

Supporting Information

Rhodamine 6G/Transition Metal Dichalcogenide Hybrid Nanoscrolls for Enhanced Optoelectronic Performance

Huihui Ye, Hailun Tang, Shilong Yu, Yang Yang and Hai Li *

Key Laboratory of Flexible Electronics (KLOFE), Institute of Advanced Materials
(IAM), Nanjing Tech University (NanjingTech), Nanjing 211816, China

* Correspondence: iamhli@njtech.edu.cn

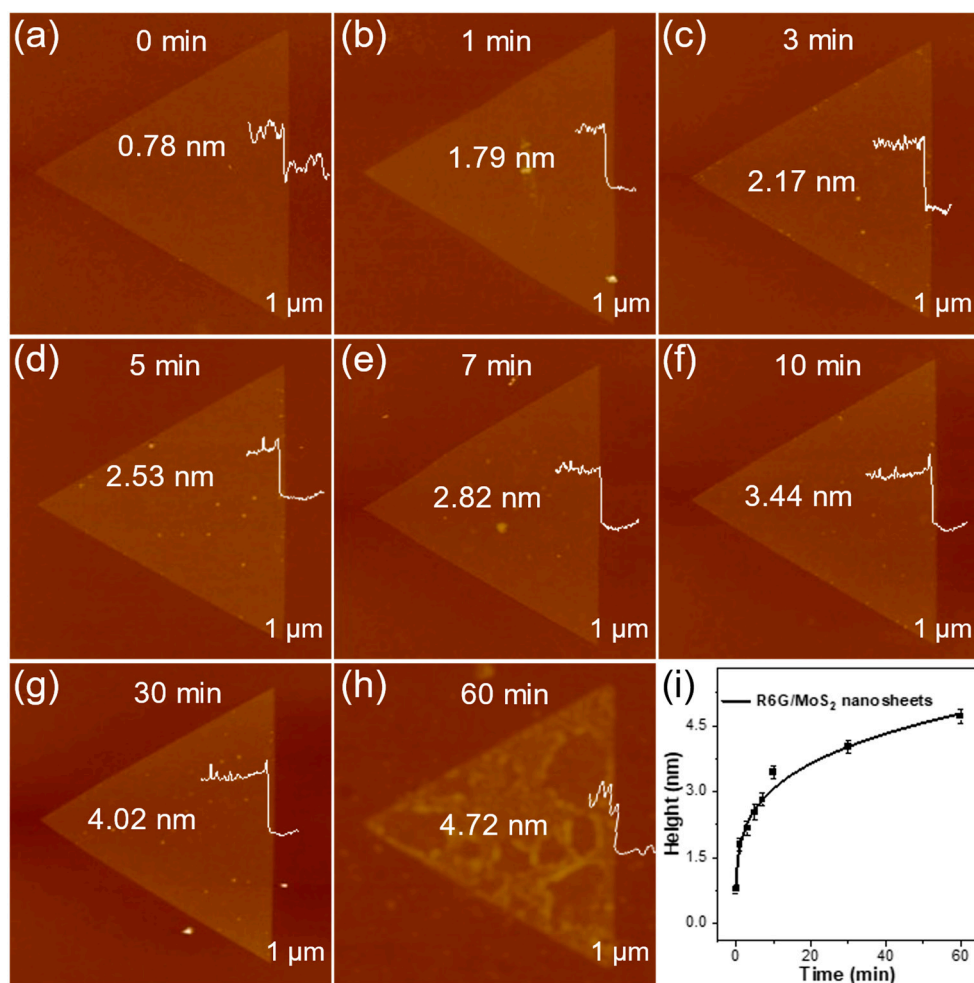


Figure S1. The AFM height images of R6G/MoS₂ nanosheets immersed into 5.0 mM R6G for (a) 0 min, (b) 1 min, (c) 3 min, (d) 5 min, (e) 7 min, (f) 10 min, (g) 30 min, and (h) 60 min. (i) The thickness of R6G/MoS₂ nanosheets as function of concentration of R6G solution.

