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Support information

Fabrication of Biomass Carbon Quantum Dots-Bi_2WO_6 Hybrids Photocatalyst with High-Performance for Antibiotic Degradation

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Characterization

The crystal structure properties of the prepared samples were evaluated by X-ray diffraction (XRD) on a D/max-RAX-ray diffractometer (Rigaku, Japan) using Cu Kα radiation (40 kV, 200 mA) by a scan rate of 7° min^{-1}. FT-IR spectra were measured using a Nexus 870 FT-IR spectrometer. The transmission electron microscopy (TEM) was performed by JEM-2100 transmission electron microscope (JEOL, Japan). Scanning electron microscopy (SEM) was characterized by Hitachi S-4800 with 5.0 kV scanning voltages (Hitachi, Japan). The nitrogen adsorption-desorption and Brunauer-Emmett-Teller (BET) was obtained on a surface area analyzer (NOVA 2200e, Quantachrome). Raman spectroscopy was performed on a DXR spectrometer. The ultraviolet-visible diffused reflectance spectra (UV-vis DRS) was carried out via an UV-vis spectrophotometer (UV-2550). Photoluminescence (PL) was measured on the Shimadzu RF-5301 fluorescence spectrophotometer. Photocurrent and electrochemical impedance spectroscopy (EIS) experiments were carried out on a CHI852C electrochemical station with a Xenon lamp (Newport 69920, 300 W).

HPLC-MS analysis

For the HPLC-MS experiments, first, we used the solution of initial TC solution (20 mg L^{-1}), degradation of TC in 30 min and degradation of TC in 90 min. And then, separated then supernatant solution by magnet, then centrifugal to confirm there were no sold, after that take 5 μl of the above solution in to mass spectrometer, and use the methanol as solvent.

Photo-electrochemical and ESR measurements

Briefly, 0.1 g photocatalyst is dispersed in 1.5 mL ethanol and 0.2 mL oleic acid, the dispersion

mixture is dipcoated onto FTO substrates (1.0 cm^2) and used as corresponding working electrodes, platinum wire and Ag/AgCl (saturated KCl) are used as counter electrode and reference electrode. The electron spin resonance (ESR) signals of radicals spin-trapped were examined on a Bruker model ESR JES-FA200 spectrometer by spin-trap reagent DMPO (Sigma Chemical Co.) in methanol and water, respectively.

Photocatalytic and trapping experiments

The photocatalytic activity of the BC-QDs@Bi_2WO_6 was evaluated by the degradation of contaminant (TC, CIP, and GFL) under visible light irradiation. A 350 W Xenon lamp with a cut-off filter (λ> 420 nm) was used for light source. In details, adding 50 mg photocatalyst into 100 mL pollutant solution (20 mg L^{-1}), and stirred 30 min to get adsorption-desorption equilibrium before illumination. At certain time intervals, 3~4 mL aqueous solution was collected and centrifuged to remove the photocatalysts for analysis by the same UV-vis spectrophotometer . The photocatalytic degradation ratio was tested via the characteristic absorption peak at 357, 274 and 287 nm to determine the concentration of TC, CIP and GFL. The trapping experiments are similar to the degradation experiments, only add tri-ethanolamine (TEOA, 1 mM), 1,4-benzoquinone (BQ, 1 mM) and isopropanol (IPA, 1 mM) as the scavengers for h^+, $\cdot O_2^-$ and ·OH, respectively.

