Electronic Supplementary Information (ESI)

Graphene quantum dots modified Bi_2WO_6 with enhanced photocatalytic activity by reinforcing the charge separation

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1 Figures

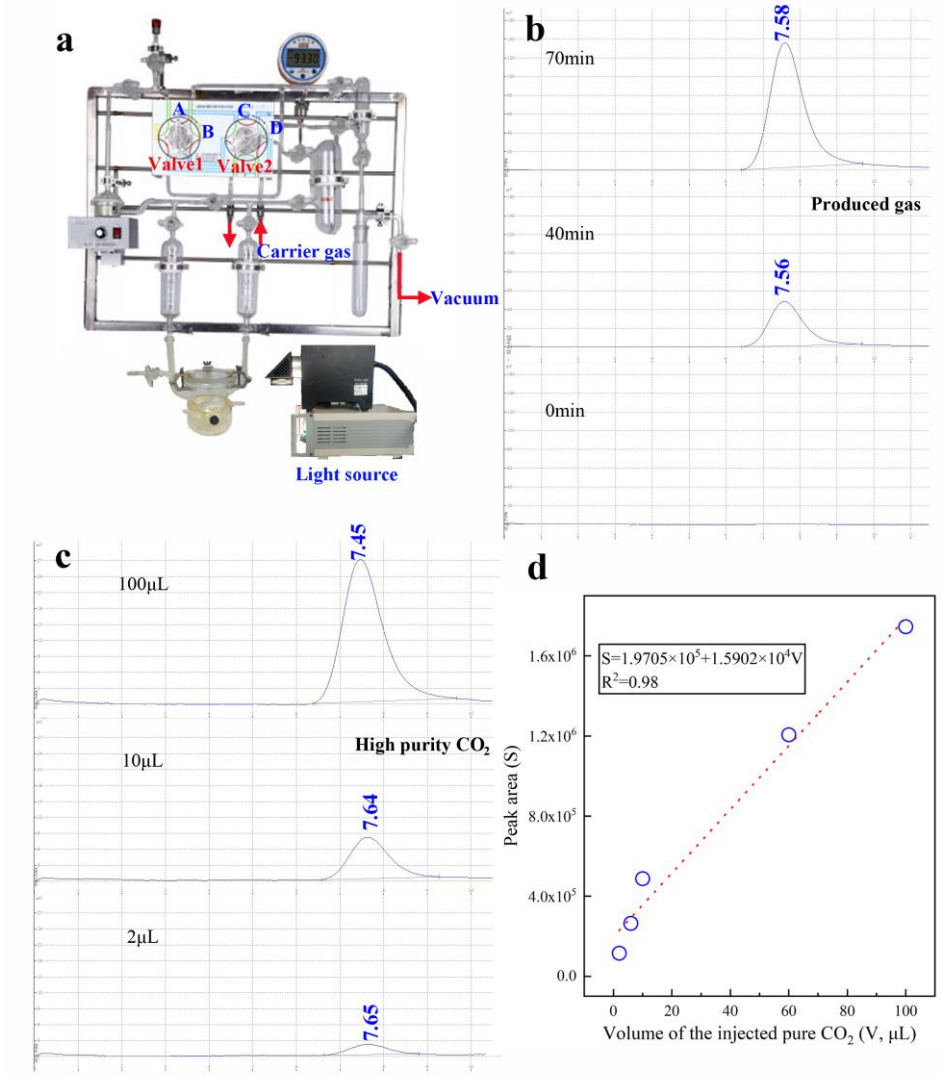


Fig.S1 The experimental apparatus (a) and the results of GC analysis of produced gas (b) to confirm the final gas products by comparison to that of high purity CO_2 (c) and its standard curves of peak areas *vs.* volume of the injected pure CO_2. Notes: Because the layout space is limited, only three corresponding GC curves of five points in Fig.S1d are provided in Fig.S1 c.

