

Title	Wide spectral photoresponse of layered platinum diselenide-based photodiodes
Authors	Yim, Chanyoung;McEvoy, Niall;Riazimehr, Sarah;Schneider, Daniel S.;Gity, Farzan;Monaghan, Scott;Hurley, Paul K.;Lemme, Max C.;Duesberg, Georg S.
Publication date	2018
Original Citation	Yim, C., McEvoy, N., Riazimehr, S., Schneider, D. S., Gity, F., Monaghan, S., Hurley, P. K., Lemme, M. C. and Duesberg, G. S. (2018) 'Wide spectral photoresponse of layered platinum diselenide-based photodiodes', Nano Letters, 18(3), pp. 1794-1800. doi: 10.1021/acs.nanolett.7b05000
Type of publication	Article (peer-reviewed)
Link to publisher's version	https://pubs.acs.org/doi/10.1021/acs.nanolett.7b05000 - 10.1021/acs.nanolett.7b05000
Rights	© 2018, American Chemical Society. This is an open access article published under an ACS AuthorChoice License, which permits copying and redistribution of the article or any adaptations for non-commercial purposes - https://pubs.acs.org/page/policy/authorchoice_termsofuse.html
Download date	2024-05-05 13:14:21
Item downloaded from	https://hdl.handle.net/10468/6874



UCC

University College Cork, Ireland
 Coláiste na hOllscoile Corcaigh

Supporting Information

Wide spectral photoresponse of layered platinum diselenide based photodiodes

Chanyoung Yim,^{1,2} Niall McEvoy,^{3,4} Sarah Riazimehr,^{1,5} Daniel Schneider,¹ Farzan Gity⁶, Scott Monaghan⁶, Paul Hurley^{6,7}, Max C. Lemme,^{1,5,8*} and Georg S. Duesberg^{2,3,4,*}

¹Department of Electrical Engineering and Computer Science, University of Siegen, Hölderlinstraße 3, 57076 Siegen, Germany

²Institute of Physics, EIT 2, Faculty of Electrical Engineering and Information Technology, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany

³School of Chemistry, Trinity College Dublin, Dublin 2, Ireland

⁴Centre for the Research on Adaptive Nanostructures and Nanodevices (CRANN) and Advanced Materials and BioEngineering Research (AMBER), Trinity College Dublin, Dublin 2, Ireland

⁵Chair for Electronic Devices, Faculty of Electrical Engineering and Information Technology, RWTH Aachen University, Otto-Blumenthal-Str. 2, 52074 Aachen, Germany

⁶Tyndall National Institute, University College Cork, Lee Maltings, Dyke Parade, Cork, T12 R5CP Ireland

⁷Department of Chemistry, University College Cork, Lee Maltings, Dyke Parade, Cork, T12 R5CP Ireland

⁸AMO GmbH, Advanced Microelectronic Center Aachen, Otto-Blumenthal-Str. 25, 52074 Aachen, Germany

*Corresponding author: lemme@amo.de, duesberg@unibw.de

Hall-effect Measurements

Hall-effect measurements were performed in a van der Pauw configuration at room temperature.

The measured Hall voltage, V_H , is defined by the following equation

$$V_H = I \times B \times R_{H\text{-sheet}}$$

where I is the applied excitation current, B is the applied DC or AC magnetic field, $R_{H\text{-sheet}}$ is the extracted sheet Hall coefficient. It can also be expressed as

$$V_H = (I \times B \times h_f) / (n_s \times e) = I \times B \times \mu_H \times \rho_s$$

where n_s is the extracted sheet carrier concentration, h_f is the applied Hall factor (equal to unity for this work), μ_H is the extracted Hall mobility, ρ_s is the measured sheet resistivity by 4-point measurement.

ρ_s can be extracted using the following equation

$$\rho_s = (\pi \times F_{AB} \times (R_A + R_B) / (2 \times \ln(2)))$$

where F_{AB} is the solution to the van der Pauw equation, R_A and R_B are the measured 4-point orthogonal resistances. F_{AB} is proportional to the ratio of the perpendicular 4-point orthogonal resistances between the equivalent geometrical contacts (i.e., R_A and R_B).

