Supporting Information

ARTICLE

Highly efficient and flexible photodetector based on MoS_2-ZnO heterostructures

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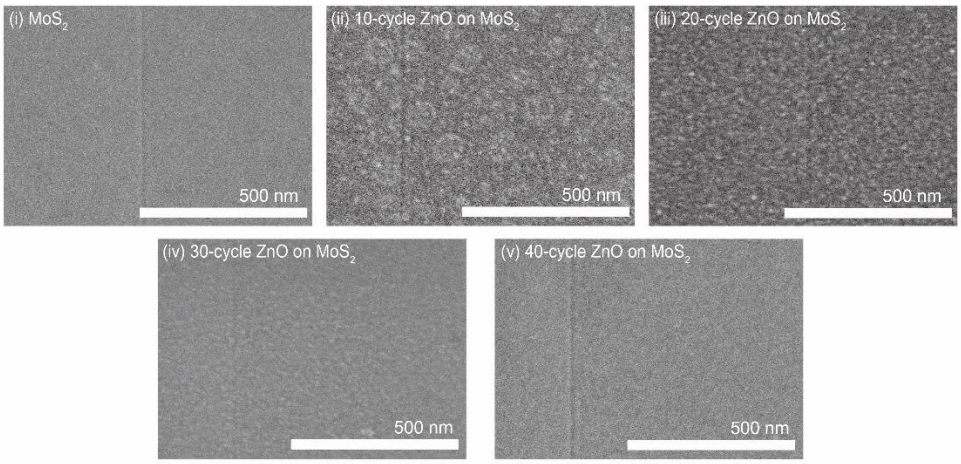

Fig. S1. High resolution FESEM images of MoS_2 nanosheets with ZnO nanopatches as a function of the process cycles (0, 10, 20, 30, and 40 cycles) during ALD process.

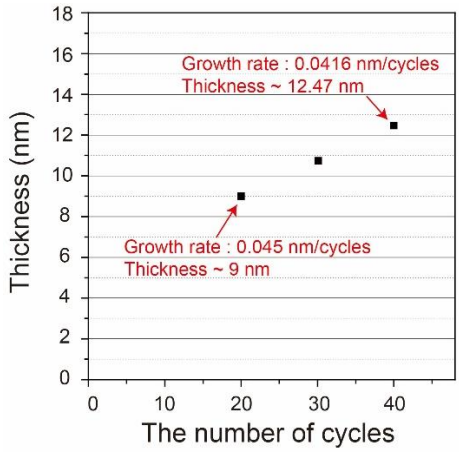

Fig. S2. XRR profile of as-deposited ZnO with regard to the number of ALD cycles.

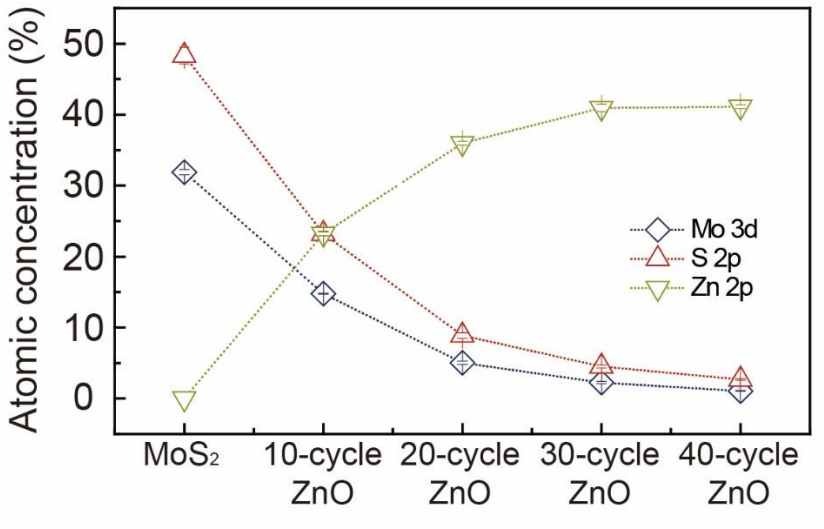

Figure S3. Atomic concentration of MoS_2-ZnO hybrid structure depending on the number of ZnO cycles