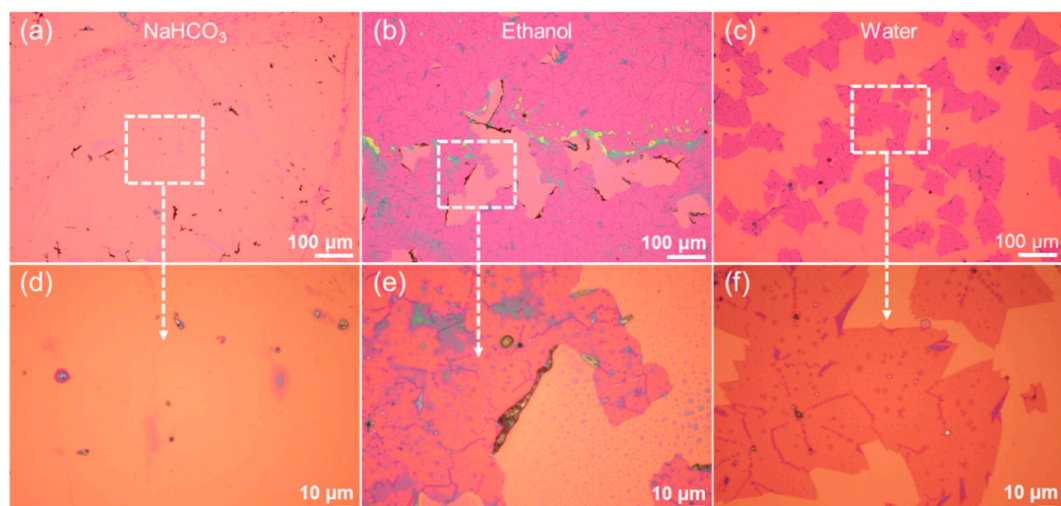


Figure S2. (a-c) The OM images of R6G/MoS₂ nanoscrolls prepared by using (a) NaHCO₃ solution, (b) ethanol and (c) water. (d-f) The corresponding magnified images of white dashed boxes shown in (a-c).

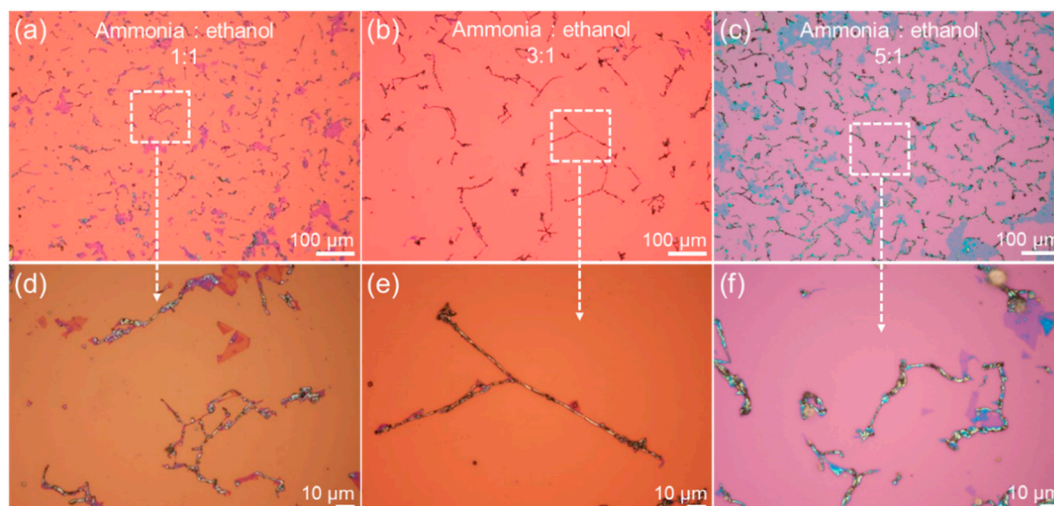


Figure S3. (a-c) The OM images of R6G/MoS₂ nanoscrolls prepared using ammonia/ethanol mixed solutions with volume ratios of (a) 1:1, (b) 3:1, and (c) 5:1. (d-f) The corresponding magnified images of white dashed boxes shown in (a-c).

