Faculty Achievement (Department of Basic Sciences and Humanities) (A. Y. 2018-19)

Sr. No.	Year	Name of the Faculty	Event Name	Title	Journal/college/university Name	Date
1	2018-19	Dr. S. S. Potdar	Journal paper Publication	Electrochemical synthesis of CuS_xSe_{l-x} thin film for supercapacitor application	Journal of Alloys and Compounds Elsevier	2018
2	2018-19	Dr. S. S. Potdar	Journal paper Publication	Facile synthesis of Nanodiced SnO_2-ZnO composite by chemical route for gas sensor application	Journal of Electronic Materials Springer	2019
3	2018-19	Dr. S. S. Potdar	Journal paper Publication	Influence of bath temperature on microstructure and NH_3 sensing properties of chemically synthes--ized CdO thin films	Materials Science-Poland Springer	2019
4	2018-19	Dr. V. S. Patil	Journal paper Publication	Synthesis of novel probe 2-chloro-6-methoxy-3-phenyl hydrazone quinoline and its application to detection of persulphate in aqueous ehanol solution by fluorescence turn on	Journal of Inclusion Phenomena and Macrocyclic Chemistry	2018
5	2018-19	Dr. V. S. Patil	Journal paper Publication	A novel FRET probe for determination of fluorescein sodium in aqueous solution: analytical application for ophthalmic sample	Indian Journal of Chemistry	2019

6	2018-19	Dr. V. S. Patil	Conference paper	A novel FRET probe for determination of fluorescein sodium in aqueous solution: analytical application for ophthalmic sample	1st International Conference on Material and Environmental Science, New College Kolhapur	7^{th} to 8^{th} January 2018
7	2018-19	Dr. S. S. Potdar	Conference paper	Study of Concentration of Monomer on Structural and Optical Properties of Poiythiophene Thin Films	1st International Conference on Material and Environmental Science, New College Kolhapur	7^{th} to 8^{th} January 2018
8	2018-19	Dr. S. S. Potdar	Conference paper	Room temperature synthesis of nano-diced SnO_2nO Composite by chemical rotue for sensing temperature application	National Conference on Science and Technology For Sustainable Development At Jaysingpur College Jaysingpur	21^{th} January 2019
9	2018-19	Ms. Khan Nilofer G.	Faculty Development Program	Intellectual Property Rights and Patenting	Sanjeevan Engineering and Technology Institute, Panhala	24^{th} February 2018
10	2018-19	Ms. Khan Nilofer G.	conference	Outcome Based Education	Shivaji University, Kolhapur	5^{th} April 2019

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Electrochemical synthesis of CuS_xSe_{1-x} thin film for supercapacitor application

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A R T I C L E I N F O

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A B S T R A C T

The CuS_xSe_{1-x} thin films were deposited on conducting substrates using copper sulphate sodium thiosulfate and selenium dioxide as a source of Cu, S, and Se by electrodeposition(ED) technique. The effect of the change in composition S and Se the structural and electrical properties of the CuS_xSe_{1-x} thin films was studied. The crystallite size, composition, microstructure, contact angle and capacitance studied using XRD, EDAX, SEM, CA, and CV. The X-Ray diffraction (XRD) graph reveals that the CuS_xSe_{1-x} films were polycrystalline in nature and $CuS_{0.6}Se_{0.4}$ shows crystallite size of 34 nm, Energy dispersive analysis X-Ray (EDAX), scanning electron microscopy (SEM) show the elemental composition and microstructures were changes with S and Se composition. The $CuS_{0.6}Se_{0.4}$ film show 31° contact angle and specific capacitance of 159 F/g.

1. Introduction

CuS and CuSe are vital p-type semiconductors, they are used in various applications such as solar cells [1,2], Supercapacitor [3], photo-catalysts [4–6] Li-ion batteries [7], medical devices [8,9], gas sensors [10] due to their good optical, electrical, chemical, physical and biochemical properties. These properties of material were depend on surface morphology [11,12]. The precise preparation of CuS and CuSe are assumed to be essential for extensive requests. Specially, preparation of nano rods, nanogranuals, nano flakes-of CuS and CuSe have extensive requests in recent years.