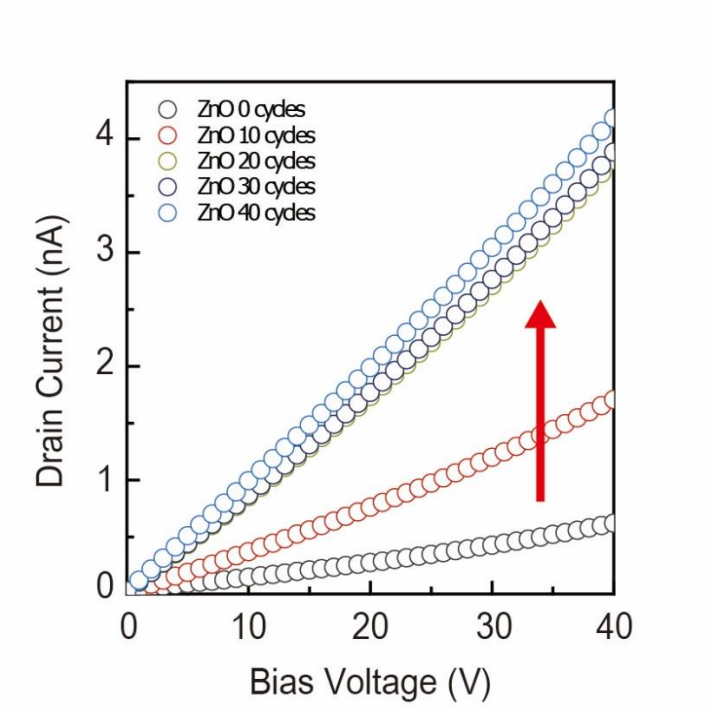

Figure S4. Output characteristics of MoS_2-ZnO hybrid structure as a function of the number of ZnO cycles.

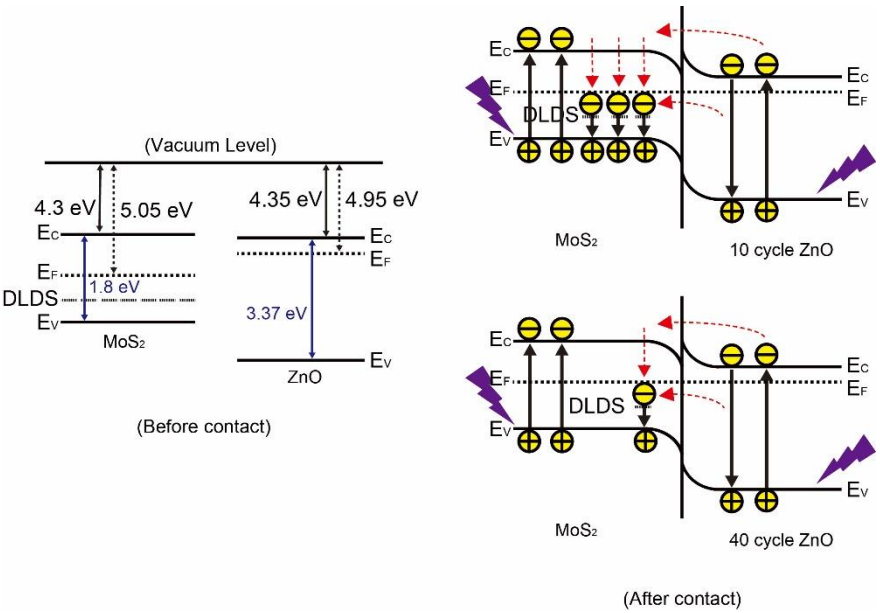

Fig. S5. Energy band diagram of photodetector based on MoS_2-ZnO hybrid structures.[S1-S4]

[Ref S1.] Chen, L., Xue, F., Li, X., Huang, X., Wang, L., Kou, J., & Wang, Z. L. (2015). Strain-gated field effect transistor of a MoS_2-ZnO 2D–1D hybrid structure. ACS nano, 10(1), 1546-1551.

