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Flame–spray made Y–doped SnO_2 Nanoparticulate Thick Films for Highly Sensitive NO_2 Detection

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Abstract

Nitrogen dioxide (NO_2) is one of the most toxic gases required to be detected and controlled for industrial safety or environmental monitoring devices [1,2]. Thus, NO_2 detection has continuously gained substantial interest and novel materials have been continuously explored for effective NO_2 detection. In this work, the 0–1 wt% Y–doped SnO_2 nanoparticles were productively synthesized by flame spray pyrolysis in a single step and then fabricated as gas sensor for sensitive detection of NO_2. 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 SnO_2 nanoparticles were highly crystalline and YO_x species might form a solid solution in SnO_2 matrix. For the gas–sensing measurements, fabricated sensors were evaluated at various NO_2 concentrations and operating temperatures ranging from 150–350°C in dry air. The test data showed that the optimal 0.1 wt% Y-doped SnO_2 sensing films exhibited a very large sensor response of ~14200 towards 5 ppm NO_2 at 200°C, which is two orders of magnitude higher than that of undoped SnO_2 sensors. In addition, the optimal 0.1 wt% Y–doped SnO_2 sensor displayed high stability as well as high selectivity against other environmental gases. Consequently, the Y–doped SnO_2 nanoparticulate sensor is a promising candidate for highly sensitive and selective NO_2 detection and may be useful in environmental and industrial applications.

Keywords: Flame spray pyrolysis, NO_2, SnO_2, Y doping, Gas sensor.

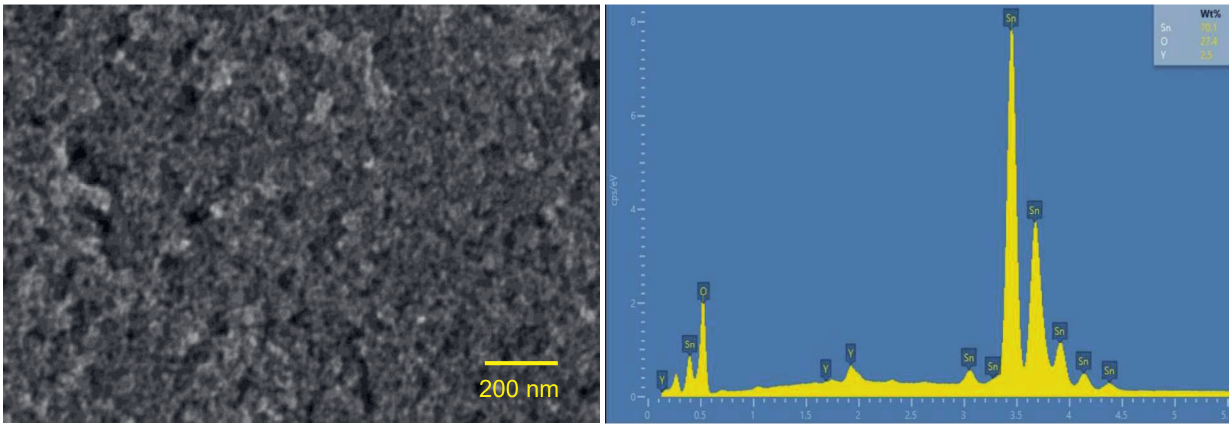

Fig.1. A typical top–view SEM image of 1 wt% Y–doped SnO_2 nanoparticles (P–1Y)(Left) and corresponding selected areas of EDX maps and EDX spectrum of Y-doped SnO_2 nanoparticles with 1 wt% Y (P-1Y).

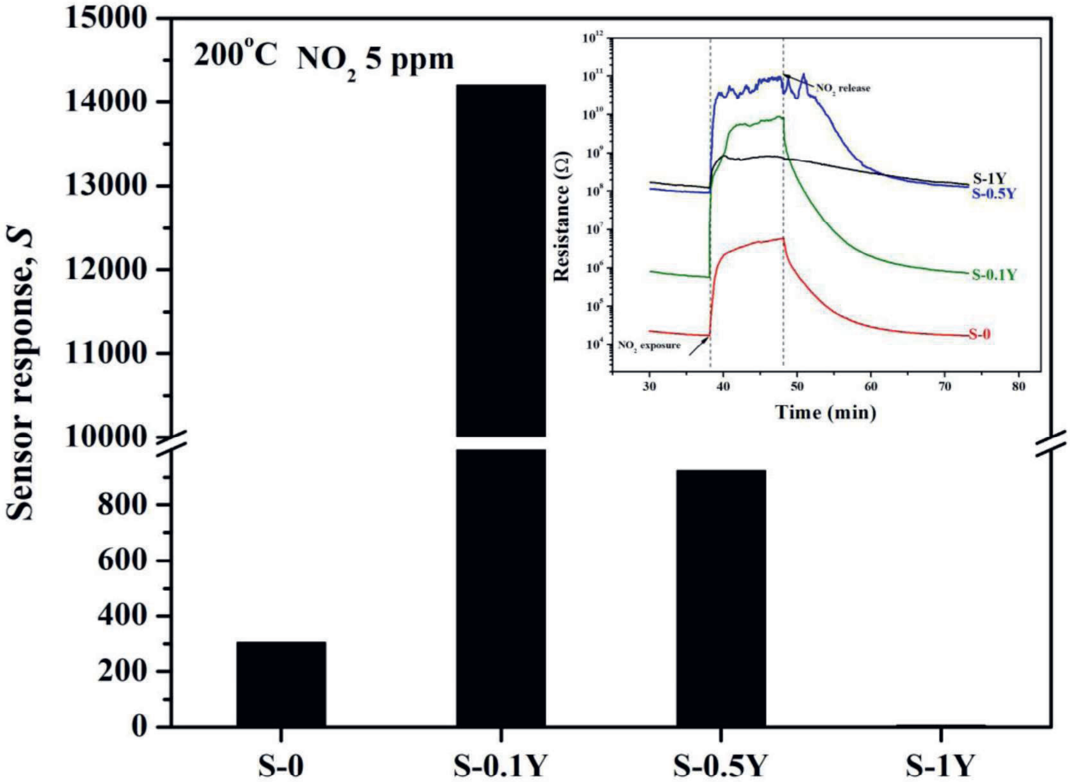

Fig. 2 the histograms of typical sensor response towards 5 ppm NO_2 with corresponding change in resistance (inset) of the 0–1 wt% Y-doped SnO_2 (S–0 to S–1Y) at optimal operating temperatures of 200˚C in dry air.

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