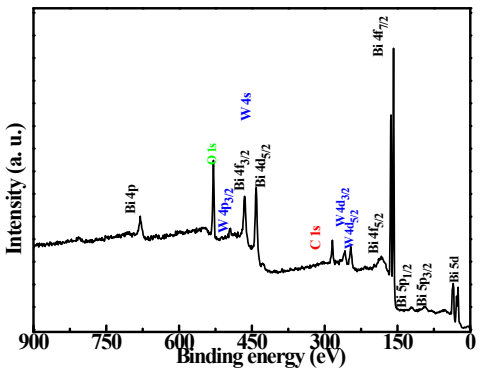

Fig. S1 The survey XPS spectra of the BC-QDs@Bi_2WO_6

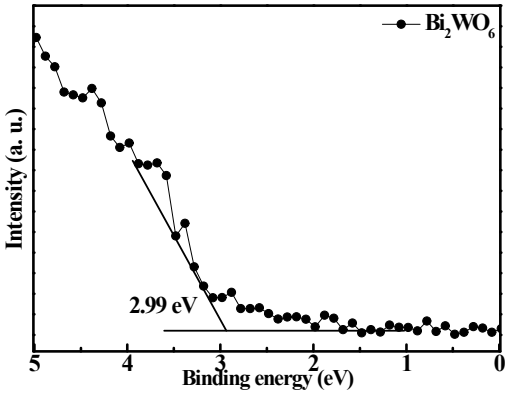

Fig. S2 XPS valence band spectra of Bi_2WO_6

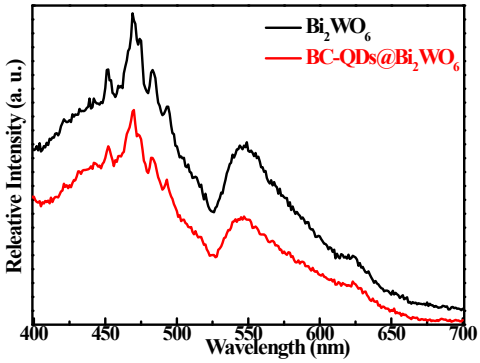

Fig. S3 PL spectra of Bi_2WO_6 and BC-QDs@Bi_2WO_6.

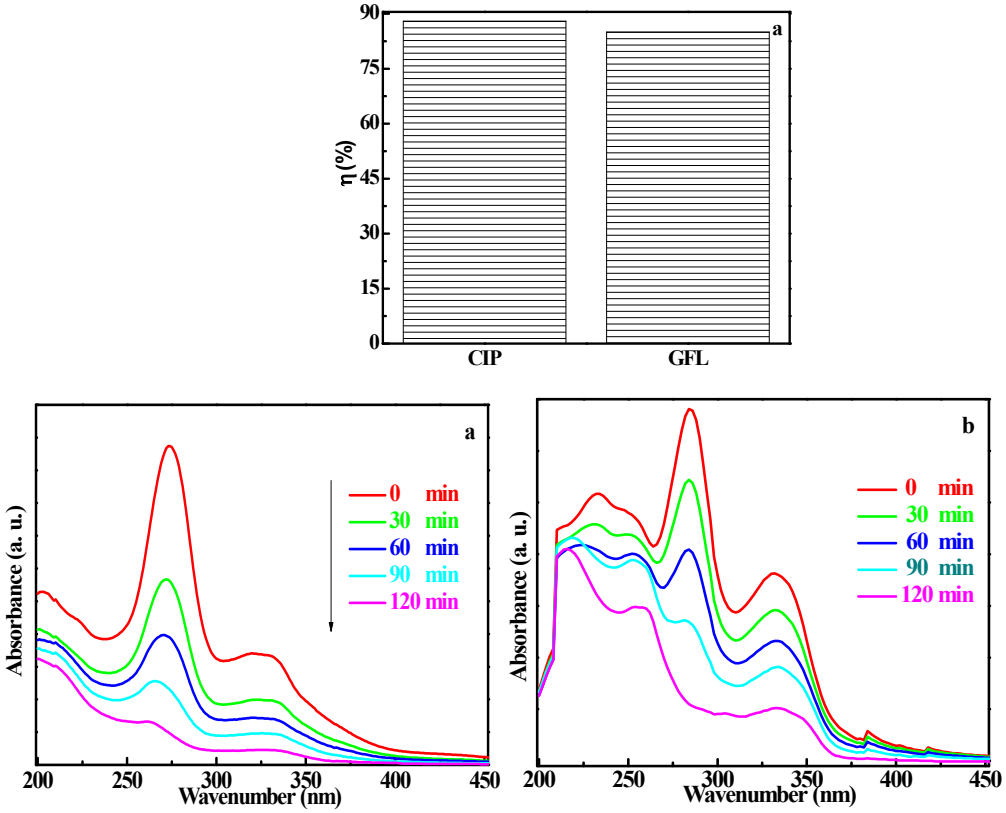

Fig. S4 The degradation dynamics curves and UV−vis spectra changes of CIP and GFL with reaction time over BC-QDs@Bi_2WO_6.

