

Supplementary Materials

Low-Noise Mid-Infrared Photodetection in BP/h-BN/Graphene van der Waals Heterojunctions

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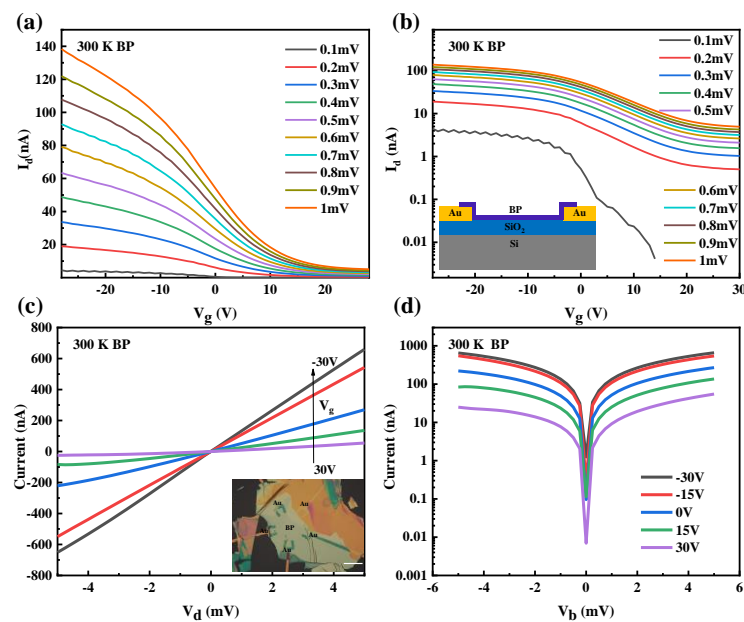


Figure S1. (a) Transfer curves obtained from a black phosphorus (BP) device at 300 K with different source-drain voltages (from 0.1 mV to 1 mV). (b) Logarithmic current-bias plot of the data in (a). The inset is the device schematic on a BP photo-transistor. (c) Linear current with two-terminal configuration characteristics at room temperature, demonstrating that the contacts between the metal electrodes and BP flakes are Ohmic. The inset shows an optical image of the BP device. (d) Logarithmic current-bias plot of the data in (c).

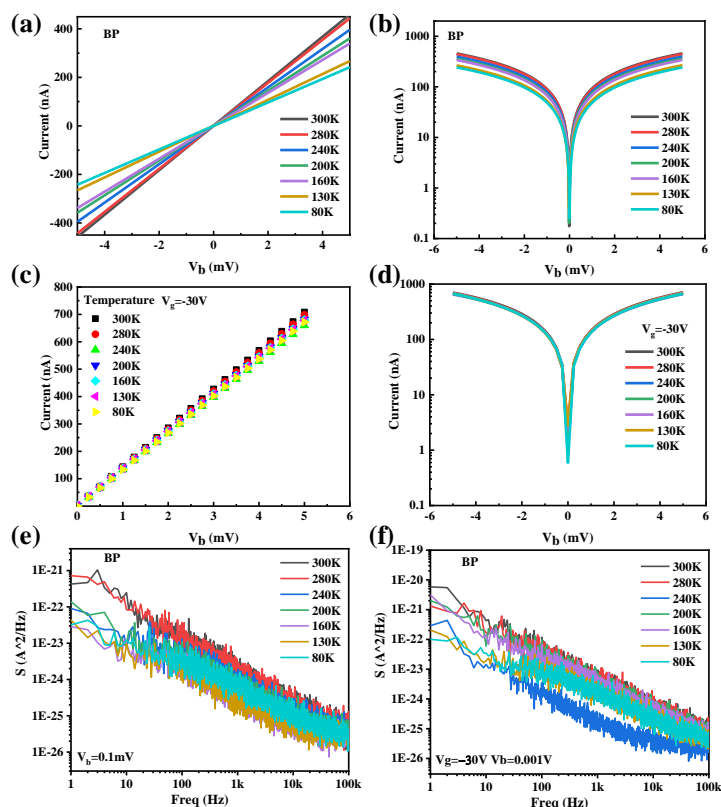


Figure S2. (a) Source-drain current as a function of temperature in a back phosphorus (BP) device at zero gate bias. (b) Logarithmic current-bias plot of the data in (a). (c) Source-drain current as a function of the temperature in a BP device at $V_g = -30$ V. (d) Logarithmic current-bias plot of the data in (c). (e) Noise spectral density $S(I^2)$ in the BP device at various temperatures and 0.1 mV source-drain bias. (f) Noise spectral density $S(I^2)$ in the BP device at various temperatures with a -30 V gate voltage and 1 mV source-drain bias.

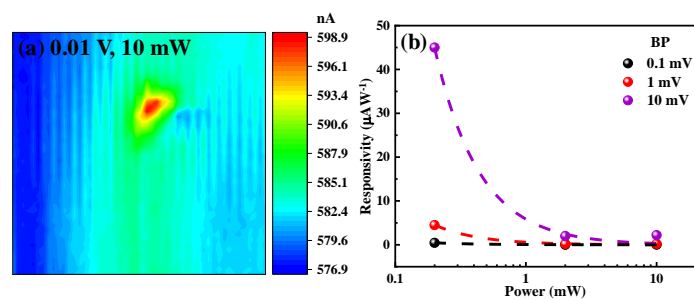


Figure S3. Photocurrent and photoresponsivity measurement in the black phosphorus (BP) device. (a) Photocurrent mapping in a BP device at a 10 mW average power and $V_b = 0.01$ V. (b) Responsivity as a function of excitation power at various V_b values.