Supporting Information

Self-Powered Photodetector of SnSeS/p-Si Heterojunction with High-performance

Yujuan Pei,[a] Miaoran Kang,[a] Weilong Deng,[a] Qiang Fu,[a] Xiangyu Fan[a], Yu Sui,[a] Jubei Hu,[a] Mengting Liu,[a] Xianjie Wang,[a b d e]* and Bo Song,[a c d e]*

[a] School of Physics, Harbin Institute of Technology, Harbin 150001, China

[b] Heilongjiang Provincial Key Laboratory of Advanced Quantum Functional Materials and Sensor devices, Harbin 150001, China

[c] National Key Laboratory of Science and Technology on Advanced Composites in Special Environments, Harbin Institute of Technology, Harbin 150001, China

[d] Zhengzhou Research Institute, Harbin Institute of Technology, Zhengzhou 450046, China

[e] Frontiers Science Center for Matter Behave in Space Environment, Harbin Institute of Technology, Harbin 150001, China

***Email Correspondence:** songbo@hit.edu.cn and wangxianjie@hit.edu.cn

KEYWORDS: Photodetector; Lateral photovoltaic effect; 2D transition metal dichalcogenides; Heterojunction; Ultrafast relaxation; Position-sensitive detectors

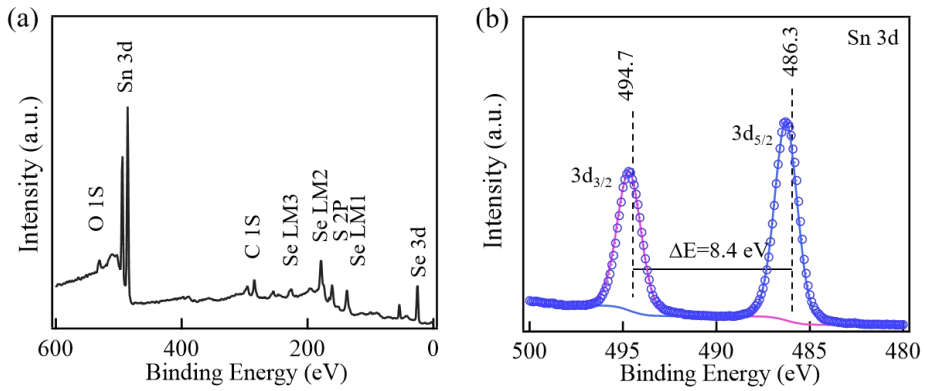

Figure S1. XPS spectra of SnSeS/p-Si heterojunction (a) full scan spectrum (b) Sn^{4+} 3d

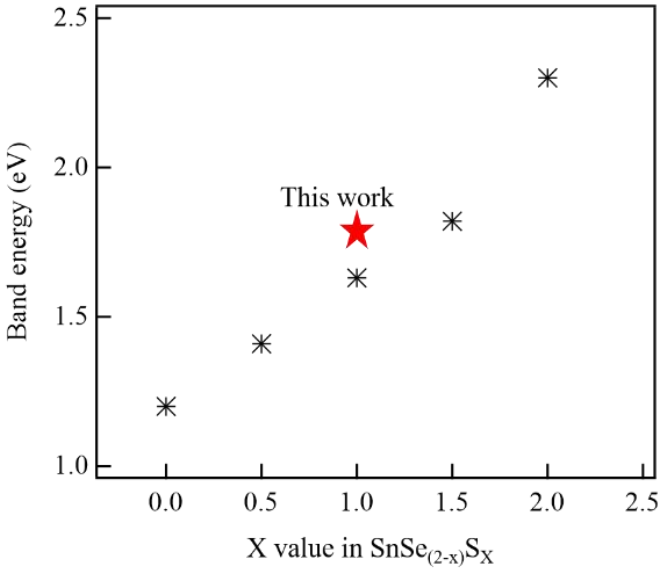

Figure S2. Bandgap of Sn $SnSe_{(2-x)}S_x$ with different rate of S/Se.

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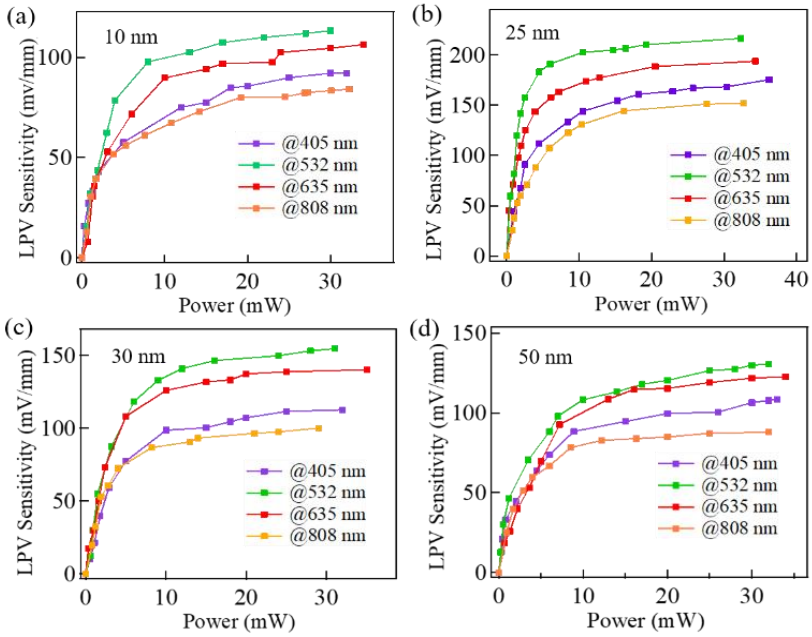

Figure S3. LPV sensitivity versus laser power and wavelength of different thickness film. (a) 10 nm. (b) 25 nm. (c) 30 nm. (d) 50 nm.

