Flame–spray made Y–doped SnO₂ Nanoparticulate Thick Films for Highly Sensitive NO₂ Detection

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Abstract

Nitrogen dioxide (NO₂) is one of the most toxic gases required to be detected and controlled for industrial safety or environmental monitoring devices [1,2]. Thus, NO₂ detection has continuously gained substantial interest and novel materials have been continuously explored for effective NO₂ detection. In this work, the 0–1 wt% Y-doped SnO₂ nanoparticles were productively synthesized by flame spray pyrolysis in a single step and then fabricated as gas sensor for sensitive detection of NO₂. The as-prepared nanoparticles and their fabricated sensing films were structurally characterized by X-ray diffraction, Energy-dispersive X-ray spectroscopy, nitrogen adsorption, and electron microscopy. The results confirmed that SnO₂ nanoparticles were highly crystalline and YOₓ species might form a solid solution in SnO₂ matrix. For the gas-sensing measurements, fabricated sensors were evaluated at various NO₂ concentrations and operating temperatures ranging from 150–350°C in dry air. The test data showed that the optimal 0.1 wt% Y-doped SnO₂ sensing films exhibited a very large sensor response of ~14200 towards 5 ppm NO₂ at 200°C, which is two orders of magnitude higher than that of undoped SnO₂ sensors. In addition, the optimal 0.1 wt% Y–doped SnO₂ sensor displayed high stability as well as high selectivity against other environmental gases. Consequently, the Y–doped SnO₂ nanoparticulate sensor is a promising candidate for highly sensitive and selective NO₂ detection and may be useful in environmental and industrial applications.

Keywords: Flame spray pyrolysis, NO₂, SnO₂, Y doping, Gas sensor.
Fig. 1. A typical top-view SEM image of 1 wt% Y-doped SnO$_2$ nanoparticles (P–1Y) (Left) and corresponding selected areas of EDX maps and EDX spectrum of Y-doped SnO$_2$ nanoparticles with 1 wt% Y (P–1Y).

Fig. 2 the histograms of typical sensor response towards 5 ppm NO$_2$ with corresponding change in resistance (inset) of the 0–1 wt% Y-doped SnO$_2$ (S–0 to S–1Y) at optimal operating temperatures of 200°C in dry air.

References

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