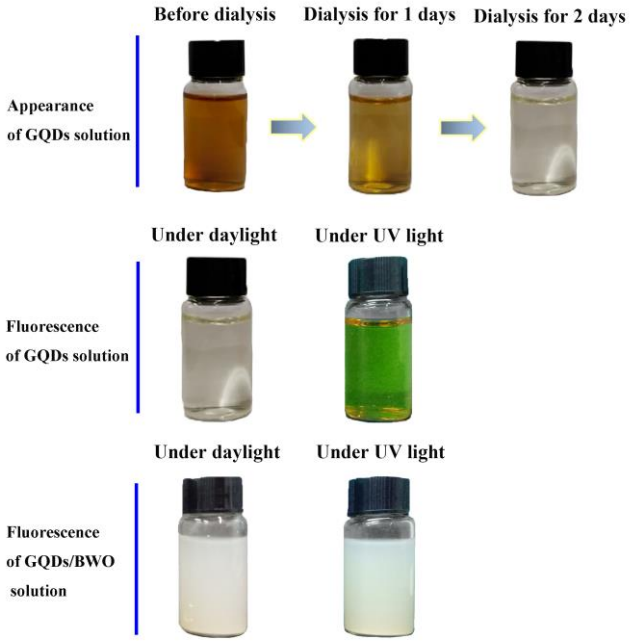


Fig.S2 Photographs of GQDs solution before and after dialysis for various time, GQDs solution and GQDs/BWO solution under daylight and 365 nm UV light

