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Porous SnO_2 Nanoplates for Highly Sensitive NO Detection

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Supporting Information

Experimental

All the chemicals were of analytical grade and used without further purification.

Synthesis of SnS_2 nanoplates The experiment is according to our previous work with slightly modification.[1] In a typical experiment of SnS_2 nanoplates, 0.35 g $SnCl_4 \cdot 5H_2O$ and 0.8 g thioacetamide were dissolved into 25 ml distilled water, and then transferred into a Teflon-lined stainless steel autoclave of 50 ml capacity. After that, the autoclave was sealed and heated at 180 ^oC for 20 h. Finally, the resulting precipitate was collected by centrifugation, washed several times with distilled water and ethanol, and dried in air at room temperature.

Conversion of SnS_2 to SnO_2

SnO_2 were prepared by the following annealing procedure: The as-synthesized SnS_2 was heated at 500 ^oC for 2 h with the heating rate of 2 ^oC min^{-1}. The resulting precipitates washed completely several times with deionized water and ethanol, and dried at 60 ^oC in air.

Characterization

The morphology and structural characteristics were observed using X-ray diffraction (XRD, Rigaku D/max 2500 diffractometer), scanning electron microscopy (SEM, Hitachi S4800) and transmission electron microscopy (TEM; JEOL 2010 with an accelerating voltage of 200 kV). Nitrogen adsorption–desorption isotherms were obtained on an ASAP 2020 nitrogen adsorption apparatus. The Brunauer–Emmett–Teller (BET) specific surface areas (S_{BET}) were calculated using the BET equation. The desorption isotherm was used to determine the pore size distribution using the Barret–Joyner–Halender (BJH) method.

Gas sensing measurements

The fabrication and testing principles of the gas sensor are similar to that described in

our previous reports.[2] Firstly, the gas-sensing samples were mixed with terpineol to form a paste and then coated onto the outside surface of an alumina tube with a diameter of 1 mm and a length of 5 mm. A platinum coil through the tube was employed as a heater to control the operating temperature. To improve their stability and repeatability, the gas sensors were aged at 300 ºC for 10 h in air. Here, the sensing properties of the sensors were measured by a NS-4003 series gas-sensing measurement system (China Zhong-Ke Micro-nano IOT, Internet of Things, Ltd.). The relative humidity (RH) is about 45%. The response and recovery times were defined as the time required for a change of the resistance to reach 90 % of the equilibrium value after injecting and that for removing the detected gas, respectively. When air and ppm-level target gas were flowed through the sensor element, the corresponding steady-state resistances of the sensor in air (R_{air}) and in the air–gas mixture (R_{gas}) were recorded, respectively. The SnO_2 sensor gas response (S) for oxidizing gas (NO) is defined as the ratio of R_{air}/R_{gas}, while the response (S) for reducing gases (H_2S, CH_4, SO_2 or CO) is defined as the ratio of R_{gas}/R_{air}.

References

1 J. M. Ma, J. Q. Yang, L. F. Jiao, Y. H. Mao, T. H. Wang, X. C. Duan, J. B. Lian and W. J. Zheng, *CrystEngComm*, **2012**, *14*, 453-459.

2 J. W. Deng, J. M. Ma, L. Mei, Y. J. Tang, Y. J. Chen, T. Lv, Z. Xu and T. H. Wang, *J. Mater. Chem. A*, **2013**, *1*, 12400-12403.

