Supporting Information

UV-light-assisted gas sensor based on $PdSe_2$/InSe heterojunction for ppb-level NO_2 sensing at room temperature

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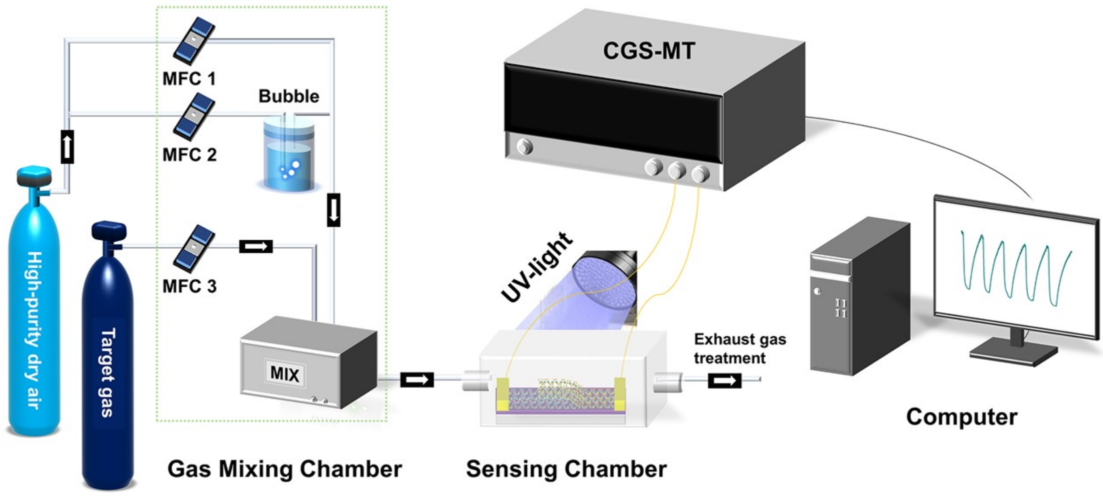

Scheme S1. Schematic diagram of the intelligent gas sensing platform (CGS-MT).

The room-temperature (25 °C) gas-sensing performance of this device was measured by an intelligent gas-sensing platform (CGS-MT, Elite Tech Co. Ltd, China) using high-purity dry air (HPDA) as background gas, as shown in Scheme S1. The sensing material was irradiated with 365 nm UV light and the intensity of UV light measured by the energy meter (Coherent FieldMaxII-TO) was about 0.6 mW/cm^2. Note that all initial gases are in the standard 4 L cylinders with a purity larger than 99.9% before they are adjusted to a determined concentration. Then, the target gases were achieved by adjusting the ratio of target gases to the carrier gas (HPDA) via the self-controlled mass flow controllers (MFC), and the total flow rate of the gas mixture was 300 mL·min^{-1}. According to the equation: $C_1 = \frac{F_0}{F_0 + F_1} \cdot C_0$ (where C_1 is the mixed target gas concentration, C_0 is the standard gas concentration in the cylinder, and F_0 and F_1 are the flow rates of target gas and HPDA, respectively. The sum of F_0 and F_1 is 300 mL·min^{-1}.), when C_0 is 300 ppm NO_2, and F_0 and F_1 are controlled to be 10 and 290 mL·min^{-1}, respectively, C_1 is expected to be 10 ppm. The other NO_2 gases with concentrations of 0.1 ppm, 0.5 ppm, 1 ppm, 3 ppm, 5 ppm, and 20 ppm and the other gases of 10 ppm NO, NH_3, H_2, CO, and ethanol were obtained in the same way.

Note that in the study of the effect of humidity toward NO_2, the dry air was divided into two ways, and one way was fed into the bubble to get humidity gas. Then, the stable relative humidity (RH) values were obtained by adjusting the mass flow ratios of dry and humidity gases in RH experiments.

