Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Electronic Supplementary Information

Stability improvement of Cu(II) doped ZnS/ZnO photodetectors prepared with facile solution-processing method

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S1 Microstructural and compositional investigations of prepared samples

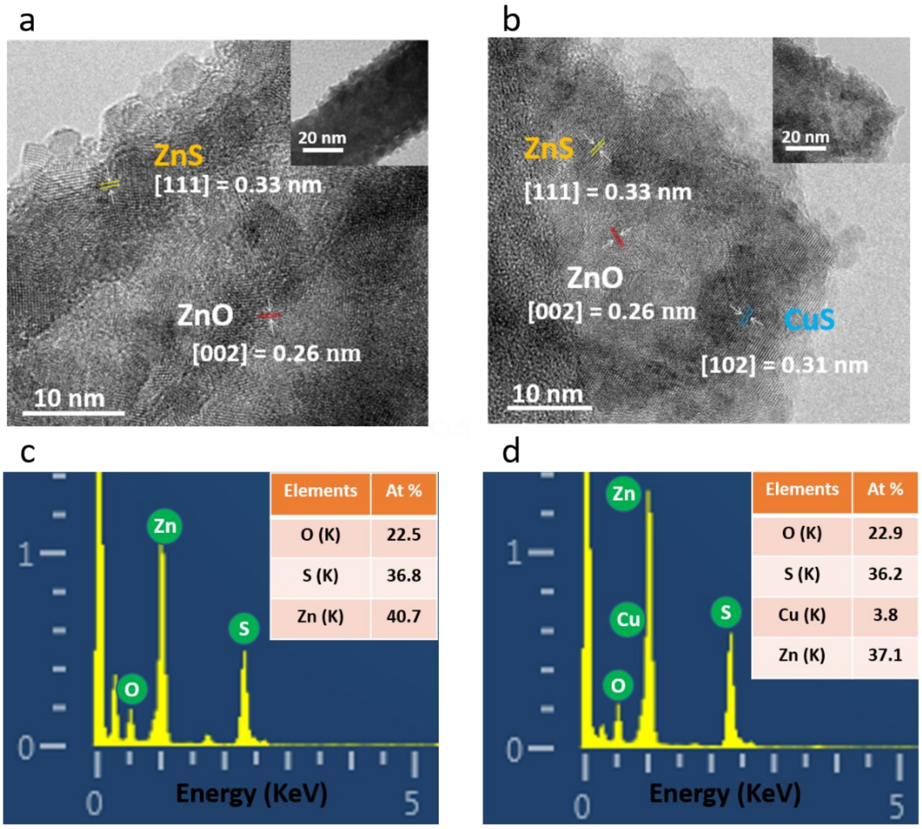

Figure S1 HRTEM images of a (a) ZnS/ZnO nanorod and (b) Cu^{2+} doped ZnS/ZnO nanorod. The inserted figures showed the corresponding TEM images, respectively. No voids could be observed at inner ZnO nanorods. EDS results of a (a) ZnS/ZnO nanorod and (b) Cu^{2+} doped ZnS/ZnO nanorod. The inserted tables presented the corresponding quantitative elemental compositions, respectively.

S2 Long-term surface wettability of ZnO-based structures

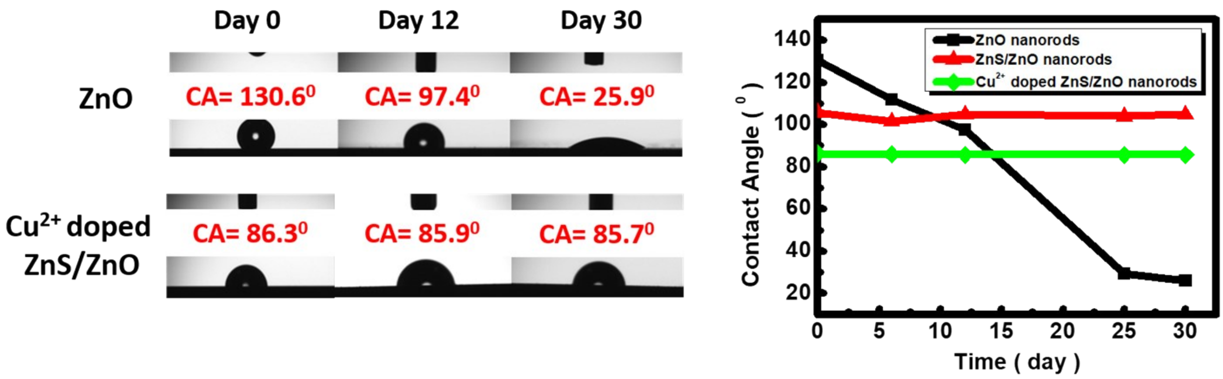

Figure S2 Contact-angle measurements of three various samples. The results indicated the highly unstable wettability of ZnO from time to time, whereas the contact angles stayed the same for long-term measurements in Cu^{2+} doped ZnS/ZnO.

