Supplementary Material (ESI) for Energy & Environmental Science


Electronic Supplementary Information for

# Fabrication of O (Dye)-Terminated Anatase $TiO_2$ Nanosheets for Dye Sensitized Solar Cells

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## Experimental Section

### Synthesis of anatase $TiO_2$ nanosheets

Single crystalline anatase $TiO_2$ nanosheets were synthesized in a hydrothermal method: 19 g of titanium (IV) butoxide was dispersed in 25 g of N,N-dimethylethanolamine (DMEA) with the aid of ultrasonic; After adding 16 g distilled water rapidly, the suspension was transferred into Teflon autoclave and heated at 150 ℃ for 16 hours; The filtered powder was washed with ethanol and centrifuged for three times and then dried at 70 ℃. The TO-500 could be obtained after annealed at 500 ℃ for 0.5 h.

### Characterization:

XRD patterns were performed with a D8 diffractometer with Cu-KR radiation ($\lambda$ = 1.54056 Å). TEM images were obtained with JEOL JEM-1400 and JEOL 2100F. SEM images were recorded with with JEOL JSM 6700F. $N_2$ adsorption-desorption isotherms were conducted at 77 K on a Micromeritics Tristar 3000 analyzer. The BET surface areas and pore-size distribution curves were concluded using adsorption data. UV-Vis absorption spectra were measured by a JASCO V-670 spectrophotometer.

### Fabrication of $TiO_2$ thin-film photoanode and solar cells

Following the preparation of paste of $TiO_2$ nanosheets (or P-25) with the reported recipe[1], the obtained paste was coated on transparent ITO glass via the doctor-blade method. The $TiO_2$ thin film photoanode to be used in DSSCs was obtained after calcination at 500 ℃ for 0.5 hour in a muffle furnace under air atmosphere. In order to focus on the effect of single crystalline anatase nanosheets, the photoanode was only coated with a single layer of nanosheet (or P-25) film. The TO-500 film and P-25 film have the same thickness of 13.7 μm. As compared to the typical photoanode of DSSCs, the scattering layer composing particles of 400 nm in size was not coated on top of crystalline $TiO_2$ layer. It is necessary to note that the transparent ITO glass was treated with 40 mM $TiCl_4$ solution for several seconds at room temperature before coating with $TiO_2$ paste. Cells were assembled with the photoanodes after soaking in 0.3 mM N719 solutions in acetonitrile/tert-butyl alcohol (1:1) solvent mixture overnight. The platinum counter electrodes were made by sputtering on the transparent ITO glass and the electrolyte (EL-HPE) employed was purchased from Dyesol Corporation.