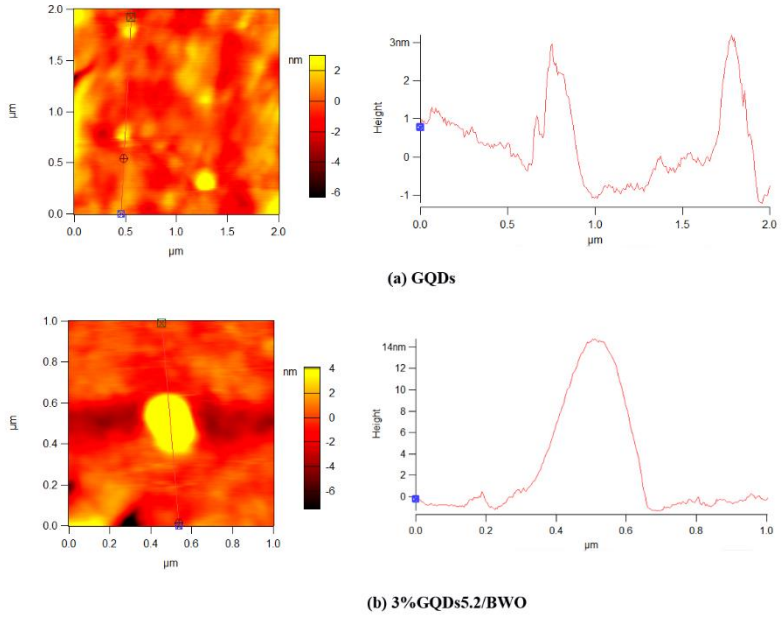


Fig.S3 AFM image of GQDs (a) GQDs; (b) 3%GQDs5.2/BWO

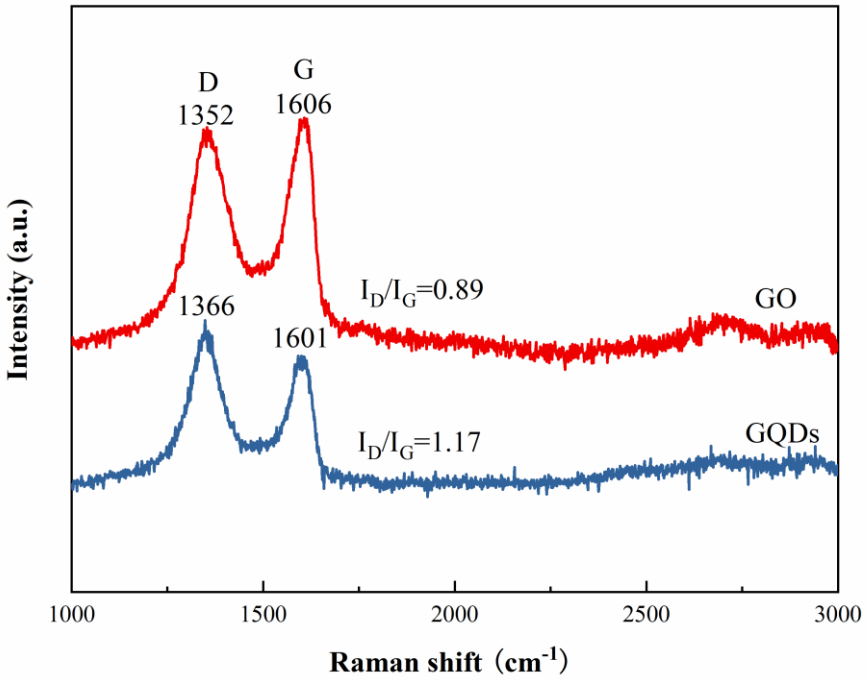


Fig.S4 Raman spectra of the GO and GQDs

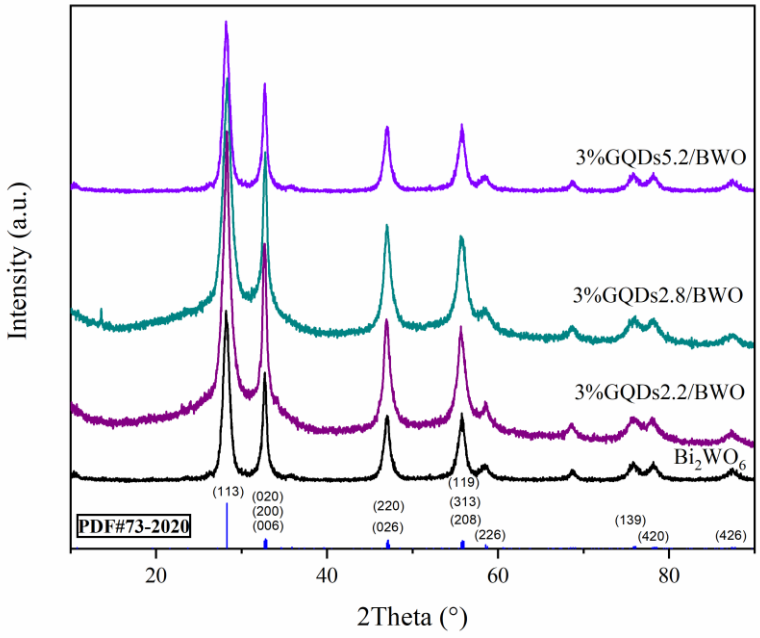


