Supplementary Information

Ag Nanoparticles Modified Cross-linked SnO_2 Nanosheets for Formaldehyde Vapor Detection

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1 Characterization

The products were characterized by XRD (Shimadzu XRD-6000) using high-intensity Cu Kα radiation with a wavelength of 1.54178 Å, as well as FESEM (Hitachi S-4800, operated at 5 kV), HRTEM (JEOL-2010 TEM) with an acceleration voltage of 200 kV, and N_2 adsorption–desorption isotherm measurements (Nova 2000E). The pore-size distribution was determined from the desorption branch of the isotherm using the Barrett–Joyner–Halenda (BJH) method. XPS (ESCALAB 250) was also performed. The elemental distribution of products was determined by EDS (Hitachi S-4800, operated at 15 kV).

2 Preparation and measurement of gas sensors

Figure S1 presents the experimental setup. The sensors were fabricated as follows: 0.1 g cross-linked Ag@SnO_2 nanosheets, and cross-linked SnO_2 nanosheets were dispersed in 0.3 ml of ethanol to produce a uniform suspension. This suspension was coated uniformly onto the outer surface of an aluminum tube on the bottom, of which a pair of Au electrodes were printed. The working temperature of the gas sensor was achieved by placing a Ni–Cr heater coil into the ceramic tube (Figure S2a). The sensor was then dried for 3 h at 60 °C, calcined for 2 h at 300 °C, and conditioned for 72 h at 300 °C for 72 h in air to improve its stability. A stationary-state gas distribution method was used to determine the gas response using an electrochemical workstation (CHI-660E, Shanghai Chenhua Instruments Co, Ltd., Shanghai, China) using a potentiostatic method with an applied voltage of 0.7 V. Gases were injected into the organic glass test chamber and mixed with air. As for reductive gases, the sensor response was defined as R_a/R_g, where R_a is sensor resistance in dry air, and R_g is sensor resistance in dry air containing test gas. In the measurement system, the responses could also be calculated using I_a/I_g, where I_a and I_g are air and test gas sensor currents, respectively. The response and recovery times were defined as the times required for sensor output to reach 90% saturation after applying or switching off the gas supply.

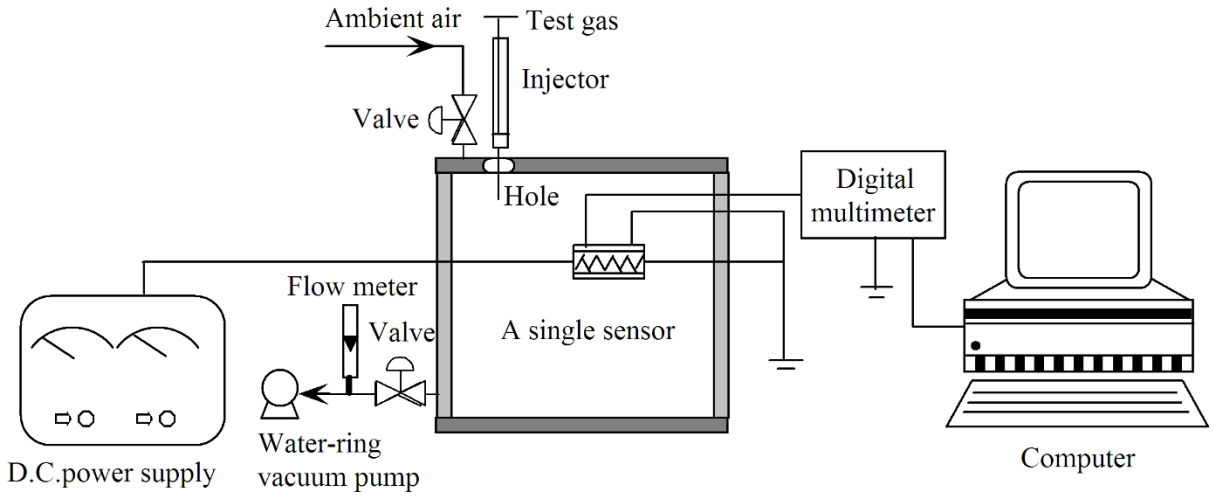

Figure S1. Experimental setup.

