Supplementary Information (SI) for Nanoscale.


# Supplementary Data

## Photothermoelectric effect driven self-powered broadband photodetection in 1T'-$MoTe_2$ with asymmetric electrodes

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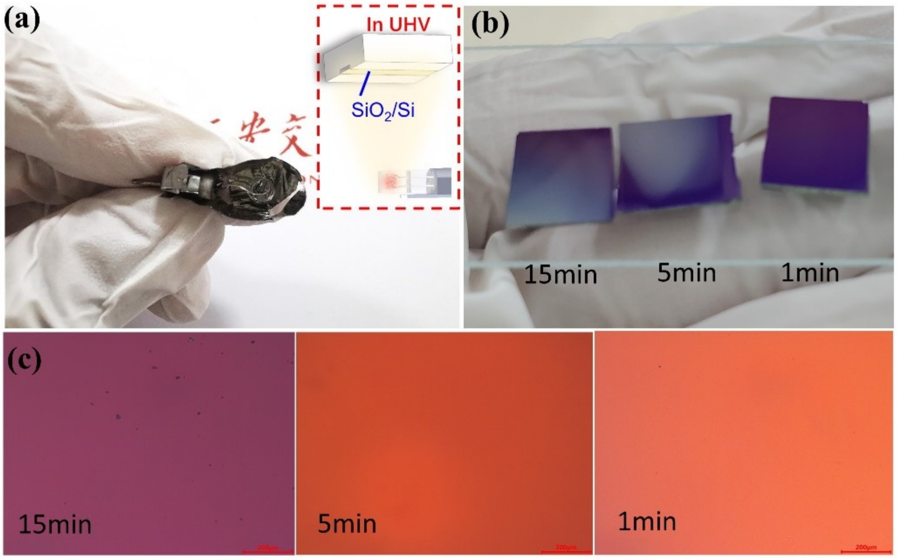


Fig. S1. Fabrication of Mo thin films using a home-built mini Mo evaporator. (a) Photograph of the homemade miniature Mo evaporator. (b) Photographs of Mo thin films deposited at different evaporation time. (c) Optical microscopy images of Mo thin films deposited at different evaporation time.

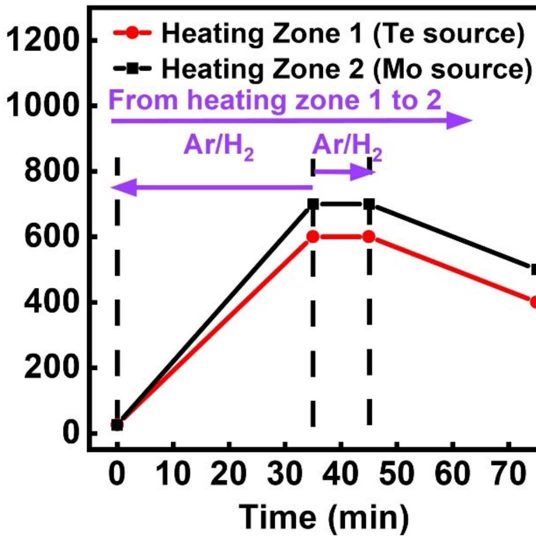


Fig. S2. Temperature-dependent curve of two-dimensional 1T'-$MoTe_2$ via chemical vapor deposition.

