

Supporting Information for

**High-performance broadband heterojunction photodetectors based on  
multilayered PtSe<sub>2</sub> directly grown on Si substrate**

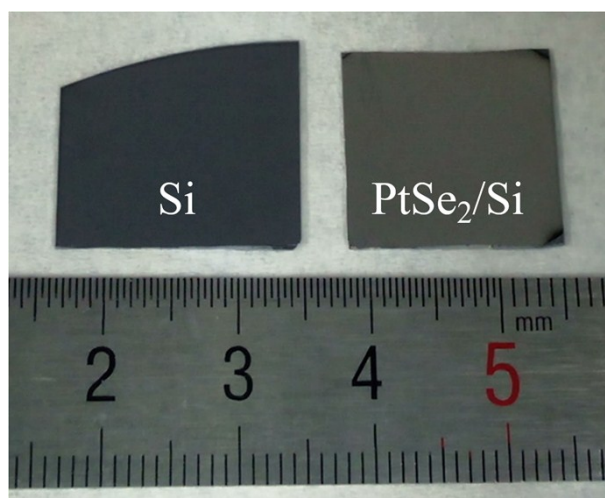
*Chao Xie,<sup>a,c</sup> Longhui Zeng,<sup>b</sup> Zhixiang Zhang,<sup>a</sup> Yuen-Hong Tsang,<sup>b</sup> Linbao Luo<sup>a</sup> and Jung-Ho Lee<sup>\*c</sup>*

<sup>a</sup> School of Electronic Science and Applied Physics and Anhui Provincial Key Laboratory of Advanced Functional Materials and Devices, Hefei University of Technology, Hefei, Anhui 230009, China

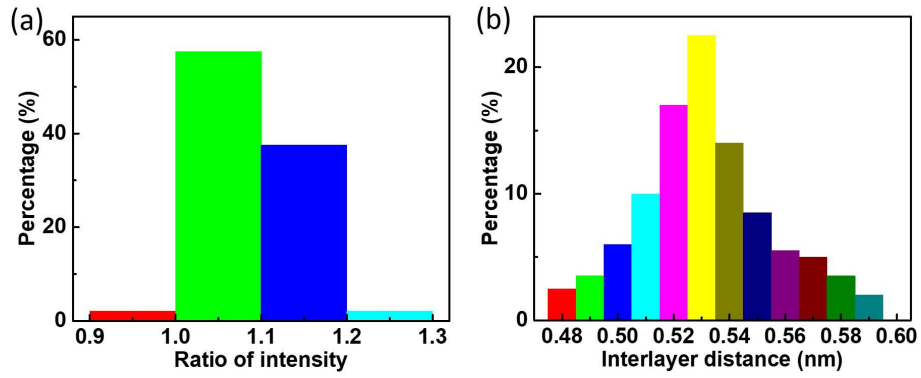
<sup>b</sup> Department of Applied Physics, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China

<sup>c</sup> Departments of Materials Science and Chemical Engineering, Hanyang University, 55 Hanyangdaehak-ro, Sangnok-gu, Ansan, Gyeonggi-do 15588, Republic of Korea

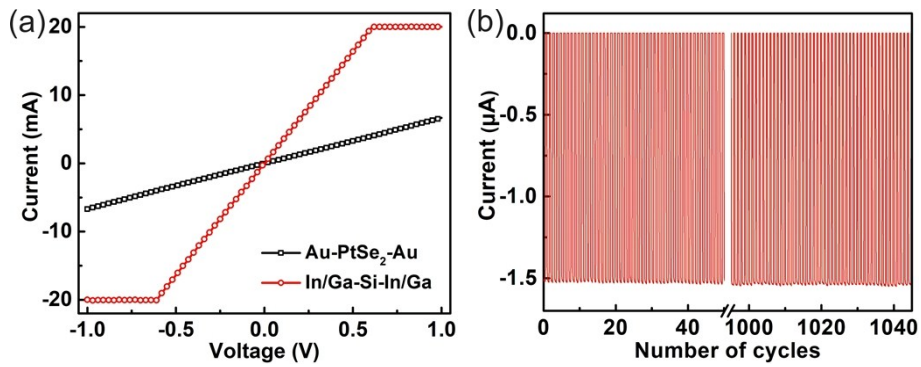
\* Email: [jungho@hanyang.ac.kr](mailto:jungho@hanyang.ac.kr)



