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

Supporting Information

High-performance self-powered photodetector based on SnP_2S_6 in visible light

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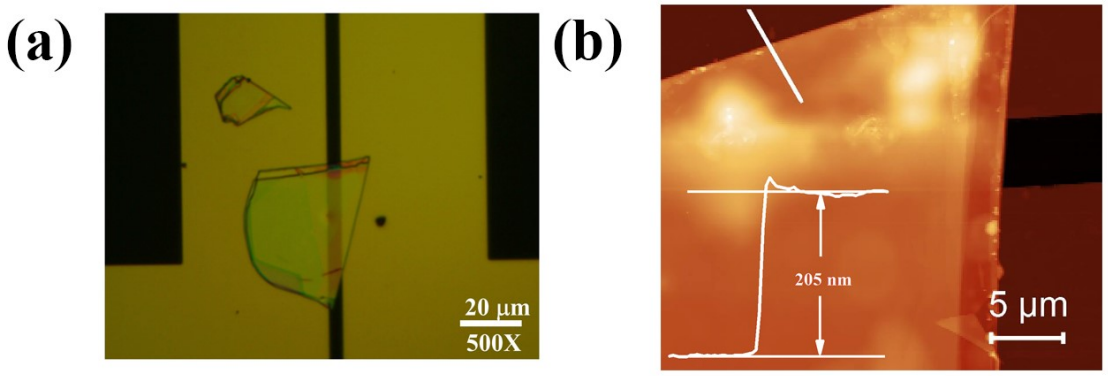

Figure S1 (a) Optical microscope image of the device. (b) AFM thickness characterization of the SnP_2S_6 flake on electrodes.

Table S1. Photodetector Performance based on different van der Waals materials

Material	Thickness [nm]	Wavelength [nm]	Response time [ms]	Responsivity [mA/W]	Detectivity [Jones]	Reference
MoS_2	2.6	white-light	500	1.5×10^5	10^{12}	[1]
$MoSe_2$	0.71	532	60	13	-	[2]
$NiPS_3$	3.5	254	3.2	126	1.22×10^{12}	[3]
$MnPS_3$	40	365	340	2880	-	[4]
$MnPSe_3$	50.1	365	1220	426	3.1×10^9	[5]
$FePS_3$	11	254	105	171.6	-	[6]
SnP_2S_6	70.6	425	20	146.82	8.0×10^{10}	This work

Table S2. Performance of self-powered photodetectors based on different materials

Material	Bias [V]	Wavelength [nm]	Response time [ms]	Responsivity [mA/W]	Detectivity [Jones]	Reference
ZnS	0	297	90/70	2560	1.67×10^{10}	7
α- Ga_2O_3	0	254	451	0.149	3.1×10^{9}	8
β-Ga_2O_3	0	254	80/30	1.28	1.77×10^{11}	9
InGaZnO	0	350	100	5	-	10
SnS	0	390	80	2.04	0.85×10^{9}	11
$AgIn_5Se_8/FePSe_3$	0	880	20	3.8×10^{-3}	5.77×10^{8}	12
CuO/ZnO	0	405	20	1.24×10^{-3}	9.77×10^{6}	13
Ag NPs-Mg2Si/Si	0	808	1.74/0.65	2550	1.51×10^{12}	14
SnP_2S_6	0	515	40	8.81	5.66×10^{9}	This work

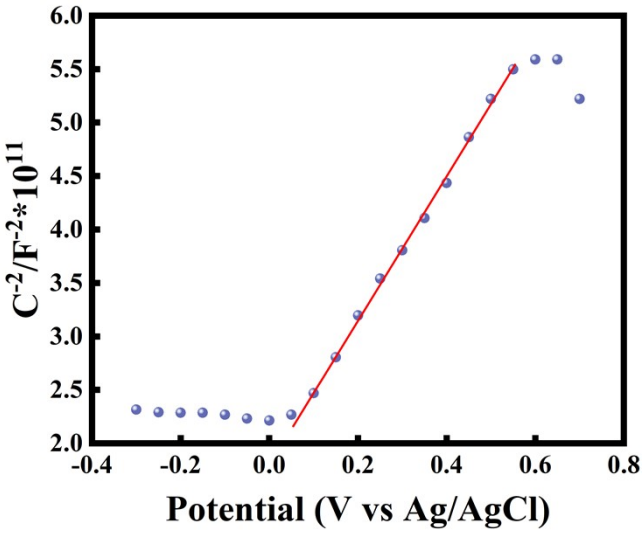

Figure S2 Mott-Schottky plot of SnP_2S_6.

The positive slope of the measured curve shows that SnP_2S_6 is an n-type semiconductor.

