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Discrimination of Gases/Vapors with Tin Oxide Sensors

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Abstract

In the present work, we investigated the discrimination of gases/vapors using Principal Component Analysis (PCA) plots with a new data algorithm of pre-processed sensor response data. Four sensors (one pure SnO_2 and other doped-SnO_2 with CdS, As_2O_3, Pd with 1 wt %, relatively) are fabricated employing screen-printing technology to identify different organic vapors. Response data, obtained from exposing five organic vapors/gases (Acetone, Methanol, LPG, Ethanol and Propanol) to each sensor have been used to classify these vapors. Initially, the response data have applied on Transformed Cluster Analysis method to classify the vapors. The test of various pre-processing data algorithms have been done and found a good one which act as a better discriminating function. The results showed a good visual classification of organic vapors on PCA plots using generated pre-processing algorithm.

Kewwords: Tin Oxide, Cadmium Oxide, Arsenic Oxide, Sensors, Algorithems

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1. Introduction

The development of gas sensor for the detection of single gas (as CO, CH_4, ethanol, LPG, acetone, TCE, SO_2 and H_2) has shown interest within the research community [1]. Considerable effort has been made towards the use of metal oxides for gas detection. The adsorption of a gas on the surface of a semiconductor can produce a significant change in electrical resistance. Since, the gas-surface interaction converted into signal response, which is the basis of the several measurements made on a variety of materials (as SnO_2, ZnO, TiO_2, Fe_2O_3, WO_3 and ZrO_3). Presently, significant efforts are being made to improve the selectivity and sensitivity of tin oxide based thick film sensors using suitable dopants [2-3].

Discrimination techniques play an important role in detecting and identifying the gas/odour present in an environment. Different mathematical models, statistical methods and pattern recognition methods such as Partial Model Building, the Fast Fourier Transform Technique, Principal Component Analysis [4], Transformed Cluster Analysis [5], and the Multiple Regression Method have been reported by many workers for the analysis of sensor response with different identification capability.

In the present study, the response data of the fabricated tin-oxide thick film sensors has been measured for different organic vapors and visual classification of these vapors have been presented. Different organic vapors (acetone, methanol, LPG, ethanol and propanol) have been tested with four sensors (pure SnO_2 and CdS, As_2O_3, Pd doped-SnO_2) in air ambient. The response data is applied on TCA method to classify the vapors but it is very poor. The response data of fabricated tin oxide sensors have been presented on PCA plot and a better visual identification of a particular vapour is