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Electronic Supplementary Information for

Photovoltatic Self-powered Gas Sensor based on Single-walled Carbon Nanotubes/Si Heterojunction

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Fig.S1 is the schematic fabrication procedure of the self-powered gas sensor based on SWNTs/Si. First lithography mask with different patterns were designed and an n-type Si wafer with a layer of 300 nm SiO_2 was patterned to expose Si surface (five identical effective sensing area 5*100 μm*500 μm and one area for sputtering electrode 400 μm*400 μm) via photolithography and reactive ion etching (RIE). Second, patterned Ti/Au electrodes (~20 nm Ti and ~150 nm Au) were fabricated by photolithography and sputtering processes. After fabricating the microchip, SWNTs (Sigma Inc.) were purified by annealing under 300 °C for 2 h in a tube furnace and then treated with concentrated HCl and 30 % H_2O_2 with volume ratio 3:1 at 60 °C for 6 h. The purified SWNTs were dispersed in dimethylformamide (DMF) via sonication for 4 h to form homogenous SWNTs dispersion (0.01 mg/ml). The as-prepared SWNTs dispersion was then drop-casted onto the prefabricated sensor chip to form a SWNT network. To remove the solvent left on SWNT network and reduce the contact resistance between SWNTs and the Ti/Au electrodes, the prepared devices were annealed in a tube furnace under pure Ar gas at 300 °C for 20 minutes.

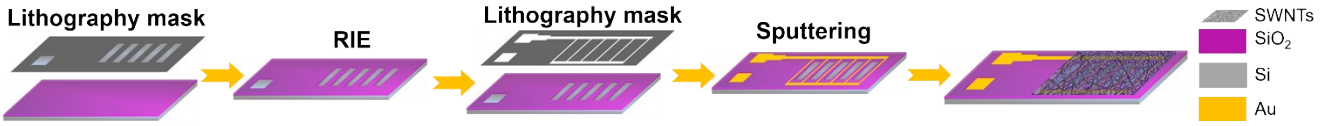

Fig.S1 The schematic fabrication process of gas sensor

Fig.S2b is the SEM image of the SWNT film which is covered on the Si and SiO_2 surface. As the thickness of SiO_2 layer is 300 nm, there is an obvious ledge at the interface of Si and SiO_2 layer and mesh-like SWNT film is worked as a bride to connect Si and SiO_2. Fig.S2a,c are the EDX results of two different locations (Si/SWNTs and Si/SiO_2/SWNTs). The contents of C atom in both locations are very low which can indicate that the SWNT film is very thin. By comparison, the percentage of O atom increases from 0% to 19.51% owing to the existing of SiO_2 layer.

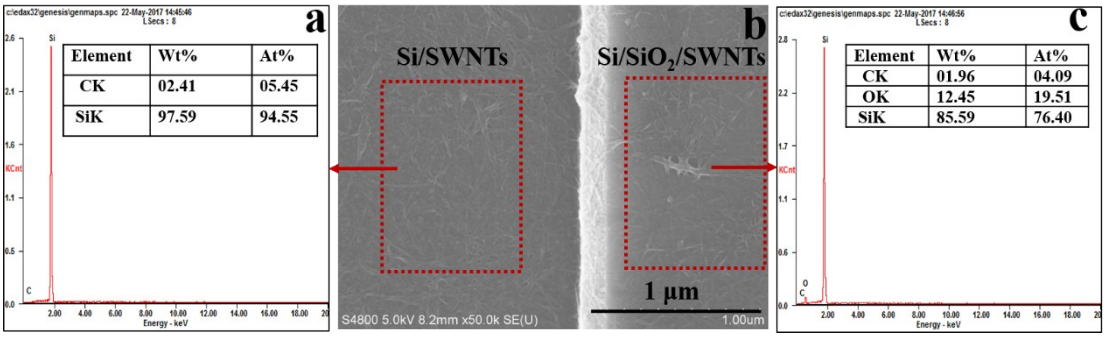

Fig.S2 a.c The EDX results of sensor at different locations; b The SEM image of the sensor at specific.

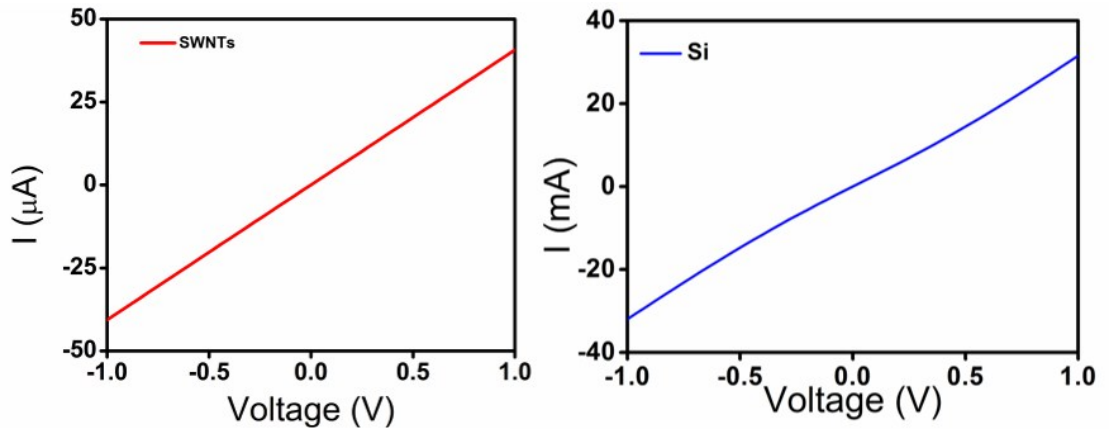

Fig. S3 (a) The Current-Voltage (I-V) curves of SWNTs-only device after annealed treatment. (b) The Current-Voltage (I-V) curves of n-Si-only device.