Fig.S5 XRD patterns of Bi_2WO_6 and 3%GQDs/BWO

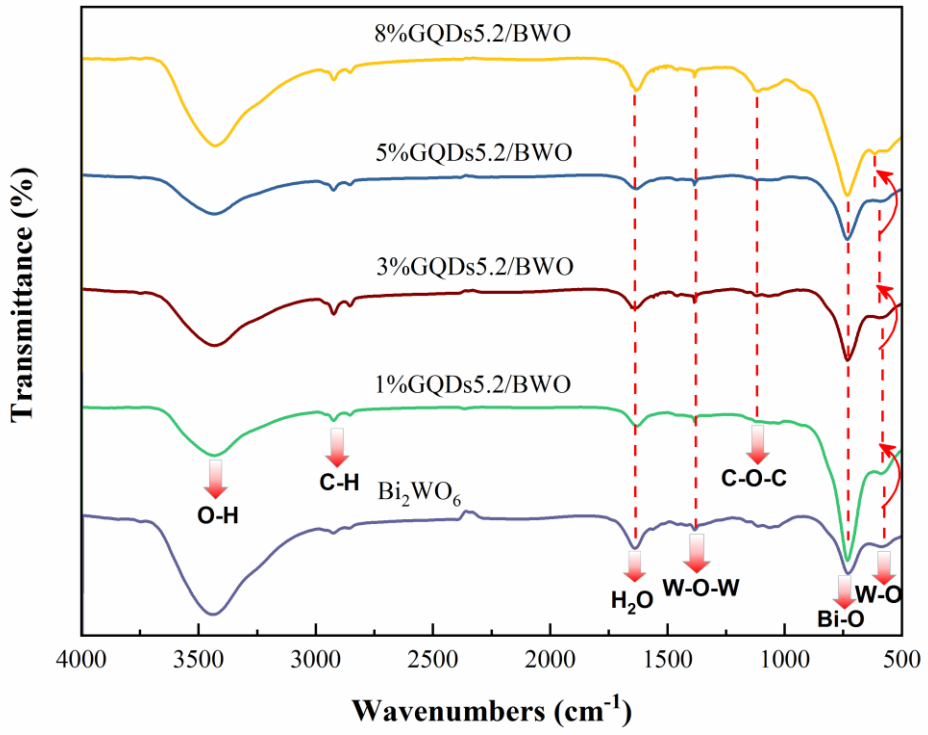


Fig.S6 FT-IR of GQDs/BWO composites with different contents of GQDs

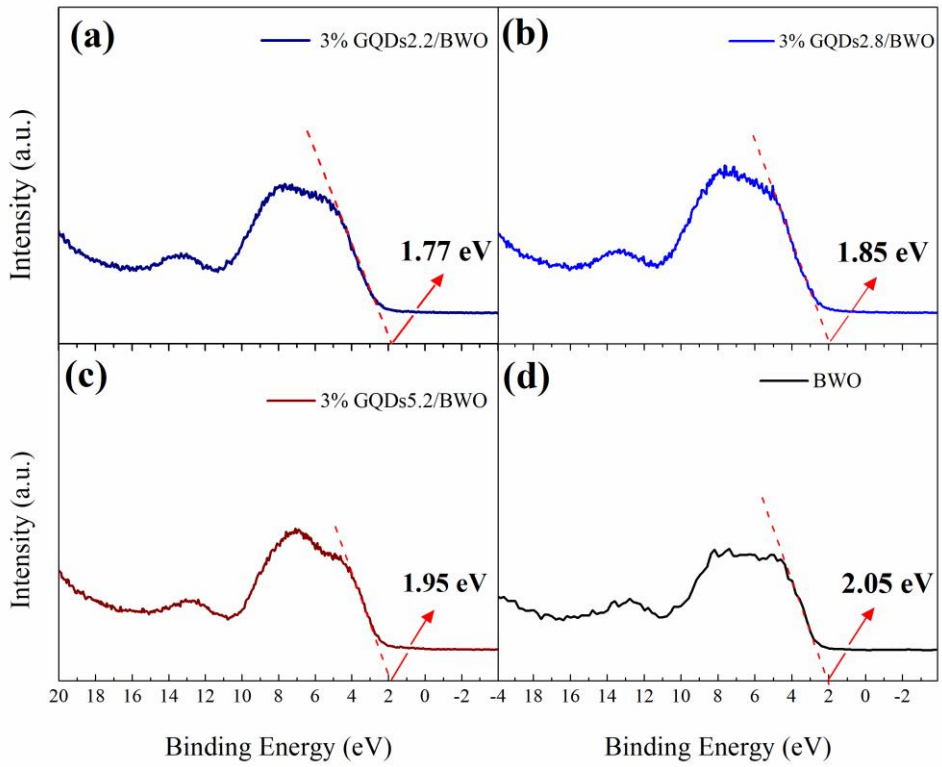
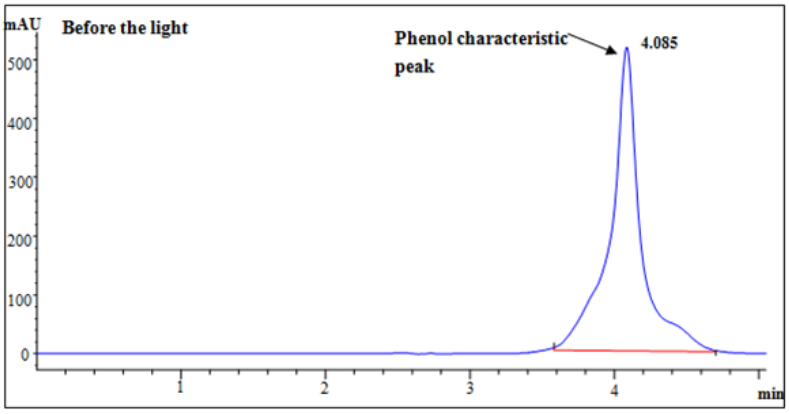