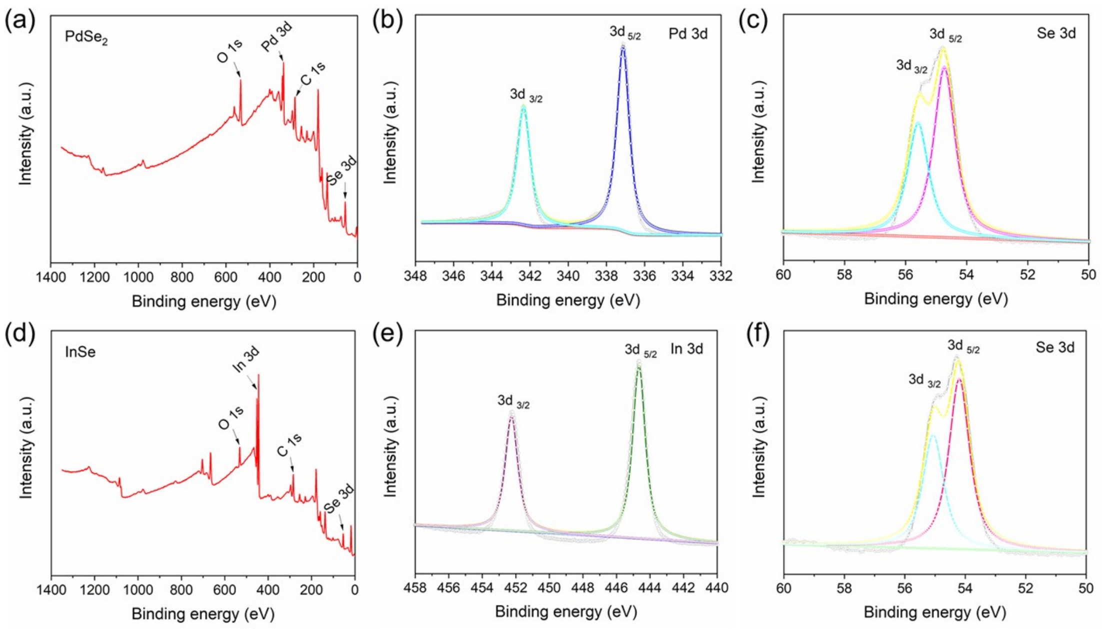

Fig. S1 XPS spectra. (a-c) Survey, Pd 3d, and Se 3d spectrums of the $PdSe_2$ film, respectively. (d-f) Survey, In 3d, and Se 3d spectrums of the InSe film, respectively.

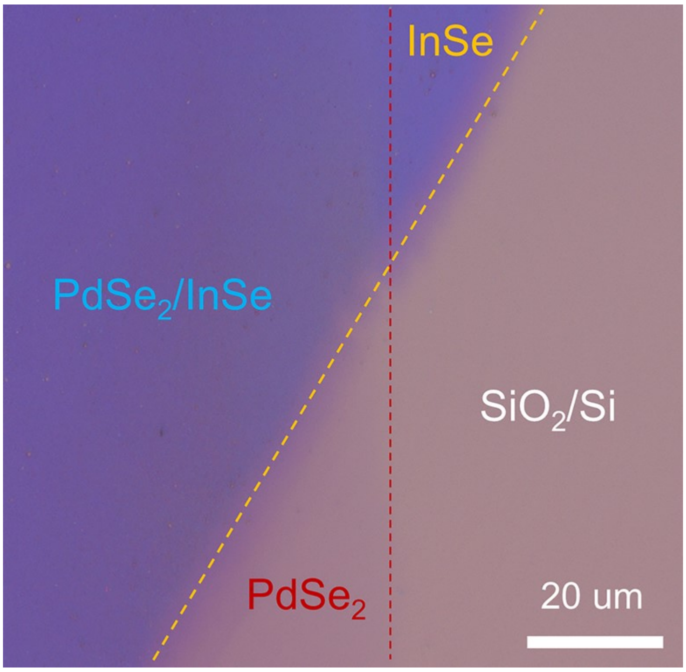

Fig. S2 Optical image of the stacked $PdSe_2$/InSe heterojunction in three different regions of the $PdSe_2$, InSe, and $PdSe_2$/InSe.

