Supplementary information

Controlling the Morphologies of WO_3 Particles and Tuning the Gas Sensing Properties

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1. Experimental Section:

Reagents: $Na_2WO_4.2H_2O$, HCl (37.5%) and tartaric acid were purchased from commercial suppliers (Sinopharm Chemical Regent) and used as received without further purification.

Synthesis and characterization of WO_3 sheet: In a typical synthesis, $Na_2WO_4.2H_2O$ (0.33 g, 1 mmol) and tartaric acid (0.1 g. 0.67 mmol) were added in order to H_2O/HCl (15 mL, 2/1 V/V) under intense ultrasonic treatment. The resulting solution was transferred to a Teflon-lined stainless steel autoclave and kept at 160 ^oC for 24 h. The products were collected by centrifugation at 8000 rpm, and washed several times with deionized water and ethanol. The thickness of the sheets can be changed by tuning the amount of tartaric acid. The samples were calcinated at 350 ^oC for 4 h before characterization.

The composition and phase of the as-prepared products were determined by means of the powder XRD pattern, recorded on a Panalytical X-pert diffractometer with CuKa radiation. The morphology and crystal structure of the as-prepared products were observed by SEM (S4800) and HRTEM (JEL 2100) with an acceleration voltage of 200 kV. All TEM samples were prepared by depositing a drop of diluted suspension in ethanol on a copper grid coated with carbon film. The surface areas of the three types of WO_3 particles were measured by the BET method by measuring nitrogen-adsorption and -desorption isotherms on a Micrometrics ASAP 2020 system.

Gas-sensing test on the WO_3 sheet: The gas-sensing tests were performed in a WS-30A measuring system (Zhengzhou Winsen Electronics Technology, China). In a typical test, a gas sensor was fabricated by coating a certain amount of WO_3 paste (consisting of WO_3 particles and the ethanol solvent) onto a ceramic tube that was previously mounted with gold electrodes and

platinum conducting wires. A resistor wire coil was inserted in the tube as a heater to provide working temperatures from 200 to 500 ^{o}C by varying the heating current. The analytes were injected either directly into the chamber or, in the case of liquids like ethanol, onto a metal-plate heater in the test chamber and evaporated completely by heating. The gas-sensing capability of the sensor was defined as the ratio R_{gas}/R_{air}, where R_{gas} and R_{air} are the electrical resistance of the sensor in test gas and in air at the working temperature of about 350 ^{o}C, respectively.

2. The calculation process of the percentage of different facets

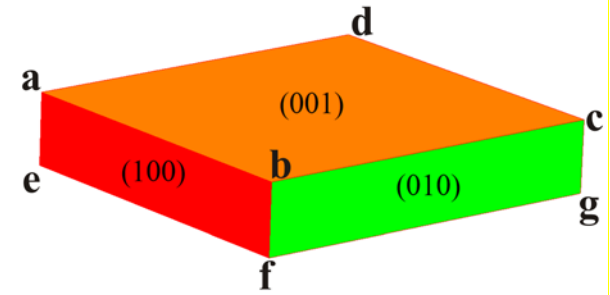

Figure S1. Schematic model of an ideal WO_3 nanosheet

From Figure S1, we can calculate that

S(001) = ab * bc $\approx ab^2$; S(100) = ab * ae; S(010) = bc * bf = bc * ae

$$\textbf{S(001)\%} = \frac{S(001)}{S(001)+S(100)+S(010)} * 100 = \frac{ab^2}{ab^2 + ab*ae + bc*ae};$$

$$\textbf{S(100)\%} = \frac{S(100)}{S(001)+S(100)+S(010)} * 100 = \frac{ab*ae}{ab^2 + ab*ae + bc*ae};$$

$$\textbf{S(010)\%} = \frac{S(010)}{S(001)+S(100)+S(010)} * 100 = \frac{bc*ae}{ab^2 + ab*ae + bc*ae}$$

The lengths of ab , bc and ae have been estimated by gathering statistics of one hundred of particles, and then calculated the average values. The inaccuracy has been labeled after the value.

Sample No	ab (nm)	ae (nm)	bc (nm)
Sample 1	240（± 10)	33 (± 5)	240（± 10)
Sample 2	140 (± 15)	65 (± 5)	140 (± 15)
Sample 3	228 (± 10)	160 (± 10)	228 ((± 10)

Base on the above formulas and the lengths of ab , bc and ae, the percentage of each facet can be calculated, and the inaccuracy has been labeled after the value.

Sample No	001	100	010
Smple 1	79.0% (± 3)	10.5% (± 1.5)	10.5% (± 1.5)
Smple 2	51.4% (± 5)	24.3% (± 2.5)	24.3% (± 2.5)
Smple 3	41.6% (± 3)	29.2% (± 1.5)	29.2% (± 1.5)