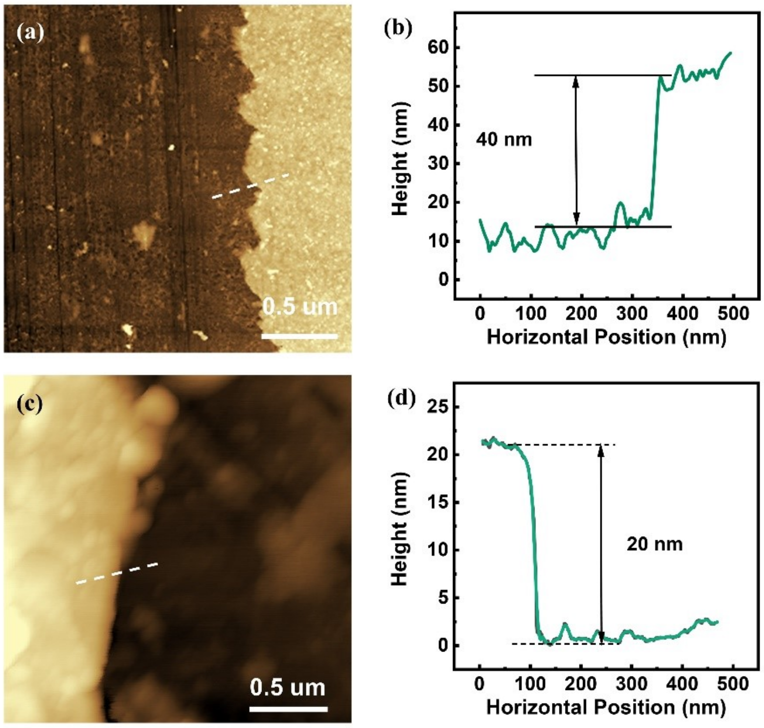


Fig. S3. AFM image of (a-b) 20 nm-thick 1T'-$MoTe_2$; (c-d) 40 nm-thick 1T'-$MoTe_2$.

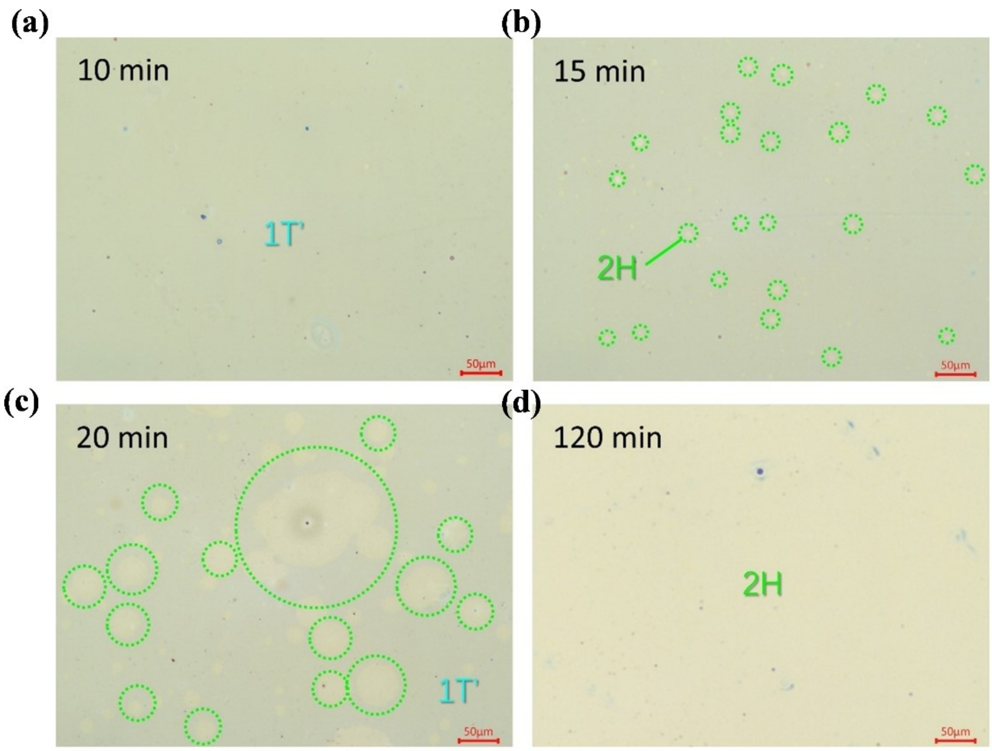


Fig. S4. Optical microscopy images of $MoTe_2$ films grown under different tellurization time: (a)10 min, (b)15 min, (c)30 min, and (d)120 min.

