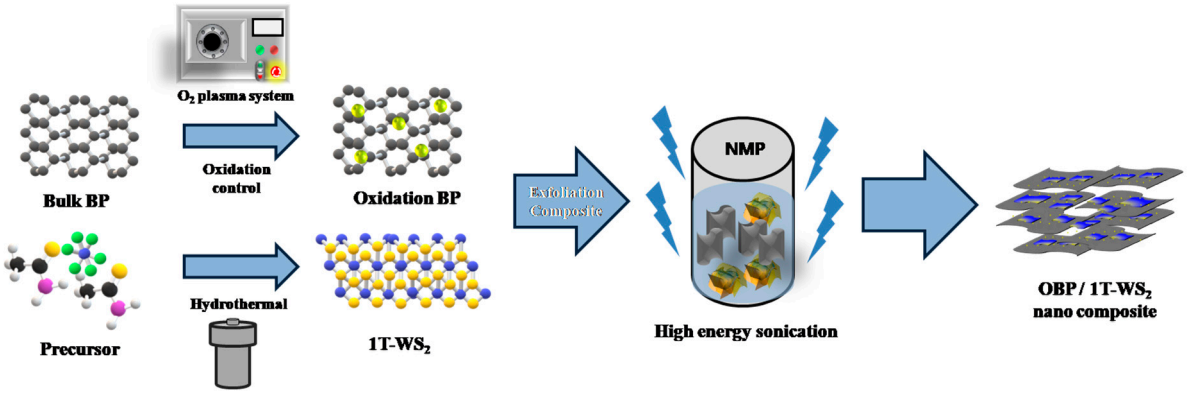
Supplementary Information for

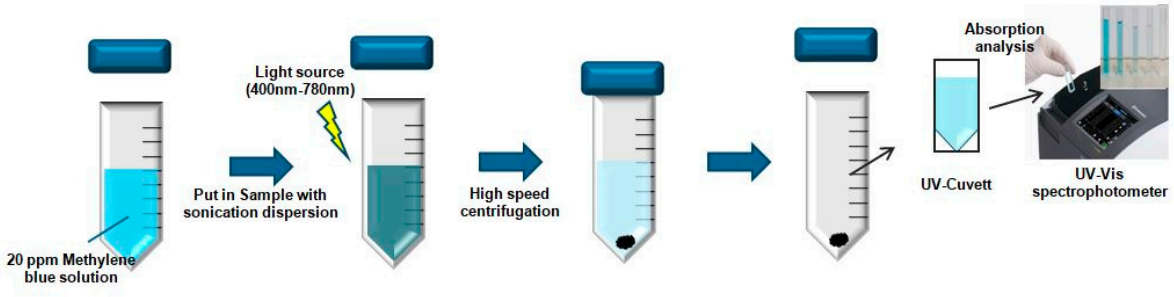
P=O Functional Black Phosphorus / 1T-WS_2 2D Nanocomposite Enhanced Efficiency Hybrid Visible-Light Photocatalyst for Environmental Polluant Degradation

Scheme S1



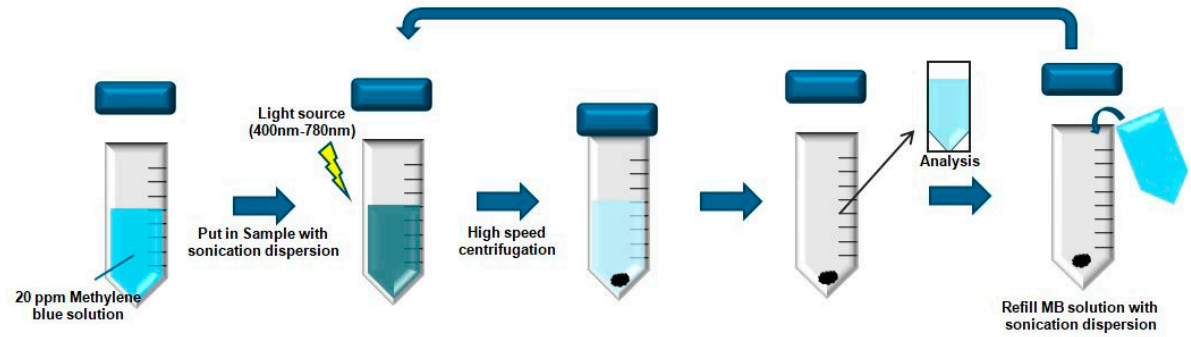
Scheme S1. Schematic illustration of the preparation of oxidation controlled black phosphorus /1T-WS_2 nanocomposite.

