

## Supporting Information

### **Ultrasensitive self-driven broadband photodetector based on 2D- WS<sub>2</sub>/GaAs type-II Zener heterojunction**

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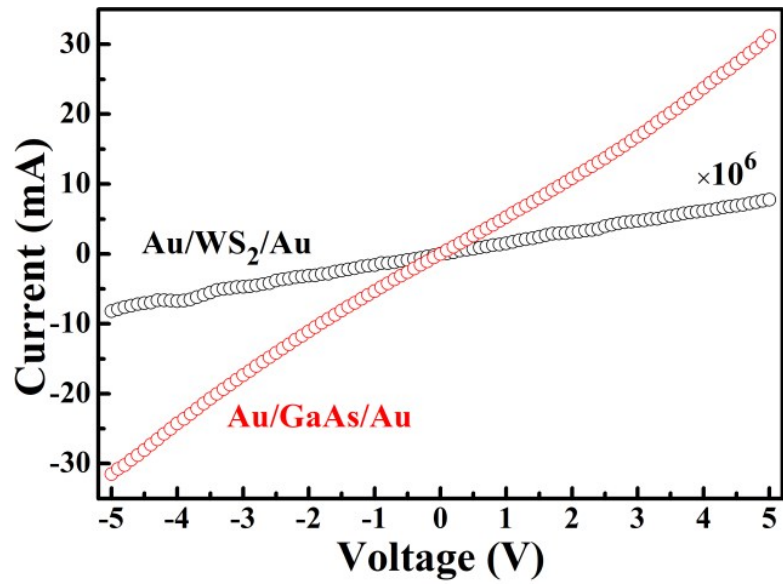
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**Fig. S1** The  $I$ - $V$  curves of the GaAs and WS<sub>2</sub> film with Au electrodes, indicating reliable Ohmic contacts with typical linear electric transport behaviors.

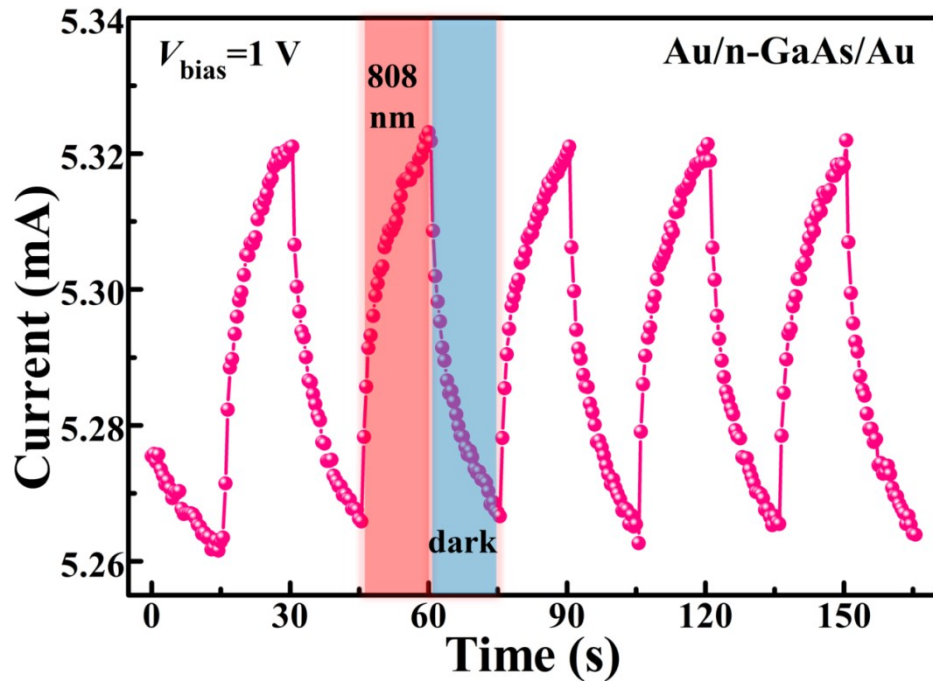
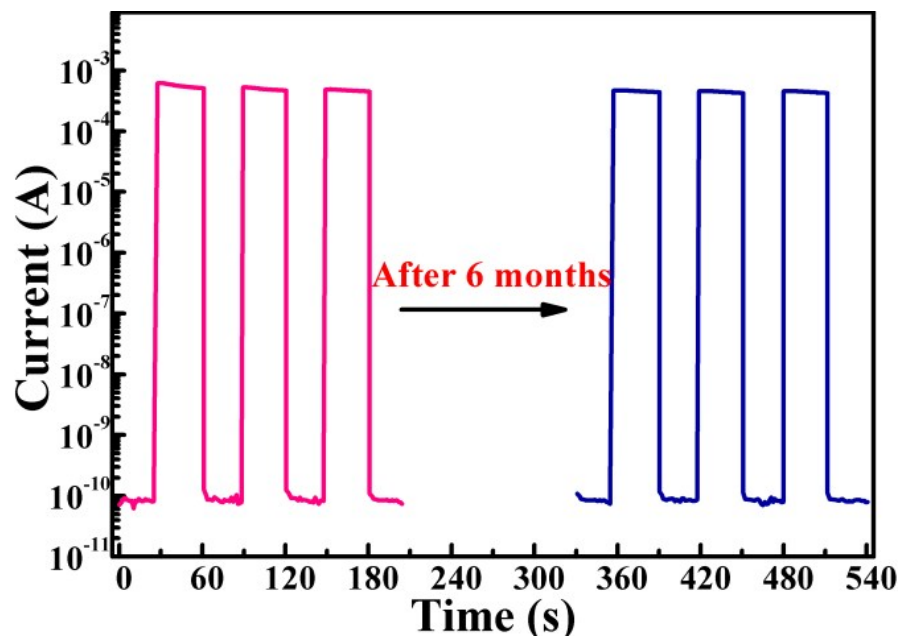
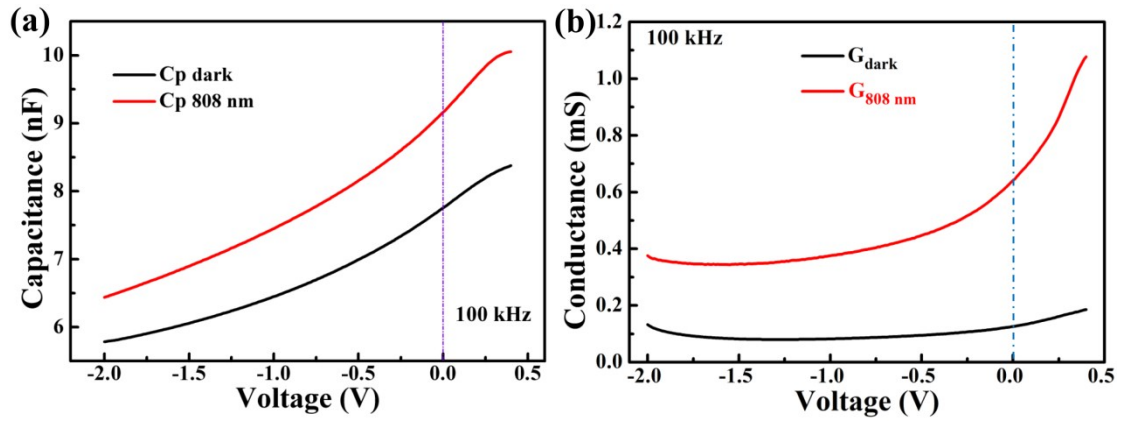