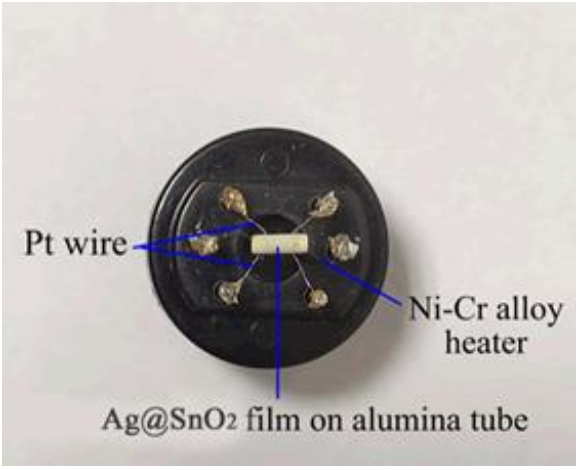

Figure S2. Photograph of the sensor.

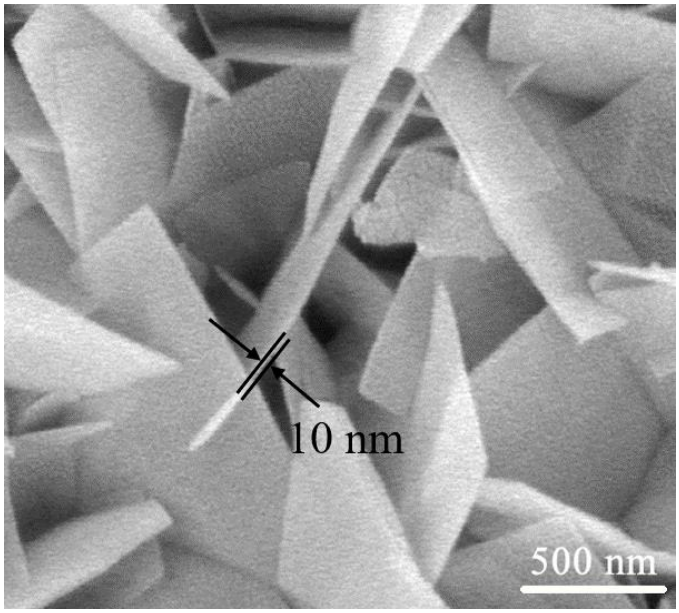

Figure S3. High magnification SEM image of cross-linked SnO_2 nanosheets.

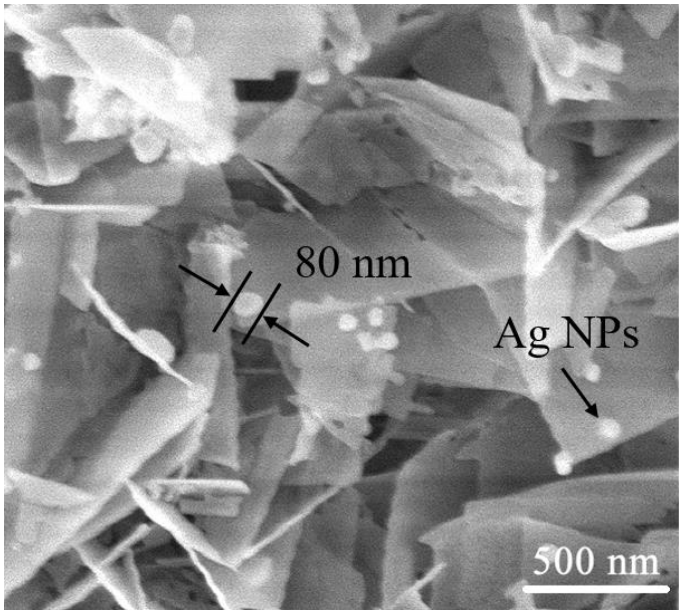

Figure S4. High magnification SEM image of cross-linked Ag@SnO_2 nanosheets.

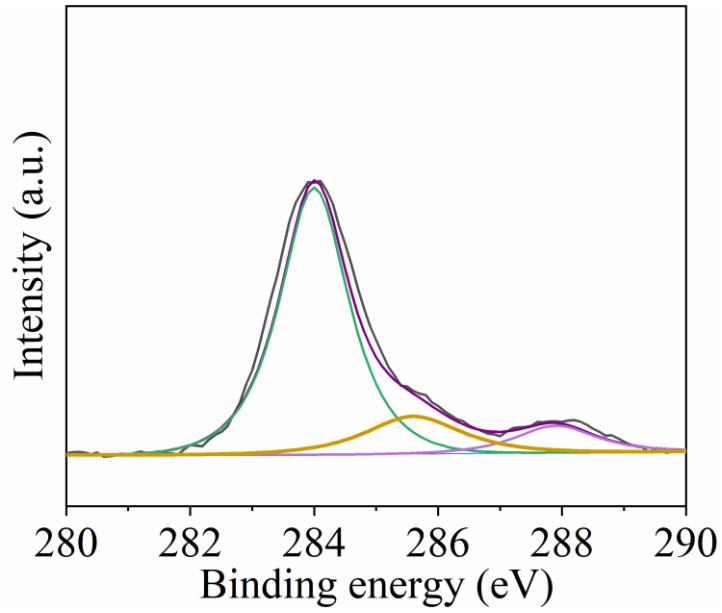

Figure S5. C 1s spectrum of cross-linked Ag@SnO_2 nanosheets.