Fig.S7 Valence band XPS spectra of GQDs2.2/BWO, GQDs2.8/BWO, GQDs5.2/BWO and BWO



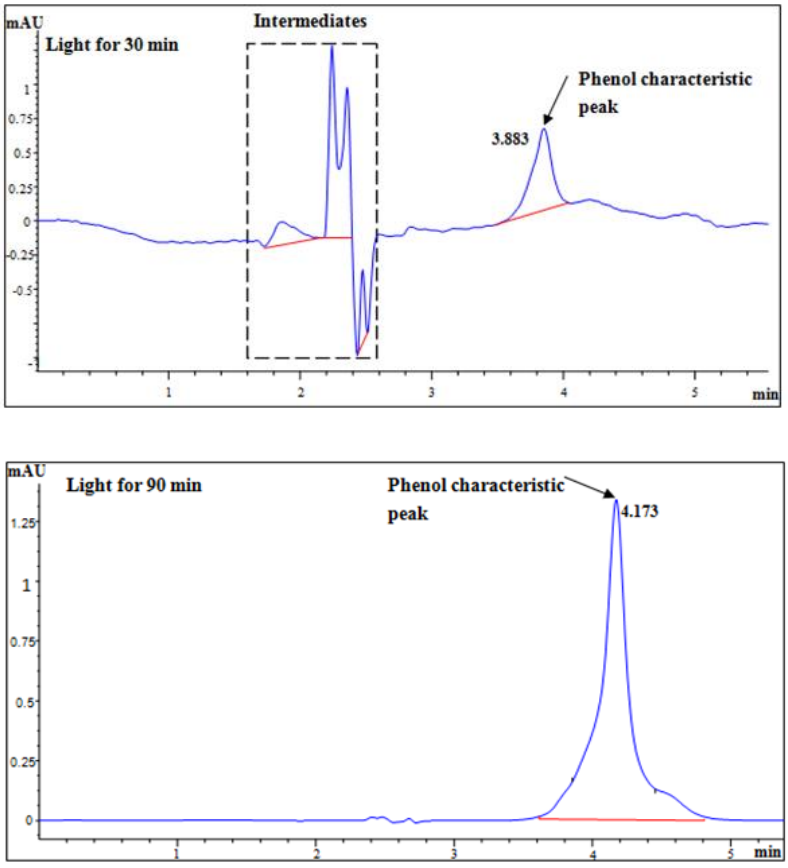
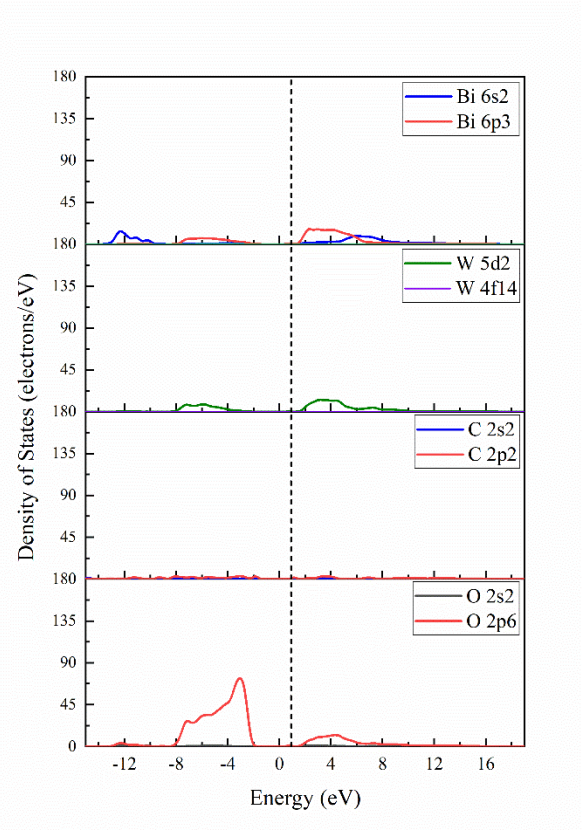
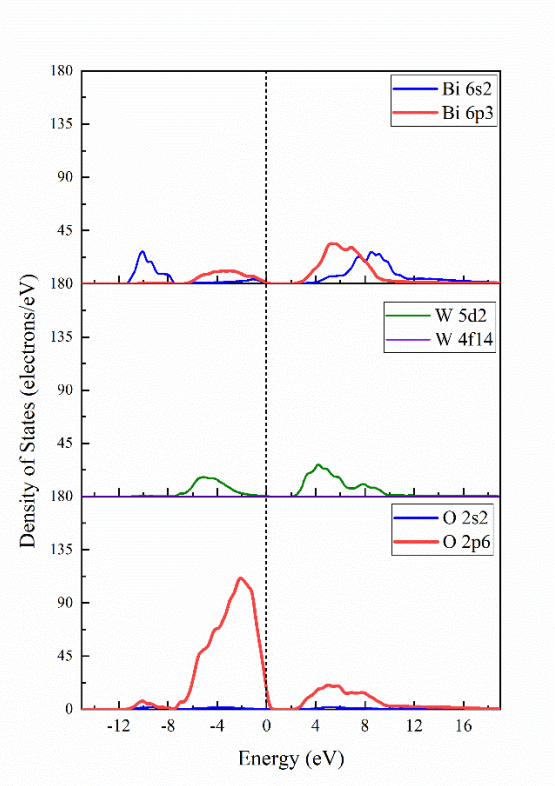


