Supporting information

Highly dispersive {001} facets exposed TiO_2 nanocrystalline on high quality graphene as a high Performance photocatalyst

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1. Preparation of monolayer GO dispersion.

Monolayer GO dispersion was synthesized from natural graphite powder by a modified Hummers method. First, graphite powder (3g) was put into an 80 ^oC solution of concentrated H_2SO_4 (12 mL), P_2O_5 (2.5g) and $K_2S_2O_8$ (2.5g). The mixture was stirred for 4.5 h with the temperature keeping at 80 ^oC. Successively, the mixture was cooled down to room temperature and diluted with 0.5 L of de-ionized (DI) water and left overnight. Then the above mixture was filtered and washed with DI water using microporous membrane to remove the residual acid. After been dried under ambient condition, the product was put into cold (0^oC) concentrated H_2SO_4 (120 mL). Then, $KMnO_4$ (15 g) was added gradually under stirring and the temperature of the mixture was kept to be below 20 °C by cooling. Successively, the mixture was stirred at 35 °C for 2 h, and then diluted with DI water (250 mL) keeping the temperature below 50 °C. After stirring the mixture for 2 h, additional 0.7 L of DI water was added. Then 20 mL of 30% H_2O_2 was added to the mixture, and the color of mixture changed into brilliant yellow along with bubbling. The mixture was filtered and washed with 1:10 HCl aqueous solution (1 L) to remove metal ions followed by 1 L of DI water to remove the acid. The resulting solid was dried in air and diluted to make a GO dispersion (0.2% w/w). Finally, it was purified by dialysis for one week to remove the remaining metal species.

2. Catalyst Activity.

The liquid-phase photodegradation of dyes (methylene blue and methyl orange) was carried out in a quartz tube under the irradiation of UV light and visible light, respectively. In a typical process for degradation of dyes under the UV irradiation, a 20 mg portion of catalyst was suspended in 160 mL of 10 ppm dyes solution. Before irradiation, the suspensions were stirred in the dark for 4 h to ensure the establishment of adsorption desorption equilibrium. Under ambient conditions and stirring, the quartz tube was exposed to the UV irradiation produced by a 500W Xe arc lamp equipped with a band-pass light filter (365 ± 15 nm). A 3 mL sample solution was taken at a certain time interval during the experiment and centrifuged to remove the catalyst completely. The solution was analyzed on a Varian UV-vis spectrophotometer (Cary-50, Varian Co.). The percentage of degradation is reported as $C/C0$. Here, C is the absorption of dyes solution at each irradiated time interval of the main peak of the adsorption spectrum, while $C0$ is the absorption of the initial concentration when the adsorption_desorption equilibrium is reached. For the visible light photocatalytic degradation of dyes, a UV cutoff filter ($\lambda > 400$ nm) was used while the other experimental conditions are the same as that of the above-mentioned degradation of dyes under the UV light irradiation.

3. Electrochemical performance

Electrochemical measurements were performed in a three-electrode cell system with 2.5 mM $K_3[Fe(CN)_6]/K_4[Fe(CN)_6]$ (1:1) mixture as a redox probe in 0.1 M KCl solution as electrolyte. The working electrodes were fabricated by pasting a homogeneous slurry of active materials, carbon black and poly(tetrafluoroethylene) in a mass ratio of 80:15:5 into a porous nickel foam current collector (1×1 cm^2) using a blade, followed by drying at 80 °C for 12 h and calendaring. The loading mass of the each electrode was about 3 mg. Platinum sheet and Ag/AgCl (KCl-saturated) electrode were used as counter and reference electrode, respectively. All the measurements were performed with a CHI 660C electrochemical workstation.