The 2-point linear I-V measurement of the PtSe₂ sample with starting Pt thickness of 1 nm is shown in Figure S1 indicating good ohmic contacts. Note that for all resistance and Hall measurements of the sample, the 2-point ohmic correlation factor is accurate to at least 0.99995, and the solution to the 4-point van der Pauw equation gives an F_{AB} accurate to 0.99. A photograph of the sample mounted on the Hall measurement card is shown in the inset of Figure

S1. The sample has almost square area of $\sim 0.95 \times 1 \text{ cm}^2$. The electrical properties of the PtSe₂ film at room temperature are summarized in Table S1.

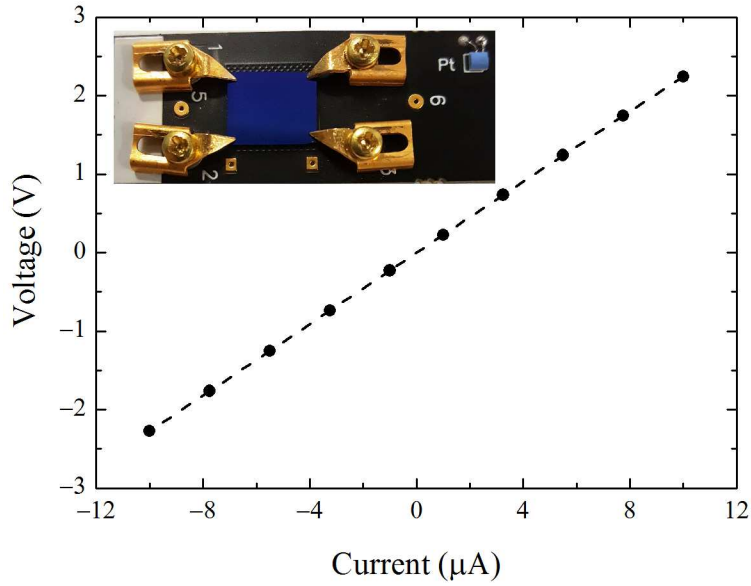


Figure S1. 2-point I-V measurement output as an illustration of the linear behavior of the sample. Van der Pauw configuration illustrating the sample mounted on the Hall measurement card is shown in the inset.

Table S1. Summary electrical characteristics of the PtSe₂ film obtained by Hall measurements at room temperature.

Number of PtSe ₂ layers	5 – 6
% of measurement accuracy	100%
Carrier type	p-type
Mobility (cm ² V ⁻¹ s)	3.5
Carrier concentration (cm ⁻³)	1.89×10^{20}
Resistivity (Ωcm)	9.53×10^{-3}

Photoresponse Measurements

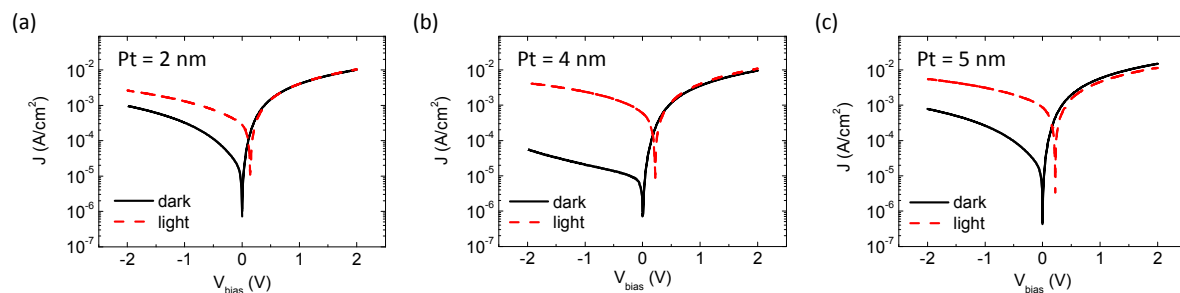


Figure S2. Plots of $J - V$ data measured in the dark and under illuminated conditions for the PtSe₂/n-Si SBDs with PtSe₂ films synthesized from (a) 2, (b) 4 and (c) 5 nm thick initial Pt layers.