Fig.S8 HPLC chromatogram of the phenol solution samples degraded at 0 and 30 min respectively over the 3%GQDs2.2/BWO sample



(a) PDOS for O, C, W and Bi atoms of GQDs/BWO



(b) PDOS for O, W and Bi atoms of BWO

Fig.S9 PDOS of various atoms of GQDs/BWO and BWO

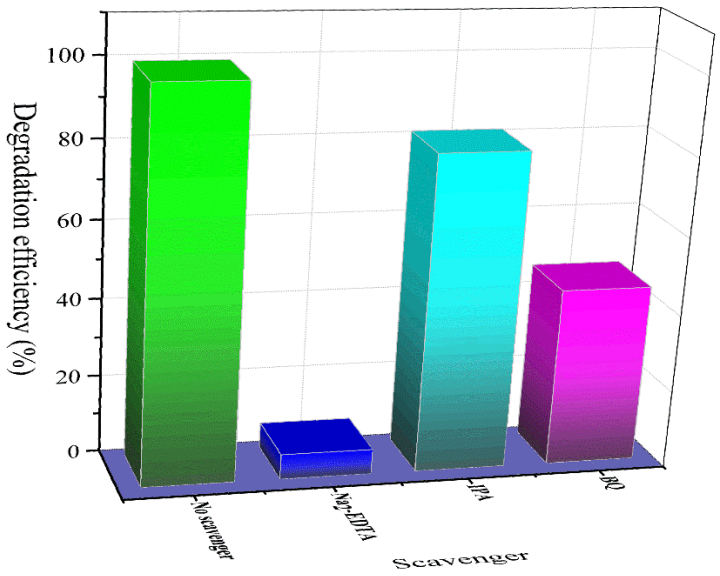


Fig.S10 Effects of three scavengers on the photocatalytic degradation rate of pollutants in the presence of GQDs/BWO

2 Tables

Table S1 The possible positions of GQDs over BWO (113) surface and the corresponding binding energies