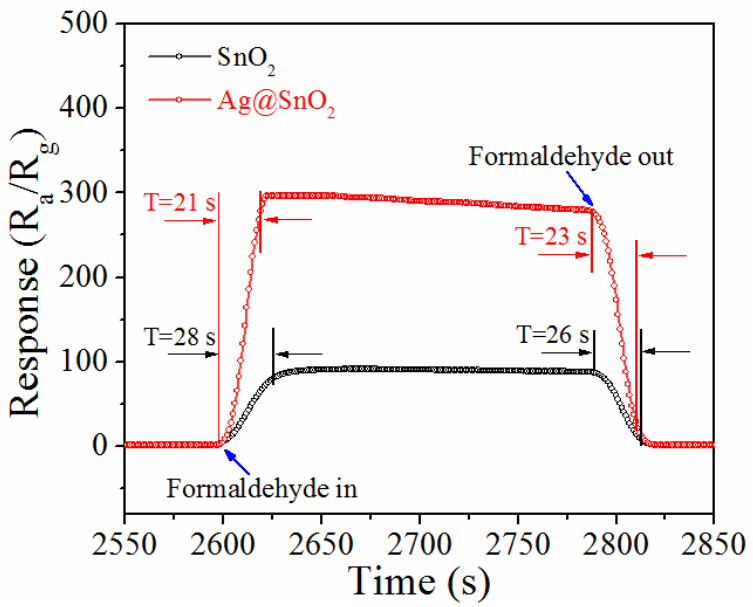

Figure S6. Response and recovery characteristics of cross-linked Ag@SnO_2 nanosheets and pure cross-linked SnO_2 nanosheet sensors to 100 ppm formaldehyde vapor.

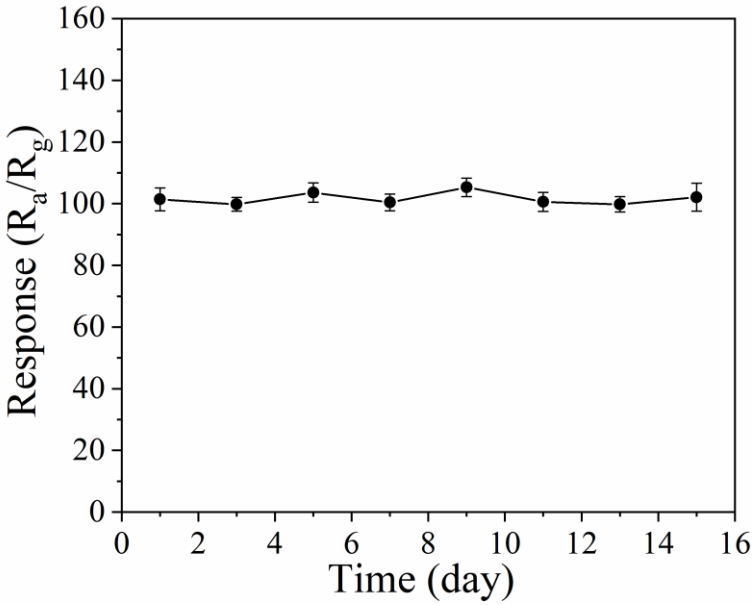

Figure S7. Long-term stability of the Ag@SnO_2 sensor towards 100 ppm formaldehyde vapor at the working temperature of 140 °C.

Table S1 Responses of SnO_2-based gas sensors towards different concentrations of formaldehyde vapor.

Sensing materials	Concentration (ppm)	Working temperature (°C)	Response	Ref.
SnO_2 nanoparticles	20	200	13	[13]
SnO_2 nanoflowers	100	300	34.6	[20]
Flower-like SnO_2 microspheres	50	275	38.3	[41]
Pt-SnO_2 nanospheres	1	200	16	[14]
Hollow PdO/ZnO/SnO_2 nanospheres	10	140	5.3	[42]
Ag-SnO_2 nanoparticles	10	125	14.4	[34]
Flower-like Bi-SnO_2 nanostructures	100	170	36.2	[43]
Cross-linked Ag@SnO_2 nanosheets	100	140	101.4	This work