Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Self-Powered Photodetector Based on Two-Dimensional Boron Nanosheets

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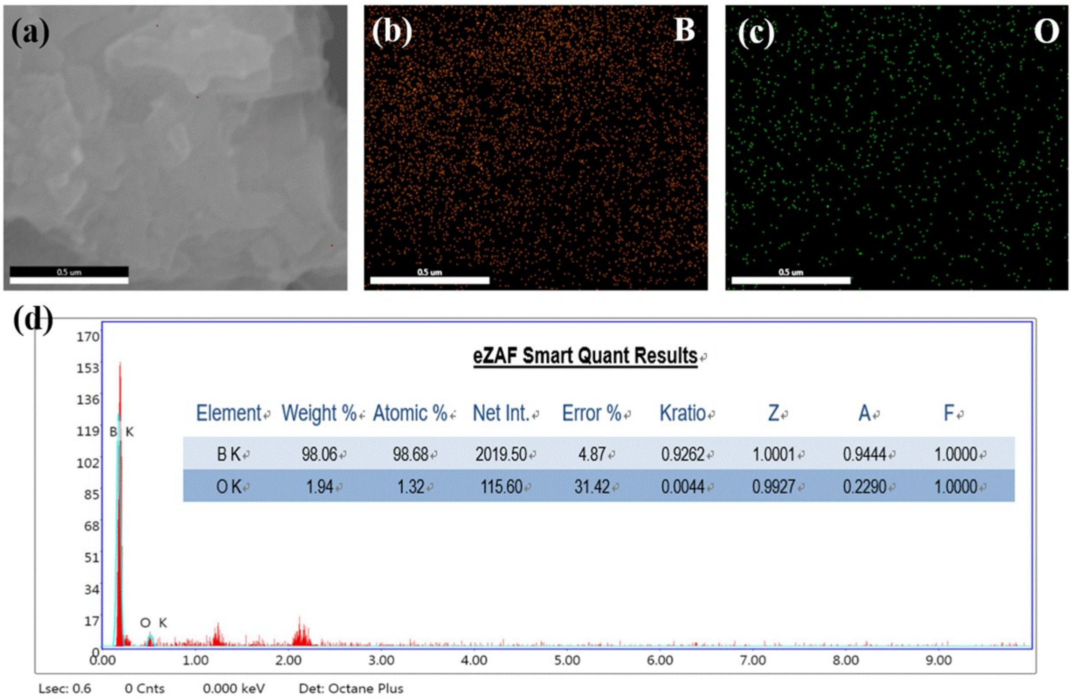

Element	Weight %	Atomic %	Net Int.	Error %	Kratio	Z	A	F
B K	98.06	98.68	2019.50	4.87	0.9262	1.0001	0.9444	1.0000
O K	1.94	1.32	115.60	31.42	0.0044	0.9927	0.2290	1.0000

Figure S1 (a) SEM image of boron nanosheets with the corresponding elemental mapping of (b) B, and (c) O element. (d) The analysis of elemental content.

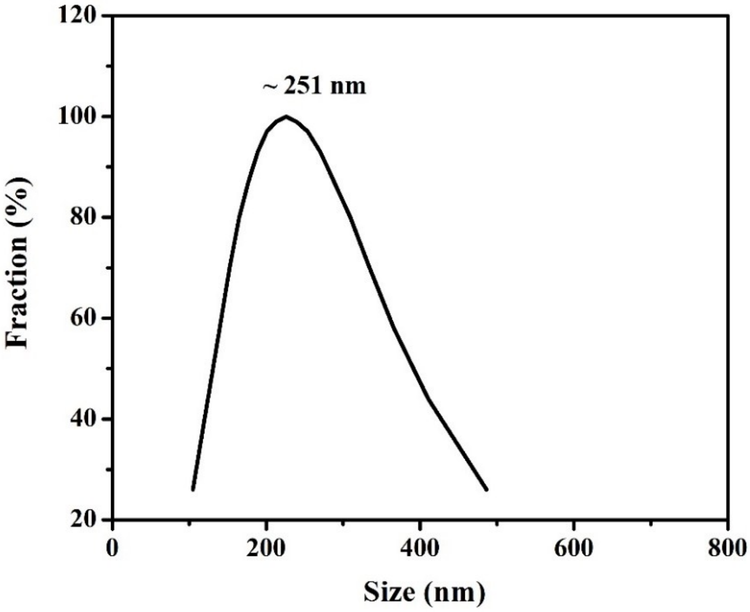

Figure S2 The size distribution of B nanosheets.