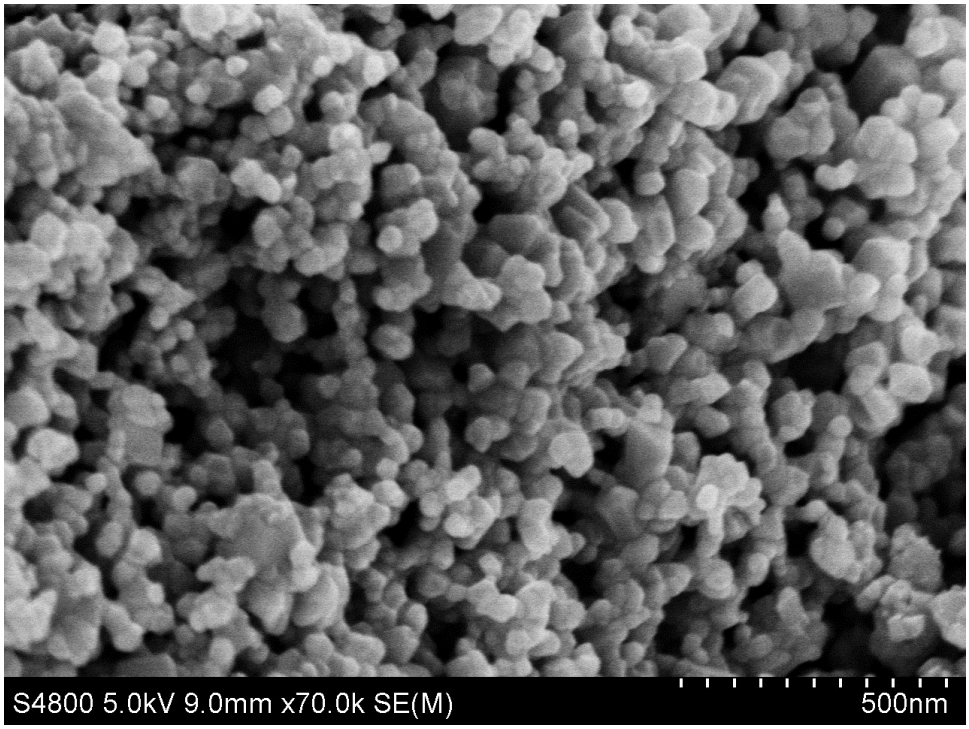

Fig. S1 SEM image of the commercial SnO_2 material.

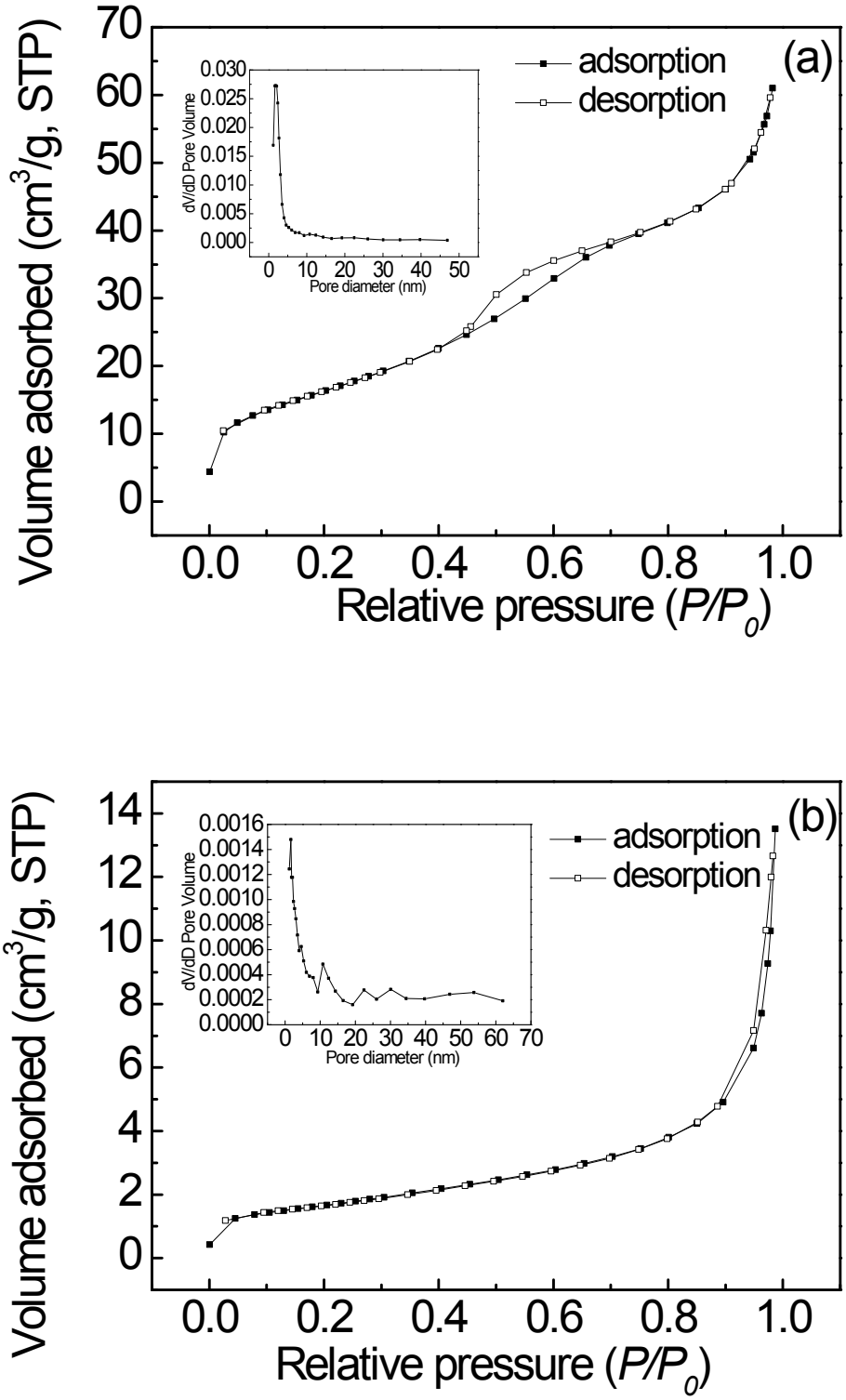

Fig. S2 (a and b) Nitrogen adsorption–desorption isotherms of s-SnO_2 and c-SnO_2, and the inset (corresponding pore size distribution curves).