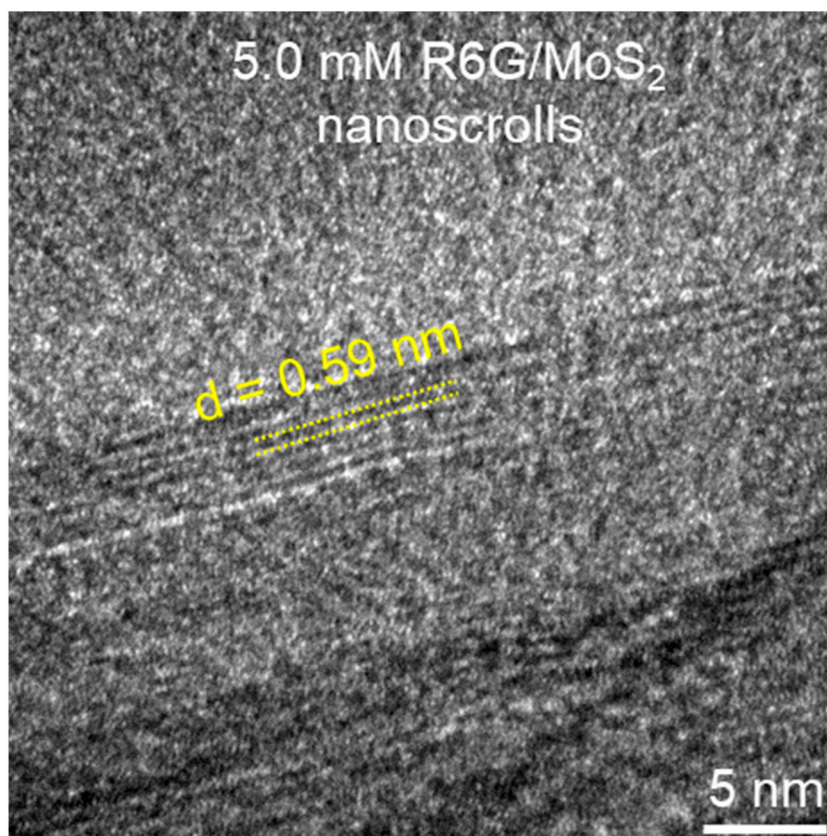


Figure S4. HR-TEM image of R6G/MoS₂ nanoscroll.

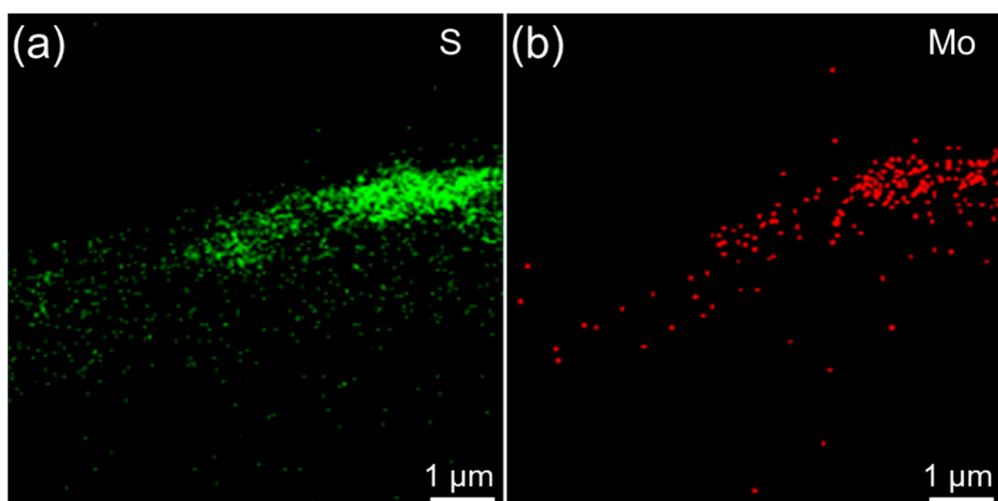


Figure S5. The energy dispersive spectroscopy mapping analysis on the distribution of (a) S and (b) Mo elements in the R6G/MoS₂ nanoscroll.

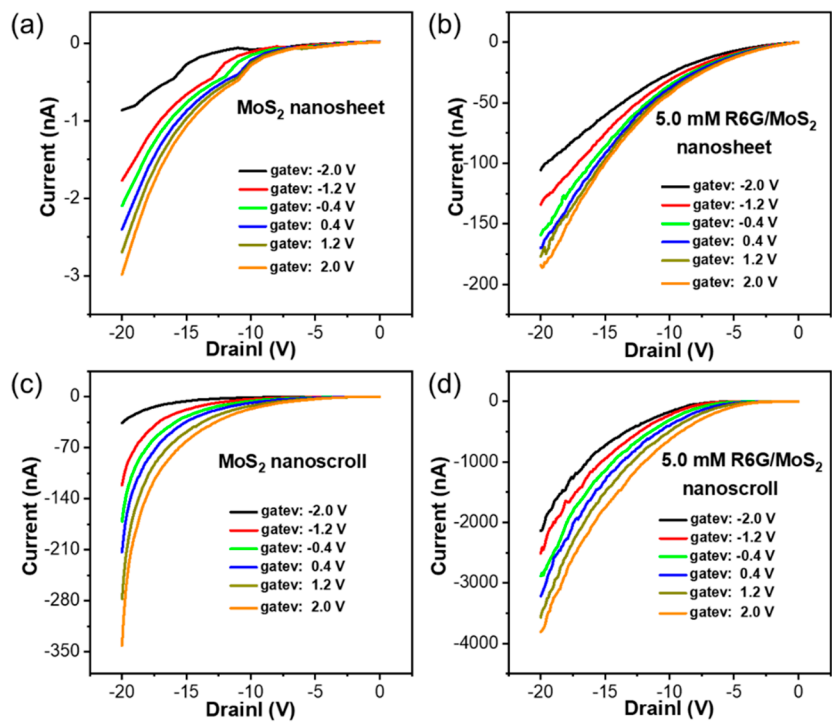


Figure S6. The output curves of (a) MoS₂ nanosheet, (b) R6G/MoS₂ nanosheet, (c) MoS₂ nanoscroll, and (d) R6G/MoS₂ nanoscroll with gate voltage ranging from -2 V to 2 V at a step of 0.8 V.