Scheme S2.



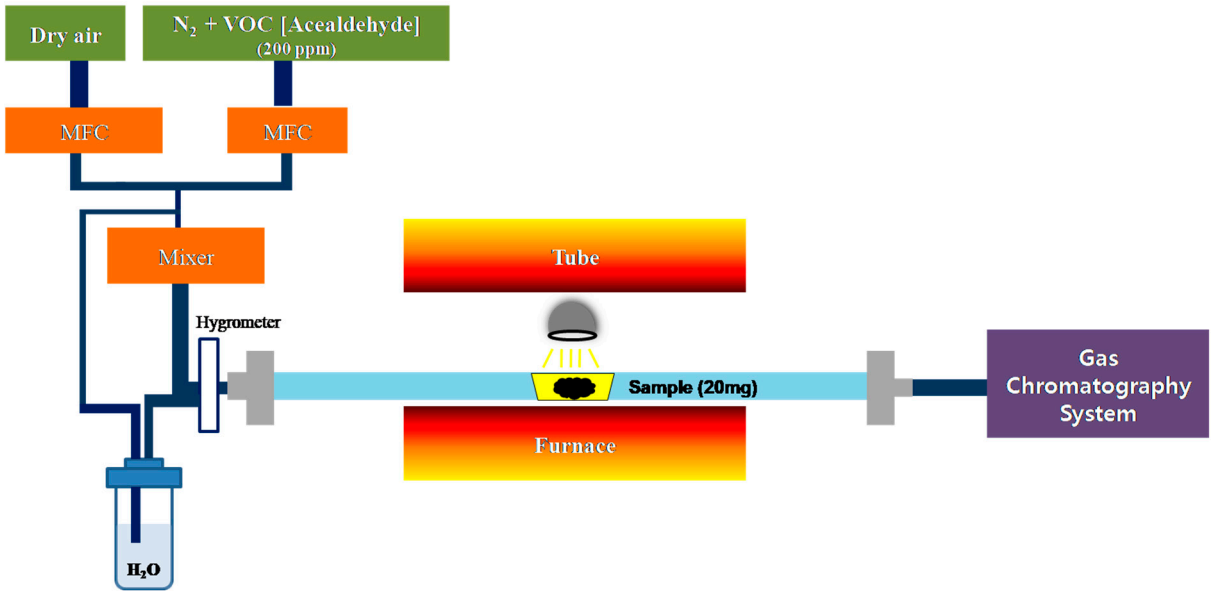
Scheme S2. Procedure for experiments regarding methylene blue solution degradation photocatalytic performance.

Scheme S3.



Scheme S3. Procedure for methylene blue degradation recycling test.

Scheme S4.



Scheme S4. Experimental set-up for photocatalytic VOC degradation.

Figure S1.