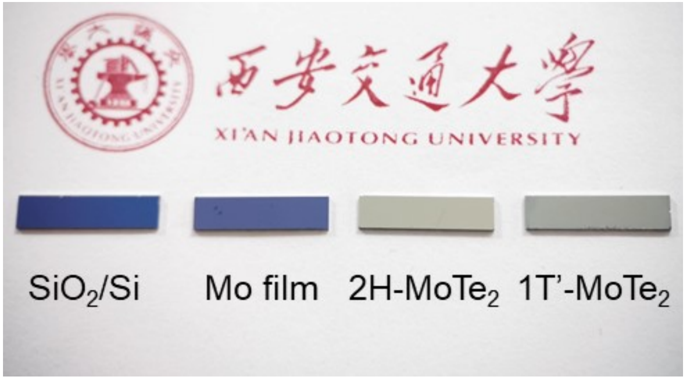


Fig. S5. Photographs of large-area 1T'- $MoTe_2$ and 2H-$MoTe_2$ samples.

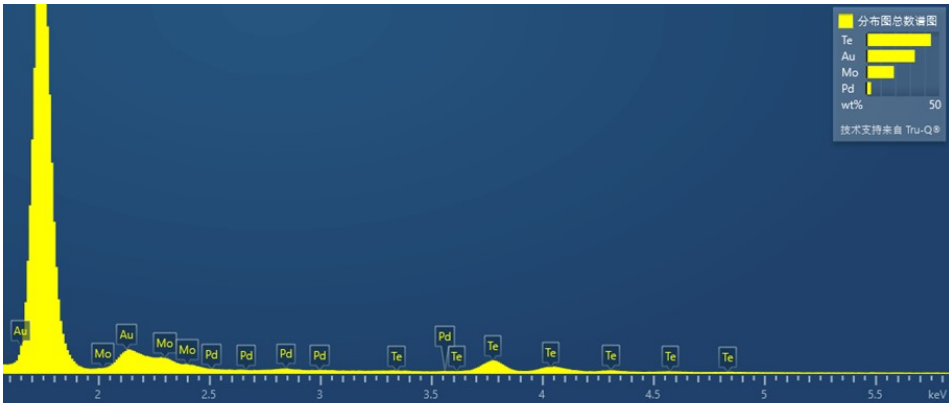


Fig. S6. EDS overall spectrum of Au/1T'-$MoTe_2$/Pd device.