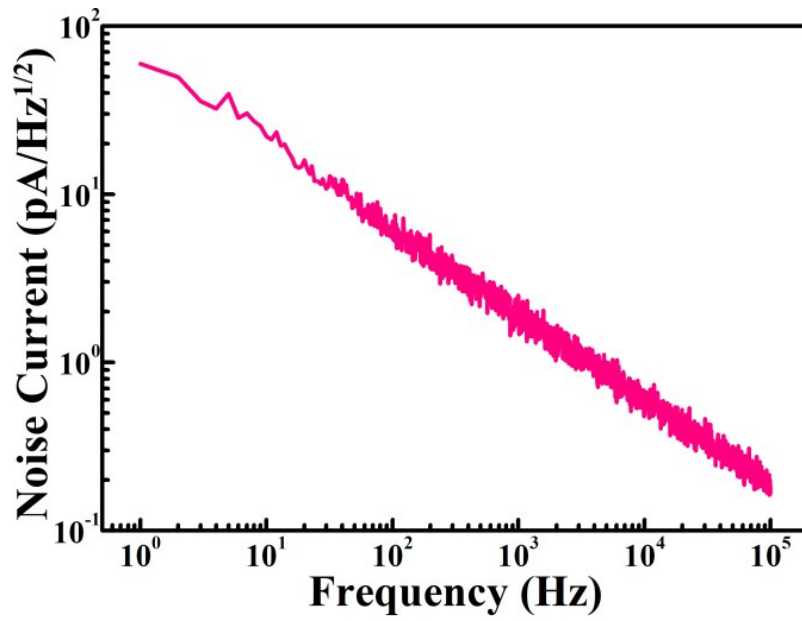
Fig. S2 The photoresponse property of GaAs to the light of 808 nm.



**Fig. S3** Stability of the device with real-time response before (pink) and after (blue) air-storage for six months.



**Fig. S4** (a) and (b) The Capacitance and Conductance of the WS<sub>2</sub>/GaAs heterojunction as a function of bias voltage under 808 nm illumination and dark condition, respectively. Test frequency is 100 kHz.



**Fig. S5** Spectra of current noise power density of the WS<sub>2</sub>/GaAs heterojunction device at 0 bias. The noise current at the bandwidth of 1 Hz in the dark is 59.7 pA.