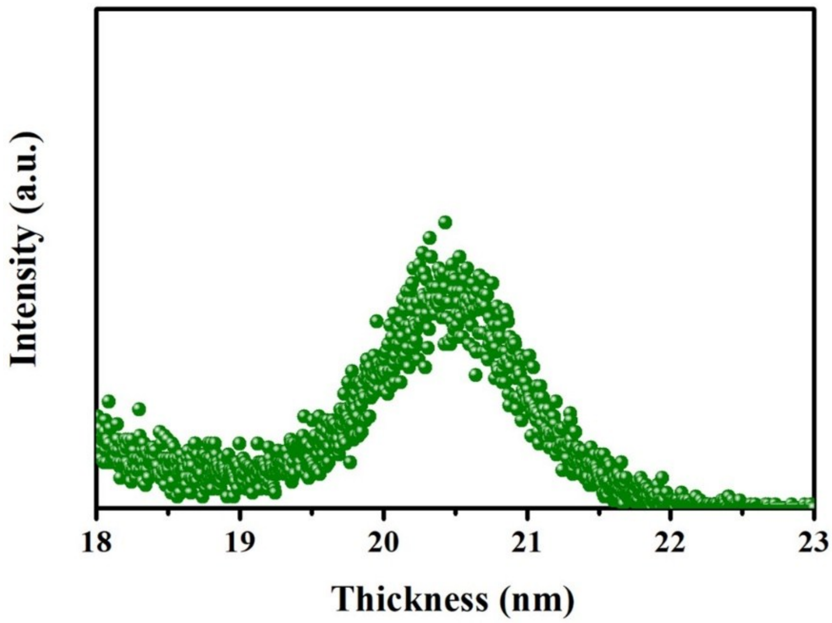

Figure S3 The thickness distribution of B nanosheets obtained under the centrifugation speed of 3000-6000 rpm.

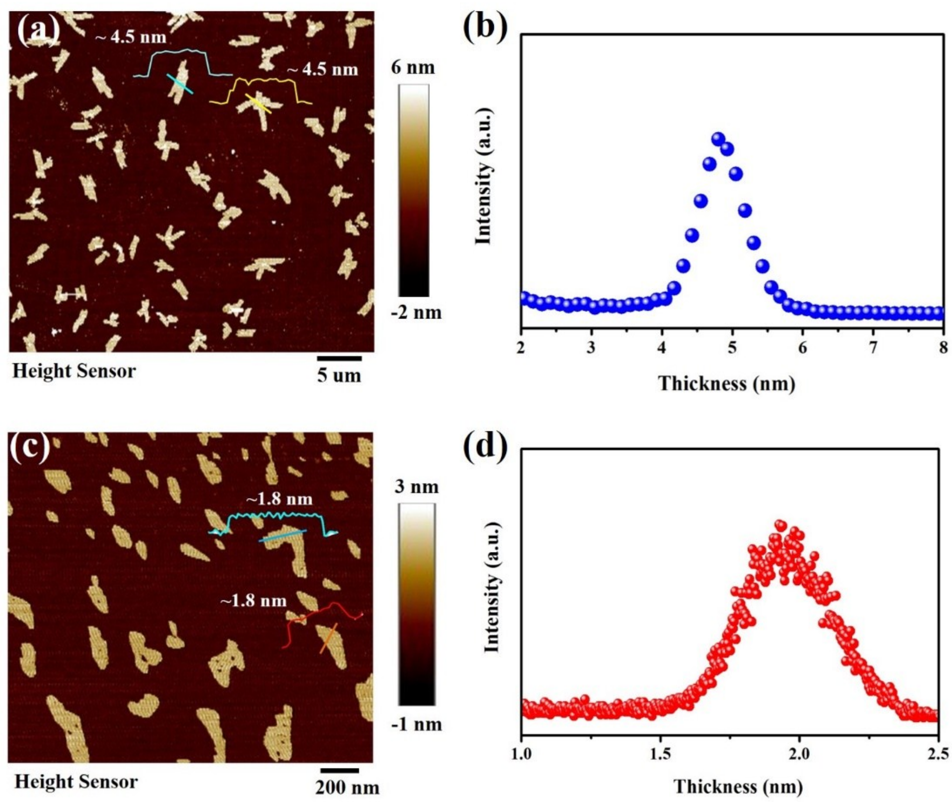

Figure S4 The AFM image and thickness distribution of B nanosheets under the centrifugation speed of (a, b) 6000-9000 rpm and (c, d) 9000-12000 rpm.