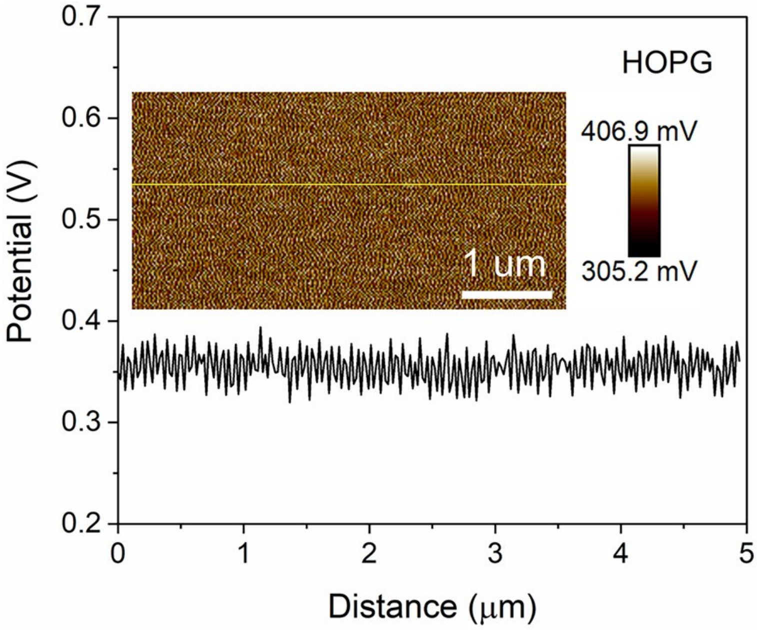

Fig. S3 By scanning a standard HOPG sample with a known work function of 4.6 eV, the V_{CPD} of HOPG was 0.37 V, and then W_{tip} was calculated to be 4.97 eV.