S3 Measured photocurrent enhancement of sole ZnO based photodetectors

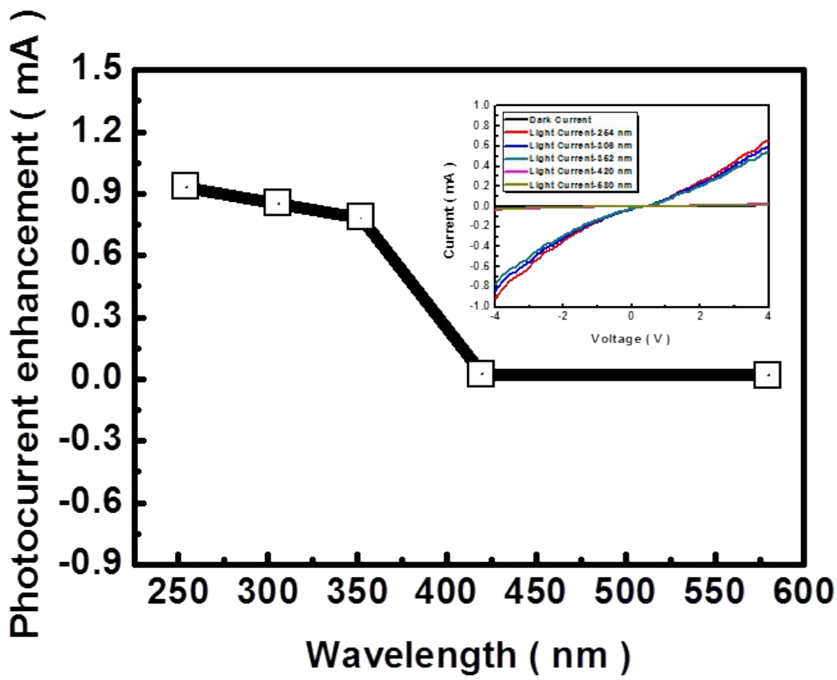

Figure S3 Photocurrent enhancement of sole ZnO based photodetectors. The inserted figures presented the measured current-voltage curves under light illuminations of various wavelengths, respectively.

