Supporting information

Bias-modified Schottky barrier height-dependent Graphene/$ReSe_2$ van der Waals heterostructures for excellent photodetector and NO_2 gas sensing applications

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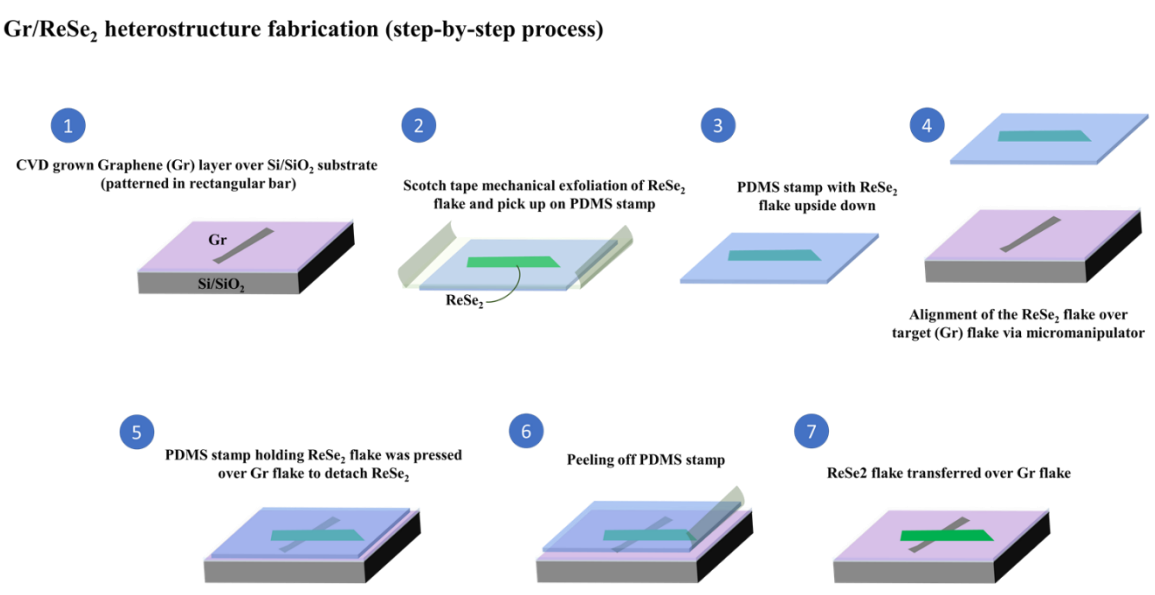

Fig. S1. Gr/ReSe2 heterostructure fabrication step-by-step detail.

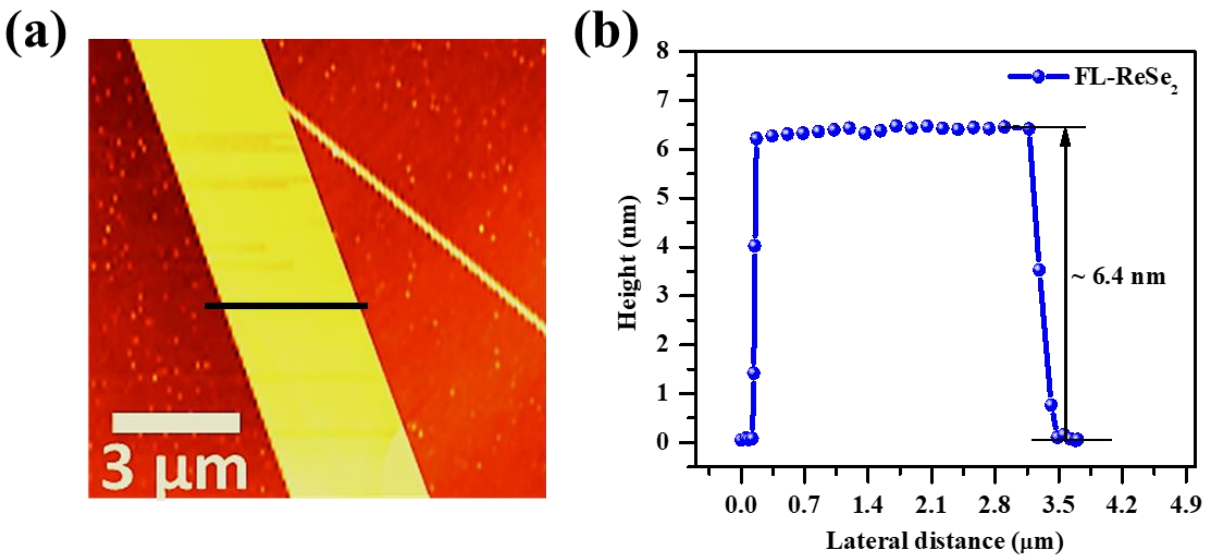

Fig. S2 (a) AFM image (scale bar: 3 µm), and (b) corresponding height profile to accurately assess $ReSe_2$ flake thickness.

