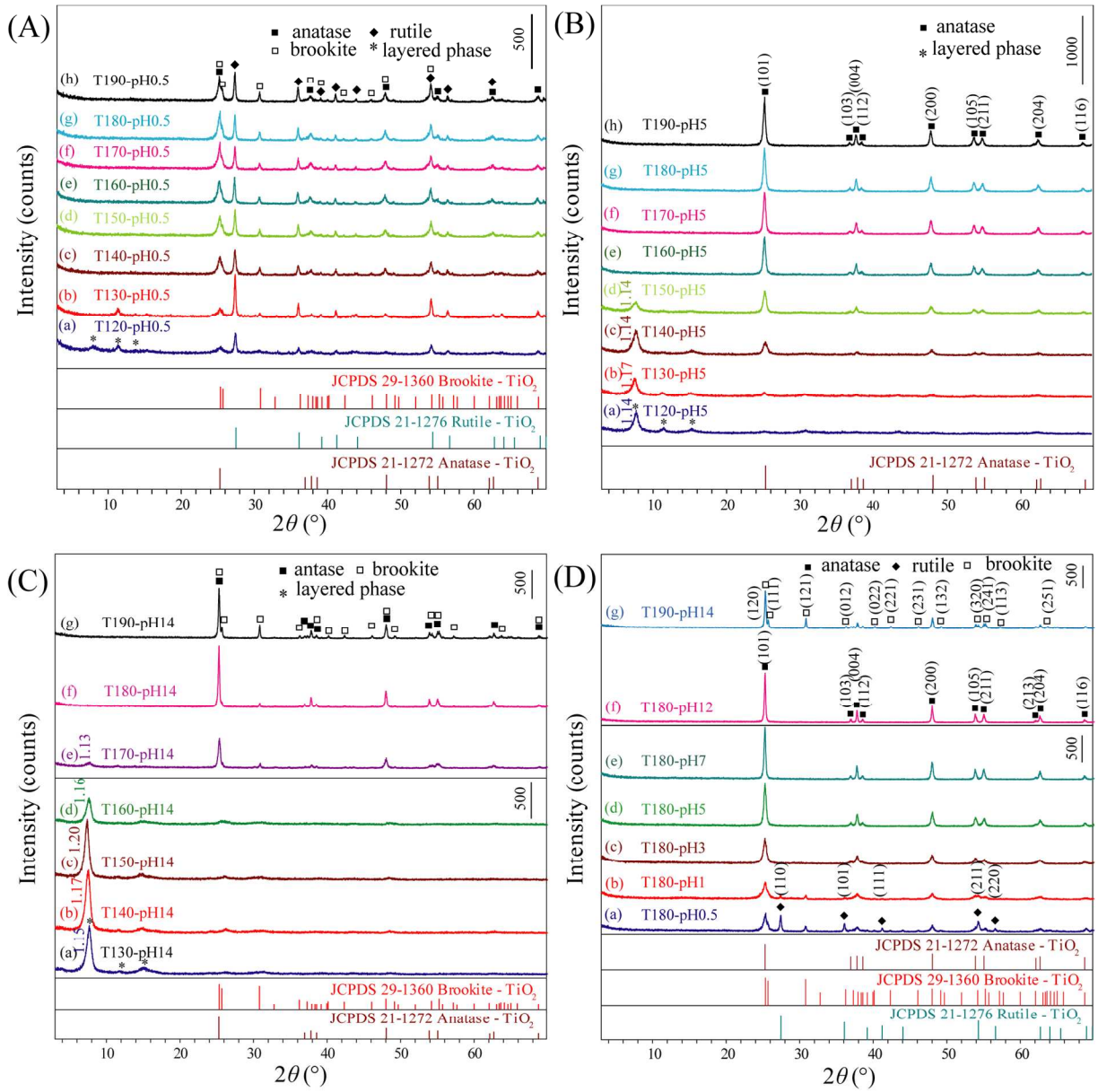

Figure S1. XRD patterns of the samples obtained at various temperatures and pH of (A) 0.5, (B) 5, and (C) 14 and (D) others.

