

## Ultra Responsive Heterostructure of Gold Nanoparticles Functionalized $\text{MoS}_2/\text{GaSe}/\text{Ga}_2\text{O}_3$ for Self-Powered Broadband Photodetection

Urvashi Varshney<sup>1,2</sup>, Anuj Sharma<sup>1,2</sup>, and Govind Gupta<sup>1,2\*</sup>

<sup>1</sup> Academy of Scientific & Innovative Research (AcSIR), Ghaziabad-201002, India.

<sup>2</sup> CSIR-National Physical Laboratory, Dr. K.S. Krishnan Marg, New Delhi, 110012, India.

\*Corresponding Author Email: [govindnpl@gmail.com](mailto:govindnpl@gmail.com), [govind@nplindia.org](mailto:govind@nplindia.org)

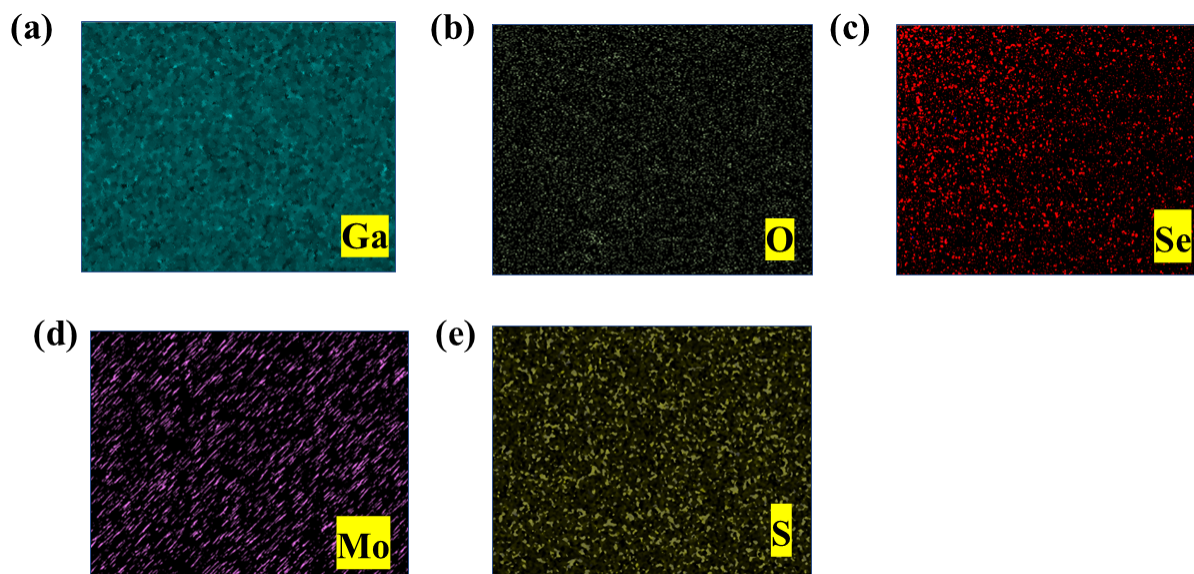


Figure S1. (a) EDAX elemental mapping of (b) Ga, (c) O, (d) Se, (e) Mo, and (f) S, of the  $\text{MoS}_2/\text{GaSe}/\text{Ga}_2\text{O}_3$  heterostructure.