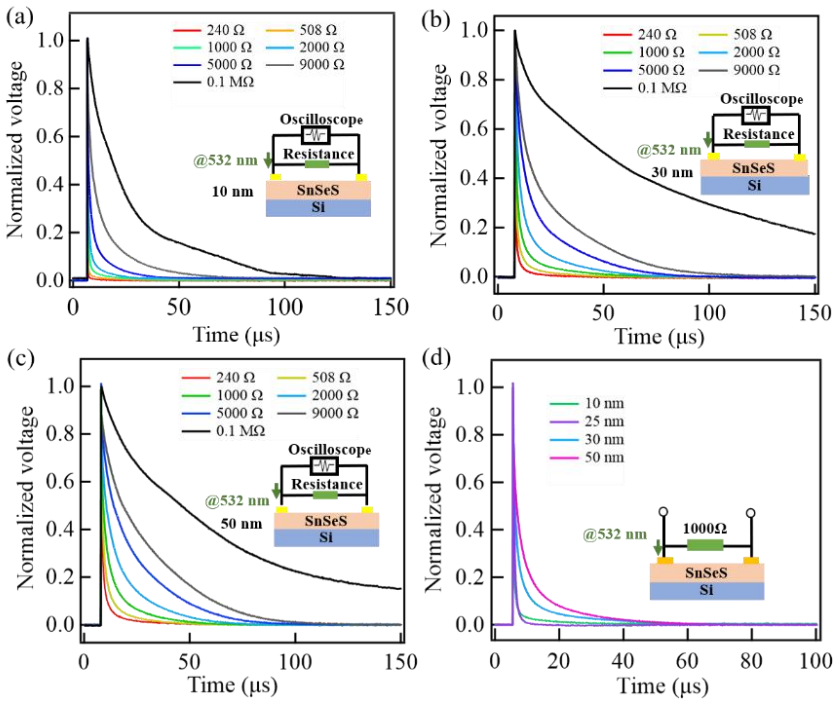

Figure S4. LPV as a function of time for SnSeS/Si heterojunction (a) 10 nm. (b) 30 nm. (c) 50 nm. VPE as a function of time for SnSeS/Si (d) 25 nm.

Figure S4 a-c show the real LPV as a function of time in different thickness of SnSeS film (10, 30 and 50 nm). The heterojunction formed by the different film

thicknesses films and Si showed clear photoelectric response under the irradiation of 532 nm nanosecond laser beam. **Figure S4 d** the LPV curves of thin films with different thicknesses in parallel with 1000 Ω resistor. The relaxation time of 10 nm and 25 nm SnSeS film is similar, which is 1.06 μs and 1.12 μs, respectively.

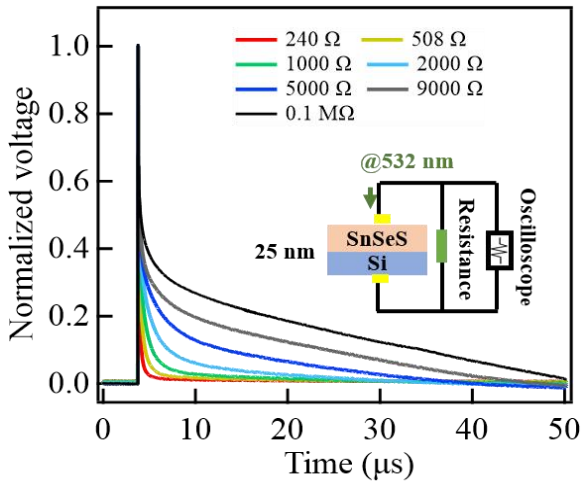

Figure S5. VPV as a function of time for SnSeS (25 nm)/Si heterojunction.

Table S1 Performance comparison of photodetectors based on the SnSeS and other 2D materials.

Device	Wavelength / nm	Rise time/μs	Decay time/μs	Ref
MoS_2	550	5×10^4	5×10^4	1
MoS_2/Si	532-980	16.7	23.5	2
WS_2/Si	340-1100	670	998	3
$MoSe_2$/Si	355-830	4.38×10^4	4.34×10^4	4
SnS_2	<600	-	1.5×10^5	5
SnS_2/PbS	400-1000	-	1.6×10^5	6
$SnSe_2$	456-850	1.45×10^4	8.1×10^3	7
SnSeS/Si	450-808	11	20	This work

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