Supporting Information for

Self-Assembled Al Nanostructure/ZnO Quantum Dot Heterostructures for High Responsivity and Fast UV Photodetector

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Supplementary Figures and Table

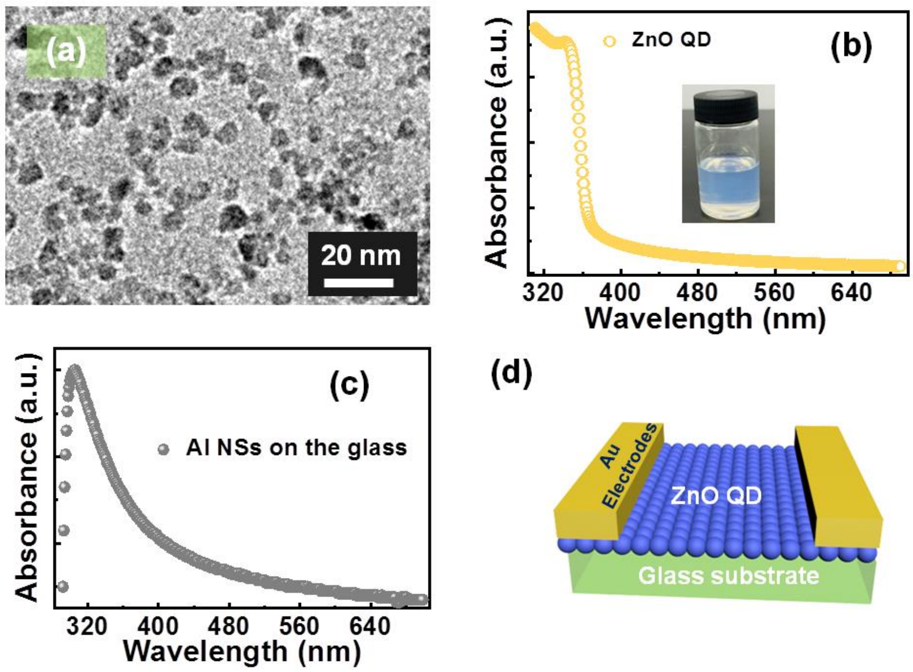

Fig. S1 (**a**) Transmission electron microscope image of ZnO quantum dots (QD). (**b**) Absorbance spectra and (Insets) optical image of ZnO QD solution. (**c**) Absorbance spectra of the Al NSs on the glass substrate. (**d**) The structure of the pristine ZnO device

