

Electronic Supplementary Information

Room Temperature Element Mercury Sensor using MoS₂-PANI Nano-sheet-flowers Composite

Dong Wang,^{*ab} Kai Zhou^a, Mojie Sun^a, Zhenxing Fang^b, Xiaomeng Liu^a and Xuhui Sun^a

^a Department of Chemical Engineering, Northeast Dianli University, NO. 169 Changchun Road, Jilin City 132012, China.

^b State Key Laboratory of Inorganic Synthesis and Preparative Chemistry, College of Chemistry, Jilin University, Changchun City 130012, China

*Corresponding author: Dong Wang

Tel: 008613844216772

E-mail: dong.wang@mail.nedu.edu.cn, sshwnsh@gmail.com

Experimental details

Synthesis

The preparation of MoS₂-PANI composite material combines synthesis of organic precursor and hydrothermal sulfuration. The precursor of Mo₃O₁₀(C₆H₅NH₃)₂·2H₂O was prepared according to a common method previously described elsewhere with some modification. 2.48 g ammonium heptamolybdate tetrahydrate, 3.34 g aniline and 0.5 g PVP were dissolved in 40 ml deionized water under vigorous stirring. The pH value was adjusted to 4-5 by dropwise adding aqueous HCl (1 M). The suspension was kept for 4 hour at 50 °C under stirring. The white product was collected by centrifugation and dried at 50 °C. For in-situ polymerization, 0.34 g as-prepared product and 0.57 g ammonium peroxydisulfate were dissolved in 40 ml deionized water under vigorous stirring. The pH was adjusted to about 2 by HCl (1 M). The suspension was kept for 6 hour at room temperature under stirring. The product was collected by centrifugation, then washed with water and ethanol, and finally dried at 50 °C.

For hydrothermal sulfuration, 0.40 g as-prepared precursor was dispersed in 20 mL of deionized water containing 0.30 g of thiourea. The suspension was transferred to a 50 ml Teflon-lined stainless-steel autoclave, sealed and maintained at 200 °C for 48 hour. The precipitates were centrifuged, washed with deionized water and ethanol several times and then dried at 50 °C overnight.

Characterizations

Powder X-ray diffraction analysis (XRD) was performed with a Rigaku Ultima IV diffractometer with Cu K α radiation, at 40 kV and 30 mA over the range 10-70°. Scanning electron microscopy (SEM) was performed with a JSM-6700F electron microscope. High-resolution TEM imaging was carried out on a Tecnai G2 S-Twin F20 electron microscope operated at 200 kV.

Element Hg sensing experiments

The structure of Hg sensor is similar to the common gas sensor. The sensor was fabricated by coating an ink of the sensing materials and ethanol on the surface of a ceramic tube attached with Au belt shaped electrodes. Element Hg sensing studies were carried out on a static system, under laboratory conditions. Variations of element Hg vapor concentrations inside the system were achieved by controlling the temperature of liquid Hg in a known volume gas bottle with a heat plate or an ice bath. Vapor pressure saturation concentration of mercury at various temperatures data is from United States Department of Labor website¹. For lower concentration of Hg, a known

volume of saturation Hg vapor at 0 °C is injected into the gas bottle to obtain the desired concentration. The system was maintained at atmospheric pressure. Change in resistance, with and without the element Hg vapor was measured using a computer interfaced Fluke 8846A RMS digital multimeter. The response of the sensor was defined as $(R_g - R_0)/R_0$, here, R_0 and R_g were the resistances of the sensor in the air and target gas with air background, respectively.

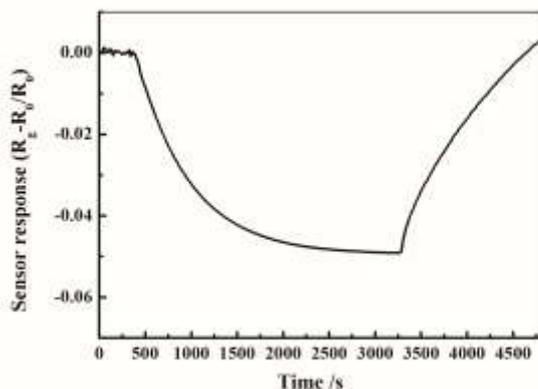


Fig. S1 Response and recovery characteristic of the sensor to Hg vapor with concentration of 0.22 mg m^{-3} .

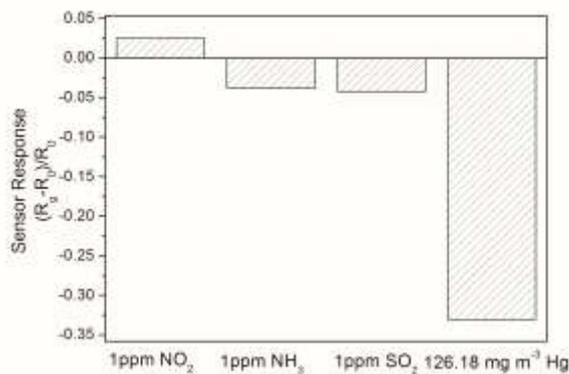


Fig. S2 Selectivity histogram of the Hg sensor towards different gases at room temperature.

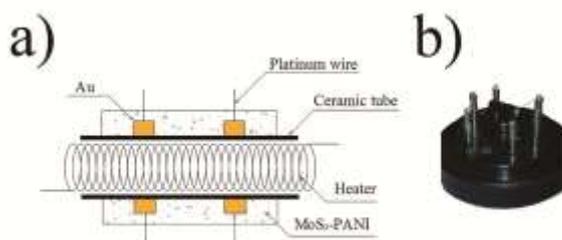


Fig. S3 a) schematic diagram and b) photo of the Hg sensor

Reference

1. <https://www.osha.gov/dts/sltc/methods/inorganic/id140/id140.html>