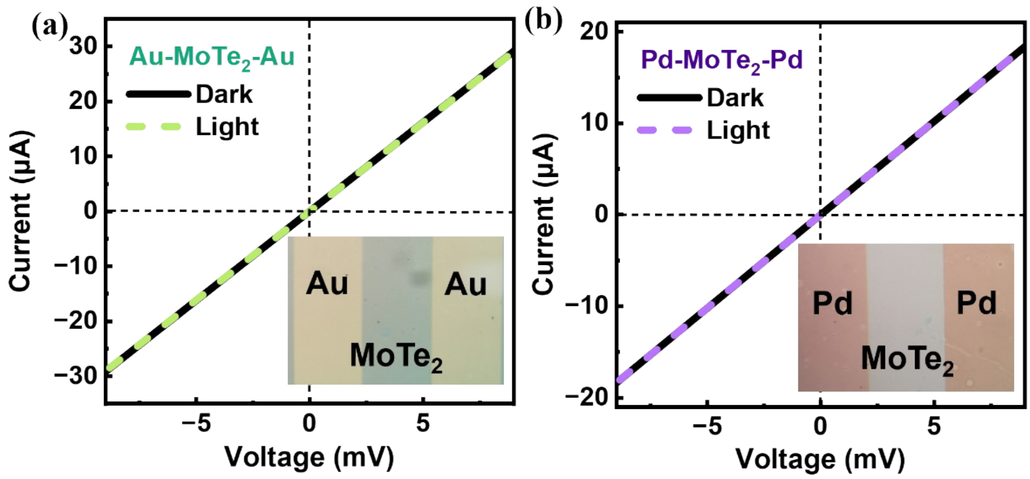


Fig. S7. The I–V curve of the device with symmetrical electrodes. (a) I–V curves of Au/1T'-$MoTe_2$/Au device under dark and illuminated conditions. Inset: optical image of Pd/1T'-$MoTe_2$/Pd device on $SiO_2$/Si substrate. Scale bar, 50 μm. (b) I–V curves of Pd/1T'-$MoTe_2$/Pd device under dark and illuminated conditions. Inset: optical image of Pd/1T'-$MoTe_2$/Pd device. Scale bar, 50 μm.

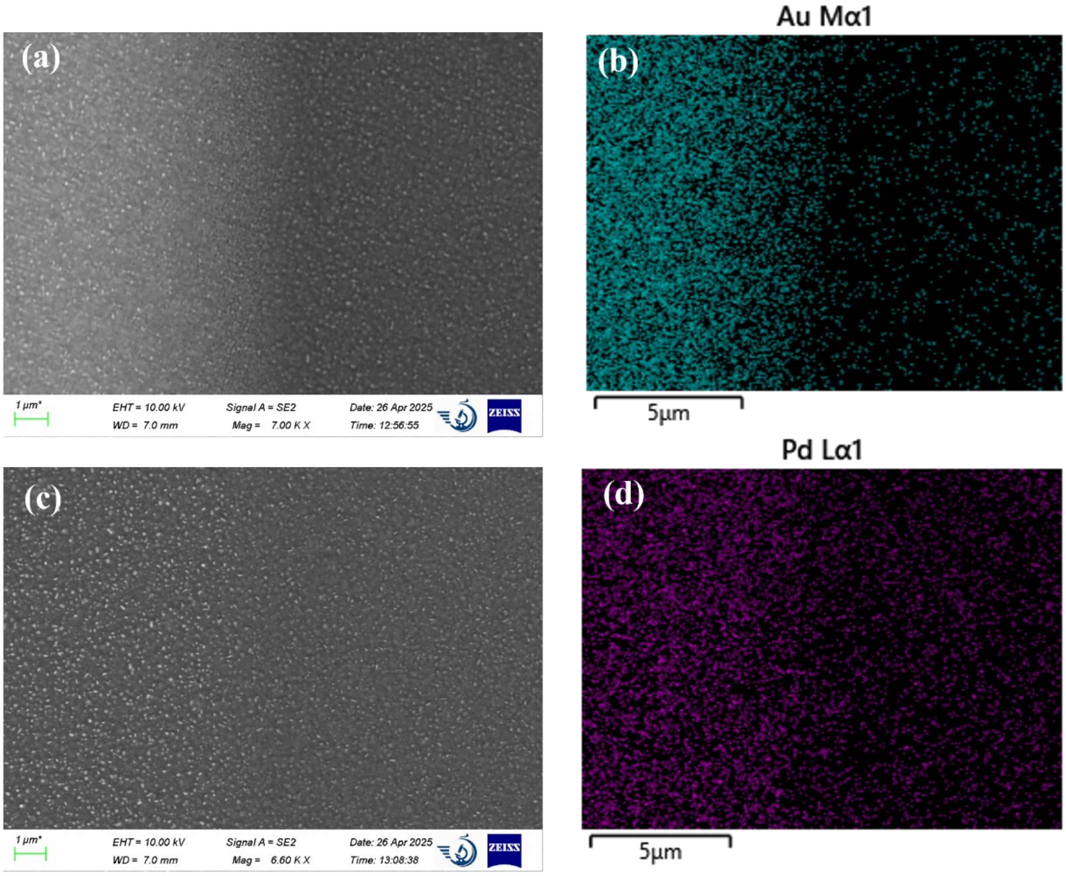


Fig. S8. Elemental gradient SEM mapping at the interfaces between Au/Pd electrodes and $MoTe_2$.