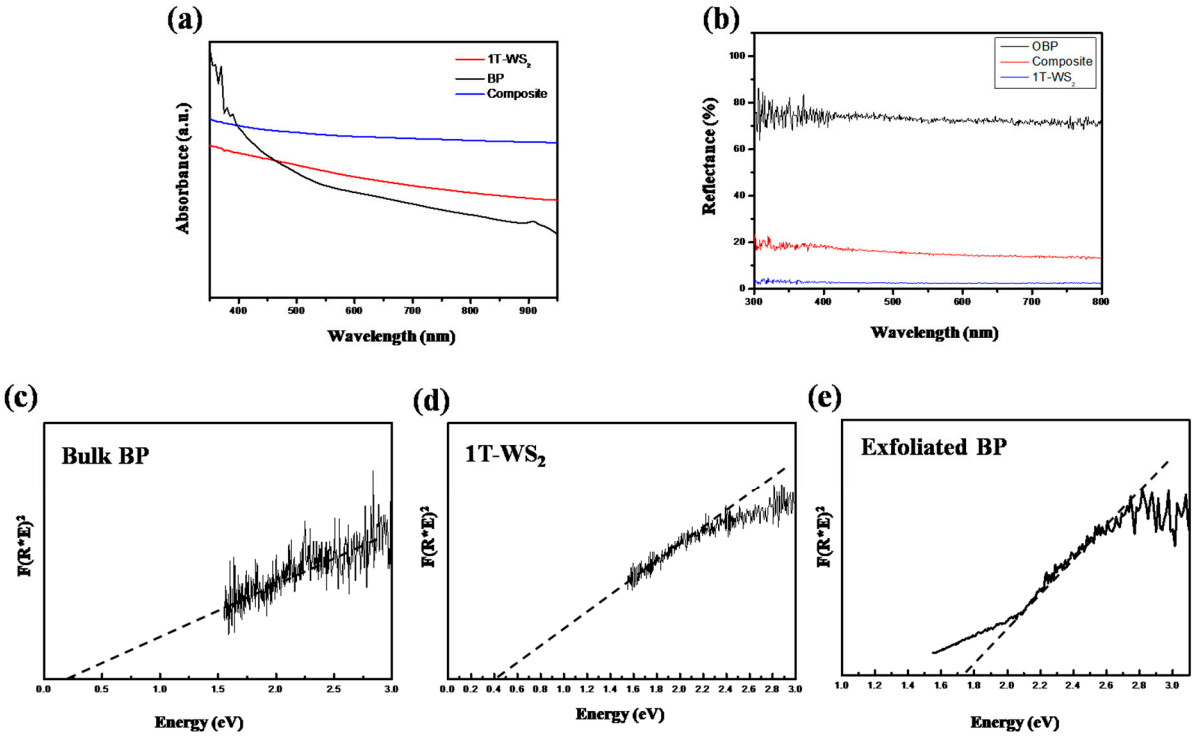


Figure S1. (a) Absorbance spectra of OBP, 1T-WS_2, and nanocomposite. (b) Diffuse reflectance spectra of OBP, 1T-WS_2, and nanocomposite.The bandgap of (c) OBP, (d) 1T-WS_2, and (e) exfoliated BP calculated using Kubelka–Munk'stheory.

Figure S2.

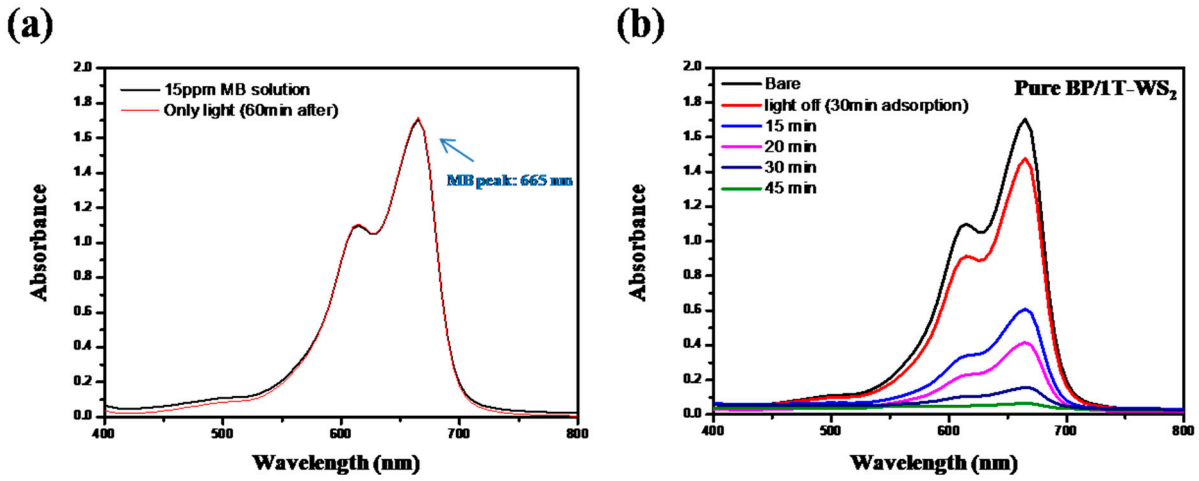


Figure S2. (a) Results of methylene blue solution irradiationfor 60 min under light without photocatalytic material. (b) UV-vis spectra of the methylene blue solution (20 ppm), which was degraded bypure BP/1T-WS_2.