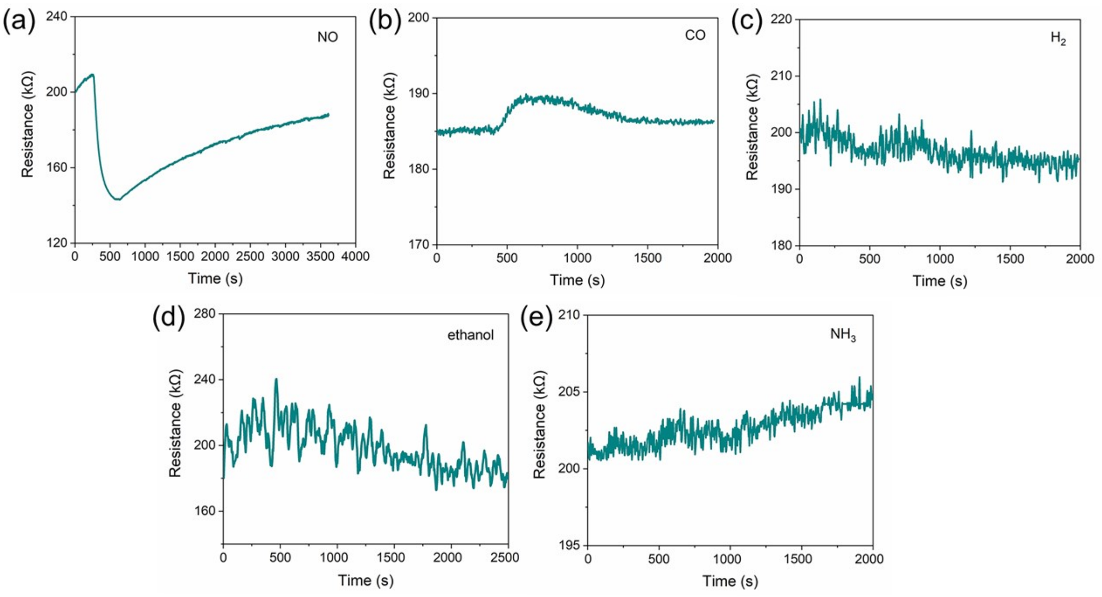

Fig. S4 The selectivity of the sensor based on $PdSe_2$/InSe heterojunction toward 10 ppm different gases of (a) NO, (b) CO, (c) H_2, (d) ethanol and (e) NH_3.

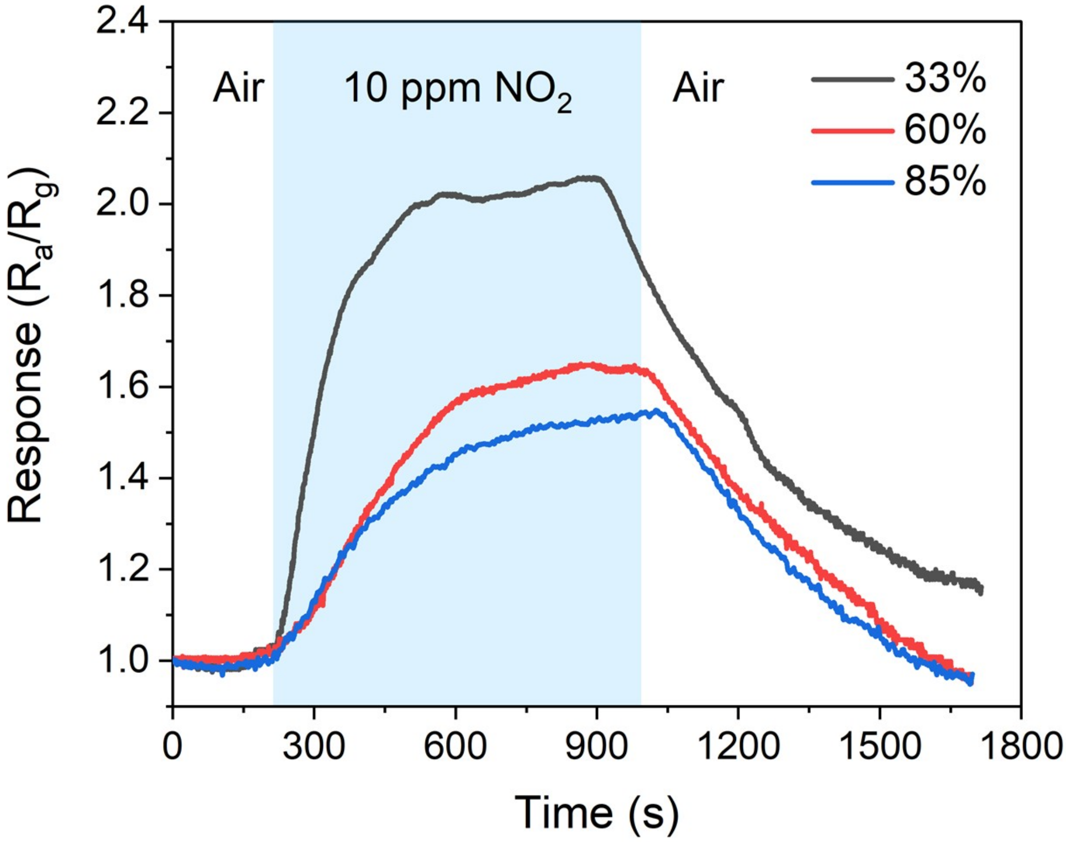

Fig. S5 Responses of the $PdSe_2$/InSe heterojunction sensor toward 10 ppm NO_2 at different relative humidity.