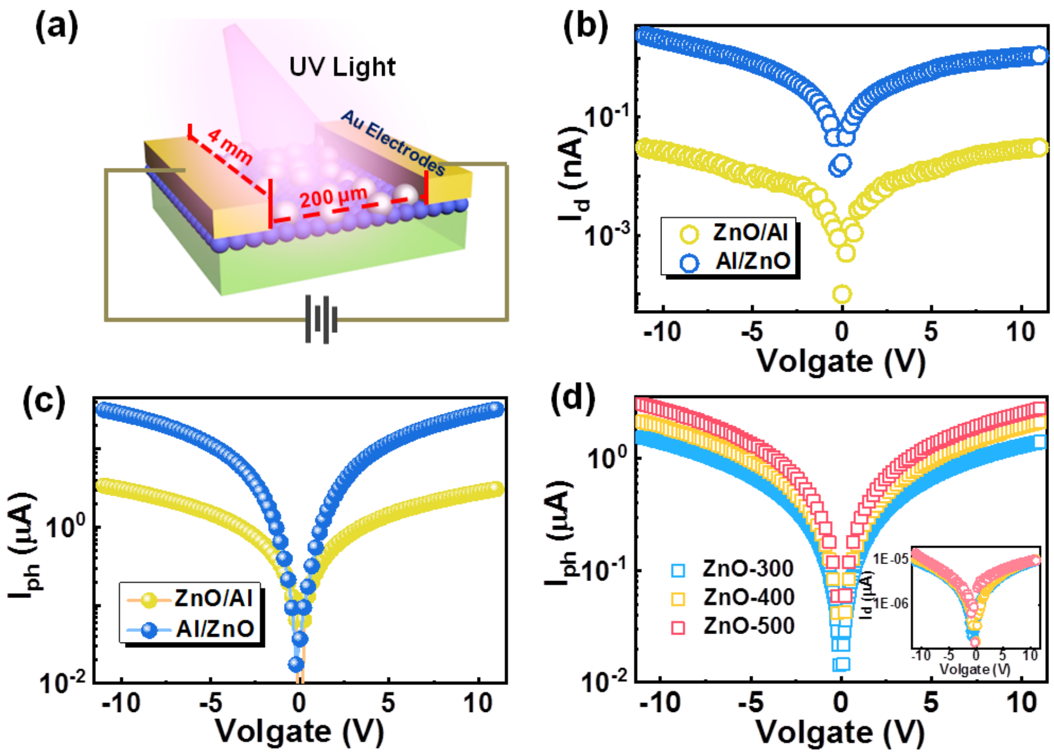

Fig. S2 (**a**) The schematic diagram of the configuration of the Al/ZnO heterostructure photodetector. Current-voltage curves of the photodetectors with various configurations (**b**) in the dark and (**c**) under 365 nm light illumination (6.9 mW cm^{-2}). (**d**) Current-voltage curves of the ZnO photodetectors annealed at various temperature under 365 nm light illumination (6.9 mW cm^{-2}) and in the dark (inset)

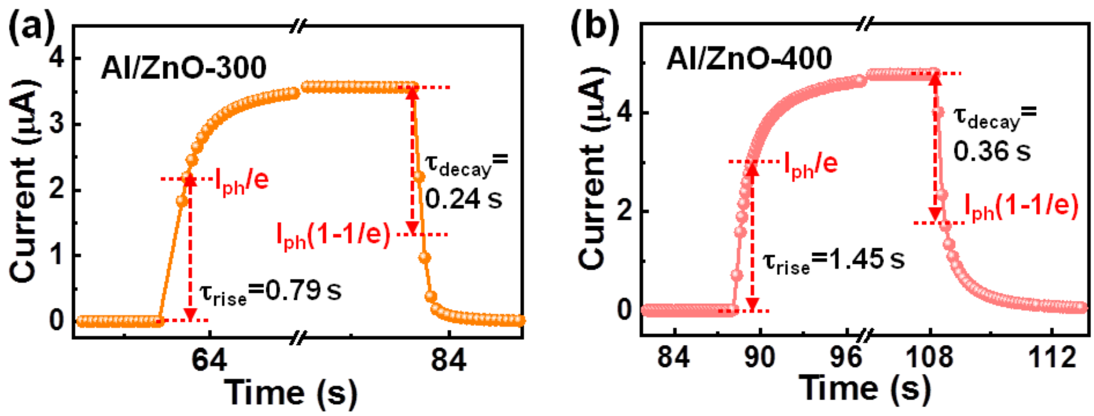

Fig. S3 Time-resolved photoresponse of the Al/ZnO photodetectors fabricated at different annealing temperatures under 365 nm light illumination (6.9 mW cm^{-2}) at a 10 V bias: (**a**) 300 ℃ and (**b**) 400 ℃.