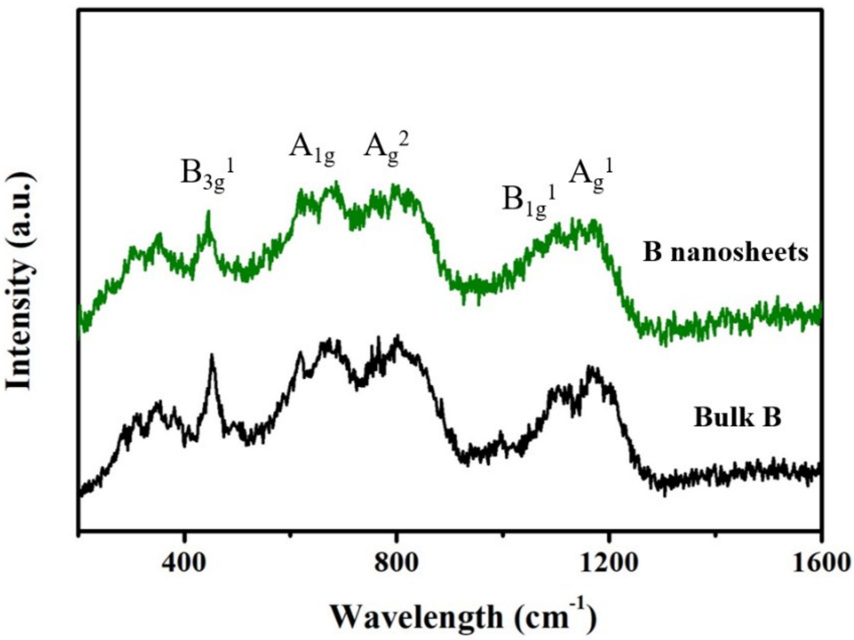

Figure S5 The Raman spectra of bulk B and B nanosheets.

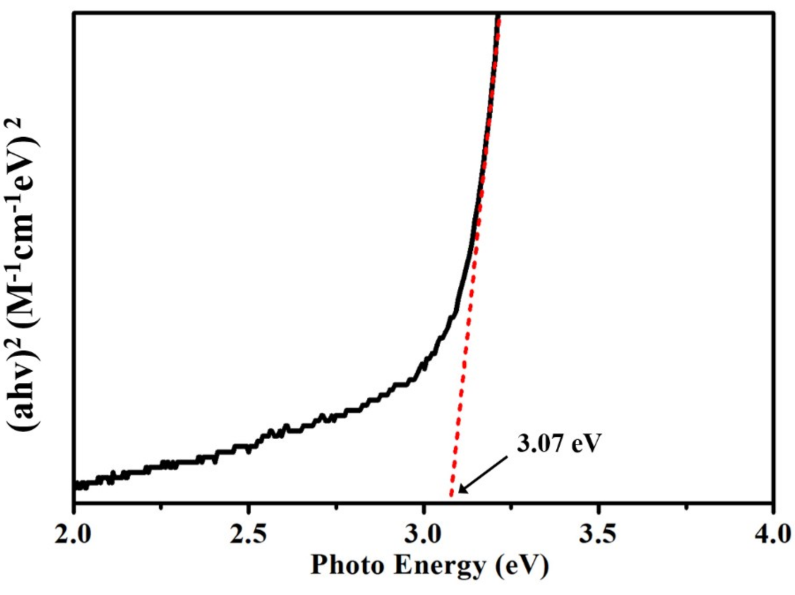

Figure S6 Tauc plot curve of the B nanosheets.

