Electronic Supplementary Information for

A low-temperature n-propanol gas sensor based on TeO_2 nanowires as sensing layer

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Experimental details

TeO_2 nanowires were synthesized on Au-coated glass substrates by thermal evaporation method. In a typical procedure, 0.5 g of Te powders with a high purity of 99.999% was placed in an Al_2O_3 boat and positioned in the central part of a 45 cm long horizontal quartz tube in a tubular electric furnace. The glass substrates coated with an Au film with a thickness of about 10 nm by ion beam sputtering method were covered on the top of Te powders with a vertical distance of 5 mm. Then, the furnace was heated to 450 °C at a heating rate of 10 °C min^{-1} and maintained at this temperature for 2 h in air at ambient pressure. After the furnace was cooled down to room temperature naturally, a layer of white wire-shaped products was obtained on the Au-coated glass substrates.

The phase structure of TeO_2 nanowires was determined by X-ray diffraction (XRD) using an X-ray diffractometer (PANalytical X'Pert Pro) with Cu $K_{\alpha 1}$ radiation (λ= 1.54056 Å) in the 2θ range of 20−60°. The operating voltage and current were 40 kV and 40 mA, respectively. The morphology of TeO_2 nanowires was observed by means of a field emission scanning electron microscope (FESEM, ZEISS Ultra Plus) with an operating voltage of 20 kV. The microstructure and components of TeO_2 nanowires were further investigated by transmission electron microscope (TEM, FEI G^2-20) equipped with an energy dispersive X-ray spectrometer (EDX). The operating voltage of TEM measurements was 200 kV. The Fourier transform infrared spectrum (FTIR) was measured on a NICOLET 380 (Thermo Fisher Scientific) FTIR spectrometer.

For fabricating gas sensor based on TeO_2 nanowires, an appropriate amount of

TeO_2 nanowires were mixed with a couple of drops of deionized water and a small amount of terpineol, and then ground softly in an agate mortar to form a slurry. The resulting slurry was coated onto an Al_2O_3 substrate by a small brush to form a layer of sensing film with a thickness of about 100 μm. The front surface of Al_2O_3 substrate was equipped with a pair of interdigitated Au electrodes, which had been previously printed on the substrate. A resistance heater was set on the rear surface of Al_2O_3 substrate to control the operating temperature. After drying in air at room temperature for 30 min, the Al_2O_3 substrate was assembled onto the sensor holder by connecting the corresponding lead wire to form the gas sensor device. Then, the device was sintered at 300 °C for 2 h to stabilize the sensing film structure and decompose the terpineol.

The gas sensing measurements were performed at the operating temperatures of 24−100 °C by a static process in a commercial gas sensing test system (WS-30A, Weisheng Electronics Co., Ltd., PR China) in a fume hood. Namely, n-propanol gas was introduced into the chamber to a predefined concentration of 100−1000 ppm by mixing air and n-propanol gas by a fan. The n-propanol gas was prepared by thermal evaporation of absolute n-propanol liquid at a hot evaporator with a high temperature of 300 °C. When the response reached a constant value, the upper cover of the test chamber was removed to exhaust the n-propanol gas. The electrical resistance of gas sensor was determined by measuring the voltage when a voltage of 5 V was applied between Au interdigitated electrodes by a volt-amperometric method. The sensor response was defined as R_a/R_g, where R_a and R_g were the electrical resistances before

and after the introduction of n-propanol gas, respectively.