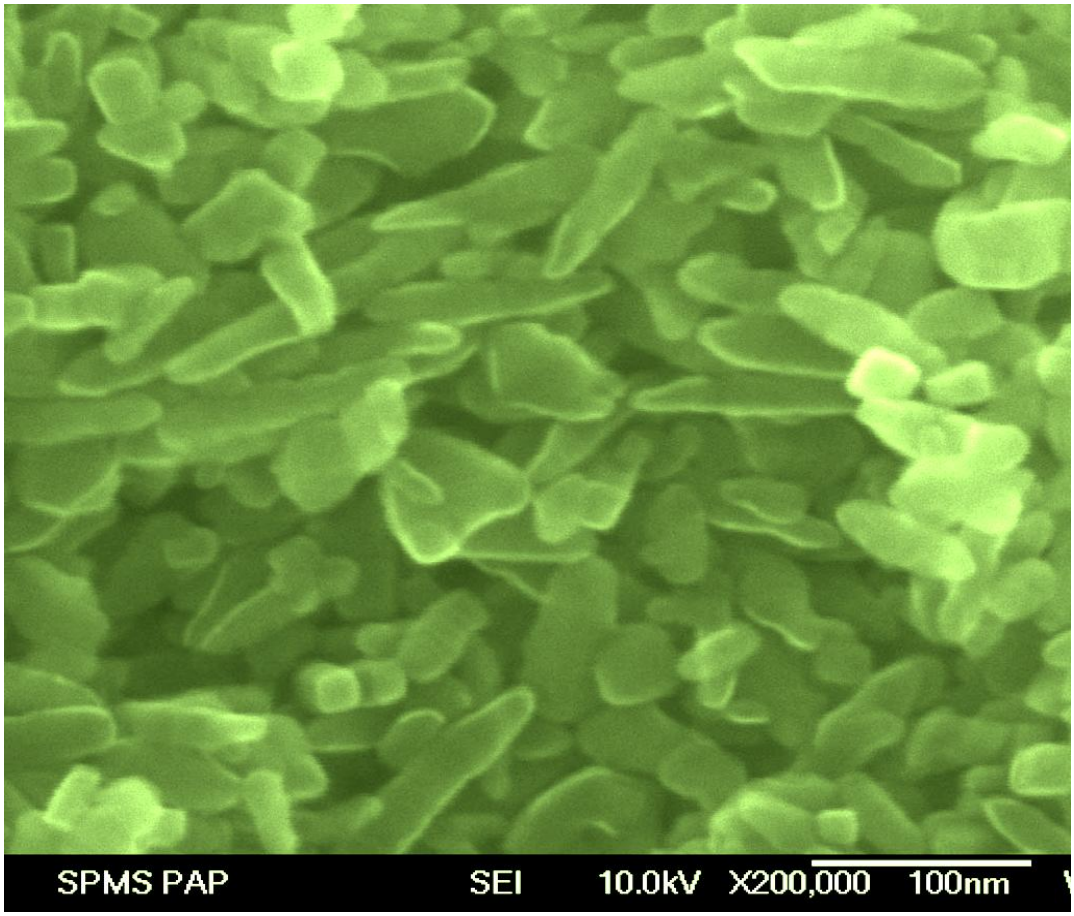



Figure S1: FESEM image of TO-500 nanosheets.

