Supplementary Information

Mixed-Dimensional Vertical Bi$_2$O$_2$Se Nanopillars/Si Heterojunction with Light Confinement Effect for High-Performance Photodetection

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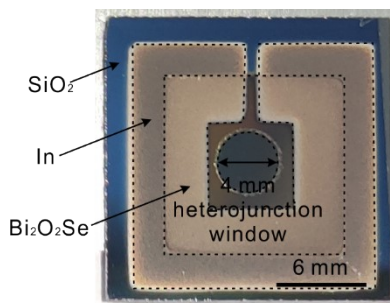[c] School of Physical Sciences, University of Science and Technology of China, Hefei, Anhui 230026, China
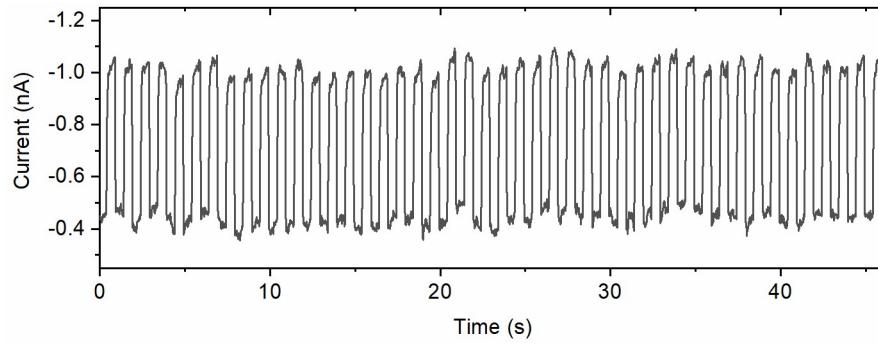[d] Nanjing Vocational College of Information Technology, Nanjing, Jiangsu 210023, China
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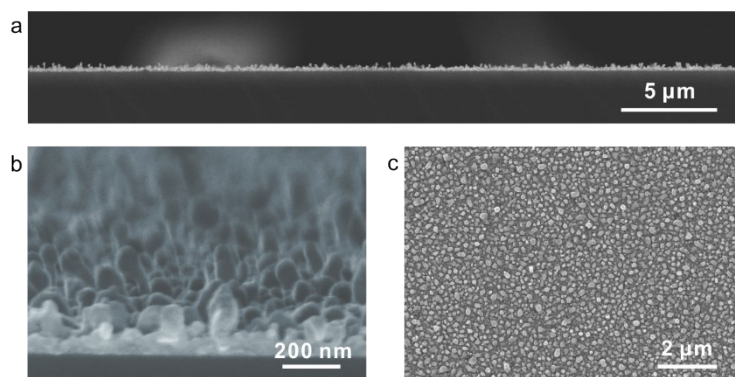
Figure S1. (a) Cross-sectional, (b) tilted, and (c) top-view SEM images of Bi_2O_2Se nanopillars.

Figure S2. Optical photograph of the Bi_2O_2Se nanopillars/Si heterojunction device.

Figure S3. Photoresponse curve of the Bi$_2$O$_2$Se nanopillars/Si heterojunction device measured under pulsed light irradiation (18 nW). A fixed zero voltage was applied during the measurement.
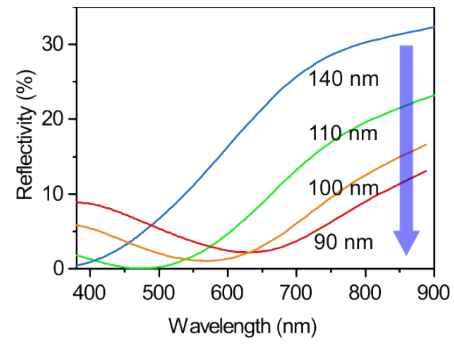
Figure S4. Simulated reflection spectra of Bi$_2$O$_2$Se nanopillars/Si heterojunction with varying nanopillar spacings.

Table S1. Comparison of device performance of mixed-dimension 1D Bi_2O_2Se nanopillars/3D Si heterojunction-based photodiodes with other Bi_2O_2Se-based photodetectors, including 2D Bi_2O_2Se photoconductors, 2D Bi_2O_2Se heterojunction photodiodes, and mixed-dimensional Bi_2O_2Se heterojunction photodiodes.[1-11]

Photodetectors	Self-driven	Detectivity (Jones)	Rise/Fall time (ms)	References
2D Bi_2O_2Se	No	-	5.4/2	[1]
2D Bi_2O_2Se	No	8.3×10^{11}	2.8	[2]
Graphene/C60 @2D Bi_2O_2Se	No	7.31×10^9	2.9	[3]
CsPbBr$_3$@2D Bi_2O_2Se	No	1.02×10^{12}	0.96/1.36	[4]
2D Bi_2O_2Se/1D Te	Yes	2.5×10^{11}	0.33/0.4	[5]
1D Bi_2O_2Se/2D $MoSe_2$	Yes	1.68×10^{10}	0.35/0.38	[6]
2D Bi_2O_2Se/2D WS_2	Yes	9×10^8	33/38	[7]
2D Bi_2O_2Se/2D BP	Yes	2.8×10^{11}	9	[8]
2D Bi_2O_2Se/2D $MoSe_2$	Yes	3.7×10^{11}	790/490	[9]
2D Bi_2O_2Se/2D Bi_2Se_3	Yes	1.18×10^7	274/318	[10]
2D Bi_2O_2Se/2D BP	Yes	1.14×10^{10}	0.12/0.14	[11]
1D Bi_2O_2Se NPs/3D Si	**Yes**	**6.1×10^{12}**	**0.024/0.04**	**Our work**

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