Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting information

Defect-Induced Photogating Effect and its Modulation in Ultrathin Free-standing Bi_2O_2Se Nanosheets with Visible to Near-Infrared Photoresponse

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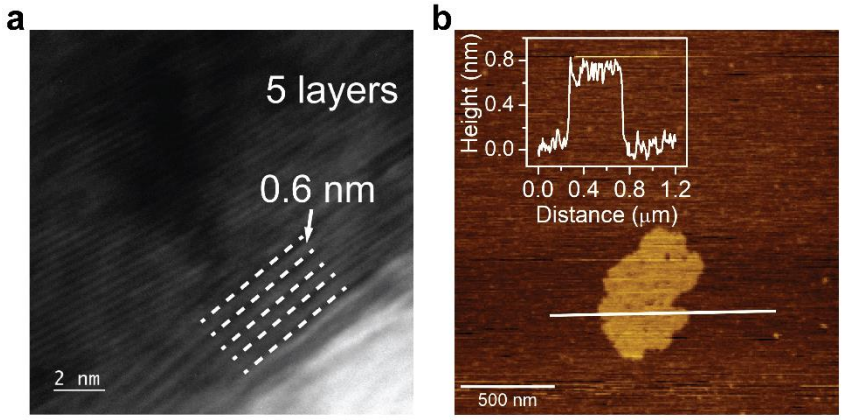

Fig. S1: (a) TEM image showing an edge of Bi_2O_2Se NS containing 5 layers (3 nm thickness). (b) AFM image of a single monolayer Bi_2O_2Se nanosheet. The inset shows the corresponding height profile of the monolayer Bi_2O_2Se.

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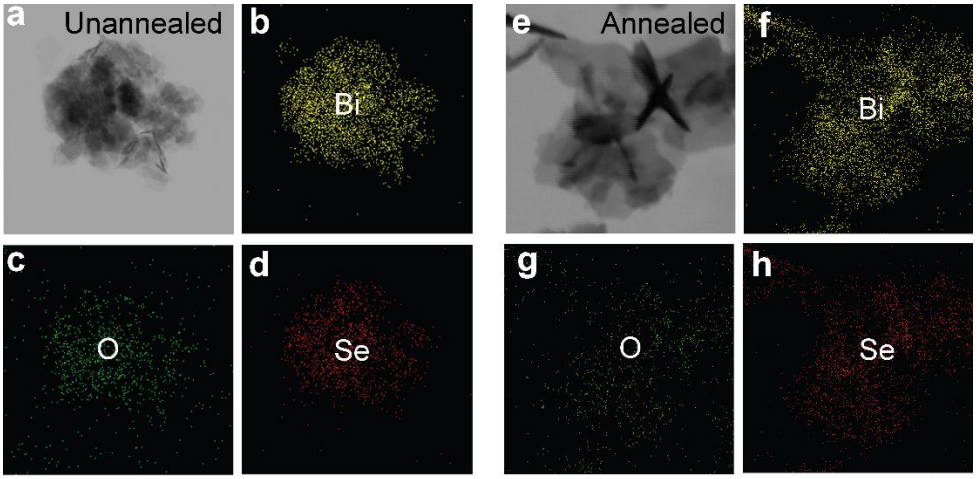

Fig. S2: (a) Bright-field TEM image of unannealed Bi_2O_2Se NS. (b-d) The corresponding STEM elemental mapping of Bi (yellow), O (green), Se (red). (e) TEM image of annealed NS, (f-h) the corresponding Bi, O, Se mapping.

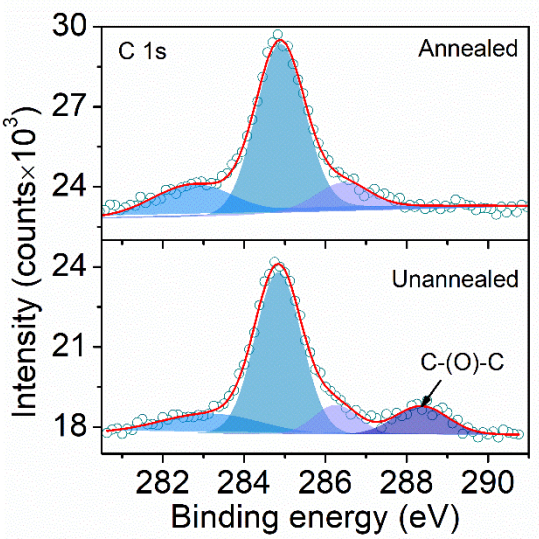

Fig. S3: Comparison of the XPS C 1s spectra of unannealed (lower panel) and annealed (upper panel) Bi_2O_2Se NSs.