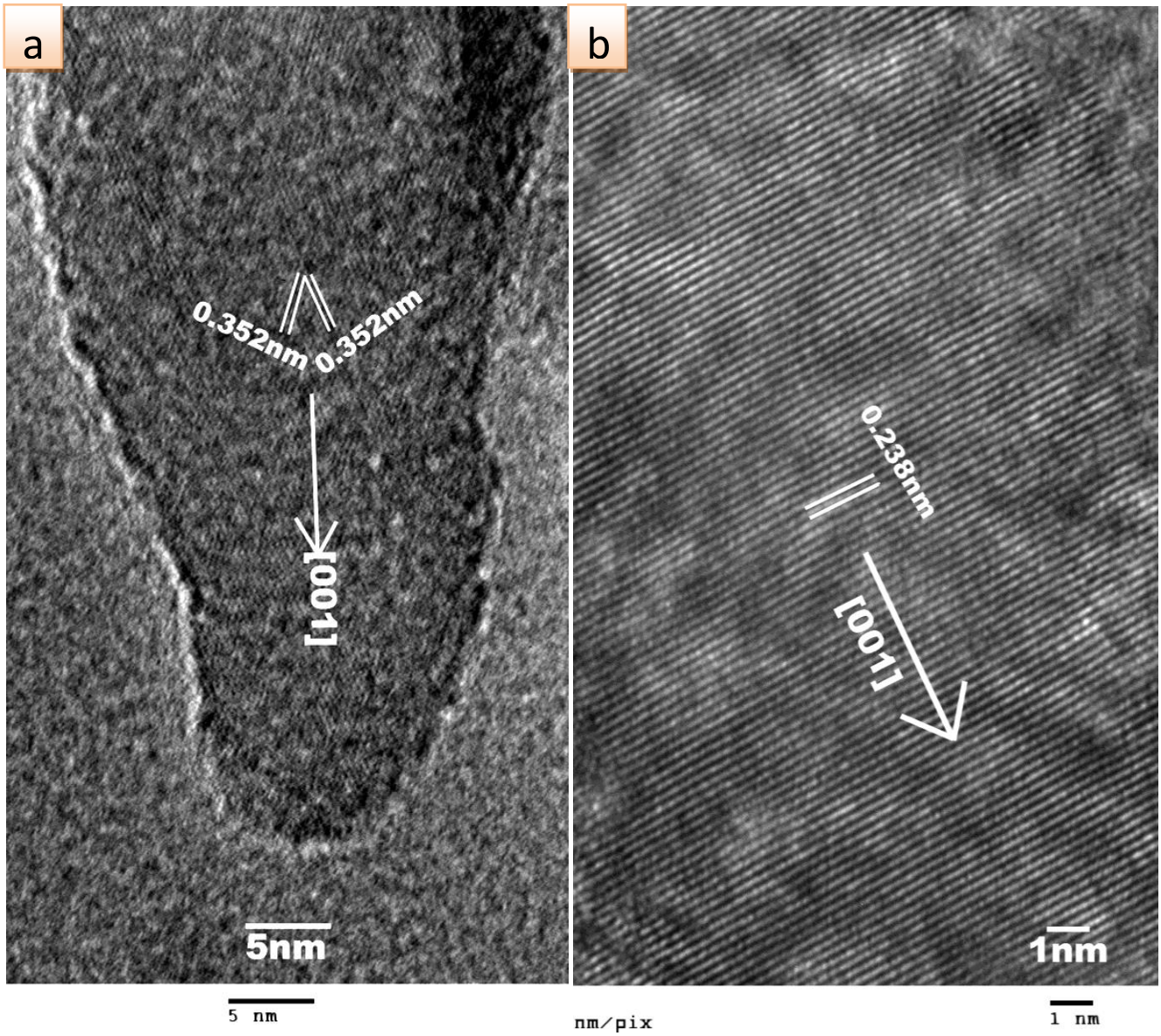



Figure S2 (a) HRTEM image showing $TiO_2$ nanosheets with the lattice spaces of 0.352 nm corresponding to the (101) planes. (b) HRTEM image showing $TiO_2$ nanosheets with the lattice spaces of 0.238 nm corresponding to the (004) planes.

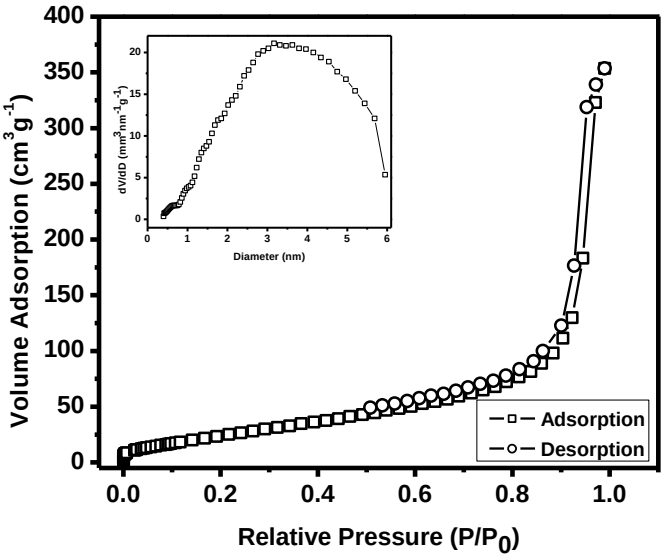



Figure S3: $N_2$ adsorption/desorption and pore size distribution (inset) of the as-synthesized $TiO_2$ nanosheets.