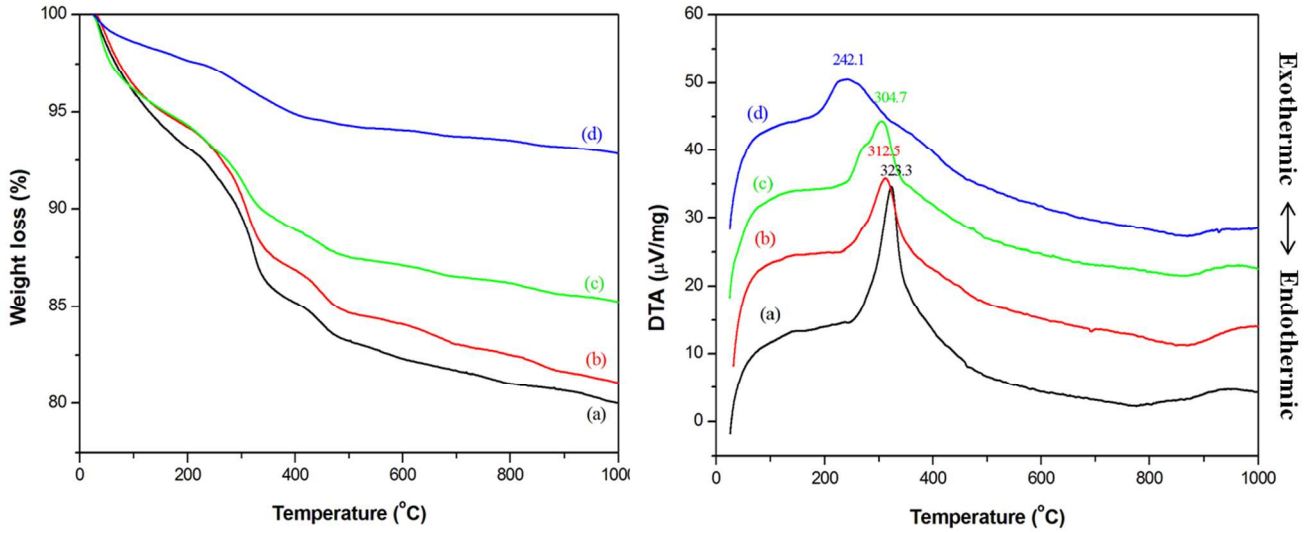

Figure S2. Thermogravimetry and differential thermal analysis (TG-DTA) curves of the samples obtained at (a) T130-pH5, (b) T140-pH5, (c) T150-pH5, and (d) T170-pH5. The exothermic peak around 300 °C corresponds to decomposition of TMA^+ ions. The measurement was carried out on a SHIMADZU DTG-60H at a heating rate of 10 °C/min.

