Chapter II

CHAPTER II

SURVEY OF LITERATURE

2.1 Introduction

Survey of Literature is one of the most vital components of our document as it offers a route in the vicinity of our findings. It helps us to set a purpose for our analysis. Review of the literature in the field of discovery is an initial step formerly than trying to format the research. This chapter gives a brief report on earlier work done on cobalt oxide nanostructures.

2.2 Literature Review

Baoyou Geng et.al. [1] reported an easy & novel coordination compound precursor way to manufacture shape-controlled Co_3O_4 nanoshapes. The outcome of the nanostructures had been tailor-made by regulating the reaction temperature & NaOH quantity throughout the procedure. The gas sensing characteristics of the prepared morphologies were observed thoroughly that disclosed that the organized material show higher sensitivity to CO & CH_4 in relation to bulk Co_3O_4 at room temperature, having well reproducibility & short response/recovery times.

Y. Lin et al. [2] suggested a feasible tool for describing qualitatively the examined CO and NH_3 sensing characteristics of Co_3O_4 compound. The sensor confirmed a steady signal & a better response & recovery after 3 cycles. Co_3O_4 nanoparticles (<10 nm) supplied a larger surface-to-volume ratio than bulk structures. Sharp absorptions at 574 & 660 cm^{-1} matches to stretching vibrations of Co_3O_4. They revealed the diffraction peaks at 2θ values of 31.3^0, 36.8^0, 44.8^0, 59.3^0 and 65.2^0 that are credited to the making of spinel oxide Co_3O_4 which is in accordance with JCPDS records (78-1970).

Rajan Lakra et. al [3] studied about synthesizing Co_3O_4 nanoparticles through utilizing cobalt nitrate as an authority of cobalt oxide. The particle size distribution was observed between 40-350 nm. An average particle size of Co_3O_4 nanoparticles is found around 100 nm.

Svetlana Vladimirova et. al. [4] examined the nanostructure of cobalt oxide by TEM. The nanocrystalline p-type $Co_3O_4$was observed to have particle size around 30-40 nm & mean particle diameter 40 nm. The values around 1034 & 1106 cm^{-1} from FTIR spectra was imposed to Co-O-H vibrations.

Jianan Deng et al. [5] explained the XRD pattern of as prepared comb & rod -like Co_3O_4 structures. The sharpness of diffraction peaks confirmed a better crystallinity. The diffraction peaks (Fig. 2(a) and (b)) in the XRD pattern has been listed as hexagonal aspect of Co_3O_4 (JCPDS card 43-1003). The sensitivity to CO gas result demonstrated the synthesized comb-like structures exhibit good catalytic activity in comparing with rod-like Co_3O_4. Significantly, the comb-like Co_3O_4 morphology showed a rapid response & recovery speed for CO gas.

K.K. Jain et al. [6] begin their article based on nanobiotechnology, succeeded through their executions in molecular diagnostics, nano diagnostics, & enhancements in the inventions, design & drug delivery, involving nanopharmaceuticals. Safety measures of invivo uses of nanomaterials are mentioned along with the necessary functions for molecular diagnostics and delivery of drugs. An act of nanobiotechnology in numerous illnesses is described briefly.

Kong et al. [7] reviewed utmost important elements which effect cytotoxicity assays & the strategies utilized to mention them, in particular for nanoparticles which human beings are notably disclosed by a number of ways, like intravenous administration, respiratory tract, dermal exhibition & ingestion.

Halevas E G et al. [8] presented a verified outline of the therapeutic uses of copper nanoparticles as effective anticancer agents. Authors have stated that though many experimental reports are available for in vitro studies, much attention must be focused on the in vivo efficacy, dislocation, & features of Cu nanoparticles, involving their potent cytotoxicity, pharmacokinetics, & pharmacodynamics to consider their merits and demerits within their limited long-term cytotoxicity, supportive in vivo pharmacology, & photothermal conversion capability.

Muhammad Imran Dinand Aneela Rani [9] summarized the formation of nickel & nickel oxide nanoparticles by various biological systems. They provided comparison for the effect of chemical & herbal synthesis on the physical characteristics of nickel & nickel oxide nanoparticles & its organic behavior. They discussed the function of reaction standards on physical characteristics of the synthesized Nickel nanoparticles. The physical & biological characteristics of nickel & nickel oxide nanoparticles using chemical & green method were compared. Green synthesis methods will helpnin the marketing of Ni and NiO nanoparticles in the area of surrounding cleansing & nanomedicine.

Xiao Liu et. al. [10] described gas sensing methods' classification with introduction, then introduced execution analysis and signals of various gas sensors. They introduced techniques of sensing thoroughly. Methods for enhancing the sensitivity & selectivity of gas sensors were explained. An anticipation of forthcoming improvement in gas sensors was cited additionally.

Jun Zhang [11] summarized the most significant developments associated to room-temperature sensing by the use of different structures and highlighted the specific sensing mechanisms & tried to mention physical property relations.

J.M. Xu et.al. [12] had given a review on the important advances in research, sensing & utility of nanomaterials for room-temperature conductometric sensors. The correlation of the nanostructure & sensor properties is analyzed to understand the structure-property relations.

H.J Kim et. al. [13] reported that P-type materials like NiO, CuO, Co_3O_4, Cr_2O_3 & Mn_3O_4 are efficient catalysts which may utilized to adapt & improve the oxidation/reduction of differnt volatile organic components.

K.I. Choi et al. [14] revealed that the response time of n-type sensors on disclosure to reducing gases is lesser than recovery time, disregarding of substance. The gas detecting technique of Co_3O_4 had explained related to the microstructural elements like surface area, nanoporosity & contact configuration between the nanostructures.