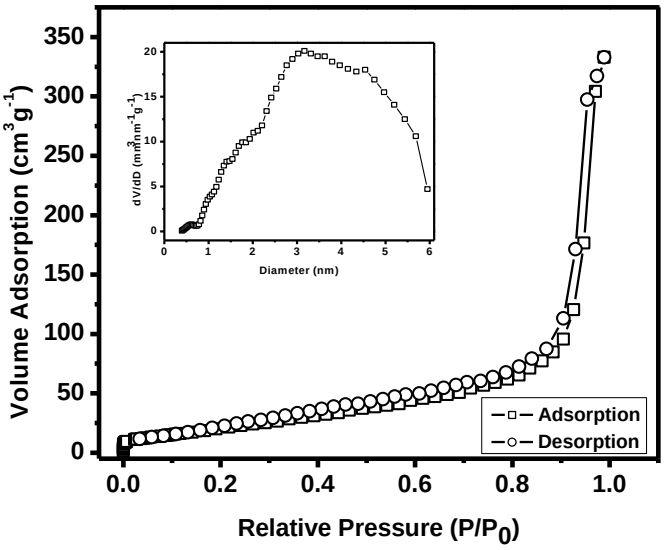



Figure S4: $N_2$ adsorption/desorption and pore size distribution (inset) of TO-500 sample

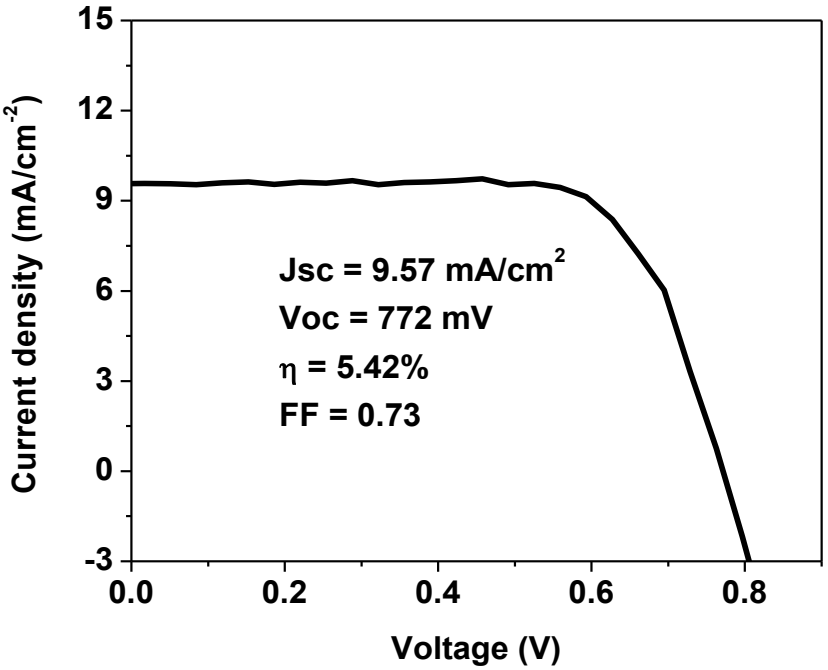
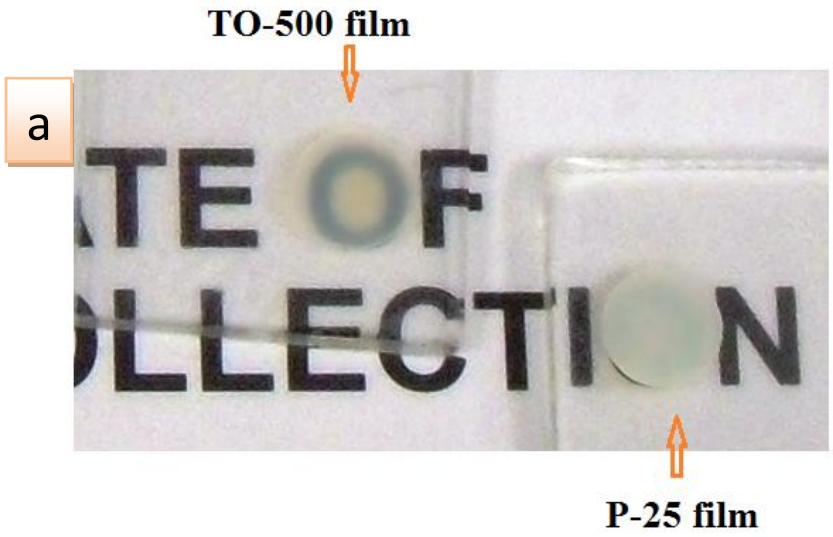