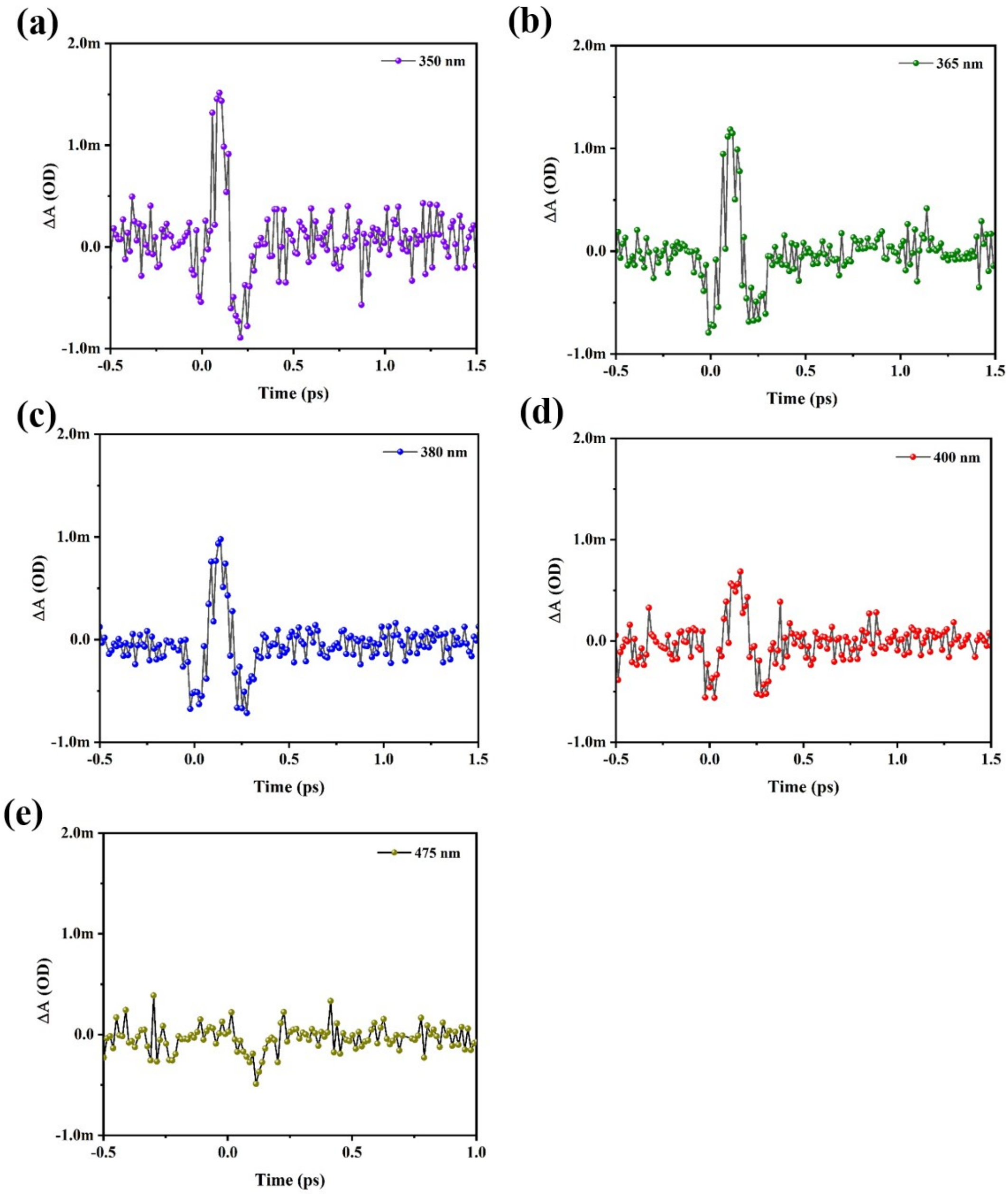

Figure S7 The TA signal of the 1mm-thickness pure quartz cuvette at different wavelengths