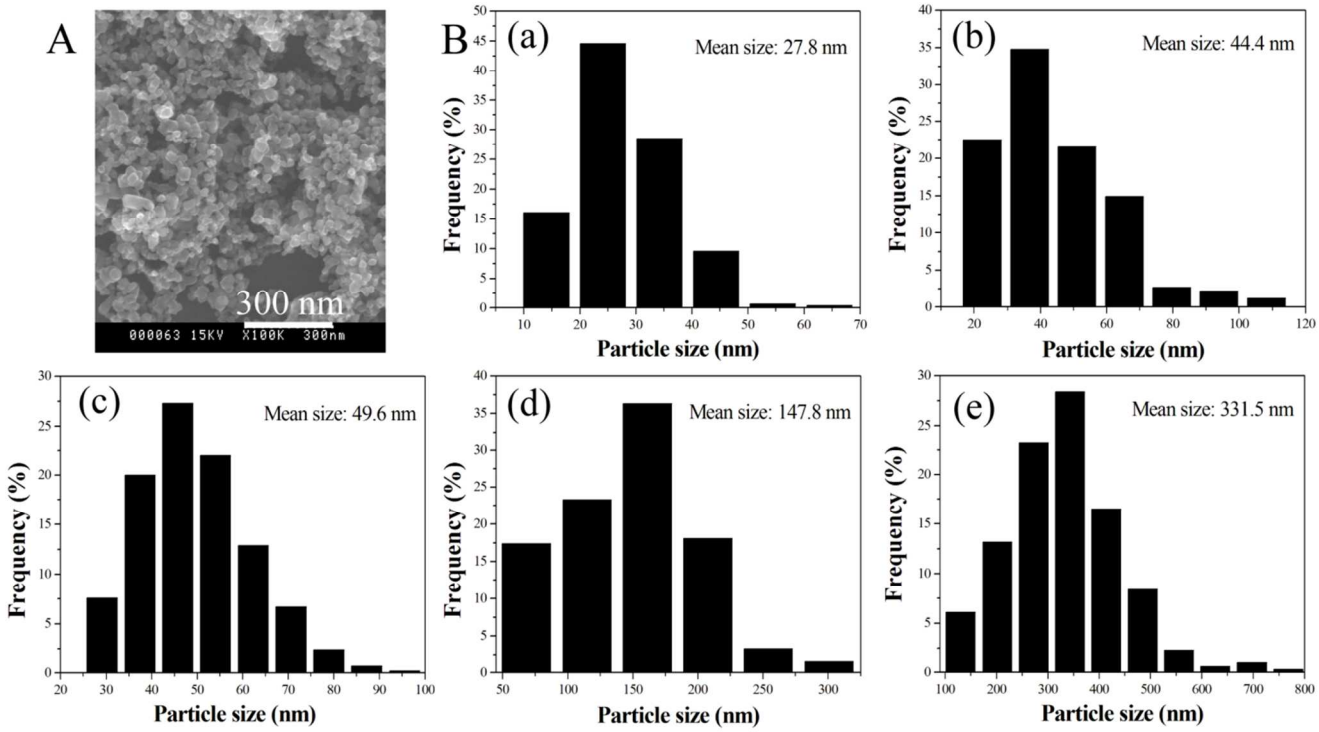

Figure S3. (A) FE-SEM images of P25 TiO_2 and (B) particles size distributions of (a) P25 TiO_2, (b) T180-pH3, (c) T180-pH5, (d) T180-pH7, (e) T180-pH12.

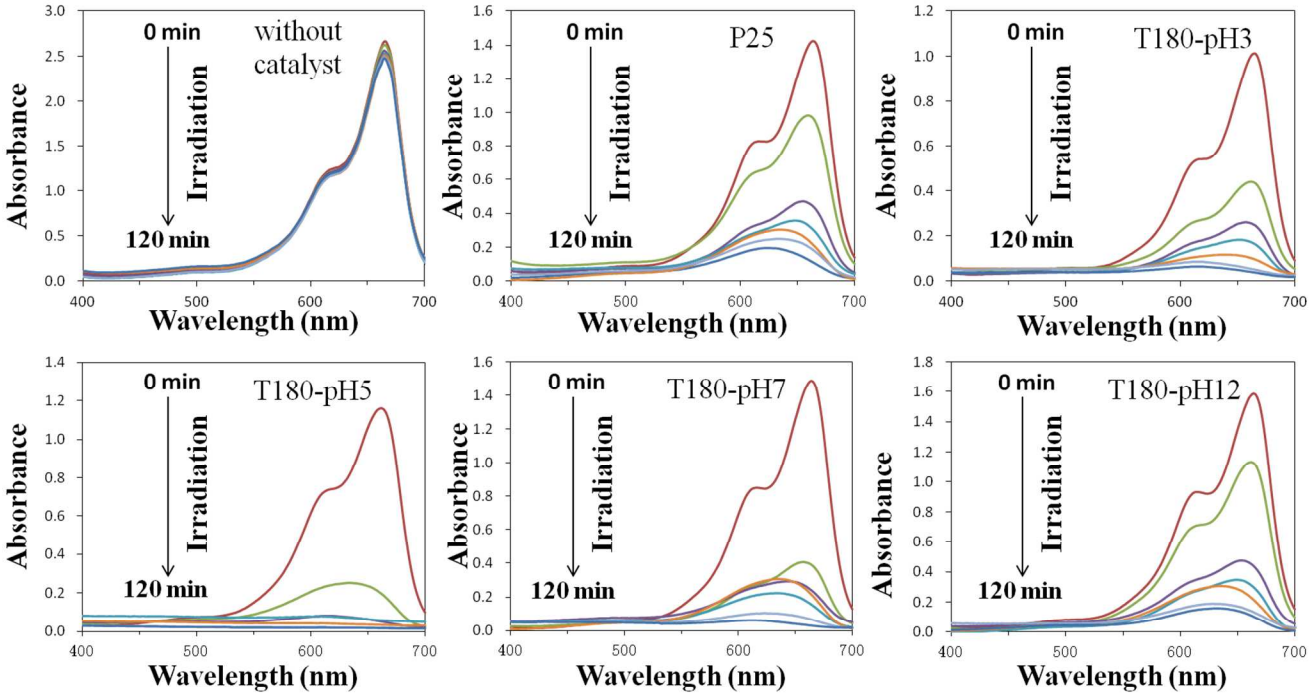

Figure S4. Absorption spectra of a methylene blue solution degraded under UV light irradiation for 120 min in the absence and present of TiO_2 nanocrystals catalyst.