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Functionalized carbon nanotubes by direct liquid injection chemical vapor deposition method as CO2 sensor

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Abstract

In the current work we have described the synthesis and characterization of Multiwall Carbon Nanotube (MWCNT) formed thin film and its implementation as a CO2 gas sensor. The MWCNT was assembled by Direct Liquid Injection Chemical Vapor Deposition method (DLICVD) make use of ethanol as a precursor in the existence of argon gas atmosphere and furnace temperature at 750 oC. The experimental set-up is shown in Figure-1. The apparatus consists of a (5×100 cm) cylindrical quartz tube provided one end with a bond for a vacuum system and for the injection of gas carrier (Ar/N2) gasses and ethanol vapor at other end. In this procedure, the catalyst particle was developed by chemical reduction of cobalt chloride particle by the sol-gel process. The synthesized cobalt nanoparticle used as a catalyst particle for the growth of CNTs and a thin film such nanoparticles on quartz glass were made by using spin coating technique with revolution rate 1500 rpm for 30 s and then film which is prepared was placed in a hot air oven for 15 minutes at 100 ℃.
The thin film of MWCNT was prepared by using spin coating technique and distinguished using scanning electron microscope (SEM), UV-visible spectrometer,X-ray Diffractometer (XRD) and particle size analyzer. The vibrational and rotational spectra were noticed through Fourier Transform Infra-Red Spectroscopy (FTIR) and Raman spectroscopy. The SEM image of the thin film revealed the nanotubelar design grown throughout the surface.

From XRD the minimum crystalline dimension was found to be 14 nm. The optical energy band space of the nanotube-formed thin film was found as 3.6 eV.

The synthesized CNT-formed thin film was employed for the CO2 sensing. The sensor response of the sensor at room temperature was found as 2.1 and the results were found 98% reproducible. The response and regaining times were create to be 30.2 and 49.6 s, respectively

It is well known that the morphologies, sizes and phases of nanomaterials have great effect on their properties and potential applications. Therefore, the synthesis of nanostructured materials with wanted properties has recently received ample attention. Carbon can be found in several different hybridization states, each having individual properties as shown in Figure 1. In fact, the electrical, thermal, mechanical and chemical effects of the different allotrope forms are directly correlated to their hybridization state and structure, opening up the chance to use the alike material for a vast range of applications .

Several techniques have been reported in the written for the synthesis of 0D, 1D, 2D, and 3D carbon nanomaterials. The most usual techniques are laser ablation, arc-discharge [25,26] and chemical vapor deposition (CVD) . CVD is the most usual employed thin-film toppling technique used to synthesize nanomaterials. Therefore, this review paper will be mainly attentive on the synthesis of novel materials via the CVD technique.

This review paper summarizes the combination of carbon nanomaterials such as fullerenes, carbon nanotubes (CNTs), carbon nanofibers (CNFs), graphene, carbide-derived carbon (CDC), carbon nano-onion (CNO) and MXene via the CVD technique.

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