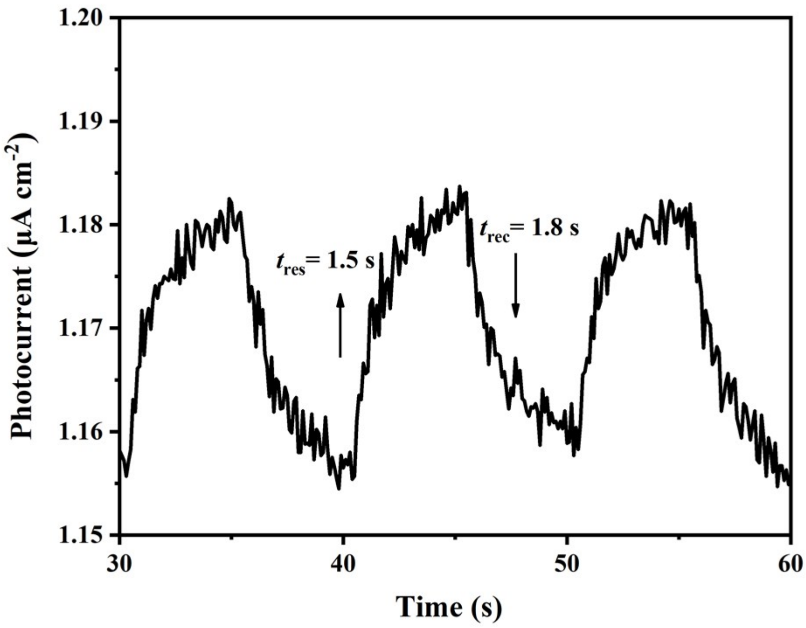

Figure S8 The profiles of response time (t_{res}) and recovery time (t_{rec}) of 2D B nanosheets-based PEC device under 0 V bias potential.

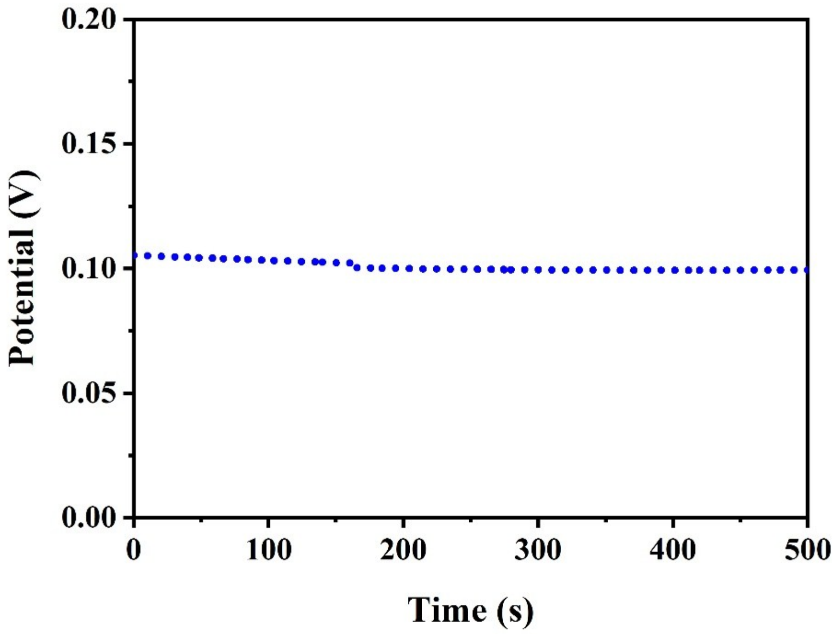

Figure S9 The stability of open circuit voltage for B nanosheets-based PEC photodetector in 0.3 M KOH electrolyte.