4. Fiugres

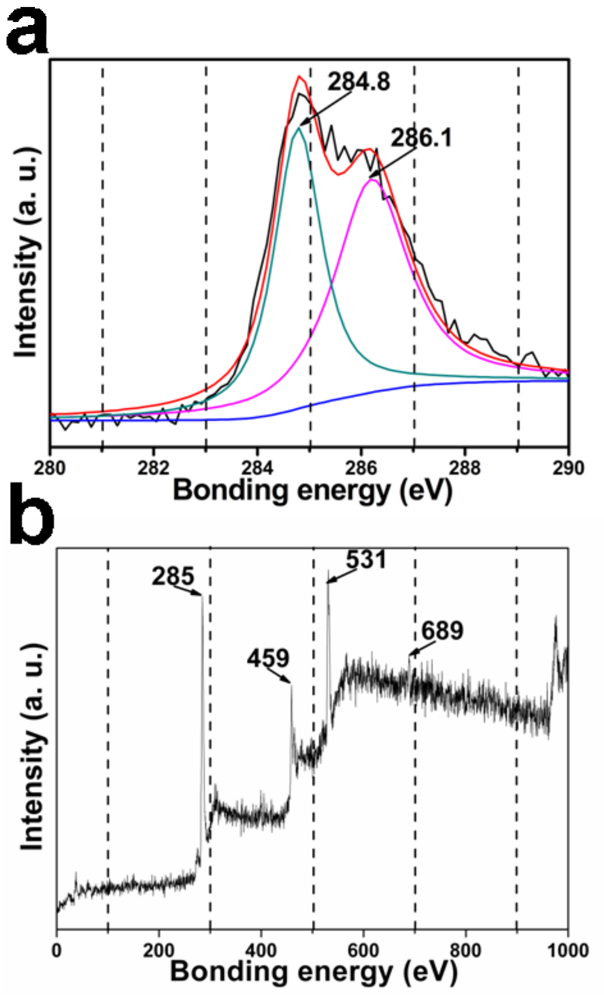

Fig. S1 High-resolution and full XPS spectra of C 1s for TiO_2/GS composite, the starting material GO was replaced by GS, and the other hydrothermal conditions is the same to the sample 100Ti/GS.

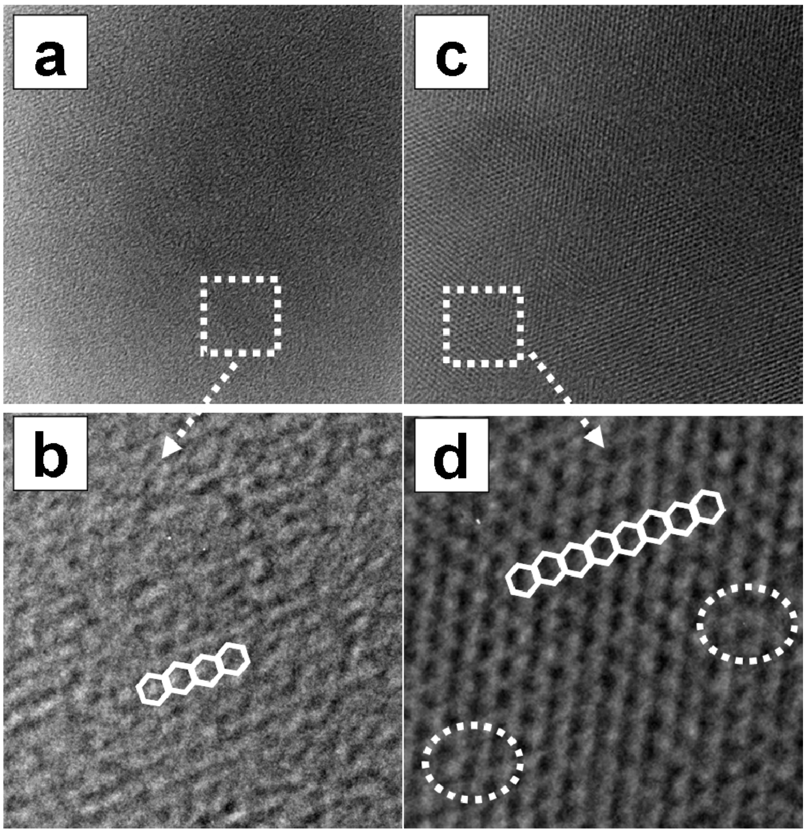

Fig. S2 HRTEM of GO (a and b) and GS (c and d).

