

High-performance BiOBr ultraviolet photodetector fabricated by a green and facile interfacial self-assembly strategy

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Experimental Details:

Material Preparation and Characterization:

All chemicals were of analytical grade and used as received without further purification and the BiOBr NSs were prepared by a facile method at room temperature. Typically, 1 mmol $\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ powders were dissolved in 15 mL glacial acetic acid. Then the above solution was added into a 12 mL aqueous solution containing 1 mmol KBr and 2 mmol CH_3COONa . The mixture was stirred for 24 h at room temperature.

Then the as-prepared BiOBr NSs were self-assembled at a water-air interface via the following procedures: As the synthesis of BiOBr NSs was completed, all the precipitates of BiOBr NSs were on the bottom of beaker after keeping stationary for a short period and most of the solution at the top of the beaker was carefully removed by a syringe. Some new deionized water was injected into the beaker. Then a smooth and condensed film was formed very rapidly at the water-air interface.

Scanning electron microscope (SEM) images and energy-dispersive X-ray spectrum (EDS) were taken with a XL30 field-emission scanning electron microscope at an accelerating voltage of 15 kV. Transmission electron microscope (TEM) images were obtained with a Hitachi 600 transmission electron microscope operating at 100 kV. X-ray diffraction (XRD) patterns were collected by a Bruker D8 ADVANCE (Germany) with $\text{Cu-K}\alpha$ radiation ($\lambda = 0.154056$ nm). Absorption spectrum of the BiOBr sample was obtained with a Hitachi U-4100 spectrophotometer. Atomic force microscope (AFM) was conducted with a SPI3800N microscope (Seiko Instruments, Inc.). X-ray photoelectron spectroscopy (XPS) measurement was performed on an ESCALAB-MKII 250 photoelectron spectrometer (VG Co.) with $\text{Al K}\alpha$ X-ray radiation as the X-ray source for excitation.

Device fabrication and characterization:

BiOBr film photodetector was constructed using ITO coated glass substrates as the interdigital electrodes which were fabricated through standard photolithography and etching procedure. First, the ITO substrate with a sheet resistance of 25 Ω /sq was cleaned in acetone, ethanol, and deionized water for 5 min, respectively. Then, it was dried by nitrogen flow. Finally, the RZJ-390 photoresist was spin-coated on the ITO substrate. After the exposal and removing steps, the uncovered ITO film was etched by hydrochloric acid to form the ITO interdigital electrodes.

The ITO substrate with interdigital electrodes was immersed into the water and withdrawn at a certain angle using a RZ-1 dip coater at a constant speed. Then the BiOBr film at the water-air interface was transferred onto the surface of the ITO interdigital electrodes and the as-prepared device was kept in air until all water was evaporated.

Current-voltage (I-V) characteristics of the device were measured at room temperature in air using an electrochemical workstation CHI 832C (Shanghai Chenhua Instrument Corporation, China). A 500 W Xenon lamp was adopted as the illumination source. UV light illumination was obtained by using a 365 nm ultraviolet band pass filter and the power density incident to the device surface was around 10 mW cm^{-2} . The light-on and light-off states were controlled by manual or mechanical chopper. The transient response was recorded by a digital oscilloscope. A standard lock-in amplifier technique was employed for the spectral response measurements.