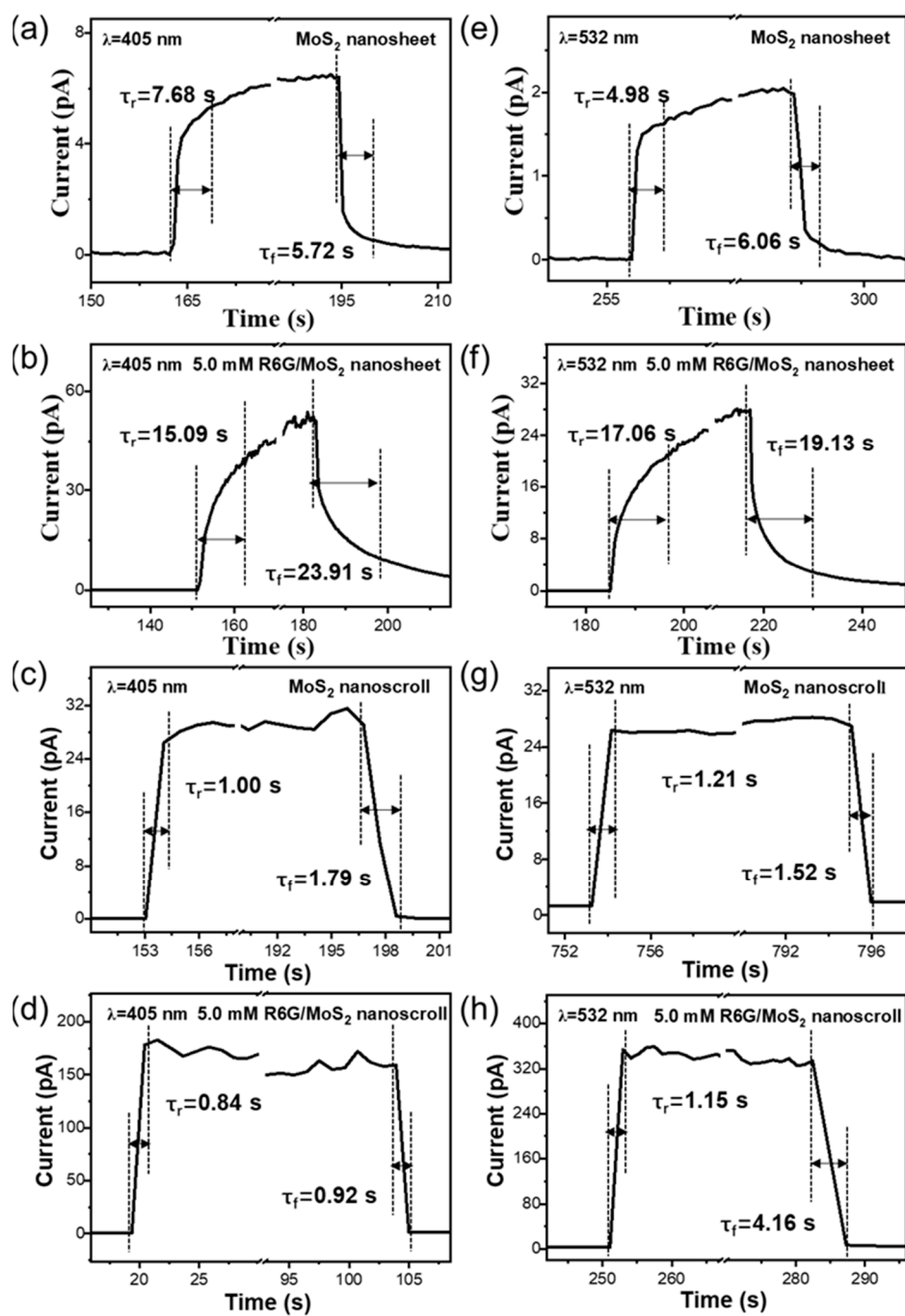


Figure S7. The response time and recovery time of (a, e) MoS₂ nanosheet, (b, f) 5.0 mM R6G/MoS₂ nanosheet, (c, g) MoS₂ nanoscroll and (d, h) 5.0 mM R6G/MoS₂ nanoscroll under (a-d) 405 nm and (g-h) 532 nm lasers.