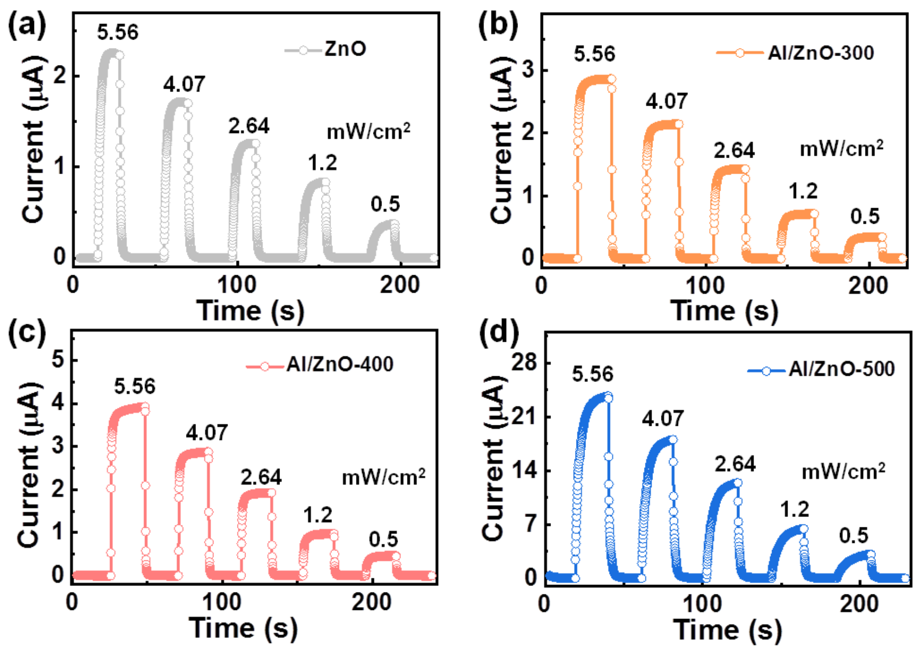

Fig. S4 Light intensity dependent photoresponse of the pristine ZnO (**a**) and Al/ZnO heterostructure detectors fabricated at different temperatures under 365 nm light illumination at a 10 V bias: (**b**) 300, (**c**) 400, and (**d**) 500 ℃

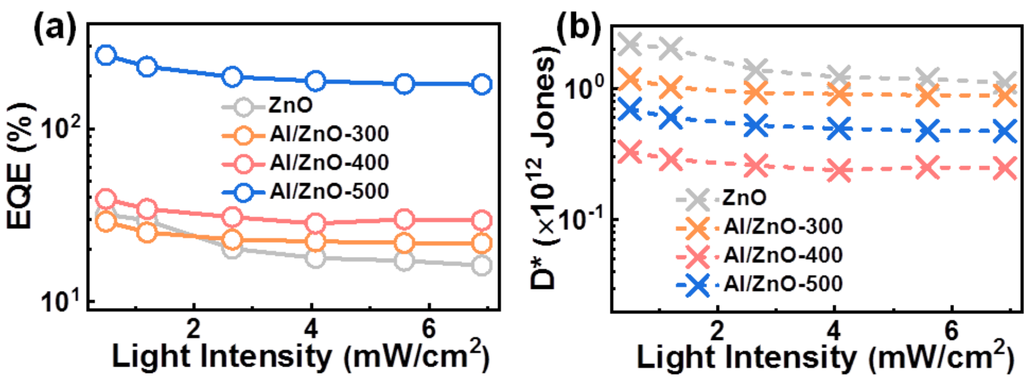

Fig. S5 (**a**) EQE and (**b**) D^* of each device under 365 nm UV illumination at various light intensities

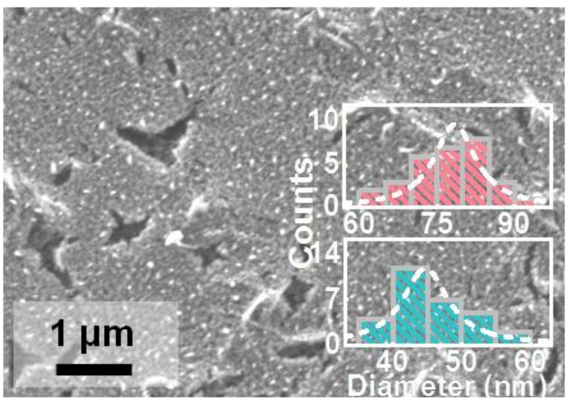

Fig. S6 SEM images of the device Al/ZnO-8 nm

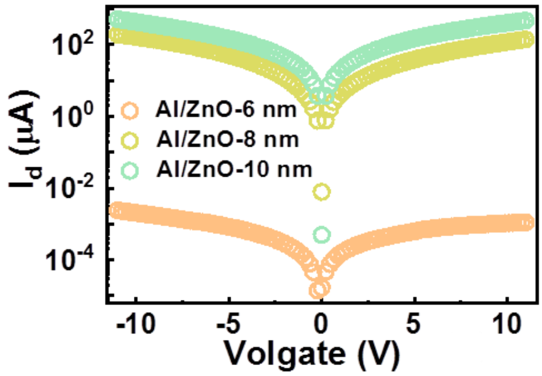

Fig. S7 Current-voltage curves of the device fabricated with various deposition thicknesses

