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Nanostructure Evolution of Zinc Stannate: A Suitable Material for Liquefied Petroleum Gas Detection

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Abstract:

We successfully synthesized a semiconducting zinc stannate (Zn_2SnO_4) - with a face-centred cubic spinel structure, a band gap ($E_g = 3.4\text{eV}$), and a crystallite size of 29 nm - by co-precipitation. Post-thermal treatment revealed three transition temperatures: 500°C, 700°C and 1000°C. We systematically monitored the formation of different nanostructures by changing the annealing temperature through diverse characterization techniques such as thermogravimetric and differential thermal analysis (TGA, DTA), X-ray powder diffraction (XRD), ultraviolet–visible and Raman spectroscopies, field-emission scanning electron microscopy (FESEM) and Energy Dispersive X-ray Spectroscopy (EDS). Our characterization data demonstrate a novel and facile way to synthesize fine quality zinc stannate (Zn_2SnO_4) nanoparticles with the specific surface area of $17\text{ (m}^2\text{g}^{-1}\text{)}$. The achieved features make the sample a potential candidate for the fabrication of a gas detection sensor. After exposing the gas sensing characteristics of the resulting Zn_2SnO_4 nanoparticles to several gases, we found out that it demonstrates outstanding sensitivity, response and recovery time, and selectivity towards liquefied petroleum gas (LPG).

Keywords: Zinc stannate; nanostructure; gas sensor; XRD; RAMAN; LPG;

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