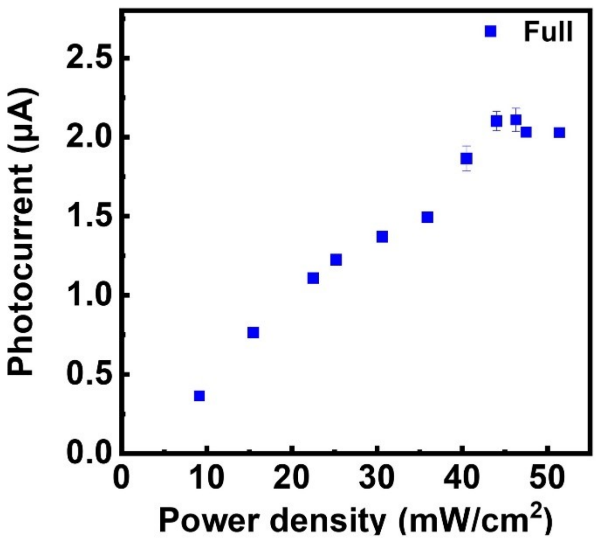


Fig. S9. Photocurrent as a function of optical power intensity under the illumination of full-spectra at $V_{bias}$=0 V.

## Note 1: Discussion of NEP and D*

The noise equivalent power (NEP) is also a key parameter for the sensitivity of photodetectors, as it determines the minimum signal that the detector can perceive. To accurately evaluate its performance, the noise power spectral density of the device is obtained through dark current measurement, and the corresponding NEP can be calculated as follows:[1, 2]

$$NEP = \frac{i_{noise}}{R \cdot \sqrt{B}} = \frac{\sqrt{S_i \cdot B}}{R \cdot \sqrt{B}} = \frac{\sqrt{S_i}}{R} \tag{1}$$

where R is responsivity, $i_{noise}$ is the noise current, $S_i$ is the noise current density, and B is bandwidth. The final NEP of the device is calculated to be $3.73\times10^{-12}$, $1.53\times10^{-12}$, and $1.48\times10^{-12}$ W/Hz$^{-1/2}$ for UV, IR and VS illumination, indicating that the device possesses the ability to detect weak illumination.

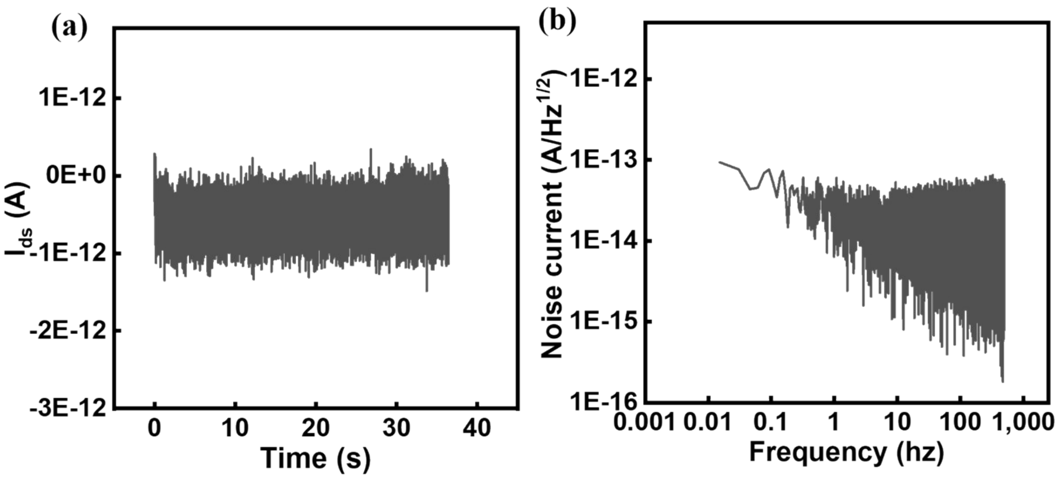


Fig. S10. (a) Dark current of the 1T'- $MoTe_2$ device at zero bias. (b) Noise spectral density of the 1T'- $MoTe_2$ device at zero bias.