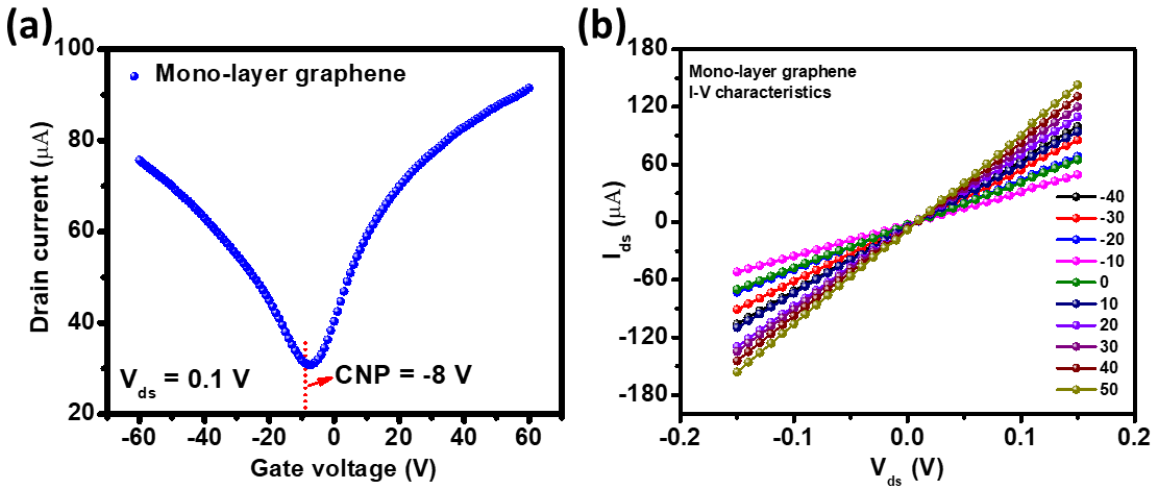

Figure S3. (a) Transfer characteristics (I_{ds} - V_{bg}) of mono-layer graphene measured at V_{ds} = 0.1 V reveals CNP = -8 V. (b) Output characteristics (I_{ds} -V_{ds}) calculated at various V_{bg} from -40 to 50 V reveal ohmic behavior of monolayer graphene.

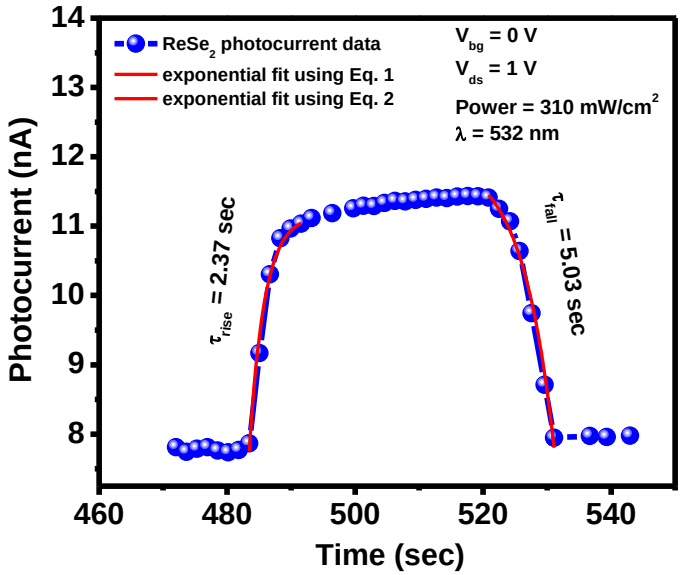

Fig. S4 Photocurrent measurement of $ReSe_2$-based photodetector at mentioned conditions.

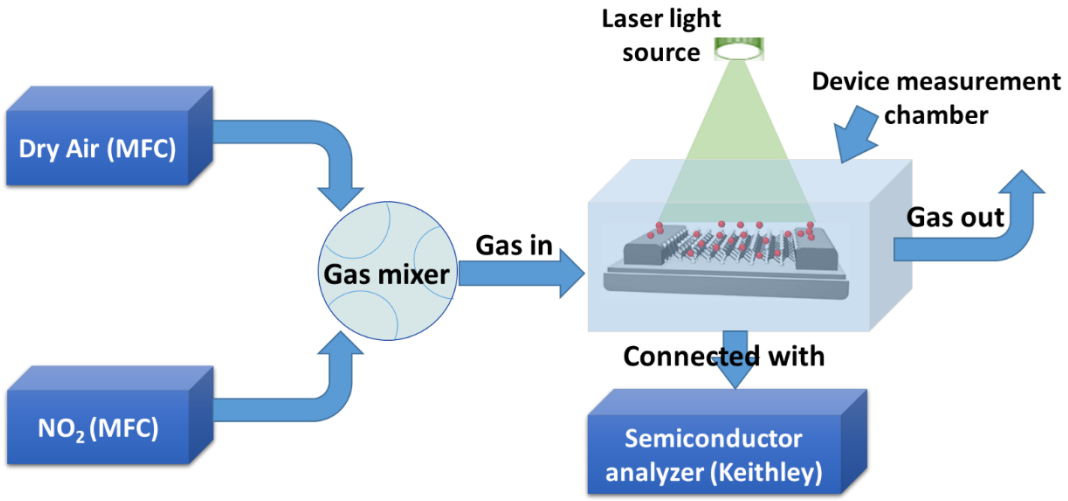

Fig. S5 MFC (mass flow controller) setup to test individual flakes (Gr, and $ReSe_2$) and Gr/$ReSe_2$ heterostructure-based NO_2 gas sensing performance.