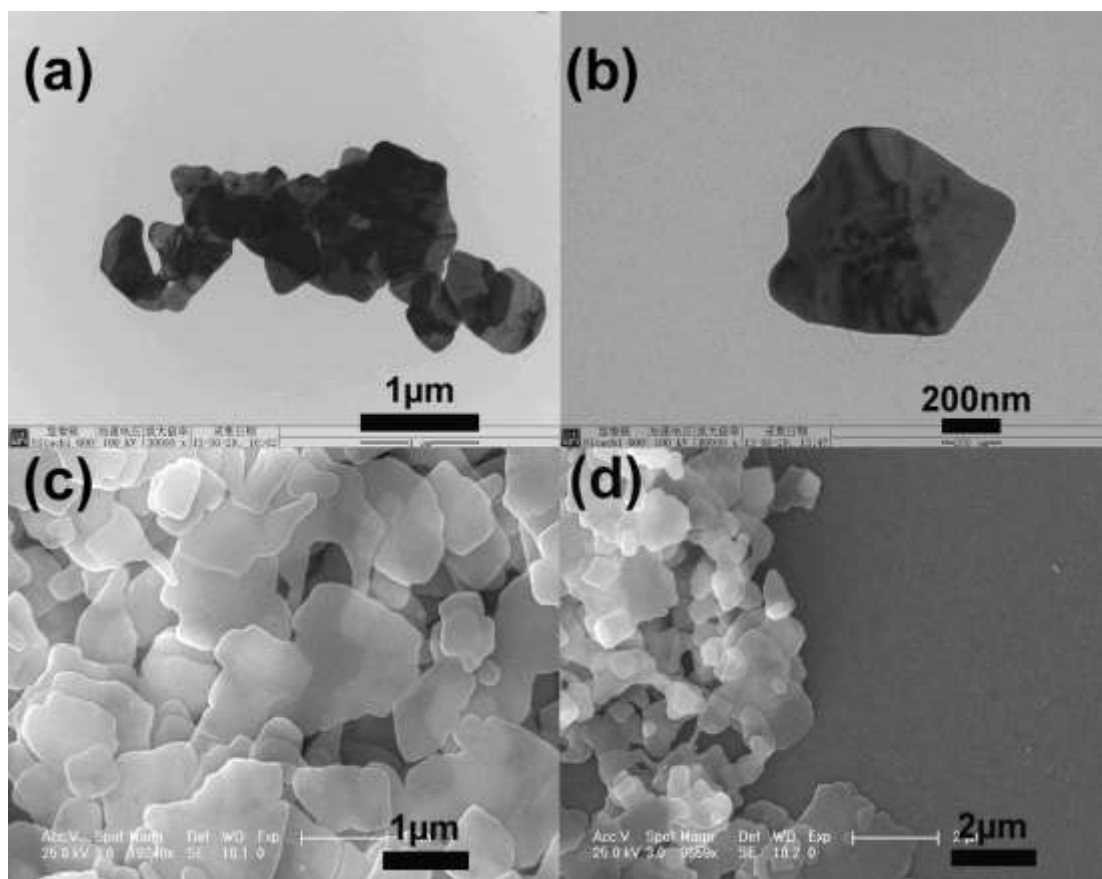


Figure S1. The TEM (a), (b) and SEM (c), (d) images of the BiOBr nanosheets.

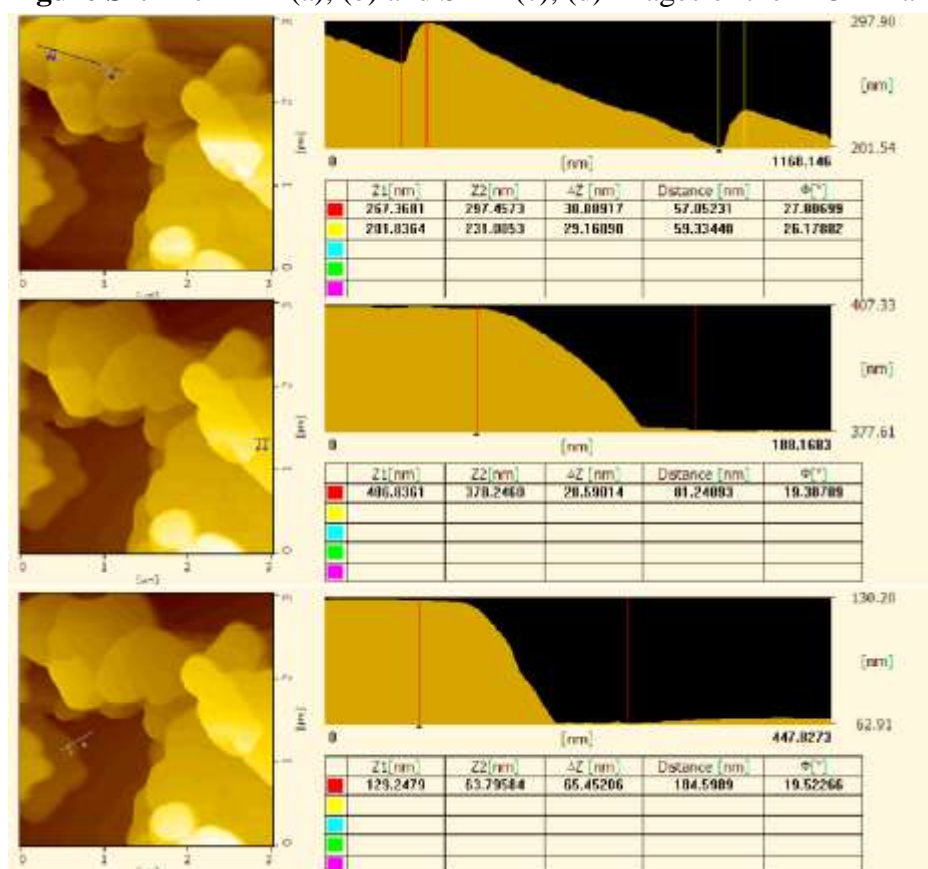


Figure S2. The AFM images of the BiOBr nanosheets.

Table S1 The EDS analysis of the BiOBr nanosheets.

