Supplementary information

Surface charge transfer induced p-CdS Nanoribbon/n-Si heterojunction as fast-speed self-driven photodetector

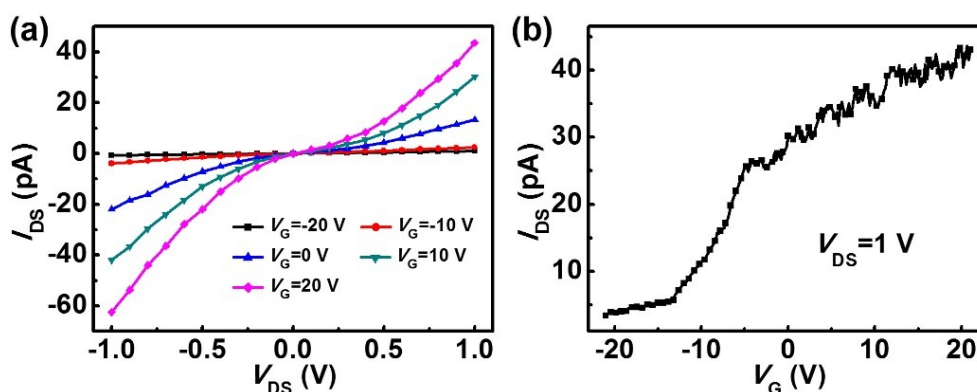*By Chao Xie, Fangze Li, Longhui Zeng, Linbao Luo, Li Wang, Chunyan Wu, Jiansheng Jie*

Fig. S1 (a) I_{DS}-V_{DS} characteristics of the FET measured at varied V_G ranging from -20 V to 20 V at a step of 10 V before coating with MoO$_3$ layer. (b) The transfer characteristic of the FET (V_{DS}=1 V) before coating with MoO$_3$ layer.

Calculation of the hole mobility/concentration of p-CdS NR: The hole mobility (μ_h) of the MoO$_3$-coated CdS NR FET can be estimated according to the formula: $g_m = \partial I_{DS}/\partial V_G = (Z/L)\mu_h C_0 V_{DS}$, where Z/L is the ratio of channel width to channel length and is equal to 1.15/12.5 for our configuration, and $C_0 = 1.15\times10^{-8}$ F/cm^2 is the gate capacitance per unit area.[1] The transconductance (g_m) is deduced to be ~ 0.39 μS by fitting the linear part of the I_{DS}-V_G curve at a fixed V_{DS} of 0.2 V (Inset in Fig. 2(b)). Based on these values, a hole mobility of $\mu_h =$ 1850 cm^{2}V^{-1}s^{-1} is obtained for as-prepared p-CdS NR. Then, the hole concentration (n_h) is calculated to be 6.62$\times10^{17}$ cm^{-3} based on the following relation: $n_h = 1/\rho q \mu_h$, where ρ is the channel electrical resistivity and p is the elementary charge.[2] Similarly, the electron mobility (μ_e) and electron concentration (n_e) for u-CdS without MoO$_3$ coating can be estimated to be 7.8$\times10^{-3}$ cm^{2}V^{-1}s^{-1} and 2.11$\times10^{15}$ cm^{-3}, respectively, based on Fig. S1.
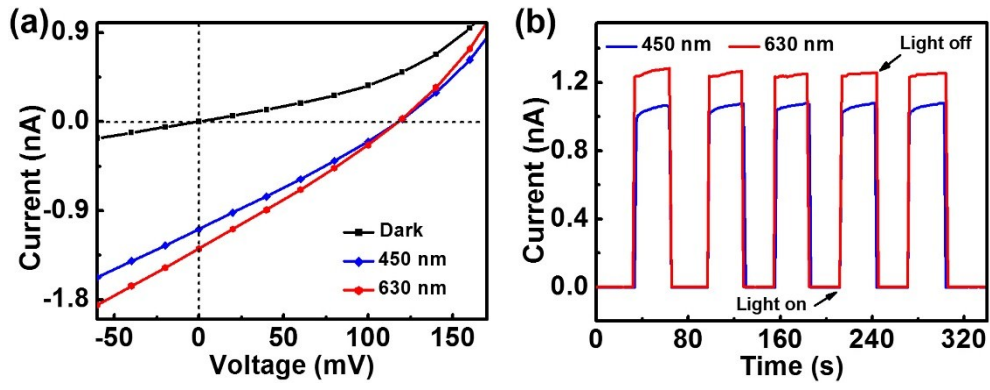
Fig. S2 (a) *I-V* curves of the p-CdS NR/n-Si heterojunction in dark and under illuminations with wavelength of 450 nm and 630 nm (light intensity: ~ 1.1 mWcm^{-2}), respectively. (b) Time response of the heterojunction device to 450 nm and 630 nm light, respectively.

References

[1] J. S. Jie, W. J. Zhang, Y. Jiang and S. T. Lee, *Appl. Phys. Lett.*, 2006, **89**, 133118.

[2] S. M. Sze and K. K. Ng, *John Wiley & Sons*, Hoboken, NJ, 2007.