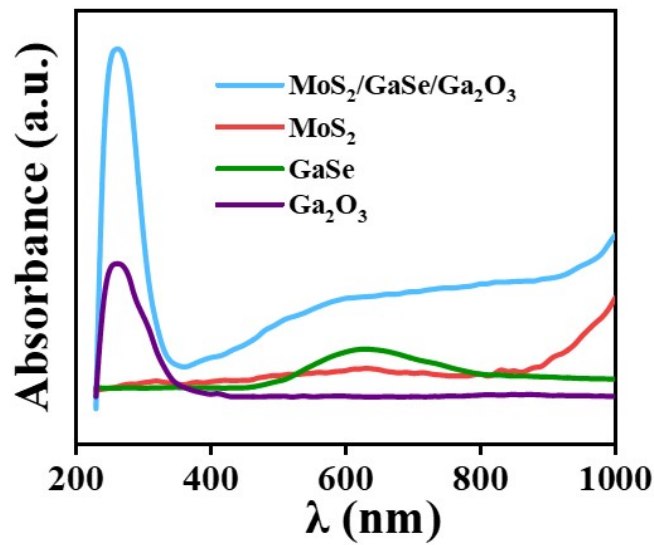


Figure S2. The absorption spectra of the MoS<sub>2</sub>, GaSe, Ga<sub>2</sub>O<sub>3</sub>, and MoS<sub>2</sub>/GaSe/Ga<sub>2</sub>O<sub>3</sub> heterostructure.

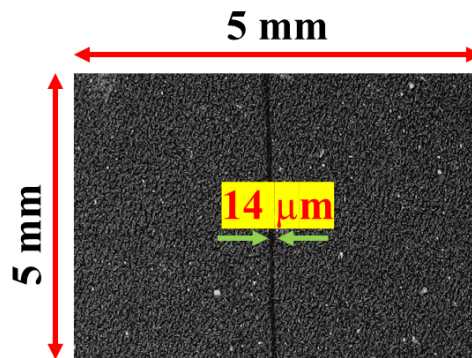


Figure S3: Optical microscope top-view image of the fabricated device.

Responsivity (R) and external quantum efficiency (EQE) are key parameters that determine the sensitivity of a photodetector. These parameters are calculated using  $R=I_p/P_dA$ .....(1) and  $EQE=h.c.R/e.\lambda$ ,.....(2) where  $I_p$  is the photocurrent,  $P_dA$  is the product of power density and effective illuminated area,  $h$  is Planck's constant, and  $e$  is the elementary charge. Detectivity (D) is another crucial parameter that determines the weakest detectable signal and is given by  $D=RA^{1/2}/(2eI_d)^{1/2}$ .....(3). The noise equivalent power (NEP), which defines the minimum

power required for a unity signal-to-noise ratio at 1 Hz, is obtained from  $NEP=(2eI_d)^{1/2}/R.....(4)$ .

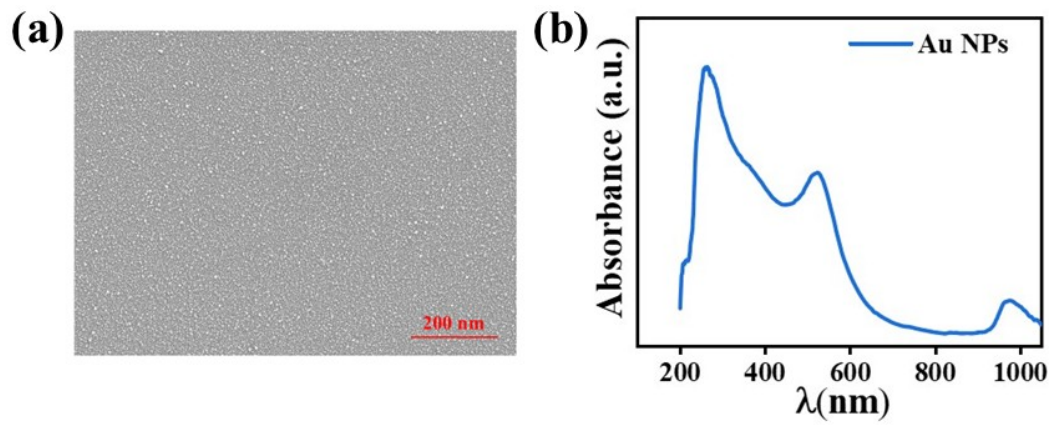


Figure S4. (a) SEM image and (b) UV-Vis-NIR spectroscopy of the Au NPs.