Figure S5: Current-voltage curve of dye sensitized solar cell with anatase $TiO_2$ nanoparticle (average size <25) film.



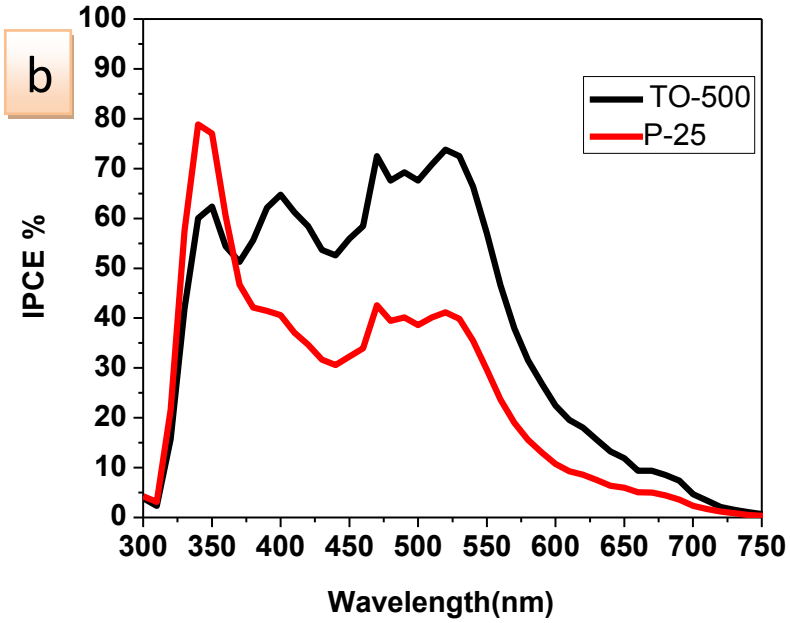




Figure S6: a) Photograph of TO-500 and P-25 films; b) IPCE of device A and B with TO-500 film and P-25 film respectively, which were fabricated and tested using similar experimental procedures.

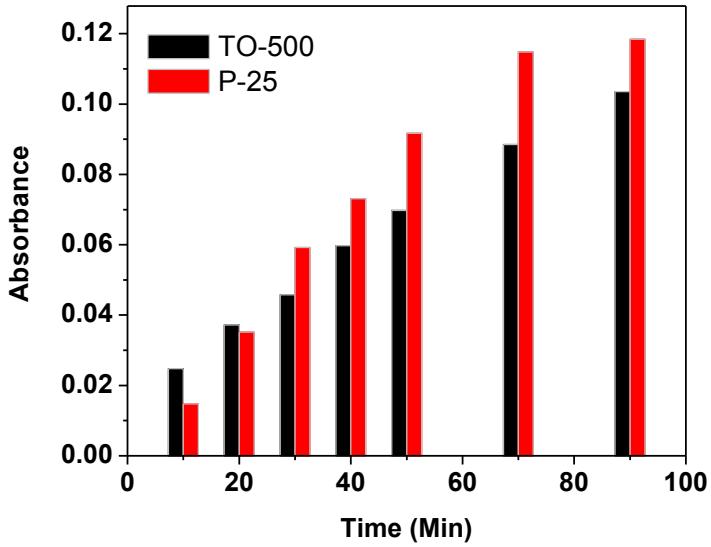



Figure S7: The absorbance of dye desorbed from TO-500 and P-25 powders at different times.