

Characterization of SnO₂-based H₂ gas sensors fabricated by different deposition techniques

1. Introduction

Due to the increased use of toxic gases in domestic and industrial processes, there is a growing need to develop low cost and portable gas sensors. Existing sensors based on electrochemistry, chromatography, calorimetry, mass spectroscopy or PH are very costly or are not easy to use. Because of these limitations, semiconductor gas sensors are gaining importance over conventional sensors systems, although they are not as specific as spectroscopy for a particular gas. Semiconductor gas sensors, particularly resistive sensors, fulfill the requirements of portability, low cost, small size, etc. and are compatible with electronic systems. Among them, attention is mainly focused on SnO₂-based gas sensors [1-4] because they have the advantages of relatively low operating temperature and long-term stability. The dominance of SnO₂ based gas sensors over other types is indicated by their higher coverage in the literature. After studying various materials [1-4], the recent trend is to study the SnO₂ material in detail and to enhance its performance perhaps by using a catalyst [5-9] for selectivity towards a particular gas, by using different deposition processes and techniques [10-20], by surface modification [12-13] of the sensor, by thickness variation [5, 10, 21] or by deposition under a different gaseous environment [11]. Gas sensing methods using SnO₂ exploit the fact that its conductance in air (G_{air}) can be changed to (G_{gas}) by the presence of reducing oxidizing gases in the atmosphere. The extent of the relative change in conductance ($G_{\text{gas}}/G_{\text{air}}$) can be directly related to the concentration of reducing oxidizing gases in the atmosphere. SnO₂ sensors can be broadly divided into three types: sintered pellet [16], thin film [14-18] and thick film [19-21]. There has been considerable progress in developing sintered and thick film gas sensors. Thin film sensors are prepared using various techniques like physical vapour deposition, chemical vapour deposition, RF sputtering, spray pyrolysis, laser ablation and electron beam evaporation. RF sputtering has proved to be one of the most successful techniques. Thick film sensors are prepared using standard screen printing technology.

This paper presents a comparative study of SnO₂ deposition techniques by investigating the electrical characteristics and surface morphology of the films they produce.