S4 On/off switch diagrams under light illuminations of 365 nm

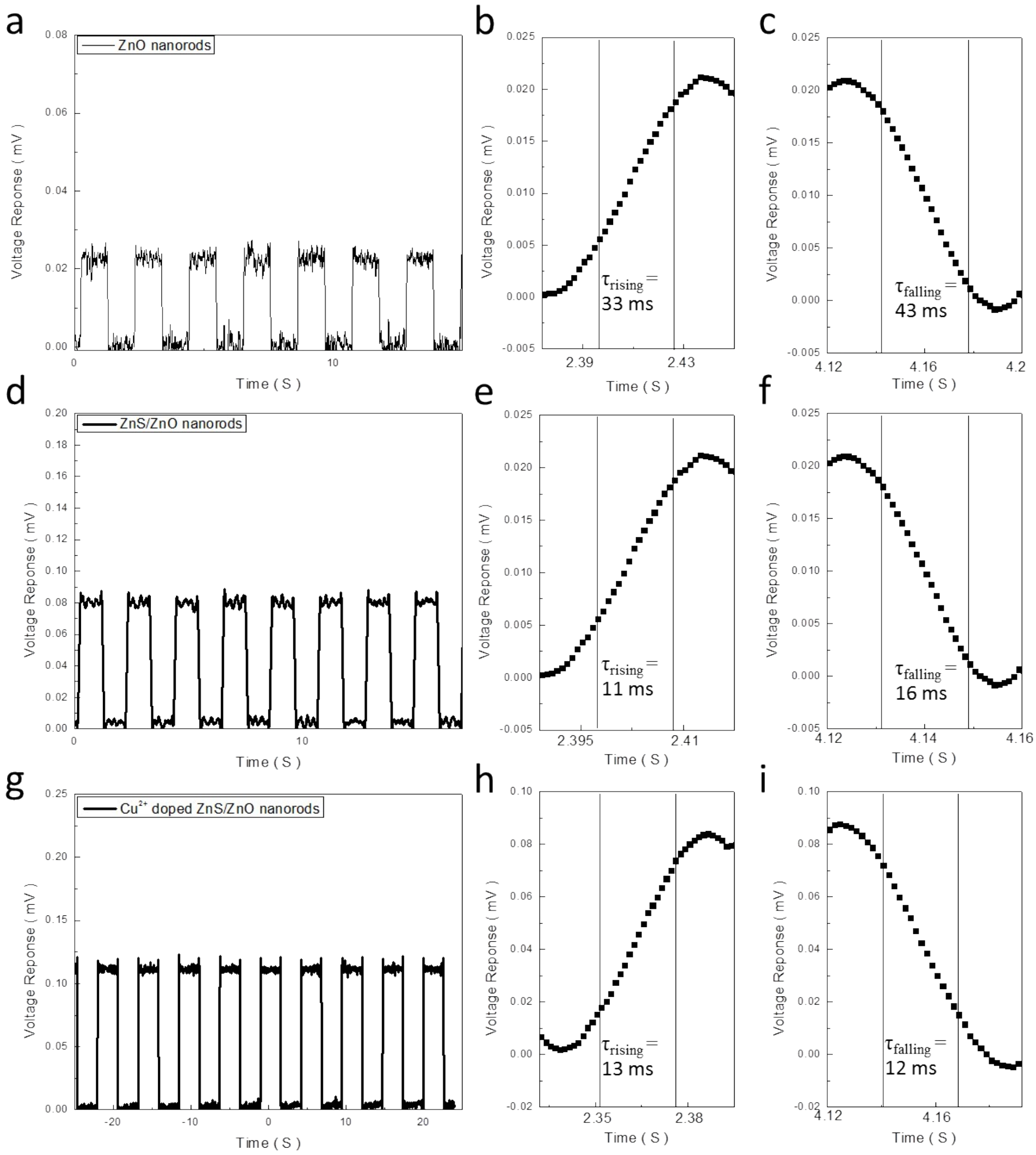

Figure S4 The on/off switch diagrams of (a)-(c) ZnO nanorods, (d)-(f) ZnS/ZnO nanorods and (g)-(i) Cu^{2+} doped ZnS/ZnO nanorods under 365-nm illumination, respectively.

S5 Long-term cycling test of Cu^{2+} doped ZnS/ZnO-based photodetectors

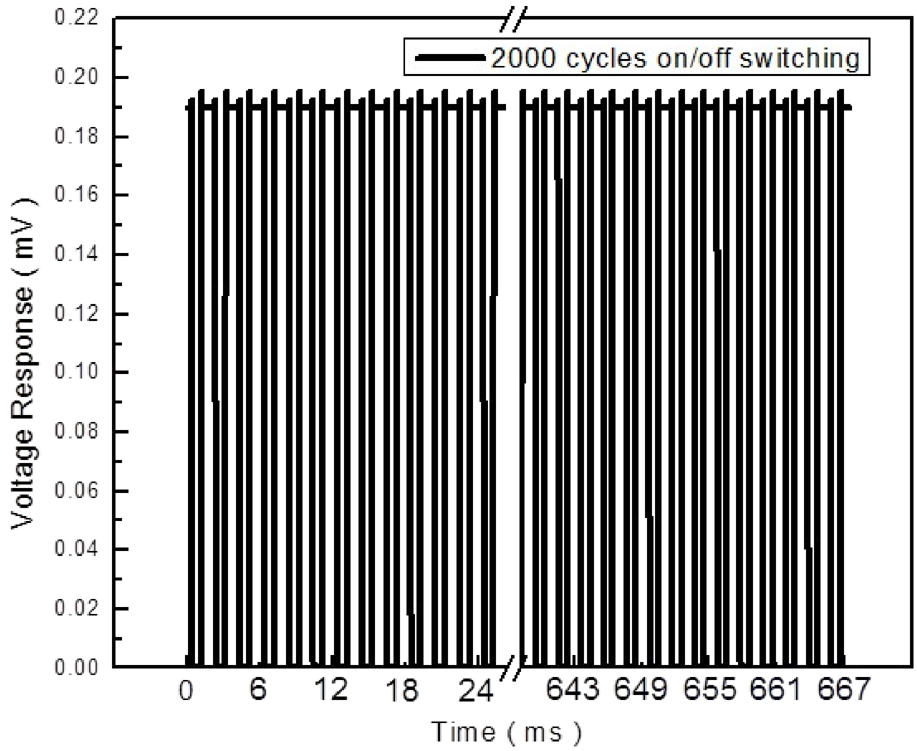

Figure S5 Cycling test of Cu^{2+} doped ZnS/ZnO-based photodetectors.