Cu-S-Se is a ternary semiconducting material have interesting physical, chemical and optical property over a binary. The properties of the ternary material are changed with altering the atomic composition [13]. Gopi et al. [14] prepared the CuS electrode to improved photovoltaic efficiency in QDSCs. Solar cell shows highest efficiency 4.67% in sulfide and poly sulfide electrolyte. Sabah et al. [15] synthesized multi-layered CuS thin film by spray pyrolysis method. Flower like microstructure cover whole surface of the substrate films which is found to exhibit the high recovery and response time for hydrogen and other gas sensing. Gosavi et al. [16] prepared the CuSe films with the help of SGT method. XRD study show polycrystalline nature. Grain size is 145 nm, band gap is 2.03 eV and roughness of CuSe film is 13.1 nm. Electrical properties displayed film were utilised in optoelectronic application. Gao et al. [17] synthesized a series of CuS_xSe_{1-x} in non-aqueous medium by reflux method. The synthesis mode is useful for the CuS_xSe_{1-x} ternary material with a different content of sulfur and selenium compositions. X-ray data shows that lattice parameter deviates with variation of sulfur and selenium content. Optical spectra reveals that absorption changes according to deviation of chemical content. CuS_xSe_{1-x} ternary material were display very good photocatalytic activity for photodegradation of RhB in aqueous solution, decomposition is dependent on composition of compound. $CuSe_{1-x}S_x$ nanoflakes have effectively been prepared by Ni et al. [18] using copper chloride, Selenium and Sulfur powder as precursor materials through hydrothermal method. FESEM study reveals that for composition in $CuSe_{1-x}S_x$ hexagonal nanoflakes shows the same morphologies in the range 200–600 nm while the thickness is 15–50 nm and all nanoflakes have smooth surfaces. The band gap energy of $CuSe_{1-x}S_x$ nanoflakes was altered by change in sulfur and

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Facile Synthesis of Nano-Diced SnO_2–ZnO Composite by Chemical Route for Gas Sensor Application

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The simple chemical bath deposition (CBD) method is used to synthesize SnO_2–ZnO nanocomposite at room temperature. Formation of SnO_2–ZnO nancomposite is confirmed by the x-ray diffraction (XRD) pattern of annealed films. Scanning electron microscopy (SEM) micrographs of nanocomposite SnO_2–ZnO depict that morphological change from nanocubes to manifold hexagonal nanorods with an increase in ZnO content in a composite sample. Also, pure SnO_2 sample exhibits interconnected nanospheres. Electron dispersive spectroscopy (EDS) is employed to confirm elemental compositions in composite films. SnO_2–ZnO samples were applied as a sensor for different test gases, namely liquified petroleum gas (LPG), ethanol, ammonia (NH_3), and hydrogen sulfide (H_2S). The maximum response of 59.67% is observed for ethanol at an operating temperature of 275°C and 24 ppm gas concentration. Also, a composite sensor shows a quick response in comparison with a bare sensor. This superior performance of composite over pure sensor may be attributed to a n–n heterojunction at intergrain boundaries. The SnO_2–ZnO sensor is found to be selective towards ethanol even at lower gas concentrations.

Key words: Chemical bath deposition method, XRD, SEM, gas sensor

INTRODUCTION

Nowadays, solid-state gas sensors are mostly operative tools to detect a concentration of toxic, hazardous, pollutant and combustible gases in atmospheres. Such solid-state semiconductor gas sensors based on metal oxides have been widely used. The *n*-type material with relatively little oxygen adsorption sites available is suitable for sensing application due to a created range of a conduction barrier such as zinc oxide (ZnO) and tin oxide (SnO_2).[1,2] Many other oxides like CdO, In_2O_3, WO_3, ZnO, SnO_2 and CeO_2, have been examined to enhance the sensitivity, gas response and selectivity[3–9] Besides this, stability of material, cheapness, controlled industrial use of gas sensor devices and gas response at lowermost operating temperature conditions are the big challenges in this field. Recently, nano-composites are attracting attention to overcome such problems. Such type of sensors were suggested to improve thermal properties since they contain many heterogenous interfaces between different phases reliability ZnO(n)–CuO(p), SnO_2(n)–CuO(p), SnO_2(n)–ZnO(n) composites showed enhanced sensitivities from single phase materials[10,11] CdO–ZnO, SnO_2–ZnO, SnO_2–In_2O_3, WO_3–ZnO, CuO–NiO, In_2O_3–ZnO[12–17] have been previously reported to be promising sensitive and