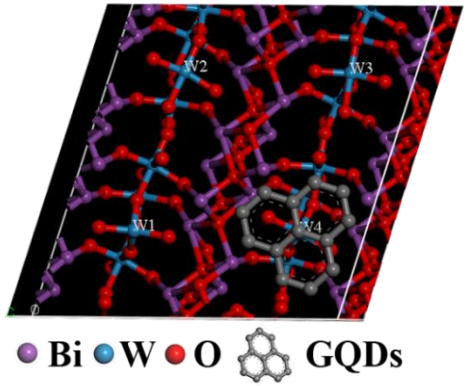
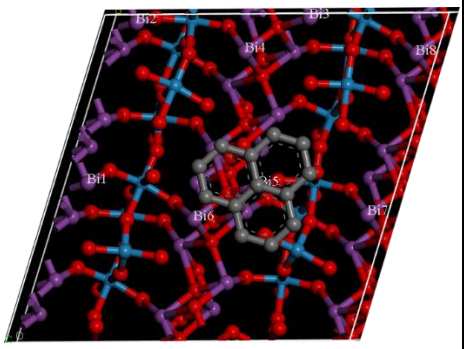
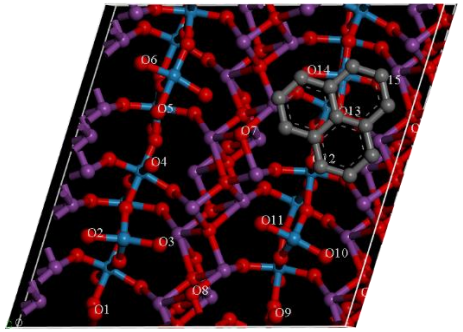
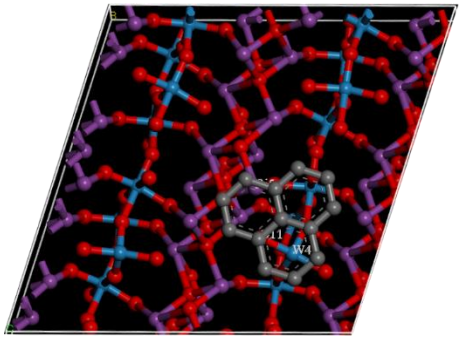
	1	2	3	4
Number of positions				
Position description	Four W atoms in the top layer of Bi_2WO_6 (113) surface were labeled. Structure No.1 refers to that the center C atom of the simulated GQDs with three benzene rings locates at the top of W 4.	Eight Bi atoms in the top layer of Bi_2WO_6 (113) surface were labeled. The center C atom of the simulated GQDs locates at the top of Bi 5.	Seventeen O atoms in the top layer of Bi_2WO_6 (113) surface were labeled. The center C atom of the simulated GQDs locates at the top of O 13.	The center C atom of the simulated GQDs locates among the top of W, Bi and O atoms.
Binding energy (eV)	-1.2059	4.2489	-3.1040	1.2850

Table S2. Comparison of the experimental and simulated lattice parameters of Bi_2WO_6 single crystal

Lattice parameters	Simulated value	Experimental value	Error range
a	5.572581	5.437260[1]	2.49%
b	16.96147	16.430180[1]	3.23%
c	5.632385	5.458420[1]	3.19%

Table S3. Comparison of the activity of various carbon nanomaterial-based Bi_2WO_6 composite for photocatalytic degradation phenol

Photocatalyst and dosage	Light source	Pollutant and initial concentration	Degradation Efficiency and time	Ref.
N-doped g −C_3N_4-Bi_2WO_6, 100mg/100mL	300W Xenon lamp with a 420 nm cutoff filter	Phenol, 10 mg/L	ab.35% (60 min), 93.1% (300 min)	[2]
$AgInS_2$ QD-modified Bi_2WO_6, 500mg/100 mL	1000 W Xenon lamp with a 420 nm cutoff filter	Phenol, 9.88 mg/L	ab.26%, 60 min	[3]
TiO_2/g−C_3N_4/Bi_2WO_6, 100mg/100 mL	500W Xenon lamp with a 420 nm cutoff filter	Phenol, 10 mg/L	ab.12% (60 min), 64% (210 min)	[4]
Bi_2WO_6/GQDs/WO_3, 20 mg/100 mL	300W Xenon lamp with a 420 nm cutoff filter	Phenol, 20 mg/L	ab.80% (60 min), 99.8% (120 min)	[5]
GQDs/BWO, 25 mg/100 mL	300W Xenon lamp with a 420 nm cutoff filter	Phenol, 10 mg/L	97.3%, 60 min	This work

References

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[3] P. Parnicka, A. Mikołajczyk, H. P. Pinto, et al, *Appl. Surf. Sci.* , 2020, **525**, 146596.

[4] G. L. Fang, M. Y. Li, H. F. Shen, S. L. Yang and J. Israr, *Mat Sci Semicon Proc.* , 2021, **121**, 105374.

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