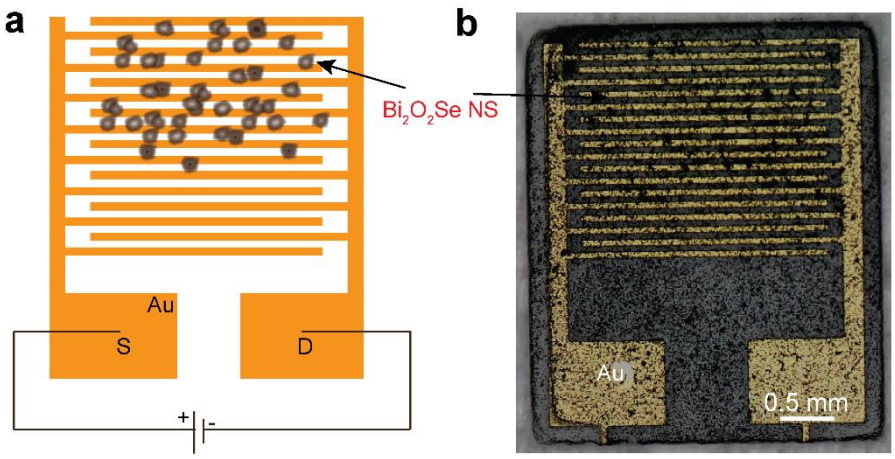

Fig. S4: (a) Schematic of the IDE pattern with Bi_2O_2Se NS (device) used for photoresponse measurement. (b) The corresponding digital photograph of a measured device.

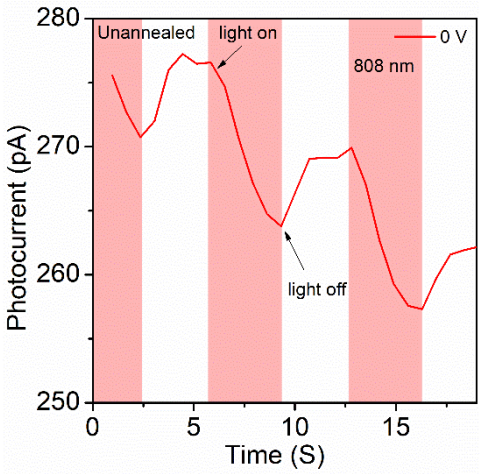

Fig. S5: Photocurrent with pulsed light (as a function of time) at 0V for unannealed Bi_2O_2Se NS showing the self-powered feature.

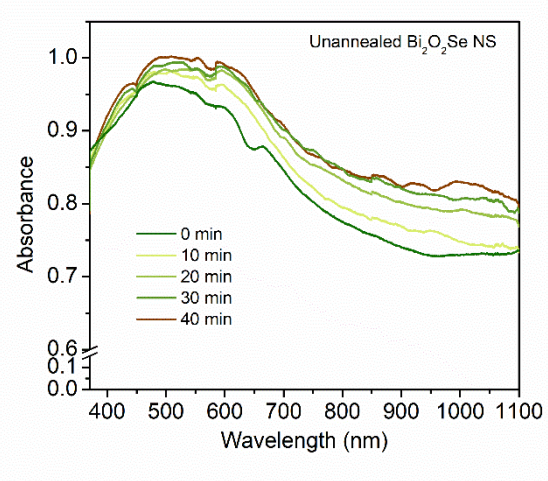

Fig. S6: Absorption spectra of unannealed Bi_2O_2Se NS after different durations of light exposure.

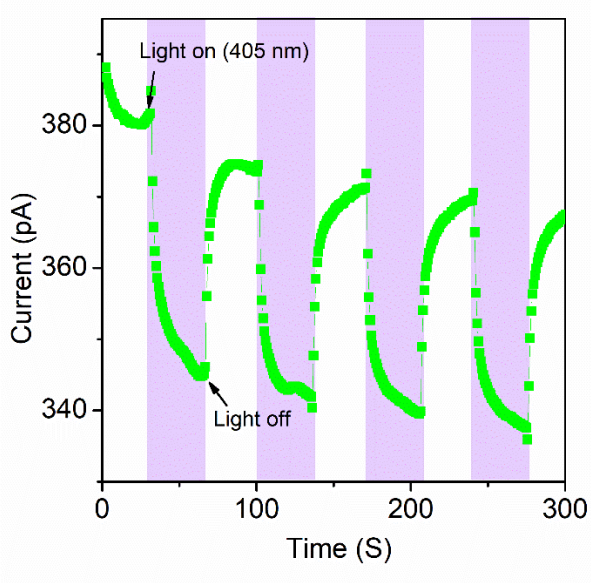

Fig. S7: Photocurrent response as a function of time for 405 nm excitation pulse, showing negative photoconductivity effect.