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sciendo

Influence of bath temperature on microstructure and NH_3 sensing properties of chemically synthesized CdO thin films

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Cadmium oxide (CdO) thin films were synthesized using chemical bath deposition (CBD) method from aqueous cadmium nitrate solution. The bath temperatures were maintained at room temperature (25 °C) and at higher temperature (80 °C). The structural studies revealed that the films showed mixed phases of CdO and $Cd(OH)_2$ with hexagonal/monoclinic crystal structure. Annealing treatment removed the hydroxide phase and the films converted into pure CdO with cubic, face centered crystal structure. SEM micrographs of as-deposited films revealed nanowire-like morphology for room temperature deposited films while nanorod-like morphology for high temperature deposited films. However, cube-like morphology was observed after air annealing. Elemental composition was confirmed by EDAX analysis. Band gap energies of the as-deposited films varied over the range of 3 eV to 3.5 eV, whereas the annealed films showed band gap energy variation in the range of 2.2 eV to 2.4 eV. The annealed films were successfully investigated for NH_3 sensing at different operating temperatures and at different gas concentrations. The room temperature synthesized film showed a response of 17.3 %, whereas high temperature synthesized film showed a response of 13.5 % at 623 K upon exposure to 24 ppm of NH_3.

Keywords: *CdO thin films; chemical bath deposition; X-ray diffraction; scanning electron microscopy; optical properties; EDAX; gas sensing*

1. Introduction

Detection of toxic gases, pollutants, combustive and process gases is important for system and process control, safety monitoring and environmental protection. Traditional analysis methods used in gas sensing include gas chromatography, Fourier-transform, infrared spectroscopy, mass spectrometry etc. These methods are complex and also require sample preparation, so that on-line, real-time analysis is difficult. However, gas sensors based on solid state semiconductor materials offer considerable advantages over other gas sensing methods. The great interest of industrial and scientific fields in semiconductor oxide gas sensors comes from their numerous advantages, such as small size, improved sensitivity towards low concentrations (at a level of ppm or even ppb) for a wide range of gaseous chemical compounds, possibility of on-line monitoring and low cost. Also, semiconductor sensors are easy to miniaturize, robust, reliable, and can be designed to operate over a range of conditions including high temperatures. Semiconductor sensors can be produced in arrays to allow sensing of multiple species simultaneously. Transparent semiconducting

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ORIGINAL ARTICLE

Synthesis of novel probe 2-chloro-6-methoxy-3-phenyl hydrazone quinoline and its application to detection of persulphate in aqueous ethanol solution by fluorescence turn on

Dhanshri V. Patil[1] · Vishal S. Patil[2] · Sandeep A. Sankpal[1] · Govind B. Kolekar[1] · Shivajirao R. Patil[1]

