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# Highly Sensitive $CH_4$ Gas Sensors Based on Flame–spray made $CrO_x$–doped $SnO_2$ Sensing Films for Livestock Farming Applications

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**Abstract**

Methane ($CH_4$) is one of the most challenging flammable gases to be detected and controlled for domestic safety or environmental monitoring. Methane sensor is highly needed in gas detection equipments for detecting methane released in home, automotive, industrial settings or livestock farming communities [1,2]. Hence, it is interesting to apply effective sensing materials for sensitive $CH_4$ detection. In this work, the as-prepared 0–2 wt% $CrO_x$–doped $SnO_2$ nanoparticles were produced by flame spray pyrolysis in a single step and fabricated as sensitive sensor for detection of $CH_4$. 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 $CrO_x$ crystallites with mixed oxidation states should form a solid solution with $SnO_2$ matrix. For the gas–sensing measurements, fabricated sensors were evaluated at the different $CH_4$ concentrations and operating temperatures ranging from 200 to 400°C in dry air. The test data showed that the optimal 0.5 wt% $CrO_x$-doped $SnO_2$ sensing films exhibited the highest sensor response of ~1250 with a short response time of less than 2 s towards 1 vol% $CH_4$ at 350°C. In addition, the optimal 0.5 wt% $CrO_x$–doped $SnO_2$ sensor displayed high stability as well as high selectivity against various environmental and flammable gases. Therefore, the $CrO_x$–doped $SnO_2$ nanoparticulate sensor is a promising candidate for highly sensitive and selective $CH_4$ sensor and may be useful in environmental, industrial, and livestock farming applications.

**Keywords:** Flame spray pyrolysis, Methane, $SnO_2$, $CrO_x$ doping, Gas sensor.

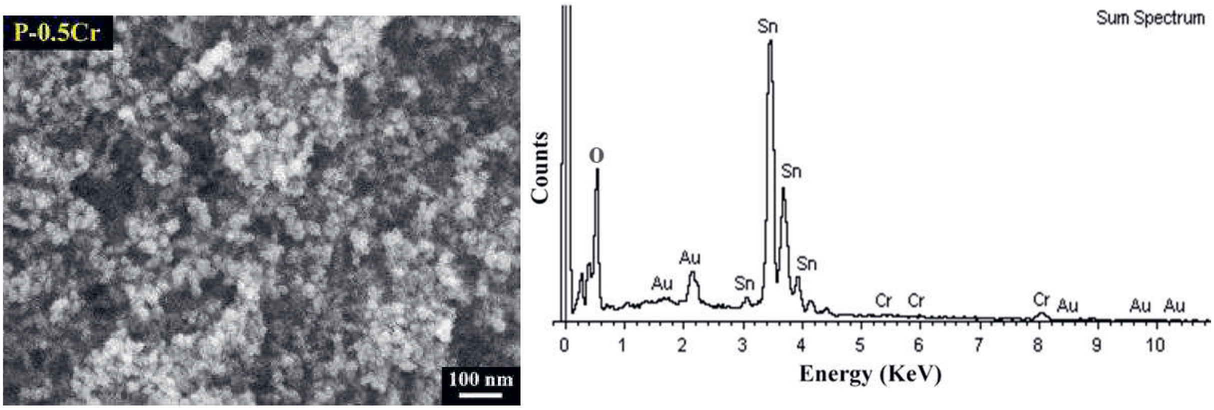


*Fig.1. A typical top–view SEM image of 0.5 wt% $CrO_x$–doped $SnO_2$ nanoparticles (P–0.5Cr) (Left) and corresponding selected areas of EDX maps and EDX spectrum of $CrO_x$-doped $SnO_2$ nanoparticles with 0.5 wt% Cr (P-0.5Cr). Au elemental spectra caused by the contamination Au-sputtering prior anlysis.*

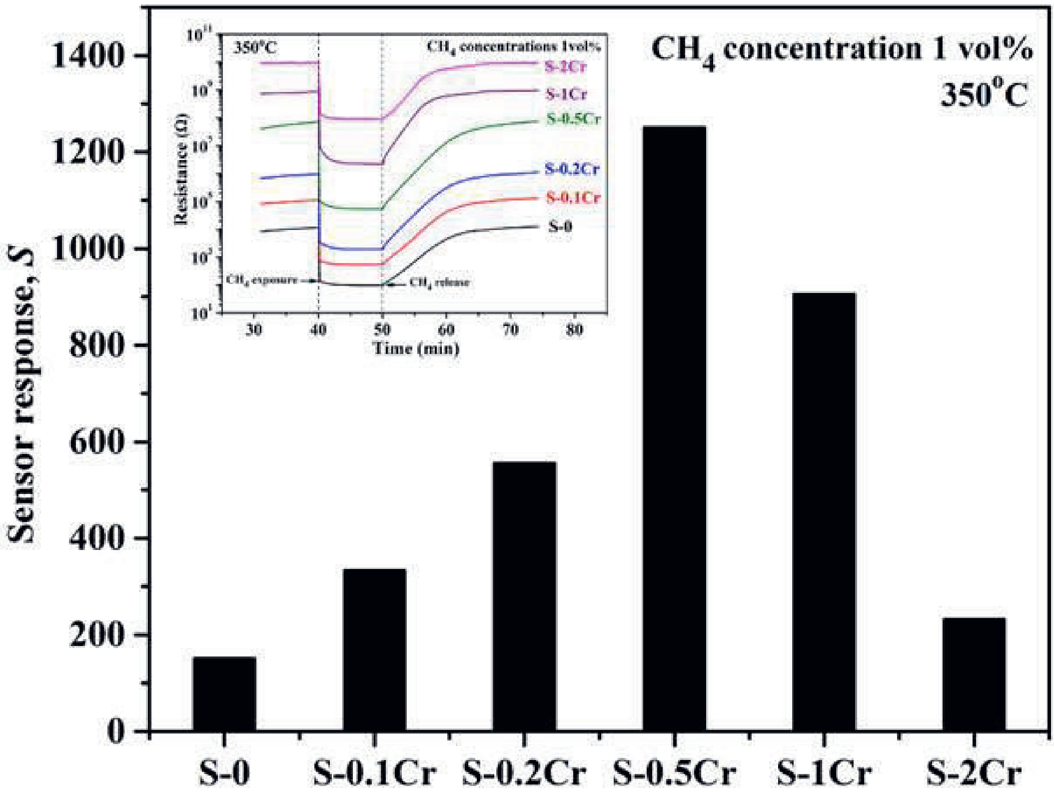


*Fig. 2 the histograms of typical sensor response towards 1 vol% $CH_4$ with corresponding change in resistance (inset) of the 0–2 wt% $CrO_x$-doped $SnO_2$ (S–0 to S–2Cr) at optimal operating temperatures of 350˚C in dry air.*

## References


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