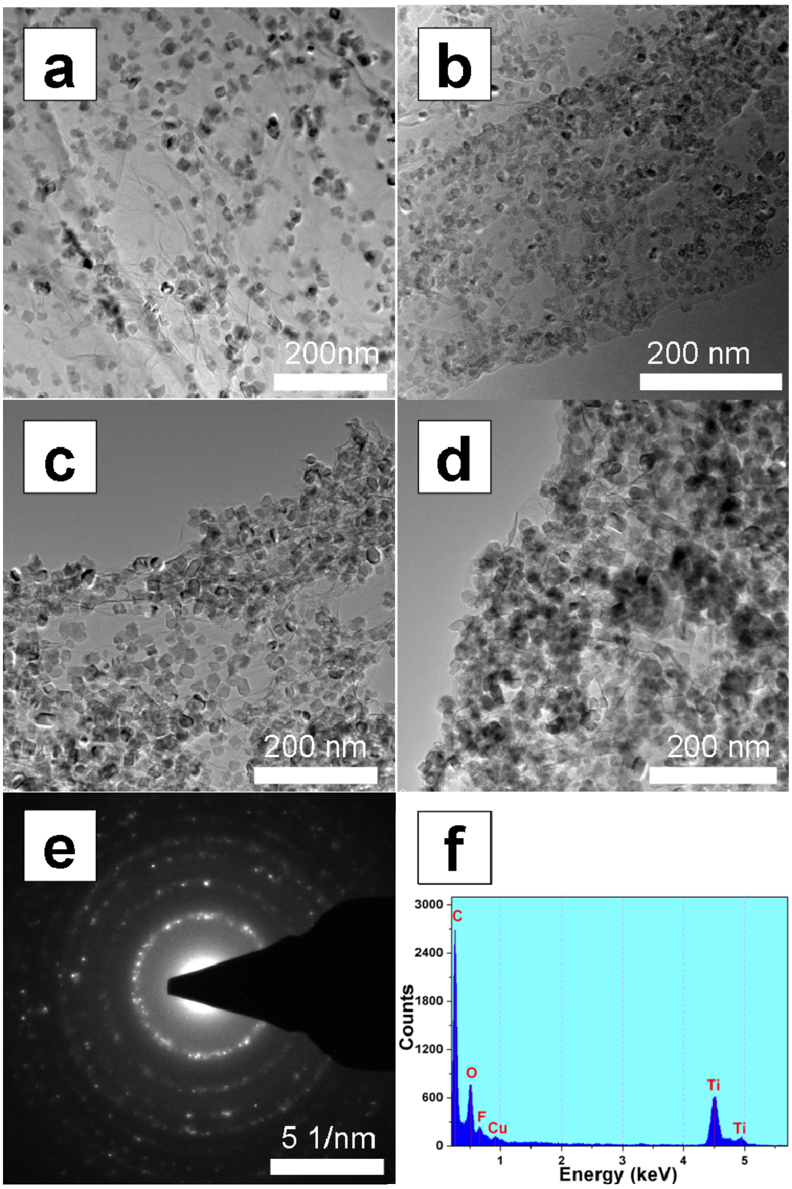

Fig. S3 TEM images of TiO_2/GS with different Ti:C ratio: a (25:1), b (50:1), c (100:1), d (200:1); SAED (e) and EDX (f) of sample c.

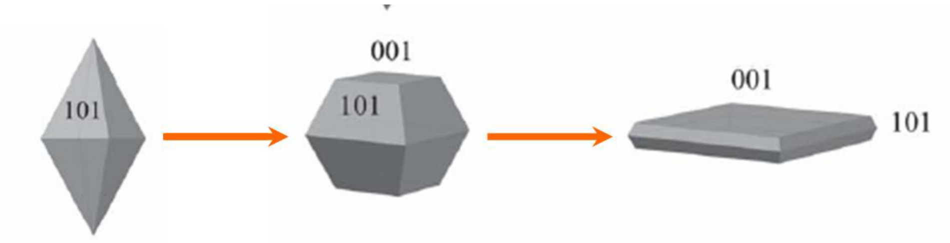

Fig. S4 Morphology evolutions of fluorinated anatase TiO_2 crystals.