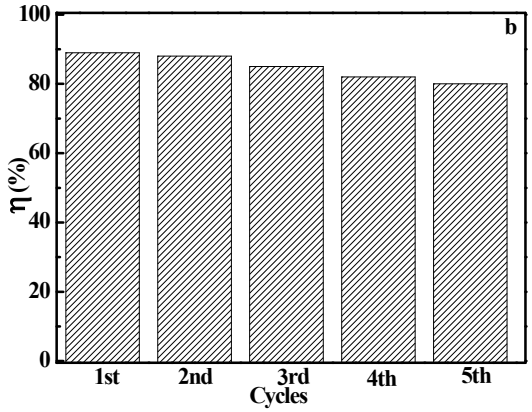

Fig. S5 Cycling photocatalytic degradation of TC over BC-QDs@Bi_2WO_6.

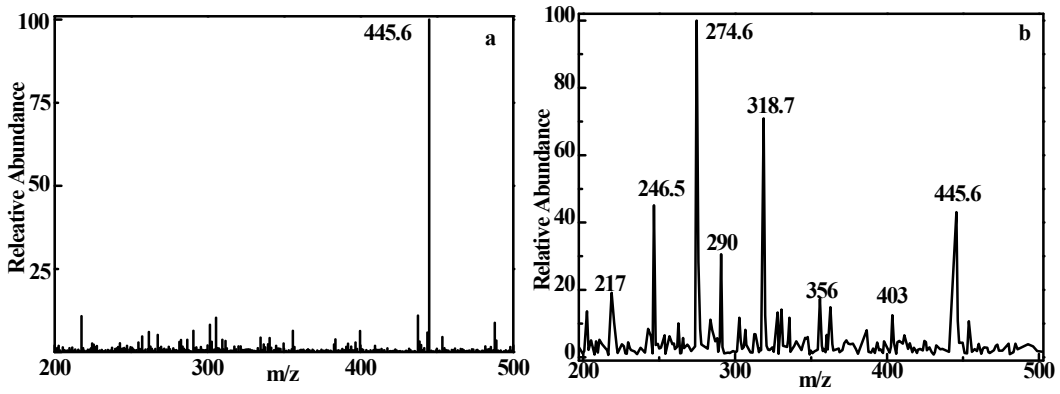

Fig. S6 m/z of degrading TC over BC-QDs@Bi_2WO_6: initial solution (a), degradation in 120 min (b).

The PL spectra presents the superior up-converted photoluminescence property of the BC-QDs. Due to the BC-QDs could be excited by long-wavelength light, from 650 to 900 nm, the up-conversion emission is obviously in the range of 350 to 700 nm. The above results indicate that BC-QDs may improve the photocatalytic efficiency by converting the near-infrared emission wavelength into visible light, which makes it useful as a powerful energy transfer component in photocatalyst design.

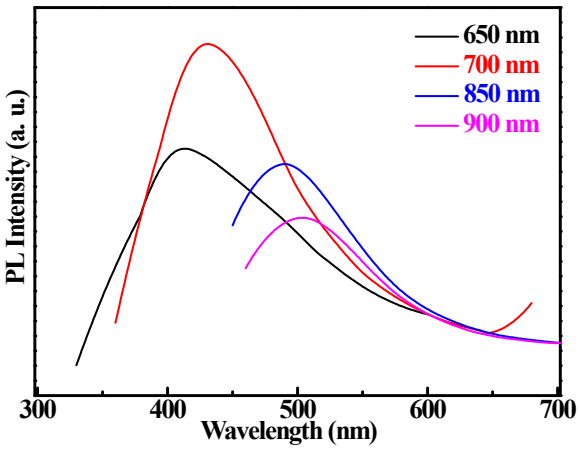

Fig. S7 Up-converted photoluminescence spectra of BC-QDs