[Ref S2.] Kang, K. M., & Park, H. H. (2017). Effect of Atomic Layer Deposition Temperature on the Growth Orientation, Morphology, and Electrical, Optical, and Band-Structural Properties of ZnO and Fluorine-Doped ZnO Thin Films. The Journal of Physical Chemistry C, 122(1), 377-385.

[Ref S3.] Nazir, G. et al. (2017). Enhanced photoresponse of ZnO quantum dot-decorated MoS_2 thin films. RSC Advances, 7(27), 16890-16900.

[Ref S4.] Park, J. H. et al (2017). Defect passivation of transition metal dichalcogenides via a charge transfer van der Waals interface. Science advances, 3(10), e1701661.

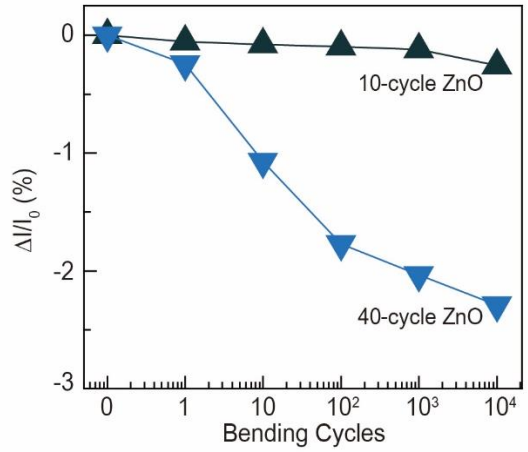

Fig. S6. The variation of electrical properties of as-deposited ZnO depending on the bending cycles.

Table S1. Rise and decay time for photodetectors based on MoS_2-ZnO hybrid structure

	MoS_2	10 cycle ZnO	20 cycle ZnO	30 cycle ZnO	40 cycle ZnO
Rise time (s)	76.11	72.92	58.85	25.63	13.96
Decay time (s)	-	-	-	246.71	55.33

Table S2. Performance comparison of MoS_2-based ultraviolet photodetectors

Material	Method	Wavelength (nm)	Bias voltage (V)	Responsivity	Reference
Pt nanostrips-MoS_2	Mechanical exfoliation method (MoS_2), Pt nanostrips (FIB)	325	4 V	14 A/W	[Ref.S5]
Single layer MoS_2	Mechanical exfoliation method	550	1 V (gate voltage ~ 50 V)	7.5 mA/W	[Ref.S6]
Multilayer MoS_2	Mechanical exfoliation method	455	1 V (gate voltage ~ -3 V)	~ 80 mA/W	[Ref.S7]
Single layer MoS_2	CVD method	~400	1 V	~1 mA/W	[Ref.S8]
ZnO-MoS_2	Solution (MoS_2), ZnO (ALD)	254	40V	2.7 A/W	This work

[Ref.S5] Kumar, R., Sharma, A., Kaur, M., & Husale, S. (2017). Pt-Nanostrip-Enabled Plasmonically Enhanced Broad Spectral Photodetection in Bilayer MoS_2. Advanced Optical Materials, 5(9), 1700009.

[Ref.S6] Yin, Z., Li, H., Li, H., Jiang, L., Shi, Y., Sun, Y., ... & Zhang, H. (2011). Single-layer MoS_2 phototransistors. ACS nano, 6(1), 74-80.

[Ref.S7] Choi, W., Cho, M. Y., Konar, A., Lee, J. H., Cha, G. B., Hong, S. C., ... & Kim, S. (2012). High-detectivity multilayer MoS_2 phototransistors with spectral response from ultraviolet to infrared. Advanced materials, 24(43), 5832-5836.

[Ref.S8] Yore, A. E., Smithe, K. K., Jha, S., Ray, K., Pop, E., & Newaz, A. K. M. (2017). Large array fabrication of high performance monolayer MoS_2 photodetectors. Applied Physics Letters, 111(4), 043110.