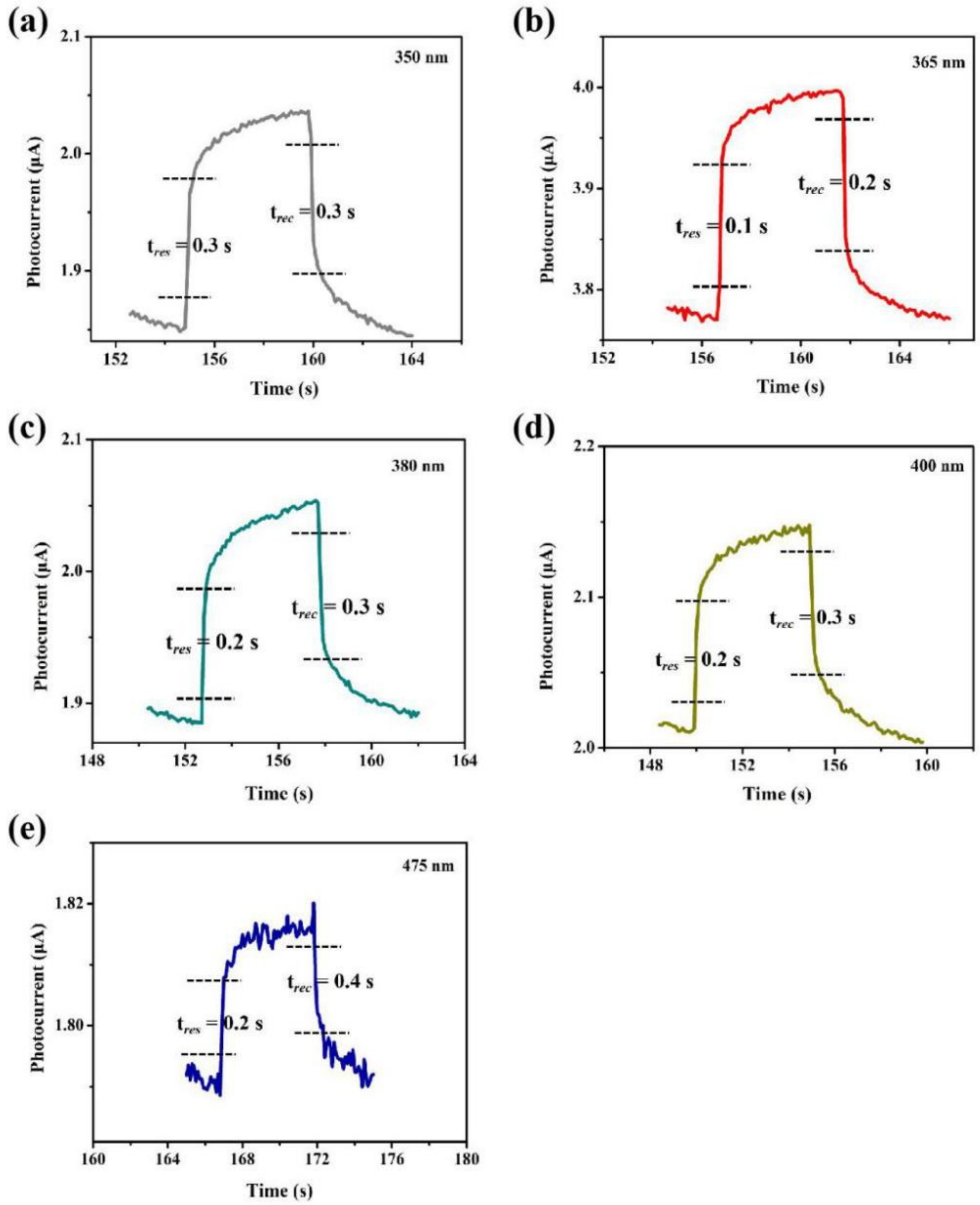

Figure S10 The profiles of response time (t_{res}) and recovery time (t_{rec}) of 2D B nanosheets-based PEC device under the irradiation of excited light with (a) 350 nm, (b) 365 nm, (c) 380 nm, (d) 400 nm, and (e) 475 nm.

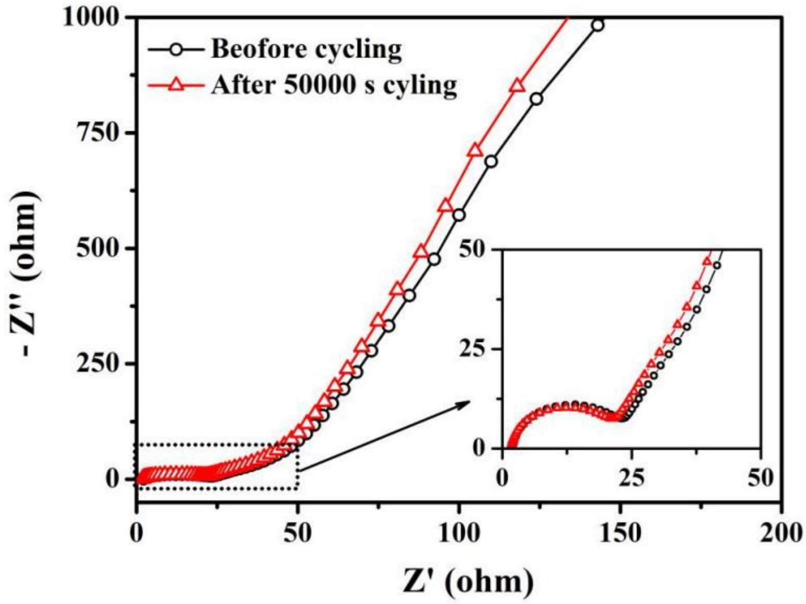

Figure S11 The comparison of EIS results of B nanosheets-based photoanode before and after photoresponse switching for 50000 s duration time.