Element	Wt %	At %
O K	5.44	33.56
Br L	28.56	35.28
Bi M	66	31.17
Total	100	100

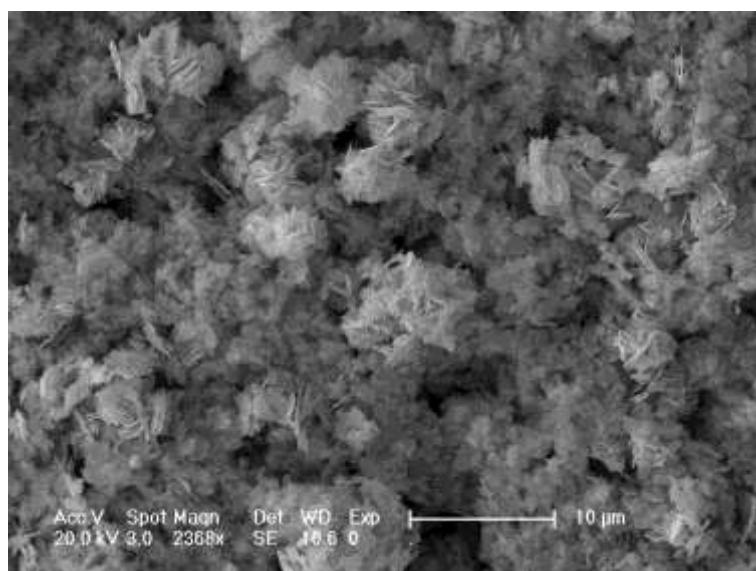


Figure S3. SEM image of the disordered BiOBr film.

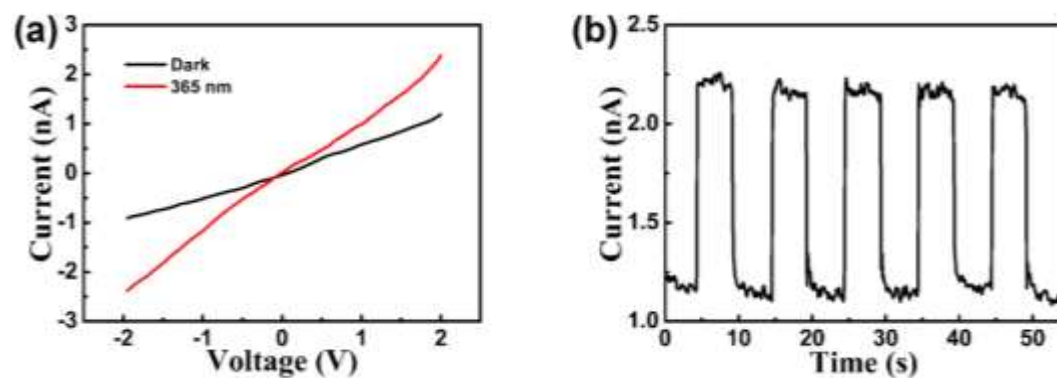


Figure S4. (a) I-V characteristics of the disordered BiOBr film photodetector illuminated with a 365 nm light and under dark condition. (b) Time-dependent photocurrent response of the disordered BiOBr film photodetector to 365 nm light (10 mW cm^{-2})

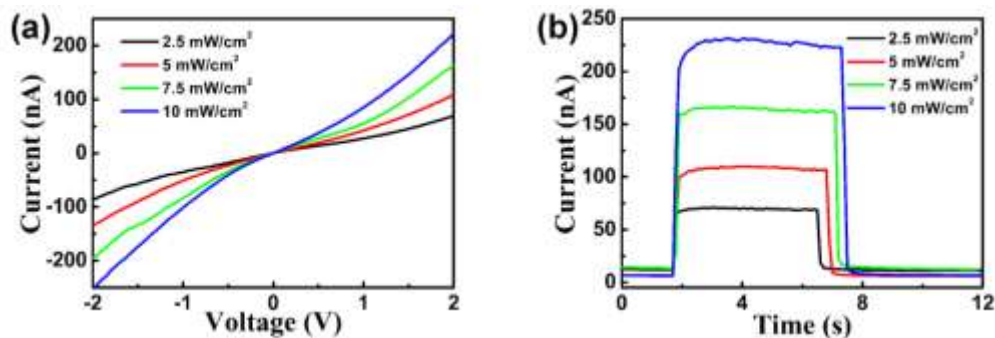


Figure S5. I-V curves and time-dependent photocurrent response of BiOBr photodetector under light irradiation of varying intensity at 365 nm.

Table S2. Comparison of the performance parameters between the present work and other photodetectors.

Photodetectors	Photocurrent to dark current ratio	Rise time	Decay time	Reference
WO ₃	60	> 10 s	> 10 s	1
Zn ₂ GeO ₄	7	0.3 s	0.2 s	2
ZnO/CdSe	< 10	> 5 min	> 1 h	3
TiO ₂ /PANI	< 2	> 5 s	> 5 s	4
ZnO/P3HT	4	> 5 s	> 10 s	5
ZnO/graphene	600	9 ms	11 ms	6
SnO ₂	4	> 20 s	> 20 s	7
BiOBr	1000	0.67 ms	0.8 ms	Present work

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