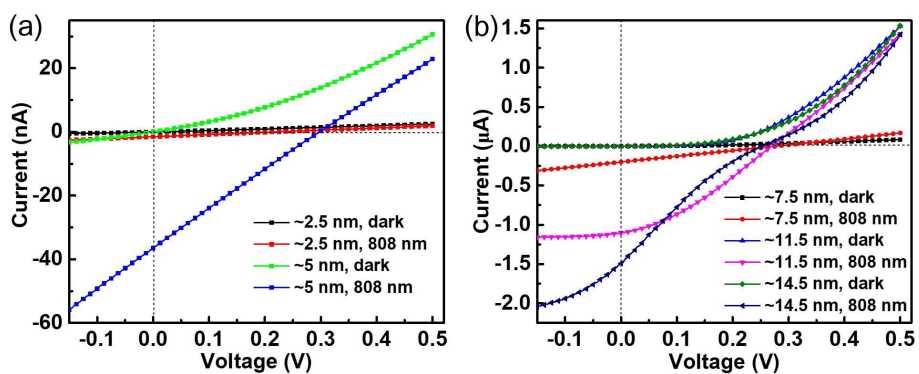
**Figure S1.** Photographs of bare Si and PtSe<sub>2</sub>/Si substrates.



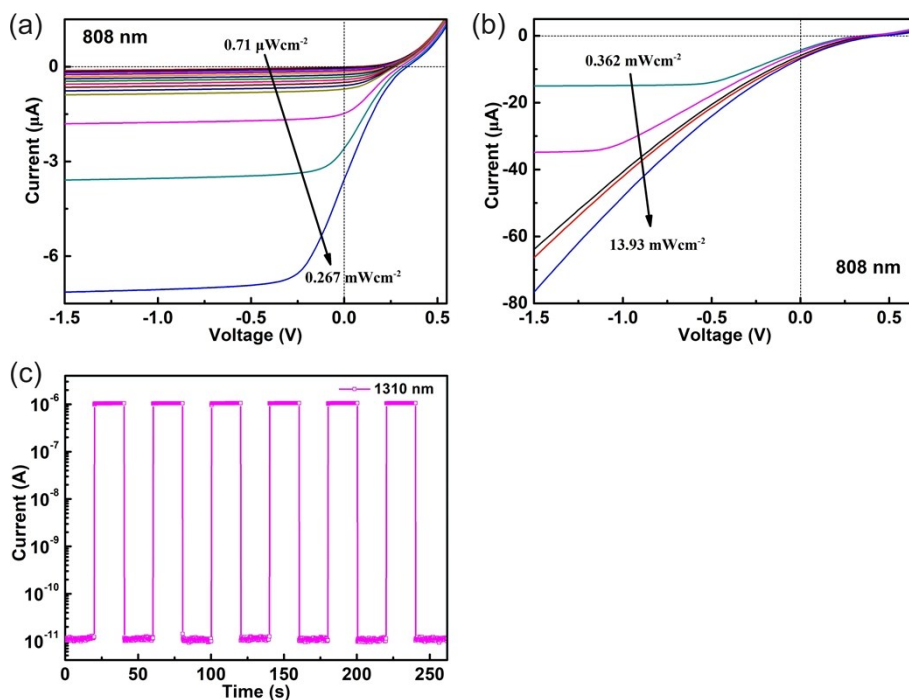
**Figure S2.** (a) The statistical distribution of the ratio of the intensity of the two distinct peaks extracted from Raman spectra of PtSe<sub>2</sub> sample. (b) The statistical distribution of interlayer spacing of crystalline domains with (001) plane of PtSe<sub>2</sub> films.



**Figure S3.** (a)  $I$ - $V$  characteristics of Au-PtSe<sub>2</sub>-Au and In/Ga-Si-In/Si heterostructures, indicating good Ohmic contact between Au and PtSe<sub>2</sub> and In/Ga and Si, respectively. (b) Time-dependent photoresponse of PtSe<sub>2</sub>/Si heterojunction photodetector during operation for over a thousand cycles.



**Figure S4.** *I-V* curves of PtSe<sub>2</sub>/Si heterojunction photodetectors with PtSe<sub>2</sub> thicknesses of (a) ~2.5 nm, ~5 nm, (b) ~7.5 nm, 10.5 nm and 14.5 nm, in dark and under 808-nm NIR illumination (87.6 μWcm<sup>-2</sup>), respectively.



**Figure S5.** (a) *I-V* curves of heterojunction device under 808-nm illumination with light intensities of (a) 0.71 μWcm<sup>-2</sup>-0.267 mWcm<sup>-2</sup> and (b) 0.362 mWcm<sup>-2</sup>-13.93 mWcm<sup>-2</sup>. (c) Time-dependent photoresponse of device under 1310-nm illumination (intensity: 5.50 mWcm<sup>-2</sup>).