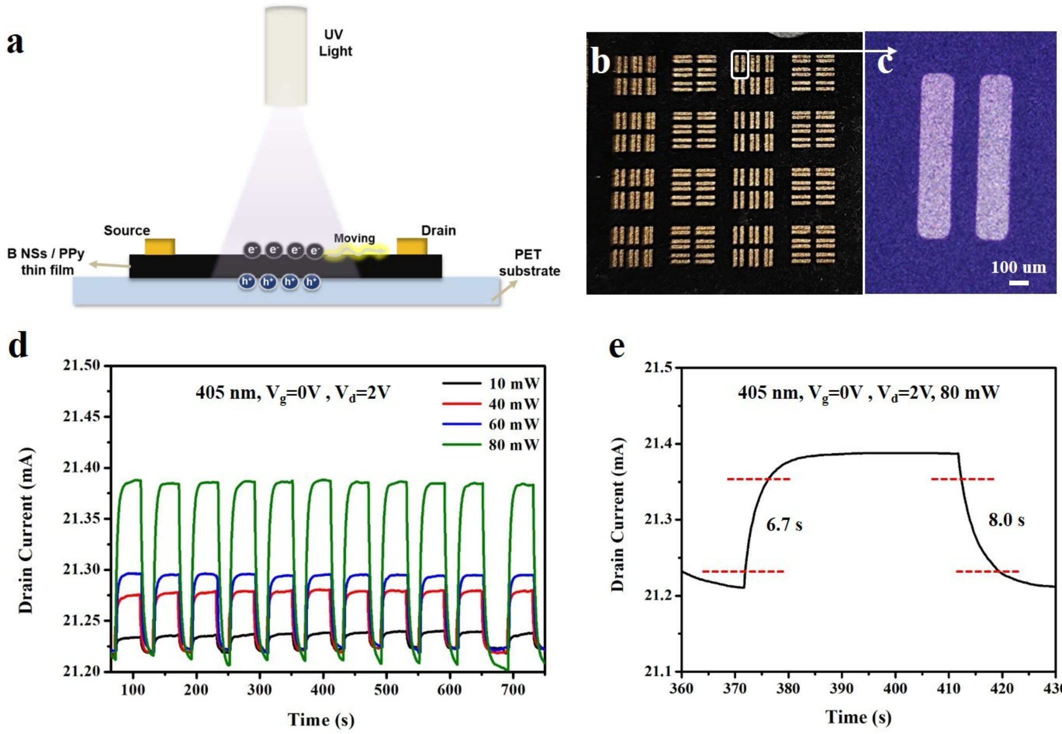

Figure S12 (a) Schematic diagram of the FET-type photodetector based on B/PPy film. (b, c) The corresponding digital images of the B/PPy-based photodetector. (d) On/off photoresponse stability test under different light power. (e) The profiles of response time (t_{res}) and recovery time (t_{rec}) of the B nanosheet-based device under the irradiation of excited light at 405 nm.

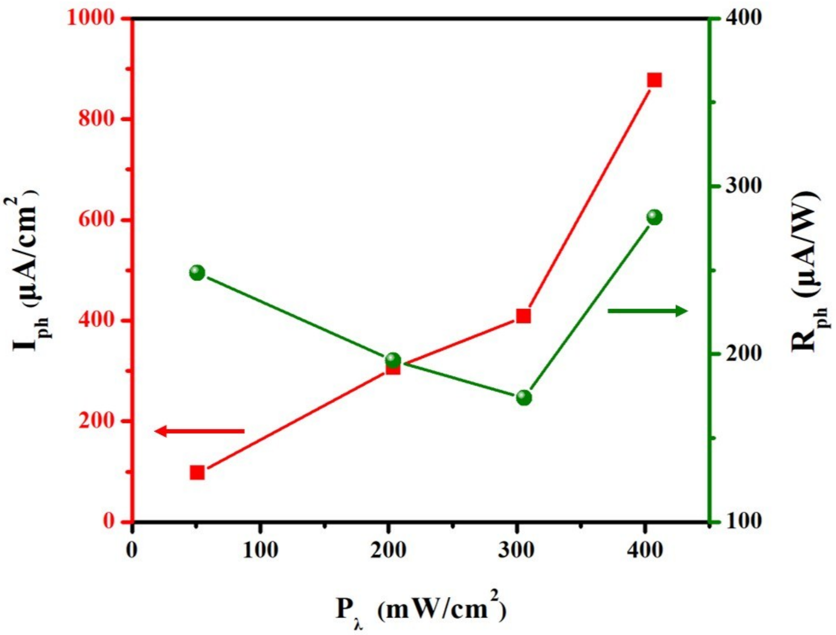

Figure S13 The profiles of I_{ph} and R_{ph} values as a function of P_λ.

