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Title of Ph. D. Thesis	:	Fabrication and characterization of carbon nanotubes based NH_3 gas sensor.

Abstract

The objective of this thesis work is fabrication and characterization of Carbon nanotube(CNT) based Ammonia (NH_3) gas sensor. The sensor development approach in this thesis is the creation of a resistive type NH_3 gas sensor using different fabrication technique.

In order to enhance the response time, a resistance based sensor is developed using a nanocomposite (CNT-Al_2O_3). This sensor's speed of response is found to be much better compared to the previous existing fabrication techniques and it results in the development of a simple and easy to handle and inexpensive NH_3 gas sensor.

This thesis comprises of seven chapters, **Chapter- 1** presents a brief introduction to carbon nanotube and gas sensor properties, its historical background and review on the gas sensor application of CNT have been discussed. **Chapter- 2** describes the experimental details on the design of chemical vapor deposition (CVD) system for the growth of carbon nanotubes, including the spectroscopic and microscopy characterization. For CVD, we employ one conventional design of Thermal chemical vapor deposition and also one novel design of Rapid heating and cooling CVD (RTCVD) system for the preparation of network and vertically-aligned carbon nanotubes. **Chapter- 3** presents the experimental techniques used during the course of this study for the characterization of carbon nanotubes and nanocomposite carbon nanotubes. It comprises microscopy, spectroscopy, and electrical characterization. For the characterization of sensor,

important techniques such as impedance spectroscopy is employed, and it is discussed in the last part of the chapter. **Chapter- 4** present Multi-walled carbon nanotubes (MWCNTs) based resistive sensors for NH_3 gas detection in the presence of dry carrier gas nitrogen (N_2). I have demonstrated by an effective approach to get improved sensitivity and fast sensor recovery. I also report the successful and efficient transfer process of two dimensional (2D) vertically aligned carbon nanotubes (CNTs) onto polyethylene terephthalate(PET) substrate by hot pressing method with an aim to develop flexible sensor devices. This technique shows great potential for the fabrication of flexible sensor. **Chapter- 5** describes and demonstrates highly stable and sensitive detection of trace level (~1ppm) NH_3 gas at room temperature. The sensor device was comprised of two planer Au electrodes deposited on SWCNTs by thermal evaporating method followed by patterning with photolithography process. The SWCNTs were characterized by various techniques including Raman spectroscopy, field emission scanning electron microscopy and transmission electron microscopy. The sensor was found to have good sensitivity with response time. In **Chapter- 6,** I have reported an age old gel-casting technique to prepare extremely sensitive CNTs sensing film using sol-gel science & technology (a novel approach). The method is simple reliable and easy to fabricate. I have demonstrated that the use of Al_2O_3 matrix, which can solve the dispersion in matrix in a more effective way to produce CNTs nanocomposite resistive gel cast tape with high surface to volume ratio. **Chapter- 7** summarizes the conclusions reached and some suggestions for future work also been discussed in this chapter.