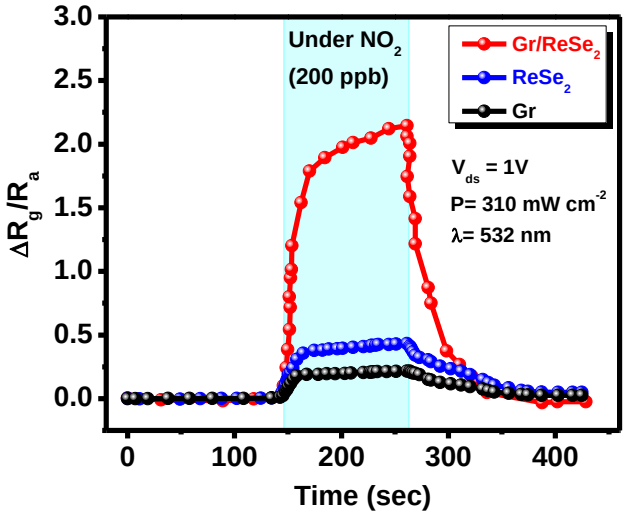

Fig. S6 Room temperature comparative analysis of Gas sensing responses from individual Gr (black), individual $ReSe_2$ (blue), and Gr/$ReSe_2$ heterostructure (red) for NO_2 (200 bb) under laser power of 310 mW cm^{-2} with a wavelength of 532 nm.

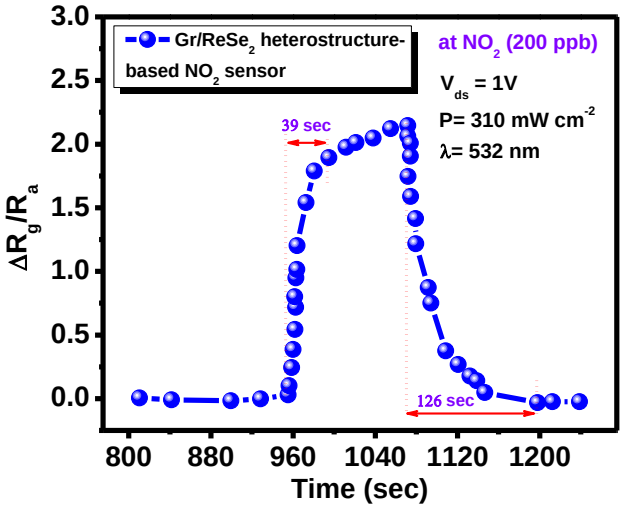

Fig. S7 Room temperature transient response of Gr/$ReSe_2$ heterostructure for NO_2 (200 ppb) under laser power of 310 mW cm^{-2} with a wavelength of 532 nm.

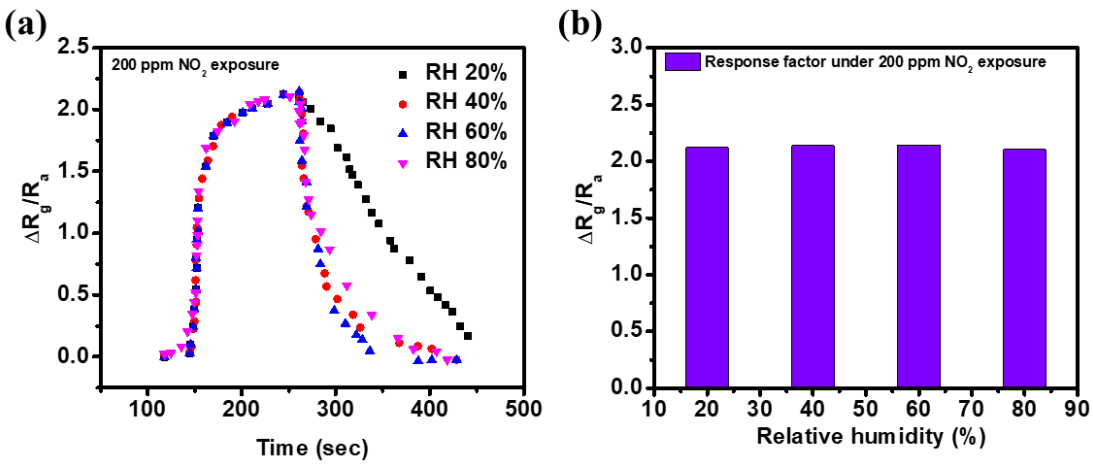

Fig. S8 (a) Response factor of Gr/$ReSe_2$-HS for 200 ppm NO_2 exposure under different values of relative humidity. (b) Corresponding column bar representation of the maximum value of response factor of Fig. (a).