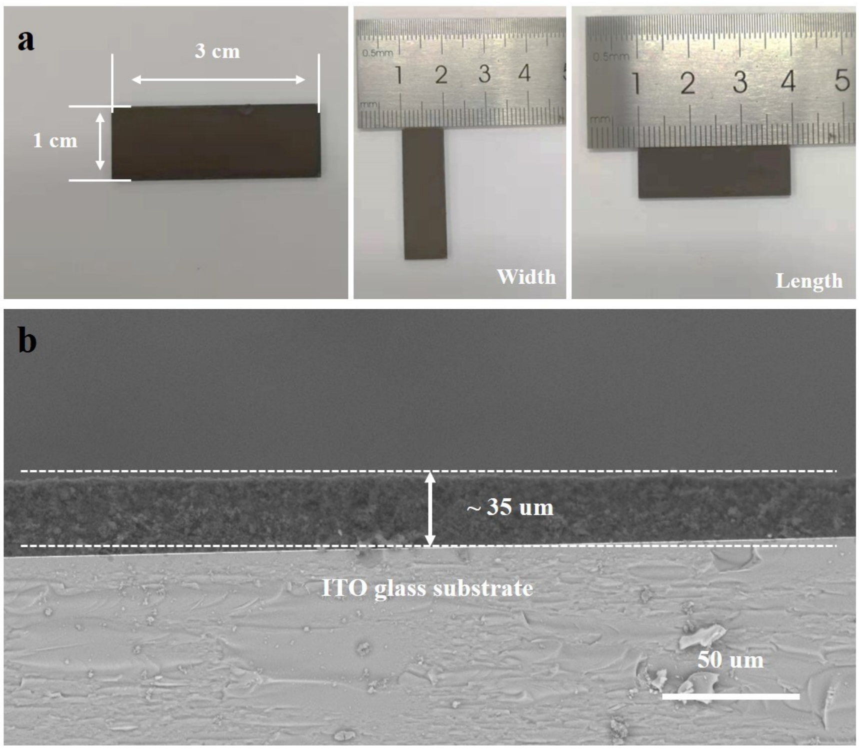

Figure S14 (a) The digital image and (b) SEM image of B nanosheets-based working electrode.

Table S1. The average thickness, size and layer number of B nanosheets obtained under different range of centrifugation speed.

Centrifugation speed	Average thickness	Layer number
3000-6000 rpm	~ 20.5 nm	> 20
6000-9000 rpm	~ 4.8 nm	16
9000-12000 rpm	~ 1.9 nm	6

Table S2. The power densities (P_λ) of excited light with various irradiation wavelengths. The gradually increased P_λ were labelled with I, II, III, IV, and VI levels, respectively.

Light / P_λ	***I*** **(mW/cm^2)**	***II*** **(mW/cm^2)**	***III*** **(mW/cm^2)**	***IV*** **(mW/cm^2)**	***VI*** **(mW/cm^2)**
Simulated light	26.2	53.1	83.4	118.2	122.1
350 nm	0.53	1.02	1.66	2.17	2.19
365 nm	0.76	1.66	2.55	3.57	3.70
380 nm	0.32	1.02	1.91	2.68	2.77
400 nm	0.64	2.04	3.55	5.22	5.35
475 nm	1.90	4.33	7.01	10.1	10.6

Table S3. Typical parameters of B nanosheets-based PEC devices under various working conditions with a fixed bias potential of 0.6 V.

Wavelength (nm)	**Power density (P_λ, mW·cm^{-2})**	**Responsivity (R_{ph}, μA·W^{-1})**	**Detectivity (D^*, Jones)**
350	2.17	91.7	1.6×10^8
365	3.57	67.5	0.97×10^8
380	2.68	61.2	1.1×10^8
400	5.22	25.1	4.4×10^7
475	10.1	2.9	0.51×10^7