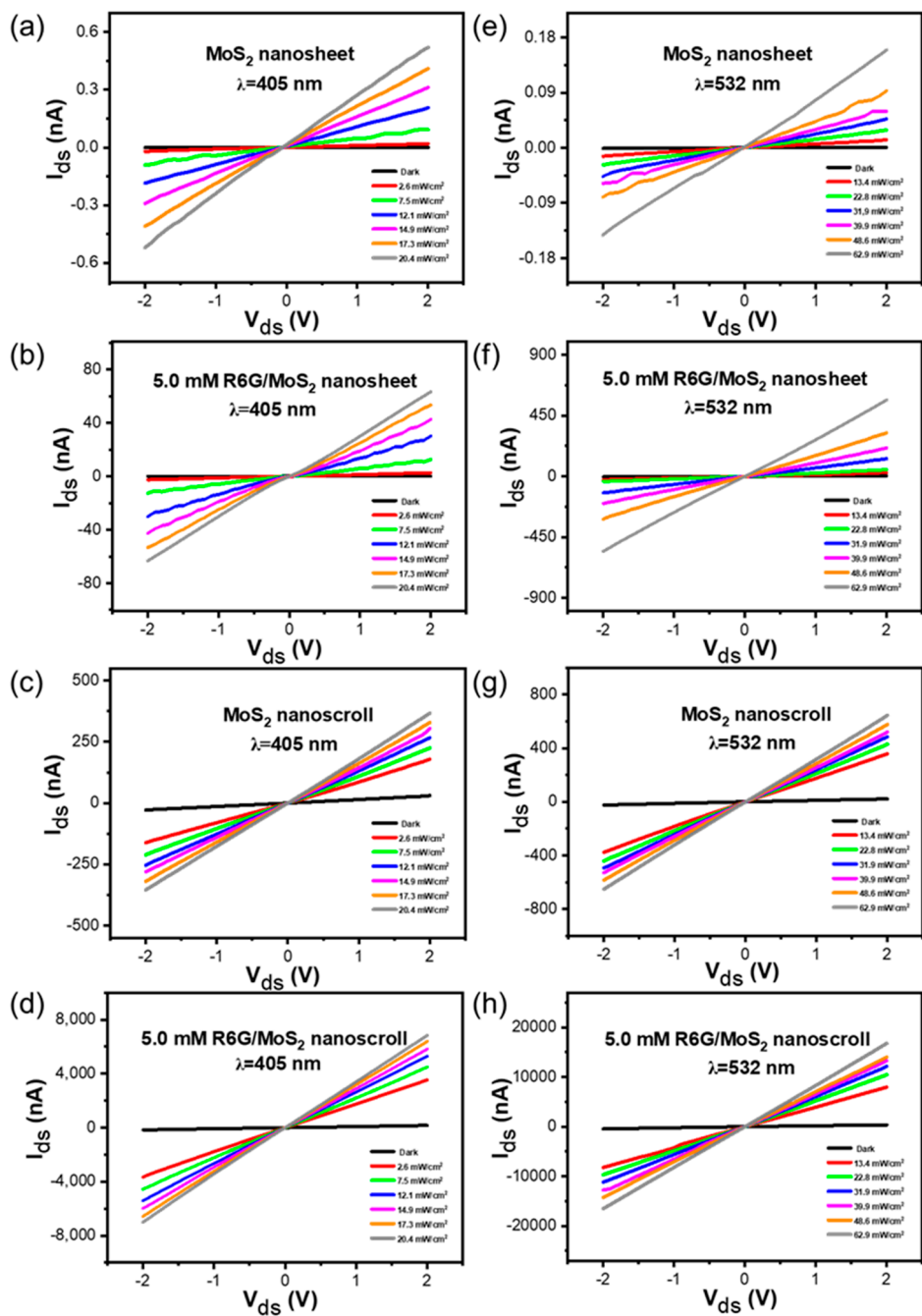


Figure S8. The I_{ds} - V_{ds} curves of (a, e) MoS₂ nanosheet, (b, f) 5.0 mM R6G/MoS₂ nanosheet, (c, g) MoS₂ nanoscroll and (d, h) 5.0 mM R6G/MoS₂ nanoscroll under (a-d) 405 nm and (e-h) 532 nm lasers.

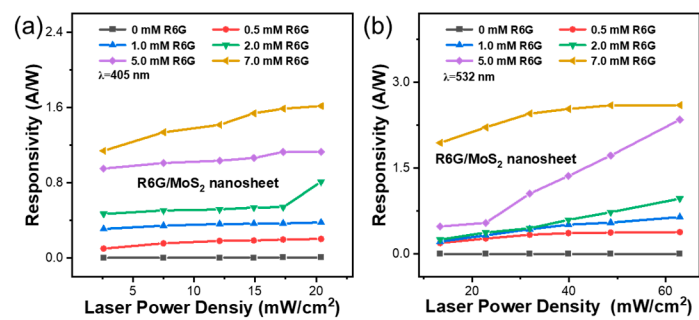


Figure S9. The photoresponsivities of R6G/MoS₂ nanosheets as a function of laser power density under (a) 405 nm and (b) 532 nm lasers.

