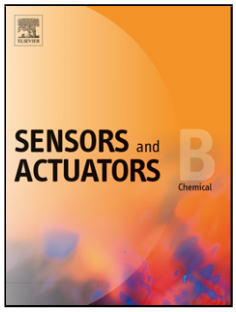

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Two-dimensional SnS_2 materials as high-performance NO_2 sensors with fast response and high sensitivity

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Research Highlights

- Novel NO_2 sensor with SnS_2-2D material integrated on micro-heater
- Large amount and mass production SnS_2-2D material by high-energy ball milling (HEBM) method for sensing applications
- Fast response/recovery time of 6/40 seconds at 10 ppm NO_2 concentrations with a response S > 1200%

Abstract

The rapid development of modern industry has resulted in increased emissions of nitrogen dioxide gas in recent decades. In order to develop a ubiquitous environmental monitoring system suitable for the Internet of things (IoT) paradigm, the high-sensitivity and fast-response detection of NO_2 gas at low concentrations is of particular importance. Recently, two-dimensional (2D) materials have shown fast response/recovery characteristics in the detection of NO_2, due to their planar crystal structures, large surface-to-volume ratios, and low electronic noise. Among these materials, tin disulfide has shown superior sensing performances, at the parts-per-million (ppm) level, in addition to fast response and good stability. Therefore, here we report the synthesis of 2D SnS_2 materials via high-energy ball milling (HEBM), followed by characterization of the crystal structures and morphologies of the products by X-ray diffraction and transmission electron microscopy. The use of the present SnS_2 nanomaterial as a NO_2 sensor enables the detection of a wide range of gas concentrations (from parts-per-billion (ppb) to ppm levels) with fast response and high sensitivity, at an optimal operating temperature of 250 °C. Under these conditions, the sensor exhibited a response >2000% and response/recovery times of