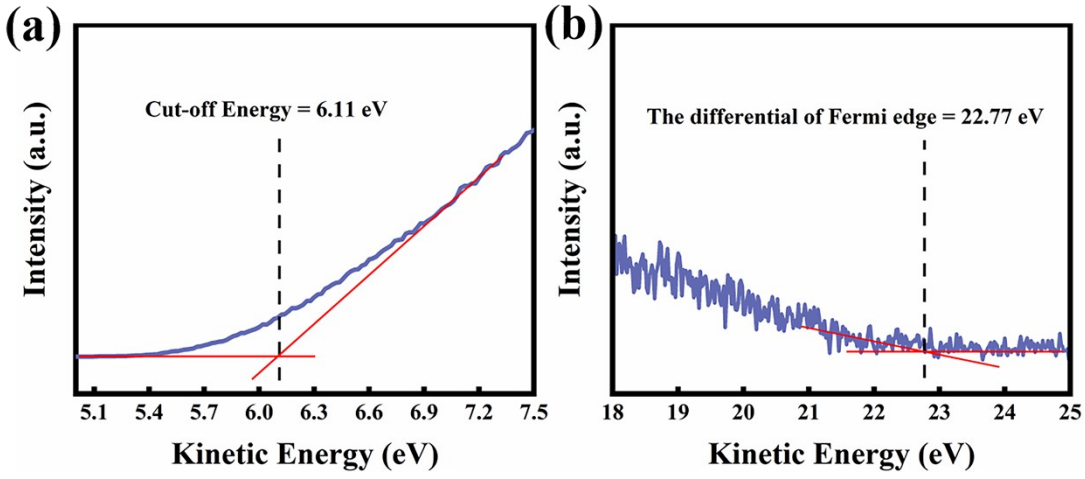

Figure S3 Ultraviolet photoelectron spectroscopy measurement of SnP_2S_6.

According to the following equations:

$$\Phi = h\upsilon + E_{cutoff} - E_{Fermi} \qquad (S1)$$

in which Φ, hυ, E_{Fermi} and E_{cutoff} are the work function, the incident photon energy, the differential of Fermi edge and the intersection of the straight line fitted by the cut-off edge and the baseline, respectively.

We substituted the cutting-off energy E_{cutoff} =6.11 eV, E_{Fermi} =22.77 eV and hυ=21.22 eV into formula S1, thus the work function of SnP_2S_6 could be achieved as -4.56 e V.

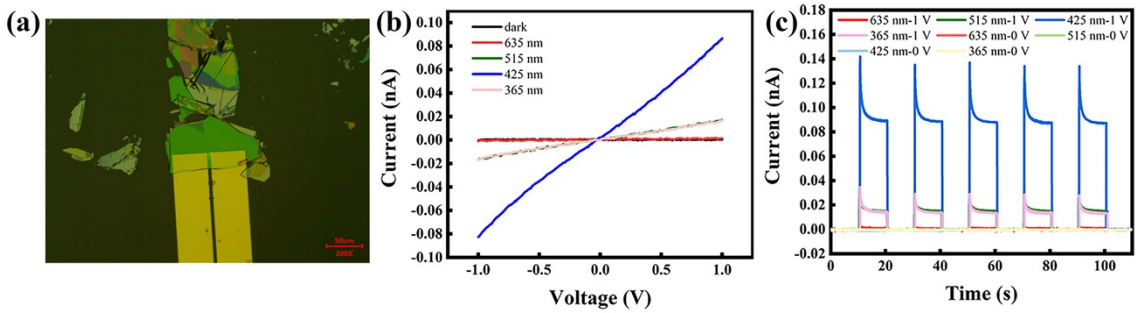

Figure S4 Photoelectric Response of symmetric electrode contact Device. (a) Optical image, (b) I-V and (c) I-t.

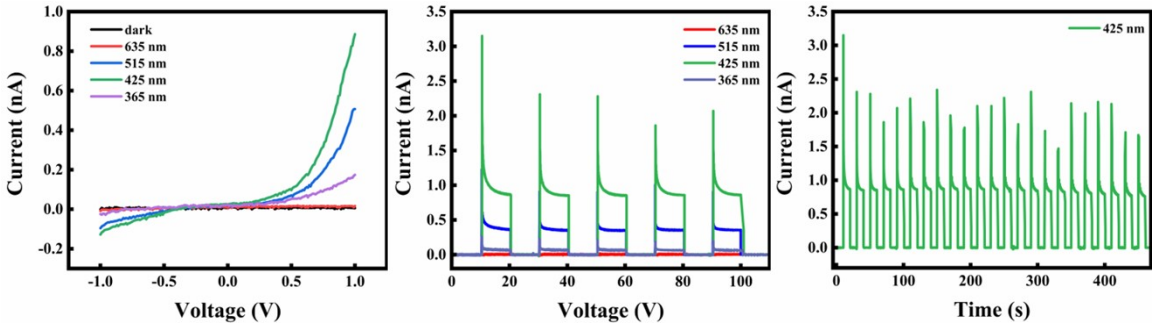

Figure S5 Stability test of the device after being placed in the glove box for 11 months. I-V curves (a) and I-t curves at 1 V (b) for different wavelengths. (c) Cycle stability measurement of the I-t curve at 1 V for 425 nm wavelength.

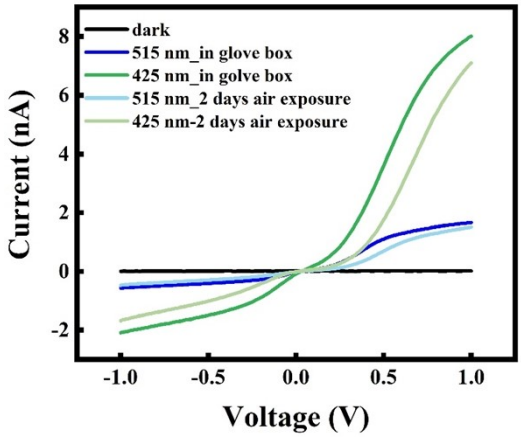

Figure S6 Air stability test of the device after 11 months in the glove box.

We have tested the device performance after exposure in air for two days. The atmospheric environment could lead to obvious decay of the device performance (the photocurrent decreased by 11.4 %) as shown in Figure S6.

References

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