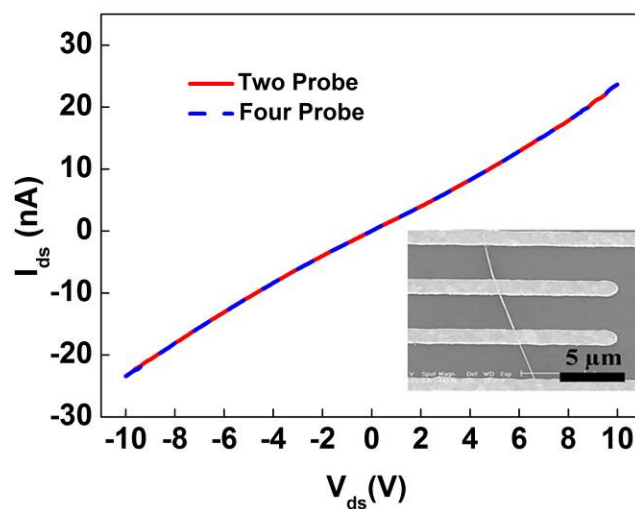
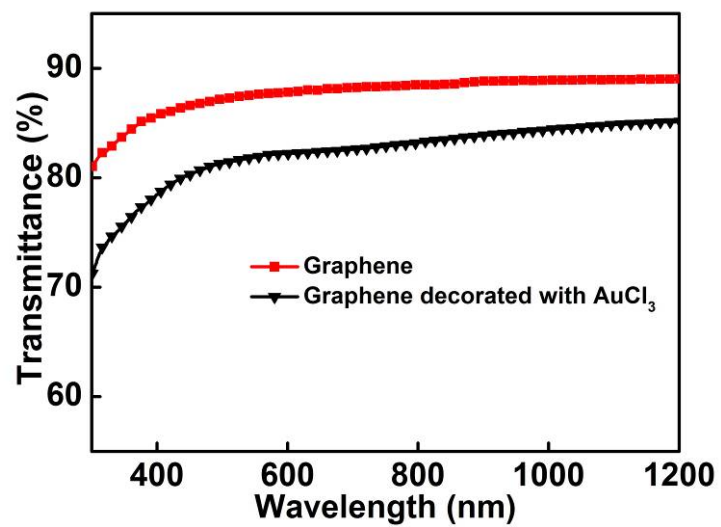


## Supporting Information



**Fig. S1**  $I$ - $V$  curves of a single p-ZnSeNW measured by two-probe and four-probe methods, respectively, with Cu/Au (4 nm/50 nm) electrodes. Inset shows the SEM image of the device for four-probe measurement.



**Fig.S2** Transmittance spectra of the multi-layer graphene film measured before and after AuCl<sub>3</sub> (10 mM) modification.

**Table S1.** Device characteristics of the ZnSeNR/SiNW p-n heterojunction arrays with different device structure under simulated AM 1.5G solar irradiation at  $100 \text{ mWcm}^{-2}$ . Three devices for each structure were measured. It is clear that the devices exhibit good stability and reproducibility.

Nano-heterojunction structures	Sample	$J_{sc}$ ( $\text{mA/cm}^2$ )	$V_{oc}$ (V)	$FF$ (%)	$\eta$ (%)
ZnSeNR/SiNW p-n heterojunction array with graphene/ $\text{AuCl}_3$ electrode	A1	7.9	0.4	22.3	0.71
	A2	8.1	0.41	22.9	0.76
	A3	8.3	0.4	23.4	0.78
ZnSeNR/SiNW p-n heterojunction array with Cu/Au electrode	B1	4.7	0.28	39.0	0.51
	B2	5.1	0.28	39.6	0.56
	B3	5.5	0.28	40.1	0.61
Drop-casted p-ZnSeNRs/ $\text{CH}_3$ -SiNW array with Cu/Au electrode	C1	11.5	0.35	42.3	1.71
	C2	13.9	0.35	46.8	2.27
	C3	14.1	0.35	44.1	2.17