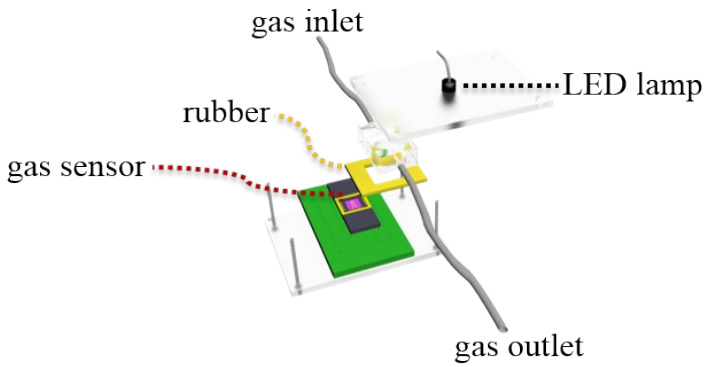

Fig. S4 The schematic graph of gas sensor testing process, all parts of the testing system are vertically placed.

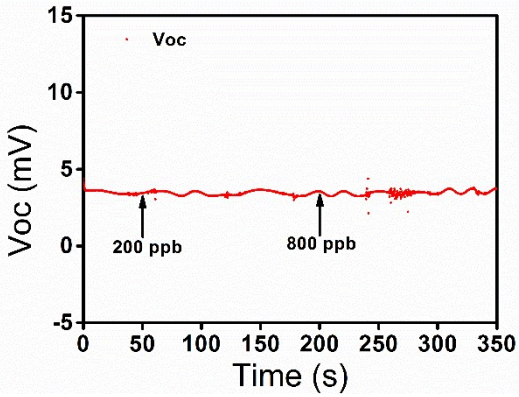

Fig. S5 The response of photovoltaic self-powered gas sensor under dark state.

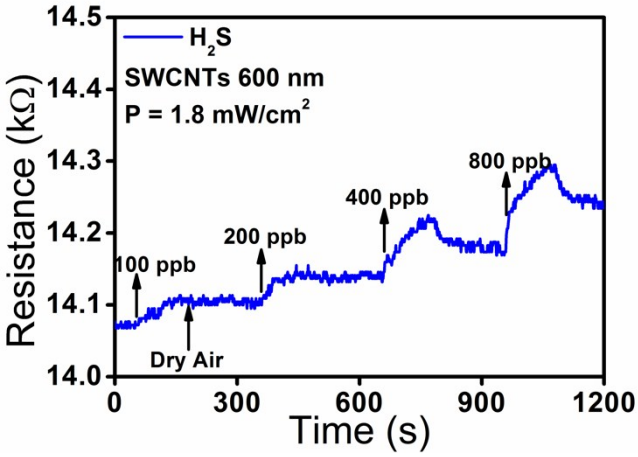

Fig. S6 The dynamic response of conventional SWNTs-only device to different H_2S concentration (V_{ds} = 2 V, λ = 600 nm, P = 1.8 mW/cm^2).

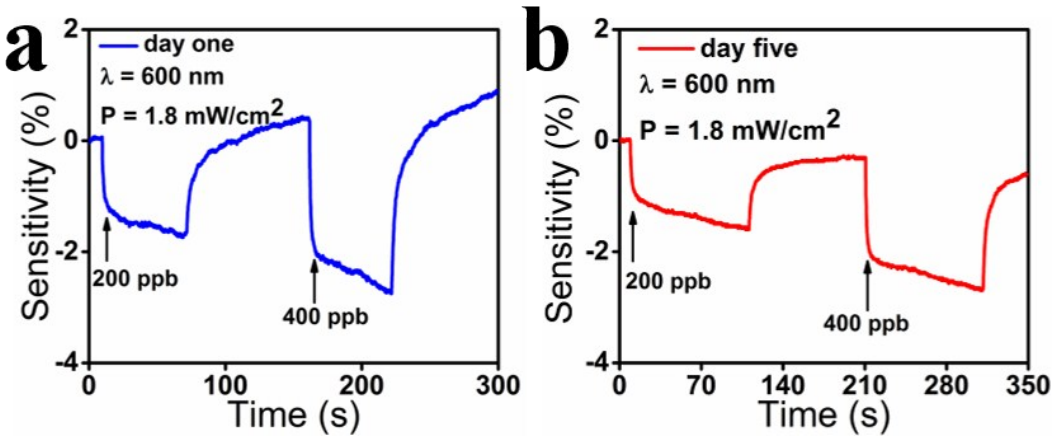

Fig. S7 The dynamic response of sensor to different concentration of H_2S at day one (a), and after five days (b) (λ = 600 nm, P = 1.8 mW/cm^2).