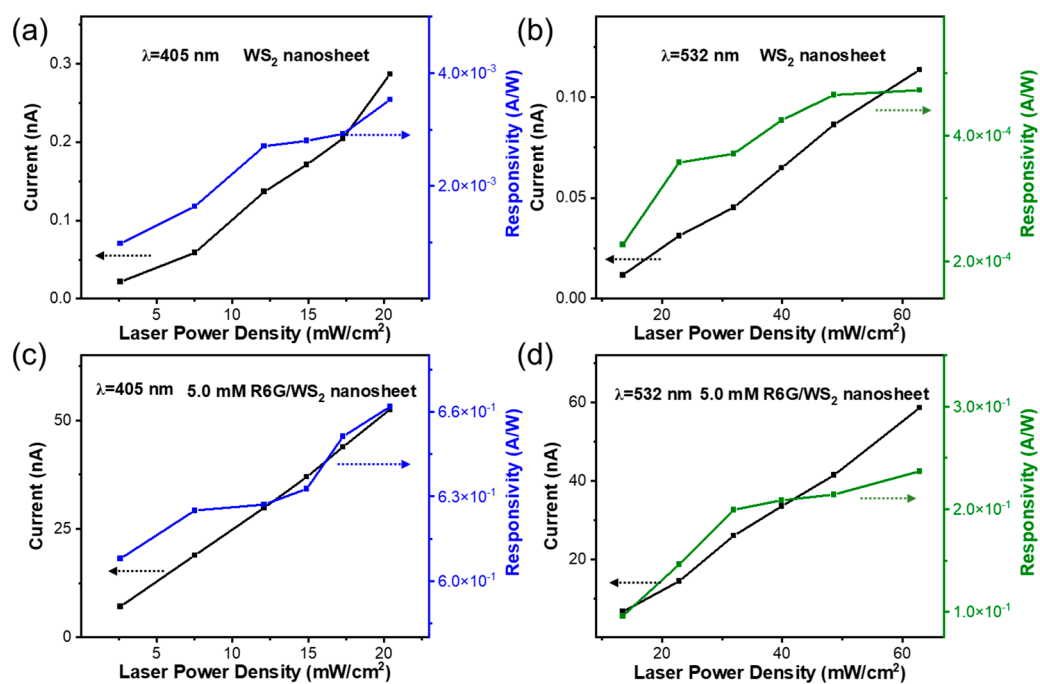


Figure S10. The photocurrent and photoresponsivities of (a, b) WS₂ nanosheet and (c, d) 5.0 mM R6G/WS₂ nanosheet as a function of laser power density under (a, c) 405 nm and (b, d) 532 nm lasers.

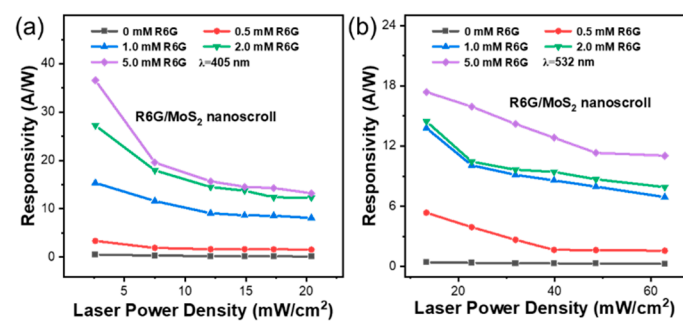


Figure S11. The photoresponsivities of R6G/MoS₂ nanoscrolls as a function of laser power density under (a) 405 nm and (b) 532 nm lasers.

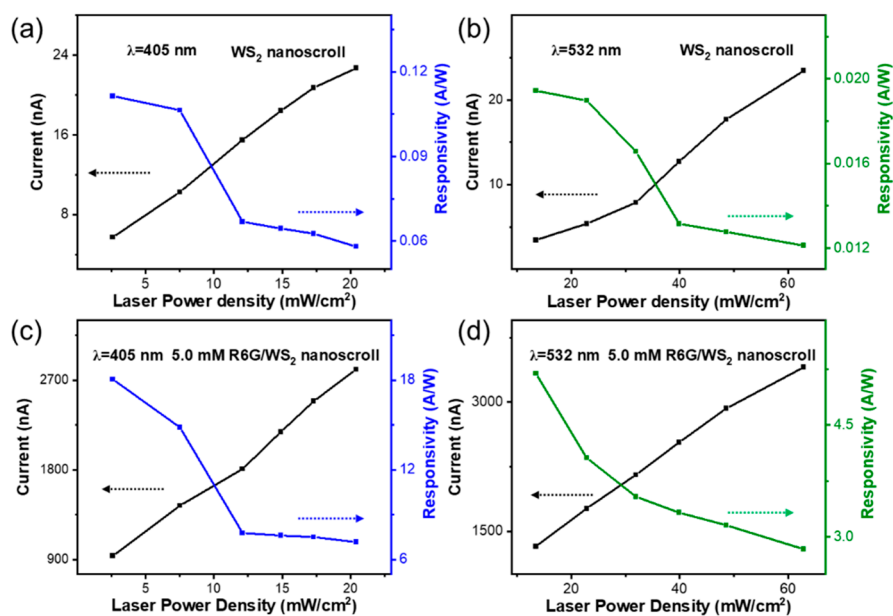


Figure S12. The photocurrent and photoresponsivities of (a, b) WS₂ nanoscroll and (c, d) 5.0 mM R6G/WS₂ nanoscroll as a function of laser power density under (a, c) 405 nm and (b, d) 532 nm lasers.