C. Cantalini et al. [15] explained the preparation of thin SiO_2-NiO/Co_3O_4 nanocomposite film consist of neither NiO nor Co_3O_4 nanocrystals in a porous SiO_2 matrix by the sol-gel method. The morphology, crystalline phase & chemical composition have been explained by the use XRD, TEM & FTIR. The H_2 sensor response between 20-850 ppm & CO between 10-500 ppm in dry air & at various operating temperatures (<300˚C) has been investigated. Detection limits of approximately 10 ppm CO & H_2 were demonstrated. The NiO doped film exhibit a barely greater sensitivity than Co_3O_4 film in sensing CO gas, & greater affinity to H_2 sensing than the Co_3O_4 doped film.

Z. Wen et al. [16] manufactured needle type Co_3O_4 nanoarray by means of facile hydrothermal method. XRD graph exhibits the peaks matches properly to cubic spinel Co_3O_4 phase (JCPDS card No.43-1003). The SAED images suggested the precursor in single crystallinity. The sensor detected ethanol below10 ppm.

Huai Ping Cong et al. [17] examined the sensitivity of porous Cobalt oxide crystals. The peaks around 664 & 573 cm^{-1} in the FTIR spectrum are attributed to the vibration peaks of Co-O mode which evidenced Co_3O_4 phase. The nanoporous Co_3O_4 particles exhibited better response & reversibility in sensitivity measurements.

A. Aslani et al. [18] reported data about the gas sensor performance of CuO nanoparticles by the active layers in CO gas resistive sensors. The gas sensitivity of various nanoparticles was mentioned as a property of morphology of initial nanoparticles. The outcomes indicated the importance of the structure of the basic CuO crystallites & clarified on the basis of characteristics & sensing values required. The higher response was obtained for the CuO nanoparticles exhibiting cloud like morphology.

Dan Li et al. [19] synthesized Co, Mn & Cr-doped ZnO nanorods using hydrothermal method. They revealed the establishments of dopants were well agreed with the quantity of Mn & Co, but the dopant inclusion was low in the study of Cr. While considering the dopants, the resulted structure was varying than ZnO nanowires. For Co, combination of rods & particles were found, directing feasible dopant dissociation. Anyway more researches were carried out to prove the affect of dopants on optical properties.

V.Singh et al. [20] reported various ways to develop the sensitivity of ZnO like functionalisation of noble metallic nanoparticles, doping of metals, by nanocomposites of various metal oxides, UV activation & post-treatment technique for high-energy irradiation by feasible sensing methods.

L. Liao et al. [21] investigated the dependences ZnO nanorods morphology, defects & associated electron donors on their structural characteristics, surface adsorptions of oxygen & detecting gas & its characterizations. The findings indicated that very thin ZnO nanorod arrays are much sensitive due to higher adsorption portions of gas because of increased electron donors & larger surface-to-volume ratio, good surface affects in contrast to thick nanorods.

C.W. Zou [22] manufactured gas sensor on the basis of p-type single CNWs & demonstrated that CuO nanowire have been a better material having better efficiency. They suggested Cu^{2+} performs a vital position in absorbing CO molecules in CO sensing. While CO molecules were adsorbed on the layer of the CNWs, then bonds are formed on the Cu^{2+} sites.

Long et al. [23] proposed the utilization of α-Fe_2O_3 doped to another metals for their improvement in gas sensors. They suggested the variation in between structure & morphology of α-Fe_2O_3 particles with dopants would guide to p & n type characteristics of gas sensors.

Barick et al. [24] prepared enormously porous nanoclusters of pure & transition metallic (Mn, Co, Ni) doped ZnO by a tender chemical method. XRD evaluation suggested the forming of uniphase ZnO shape with nanocrystallinity. The transition metallic ions, Mn, Ni & Co have been effectively doped to ZnO & are equally arranged. The round porous structure consists of several nanocrystals with steady, precise & distinct. Anyway, hollow structures were not regular & the sizes of pores are not uniform. The hysteresis loop in N_2 adsorption-desorption isotherm curves suggested the 3D intersection community of pores will increase by dopants through the preparation of tiny nanocrystals that will improve the porous communication. The mesoporous ZnO nanoclusters exhibited excellent photo catalytic undertaking of MB by UV in comparison to transition metallic (Mn, Ni, Co) doped ZnO.

Sharma H et. al [25] attempted shipping of anticancer drug to ZnO nanoparticles, to collaborate the medicinal recreation of drug along anticancer activity of ZnO drug-loaded nanoparticles for creating greater cytotoxicity. That is, the best possible anticancer activity. That is because of higher focussing & retention of drug targeted nanoparticles in cancerous cells due to the fact of higher targeting capability of ZnO nanoparticles.

Chattopadhyay S, et. al. [26] observed to examine the anti-cancer activity of surface functionalized CoO nanoparticles. Improvement of better nanoparticles exhibited anti-cancer activity, introduced higher efficiency & decreased toxicity for medication. They focused on examination of modified CoO nanoparticles. They analyzed physical and chemical properties CoO nanoparticle and target the cancerous cells more effectively. The high specific uptake has led to the exploration of utility of recent anti-cancer drug development therapy.

This survey of literature indicates that not much work has been done on the synthesis & pure and doped Co_3O_4 nanoparticles for the gas sensing behavior. This research is an extensive work explaining about the synthesis, characterization and applications of pure and doped Co_3O_4 nanoparticles.

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