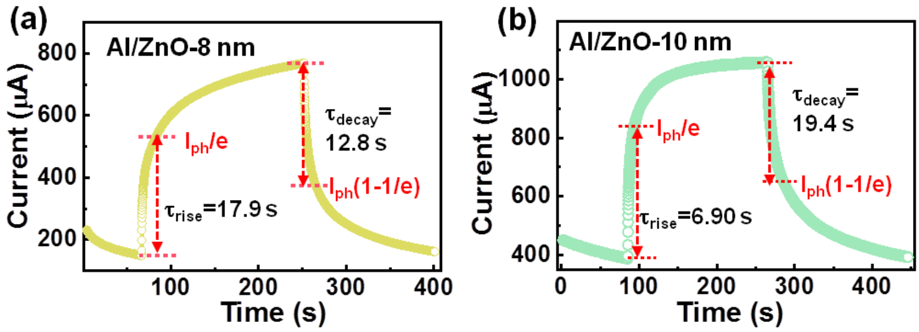

Fig. S8 Time-resolved photoresponse of devices (**a**) Al/ZnO-8 nm and (**b**) Al/ZnO-10 nm under 365 nm light illumination (6.9 mW cm^{-2}) at a 10 V bias

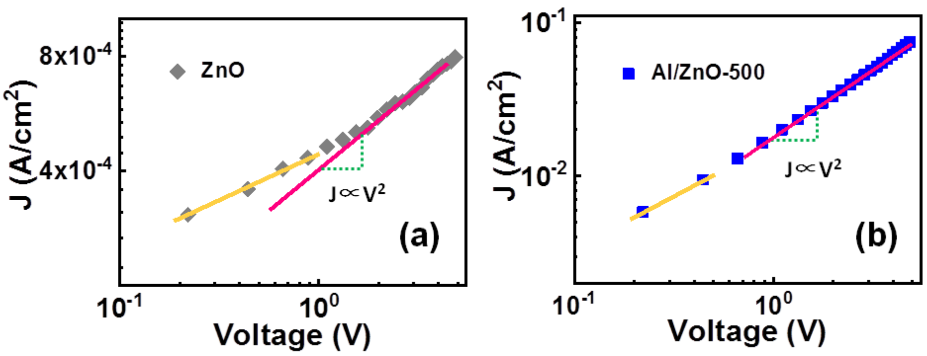

Fig. S9 Logarithmic current density-voltage (J-V) characteristic of the pristine ZnO (**a**) and Al/ZnO-500 heterostructure (**b**)

Table S1 Average dimension of long axis (*D*1) and minor axis (*D*2), and density of the Al NSs of the devices Al/ZnO-8 nm and Al/ZnO-10 nm

Samples	*D1* (nm)	*D2* (nm)	Density (cm^{-2})
Al/ZnO-8 nm	78.1	45.4	3.2×10^{7}
Al/ZnO-10 nm	95.6	46.3	2.5×10^{7}

S2 Caculation of the Carrier Mobility

The electron mobility was calculated by using the Mott–Gurney space-charge-limitedcurrent (SCLC) equation [S1, S2]:

$$J = \frac{9}{8}\mu_{eff}\varepsilon_0\varepsilon_r\frac{V^2}{d^3}$$

where J is the current density, μ_{eff} is the effective charge carrier mobility, ε_0 is the permittivity of the vacuum, ε_r is the relative dielectric constant, V is the applied voltage, and d is the thickness of the active layer. The value of ε_r for ZnO is 2.9 according to the previous reports [S3]. The effective carrier mobilities are 0.084 and 0.197 $cm^2\ V^{-1}\ s^{-1}$ for the pristine ZnO and Al/ZnO heterostructure, respectively. Thus, the inter-diffusion of Al to ZnO matrixs slightly improved the carrier mobility, which was of benefit for the improvement of photocurrent.

Supplementary References

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