S6 Responsivity and EQE examinations

Table S1 Device responsivity and EQE results

	Responsivity (A/W @ 4 V)	**EQE (%)**
Light sources : 365nm		
ZnO nanorods	0.37	126
ZnO/ZnS nanorods	0.48	163
Cu^{2+} doped ZnS/ZnO nanorods	0.57	193
Light sources : 420nm		
ZnO nanorods	0.23	68
ZnO/ZnS nanorods	0.49	145

Cu^{2+} doped ZnS/ZnO nanorods	0.73	216

The responsivity and EQE of devices were evaluated by the following equations,

$$R = I_{photocurrent} / P_{power\ of\ light}$$

$$EQE = R \times (hC/e\lambda)$$

where $I_{photocurrent}$ was photocurrent enhancement, $P_{power\ of\ light}$ was power of light source, h was Plank constant, C indicated the light velocity, λ was the excited wavelength and e indicated the electronic charge.[1]

S7 Thermal stability test

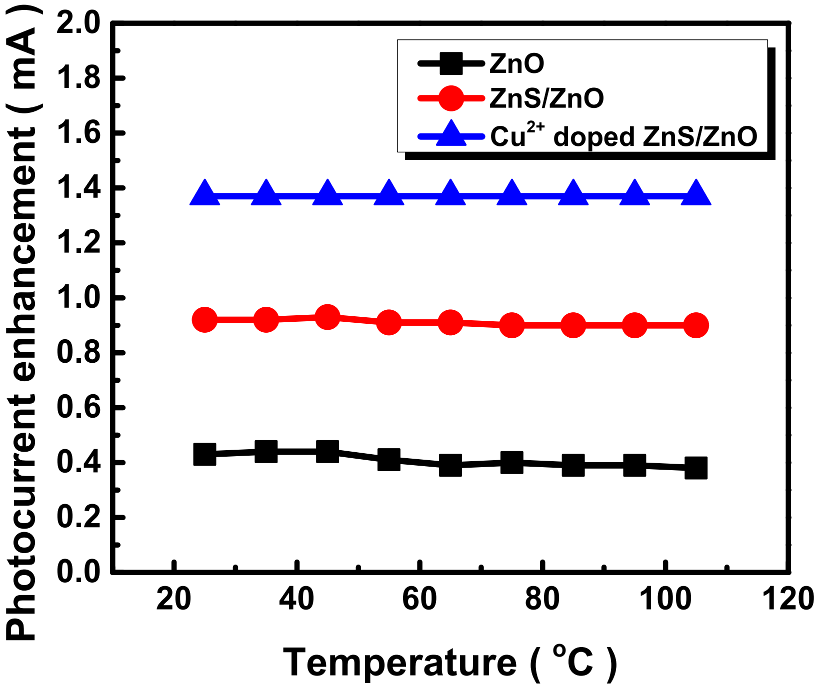

Figure S6 Thermal stability test of various ZnO-based photodetectors.

S8 Comparisons of ZnO-based photodetectors

Table S2 Comparative table of the ZnO-based photodetectors

	Range of detection	Bias (V)	Responsivity (A/W)	Detectivity (10^{-12} cmHz$^{1/2}$W^{-1})	τ_{Rise}/τ_{Decay}	I_{On}/I_{Off} ratio	Reference
Fe doped ZnO/ZnO core-shell nanorods	350-365 nm	8	3.66	NA	22 s/ >1200 s	>100	2
ZnO NW-Co_3O_4	Visible	0.1	0.022	4.12	6 s/NA	NA	3
ZnO/Cu_2O Core-shell nanowires	UV	0	7.67X10^{-6}	NA	<90 ms/<90 ms	NA	4
Branched ZnS-ZnO Heterostructure Nanofilms	UV	10	1.6X10^{-7}	NA	0.77 s/0.73 s	6.21	5
Type-II ZnO/ZnS Core/Shell Nanowire Array	Visible	1.5	0.54	NA	NA	4.25	6
Cu^{2+} doped ZnS/ZnO nanorods	254-580 nm	4	0.73	127.2	17 ms/19 ms	22800.0	**This work**

Reference

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