Table S1. Performance comparison of this work to the lately reported TMDC photodetector.

Material	R (A/W)	EQE (%)	D* (cm·Hz ^{1/2} W ⁻¹)	Reference
R6G/MoS ₂ nanoscroll	66.07	20261	1.25×10 ¹²	this work
MoS ₂ nanotubes	20.6	4947.6	1.94×10 ¹²	ACS Appl. Mater. Interfaces 2024 DOI: 10.1021/acsami.4c01823
In ₂ Se ₃ -WS ₂ heterojunction	6.35		3.1×10 ¹¹	Opt. Mater 2024, 149, 115052
Zn-MoS ₂ heterojunction	1.45	30.2	1.28×10 ¹²	J. Mater. Chem. C 2024, 12, 5247-5256
Te/2D MoSe ₂	0.328	79	8.2×10 ⁹	Adv. Funct 2024, 34, 2311134
BP/R6G/MoS ₂ heterojunction	0.19	44.9	6.1×10 ¹⁰	Nano Res. 2023, 16, 10537

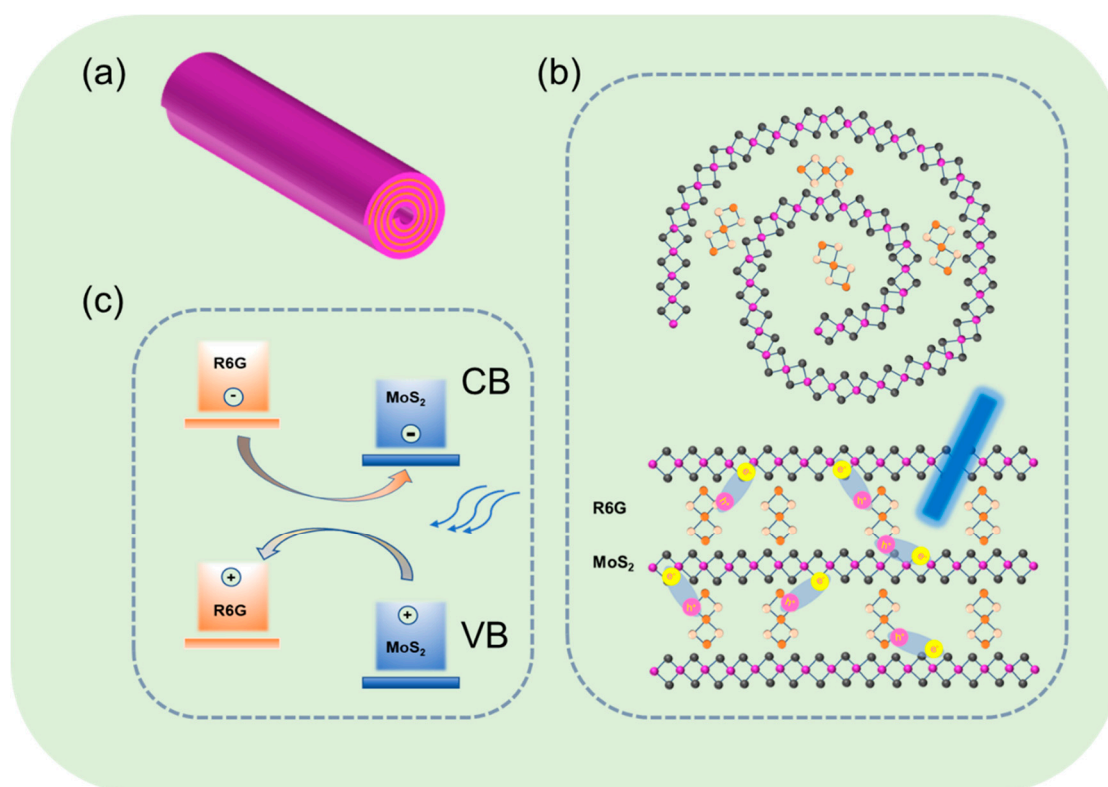


Figure S13. (a) The scheme of R6G/MoS₂ nanoscroll. (b) Interlayer transport behaviour of photogenerated carriers in multiple interfaces of R6G/MoS₂ nanoscroll. (c) The schematic diagram of energy-band arrangement of R6G/MoS₂ nanoscroll.