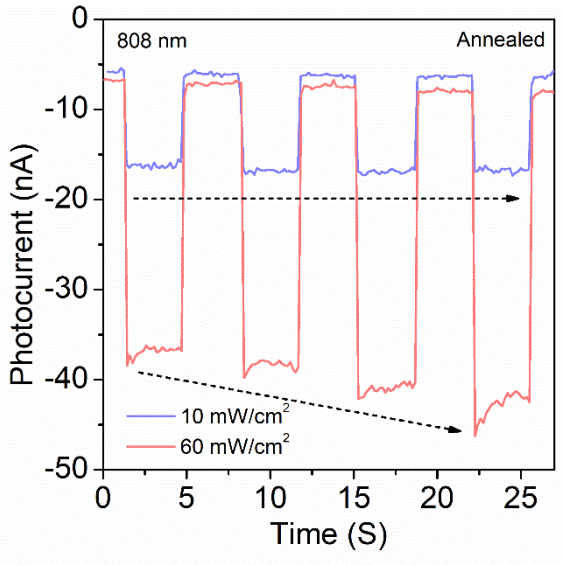

Fig. S8: Photocurrent as a function of time for annealed NS at two different intensities (laser) showing the bolometric effect at higher power.

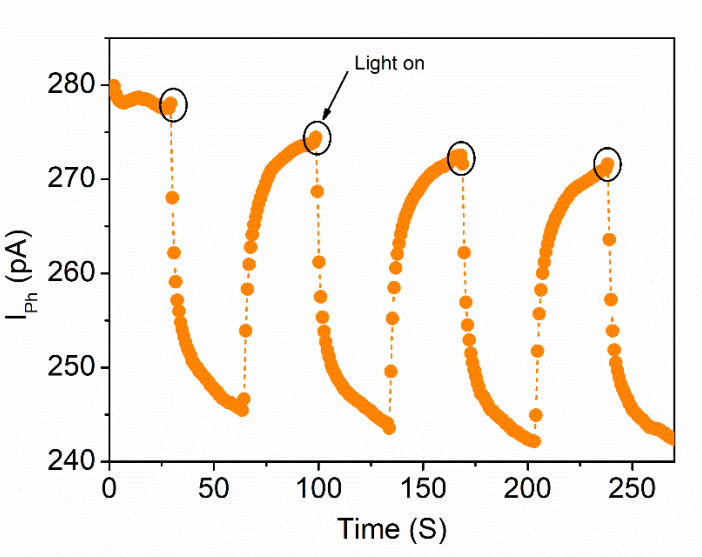

Fig. S9: Pulsed photocurrent under 808 nm excitation showing transition of positive PC (encircled) to negative PC at the time of turning on the light.

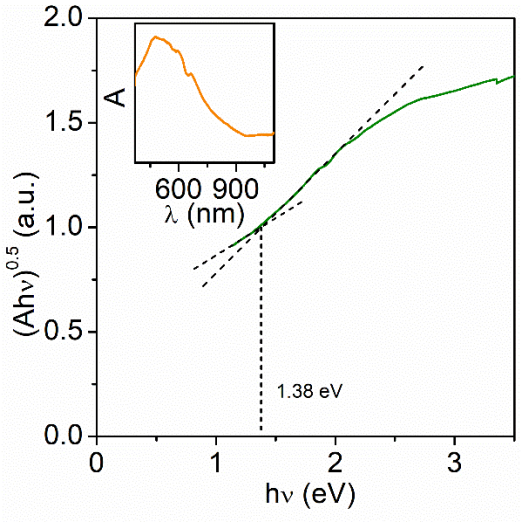

Fig. S10: Tauc plot indicating the band gap of 1.38 eV. The inset shows the corresponding absorption spectrum.