Figure S3

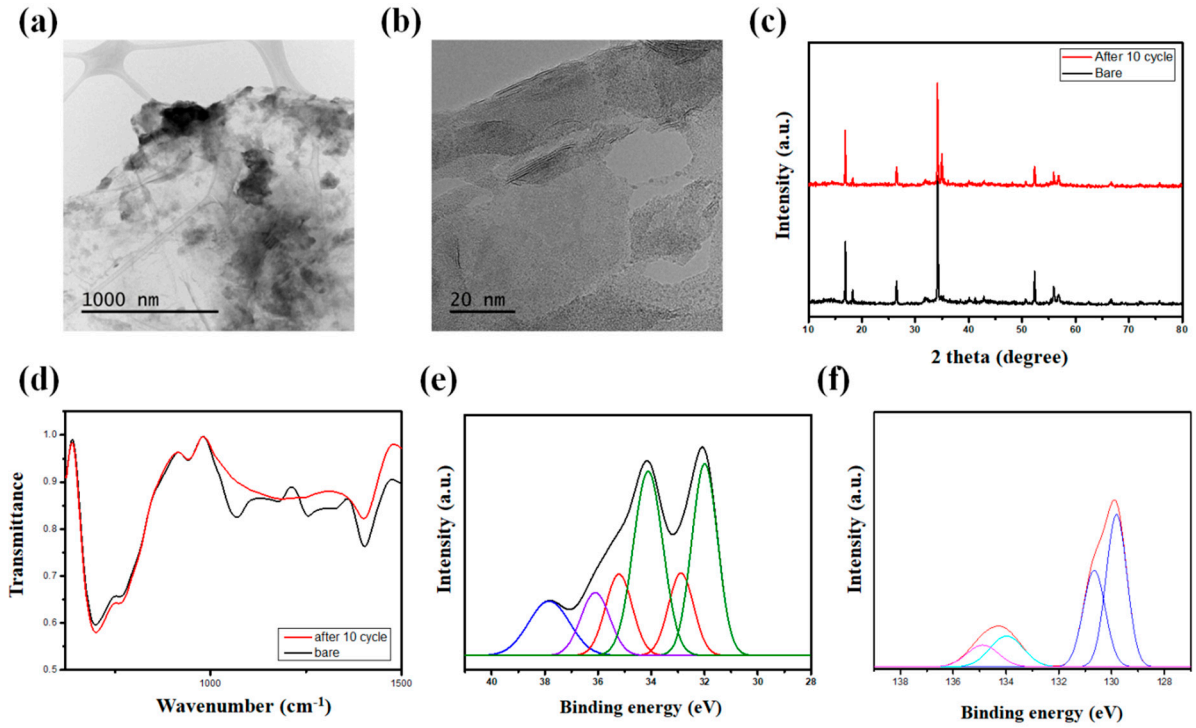


Figure S3. (a, b) TEM, (c) XRD, (d) FT-IR, and (e,f) XPS data of the OBP/1T-WS_2 nanocomposite after continuous photocatalytic reaction stability testing in Figure 6c.

Figure S4.