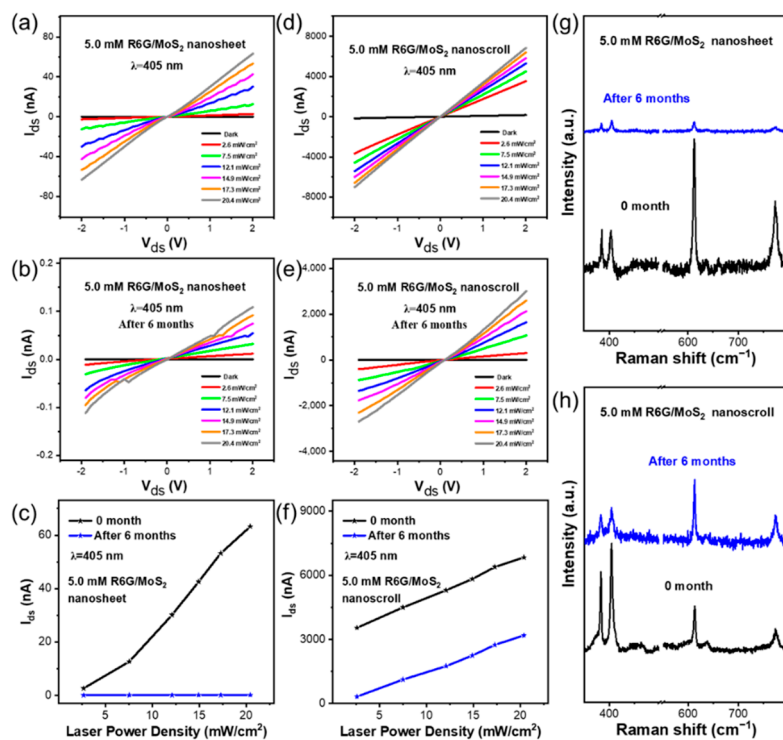


Figure S14. The photocurrent plots of 5.0 mM R6G/MoS₂ nanosheet and nanoscroll measured (a, d) before and (b, e) after being stored in ambient conditions for 6 months. (c, f) The photocurrent plots and (g-h) Raman spectra of 5.0 mM R6G/MoS₂ nanosheet and nanoscroll before and after being stored in ambient conditions for 6 months.

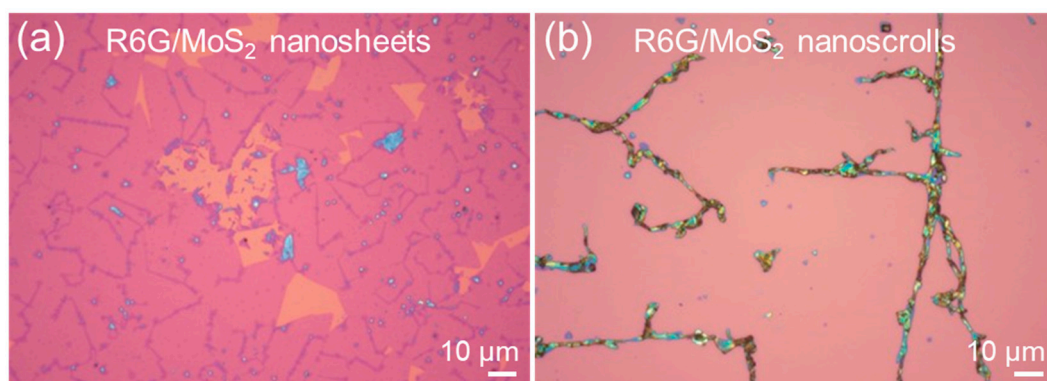


Figure S15. The OM images of (a) R6G/MoS₂ nanosheets and (b) R6G/MoS₂ nanoscrolls.

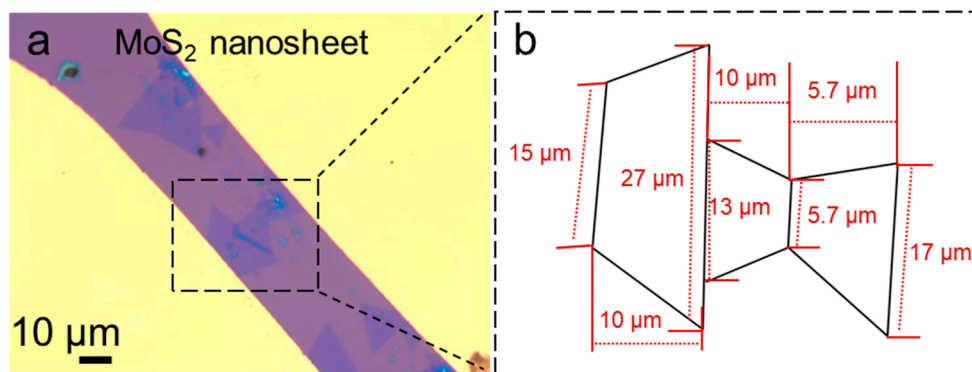


Figure S16. The (a) OM image and (b) corresponding schematic illustration of MoS₂ nanosheet based device.