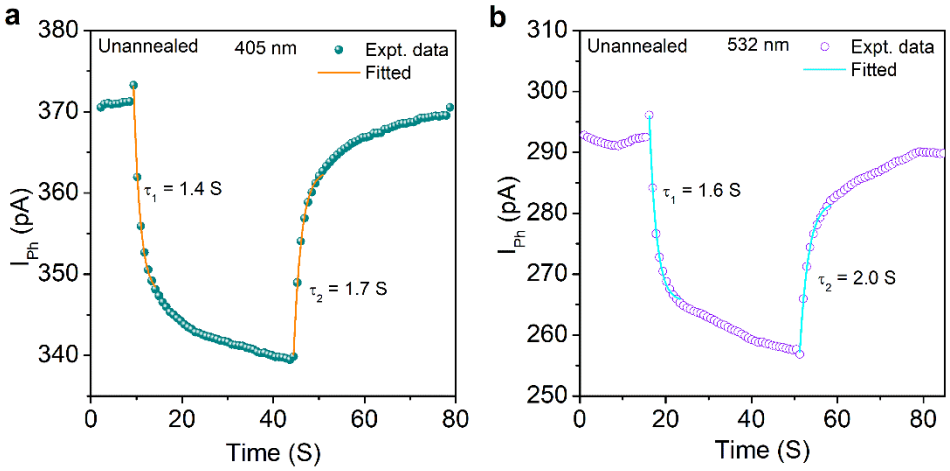

Fig. S11: Photocurrent response time (decay and rise) of unannealed Bi_2O_2Se photodetector under (a) 405 nm, (b) 532 nm pulsed lasers. The solid lines correspond the exponential fittings to initial decay/rise and the symbols are the experimental data.

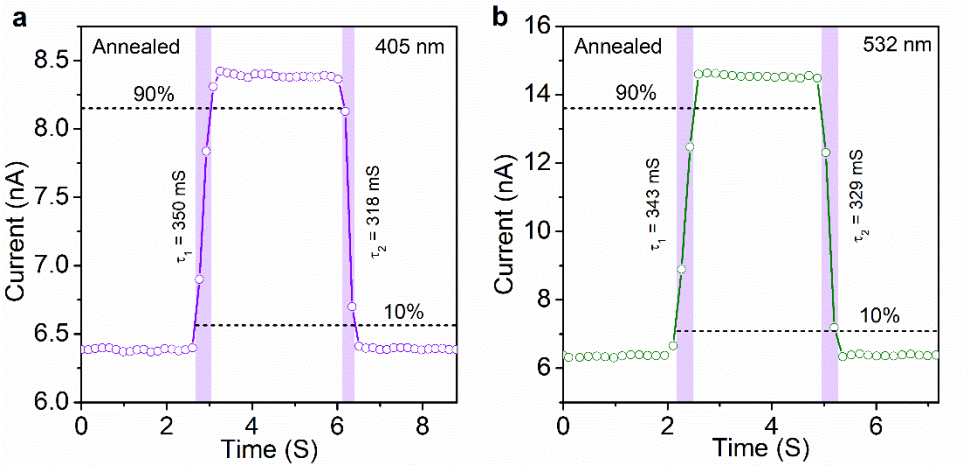

Fig. S12: Photocurrent response time (decay and rise) of annealed Bi_2O_2Se based photodetector under (a) 405 nm, and (b) 532 nm pulsed lasers.

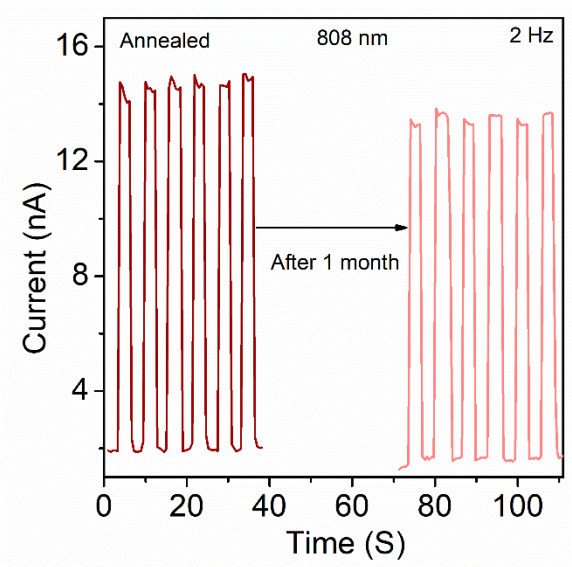

Fig. S13: Comparison of photocurrent response between freshly prepared and one-month old (storage in ambient condition) annealed Bi_2O_2Se photodetector showing good stability.

Table S1: XPS peak positions for different elements in unannealed and annealed NS.

XPS peaks		*Binding energy (eV)*	
		Unannealed NS	*Annealed NS*
Bi 4f	Bi 4f 7/2	158.1	153.2
	Bi 4f 5/2	163.4	163.5
O 1s	O 1s (I)	529.1	529.4
	O 1s (II)	531.0	531.6
	O 1s (III)	532.8	533.6
Se 3d	Se 3d 5/2	52.3	52.6
	Se 3d 3/2	53.1	53.4
C 1s	C 1s	284.8	284.8
	C-(O)-C	288.4	absent