Spectral Response Measurements

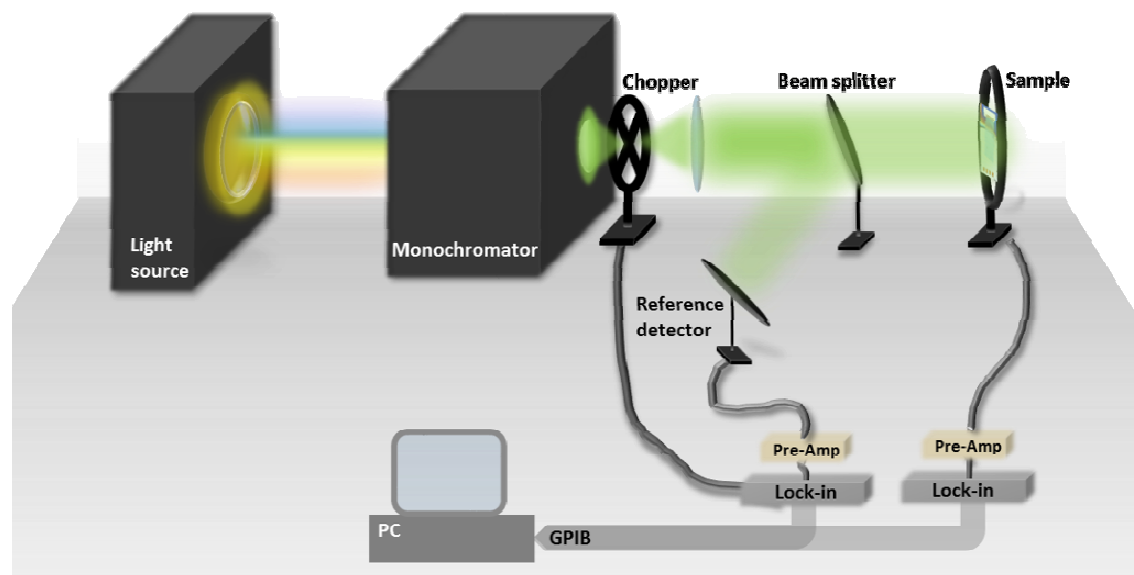


Figure S3. Schematic diagram of the spectral response measurement system.

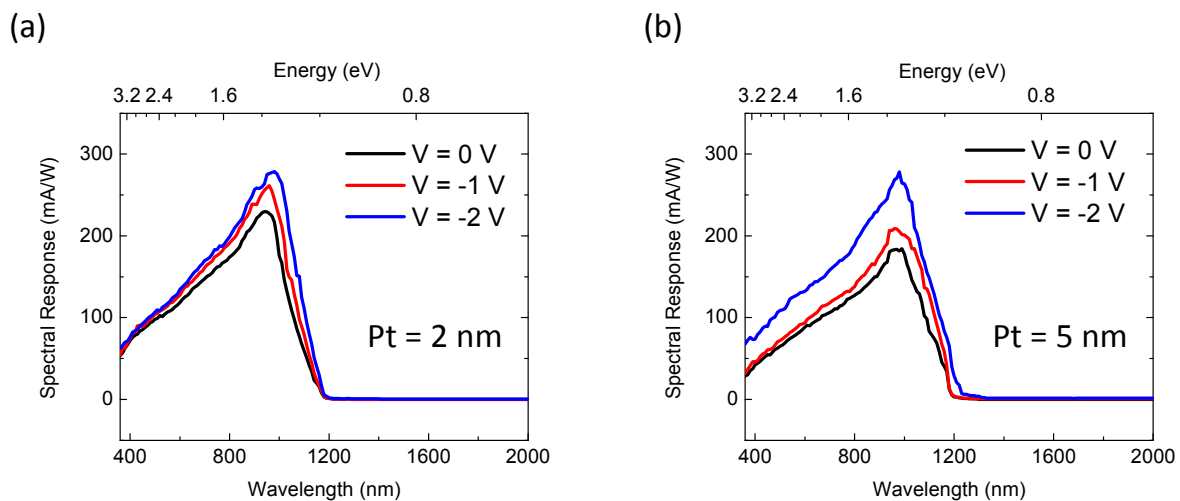


Figure S4. Absolute SR plots of the PtSe₂/n-Si SBDs with PtSe₂ films grown from (a) 2 nm and (b) 5 nm thick Pt layers under various reverse dc biases.