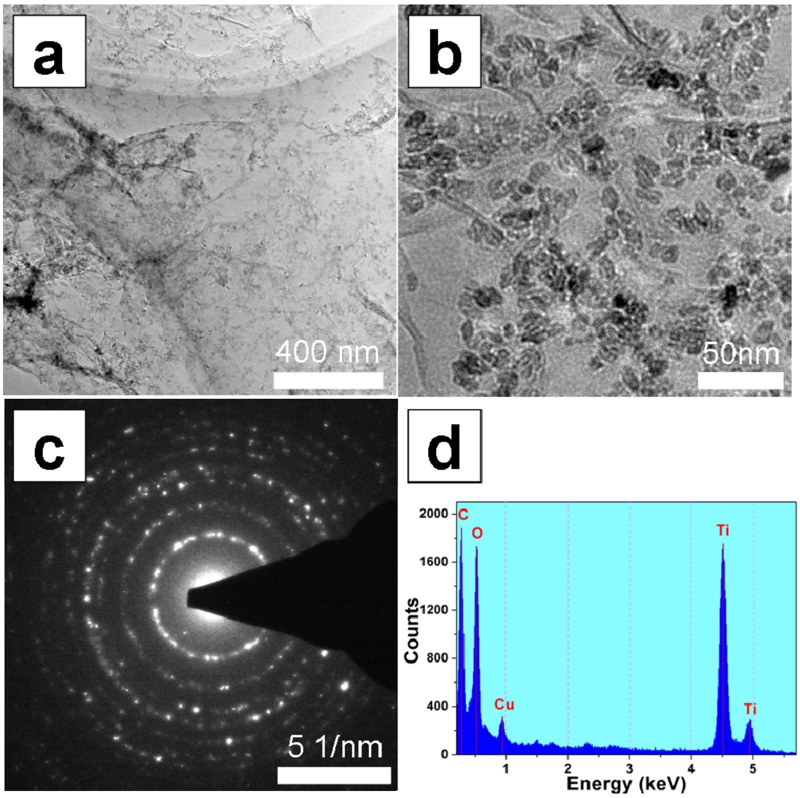

Fig. S5 TEM images (a and b), SAED (c), EDX (d) of TiO_2/GS sample without adding HF as a morphology controlling agent. The Ti:C ratio is 100:1.

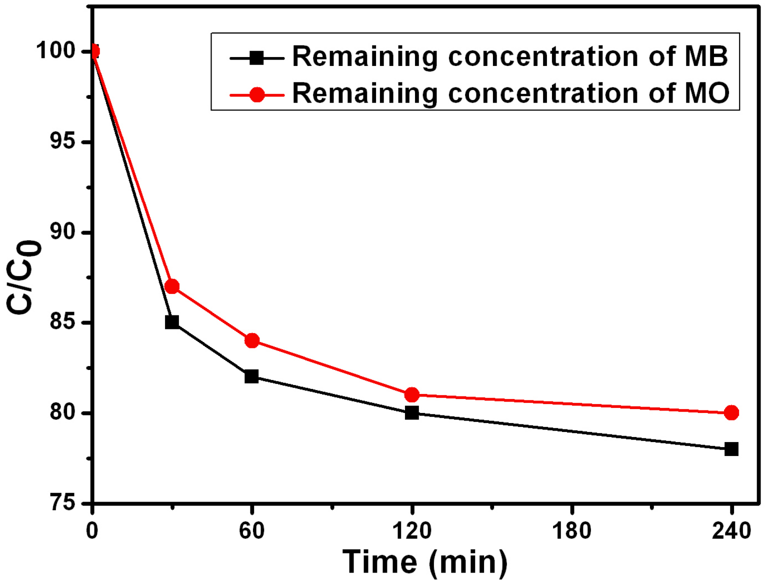

Fig. S6 The remaining concentration fraction of dyes (MB/MO) after dark adsorption.

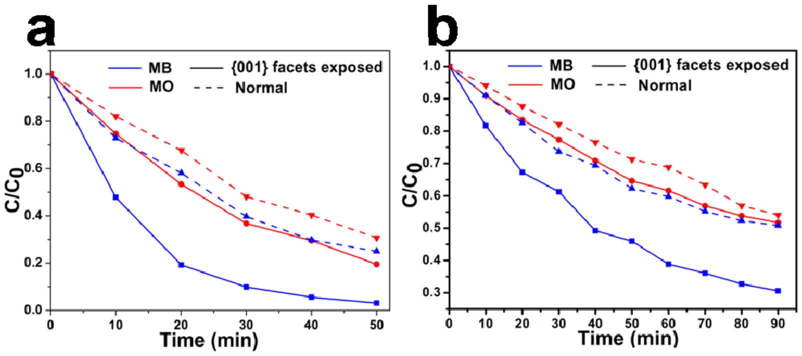

Fig. S7 Liquid-phase photocatalytic of {001} facets exposed TiO_2/GS and the normal TiO_2/GS under the irradiation of (a) UV light and (b) visible light (λ>400 nm). The Ti:C ratio of the two samples are 100:1.