Based on the obtained NEP, we further evaluated the D* according to the formula:

$$D^* = \frac{\sqrt{S\Delta f}}{NEP} = \frac{R\sqrt{S\Delta f}}{RMS(i_n)} \tag{2}$$

Where NEP is the noise equivalent power, RMS ($i_n$) is the root mean square of the total noise current, and $\Delta$f is the bandwidth of the measurement. The D* of our device achieved were $3.73 \times 10^8$, $1.53 \times 10^8$, and $1.48 \times 10^8$ Jones for UV, Vis, IR illumination, respectively.

Ref:


1. J. Liu, Q. Hao, H. Gan, P. Li, B. Li, Y. Tu, J. Zhu, D. Qi, Y. Chai, W. Zhang and F. Liu, *Laser Photonics Rev.*, 2022, **16**, 2200338.

2. F. Wang, T. Zhang, R. Xie, Z. Wang and W. Hu, *Nat. Commun.*, 2023, **14**, 2224.

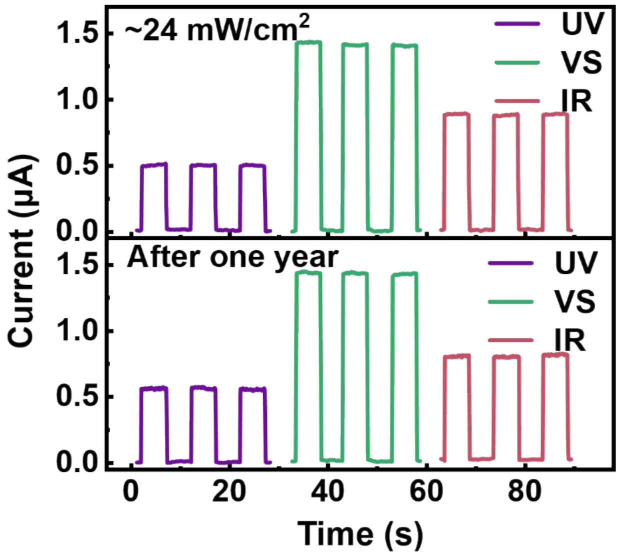


Fig. S11. I−t curves of the 1T'-$MoTe_2$ devices. Upper panel: fresh device; Lower Panel: after 1 year.

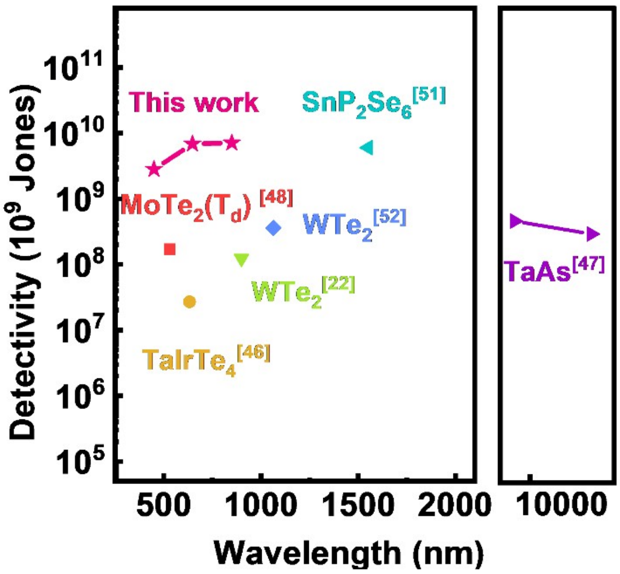


Fig. S12. The specific detectivity of the detector as a function of power intensity under light with different spectral bands.