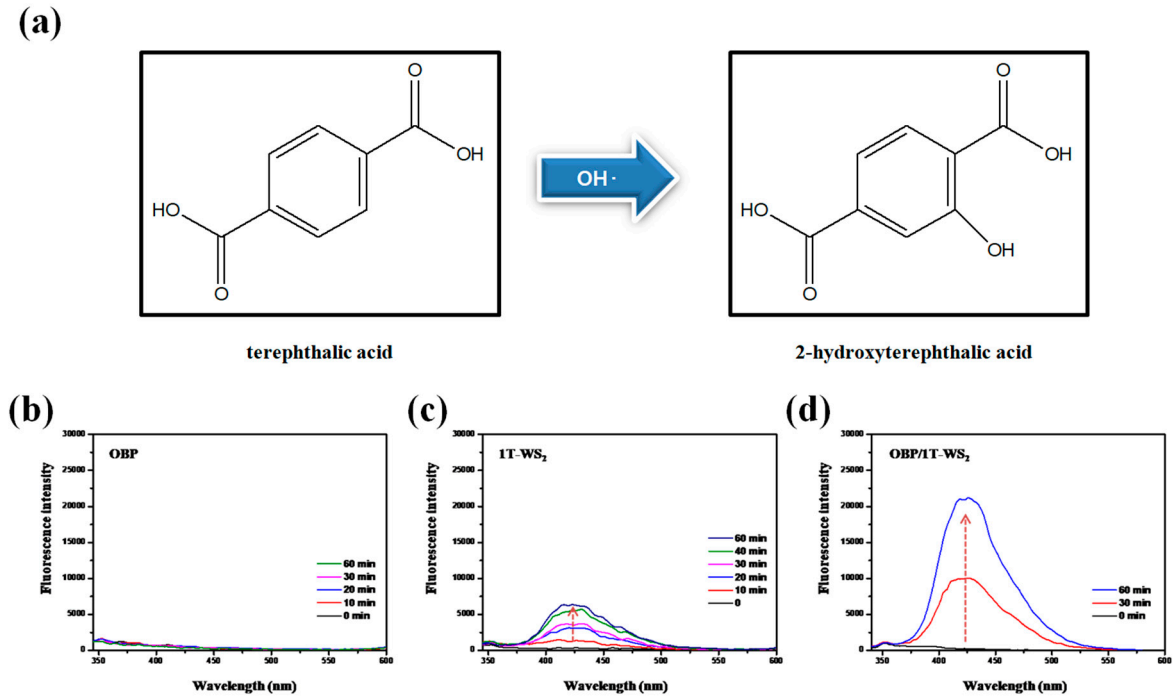


Figure S4. (a) The formation of hydroxy products due to the reaction between terephthalic acid and ·OH. The production of 2-hydroxyterephthalic acid was monitored by measuring the fluorescence emission spectra (λ_{em}= 425 nm, λ_{ex}= 315 nm) obtained over OBP (b), 1T-WS_2 (c), OBP/1T-WS_2 (d).

Table S1.

Table S1. Comparison with reported cases of MB decomposition visible photocatalyst.

Photocatalyst material	Bare MB Absorbance	Kinetic parameter	Reaction time	Recycle Test	Reference
CeO_2/TiO_2 nanotube	0.8	3.6×10^{-2} min^{-1}	150 min	3 cycle	79
Palladium doped TiO_2	3.0	4.4×10^{-2} min^{-1}	150 min	10 cycle	97
TiO_2 / Graphene Porous composite	10 mgL^{-1}	2.1×10^{-2} Min^{-1}	180 min	3 cycle	98
C-doped anatase TiO_2	Not shown / 50 ml	0.7×10^{-2} Min^{-1}	90~120 min	N/A	99
OBP/1T-WS_2 nanocomposite	**1.6 (20 mgL^{-1})**	**10.31×10^{-2} min^{-1}**	**20 min**	**10 cycle**	**This study**

Table S2.

Table S2. Comparison with reported cases of acetaldehyde decomposition visible photocatalyst.

Photocatalyst material	Light Source	catalytic efficiency	Reference
GO-TiO_2	200 W Xenon lamp	65% degradation 25 ppm / 0.1g	100
S-doped TiO_2	F8T5 WW 8W lamp	60% degradation 500mg 500 mL of acet-aldehyde with 500 μM initial concentration (in aqueous solution)	101
Mica/TiO_2/Fe_2O_3 composite	10 mgL^{-1}	80% degradation 500 ppm 8 sccm 0.1g	102
OBP/1T-WS_2 nanocomposite	**20W White LED**	**60 μmol / g min**	**This study**