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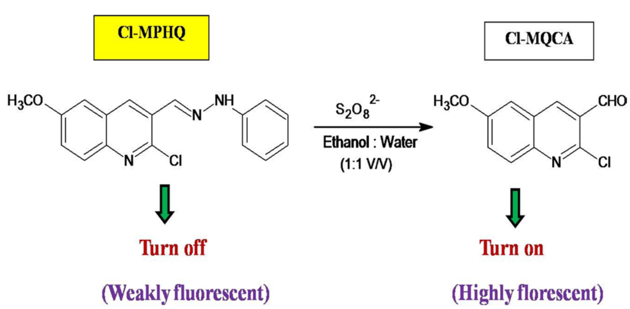
Abstract
A highly sensitive and selective fluorimetric detection method has been developed for persulphate anion using fluorescence turn on of 2-chloro-6-methoxy-3-phenyl hydrazone quinoline (Cl-MPHQ) in aqueous ethanol solution. Cl-MPHQ is a weakly fluorescent compound synthesized via a one-step reaction of 2-chloro-6-methoxyquinoline-3-carboxyaldehyde (Cl-MQCA) and phenyl hydrazine. The treatment of Cl-MPHQ with persulphate ion in aqueous ethanol solution (1:1 V/V) generates fluorescent Cl-MQCA, through C=N bond cleavage. The fluorescence intensity increased linearly with the concentration of persulphate ion (0–100 µmol L^{-1}). The detection limit of the method is 1 µmol L^{-1}determined from the standard deviation of the blank signal (3σ). The relative standard deviation of the method is 3% for 20 µmol L^{-1} of persulphate ion. The proposed method is simple, sensitive and useful for selective detection of persulphate ion in an aqueous ethanol solution.

Graphical Abstract



Keywords 2-Chloro-6-methoxy-3-phenyl hydrazone quinoline · Fluorescence turn on · Persulphate ion detection

Introduction

Persulphate anion ($S_2O_8^{2-}$) is a strong, two-electron oxidizing agent with a redox potential of 2.01 V [1]. Persulphate widely used for chemical oxidation of organic contaminants in polluted soil, ground-water and wastewater [2–11]. Persulphate salts have many uses, such as bleaching of textiles and natural fibers, removal of thiosulphate anions from photographic plates, initiators for olefin polymerization and etching of printed circuit boards and photo resists [12]. The analytical methods available for the determination of persulphate include iodometry and spectrophotometry [5, 13–16].

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A novel FRET probe for determination of fluorescein sodium in aqueous solution: Analytical application for ophthalmic sample

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Fluorescent pyrene nanoparticles (PyNPs) have been prepared by a reprecipitation method in the presence of sodium dodecyl sulphate (SDS) as a stabilizer. The formation of PyNPs has been confirmed by dynamic light scattering (DLS), UV-visible absorption spectroscopy, fluorescence spectroscopy and excited state lifetime measurements. DLS results of PyNPs shows a narrow size distribution with average particle size of 77.4 nm and negative zeta potential. The systematic FRET experiments performed by measuring fluorescence quenching of PyNPs with successive addition of FL-Na analyte exploited the use of PyNPs as nanoprobe for detection of FL-Na in aqueous solution. The fluorescence of PyNPs has been quenched by Fl-Na and quenching has been in accordance with the Stern-Volmer relation. The distance r between the donor (PyNPs) and acceptor (FL-Na) molecules has been obtained according to the fluorescence resonance energy transfer. The fluorescence quenching results have been used further to develop an analytical method for estimation of fluorescein sodium from ophthalmic samples available commercially in the market.

Keywords: Fluorescent pyrene nanoparticles, Fluorescein sodium, Fluorescence resonance energy transfer

Fluorescein sodium (FL-Na), also called uranine, is a non-toxic, low molecular weight and highly water-soluble dye, shows the physical property of fluorescence and commonly used as a quantitative fluorophore for studying different tissues of the eye[1-3]. Fl-Na shown in Fig. 1 is extensively used as a diagnostic tool in the field of ophthalmology and optometry. It is available as sterile single use sachets containing lint-free paper applicators soaked in Fl-Na[4]. It has a pK_a of 6.4 and its ionization equilibrium leads to pH-dependent absorption and emission over the range of 5 to 9. It can exist in seven prototropic forms, each of which possesses its own distinct spectral properties[5]. In neutral solutions, such as water and methanol (which also act as polar solvents) it exists mainly as dianion. It is widely used as fluorophore in the biosciences and as a fluorescent tracer for many applications[6]. Few methods have been used for detection and estimation of dyes[7-9]. A direct fluorimetric method requires separating the analyte from interfering constituents in the samples and having absorption in the region of analyte molecule. By contrast the fluorescence quenching/enhancement methods have high sensitivity and more simple detection and do not need separation of analyte molecules from other interfering constituents[10-13]. Therefore, the development of sensitive and selective sensors for FL-Na is of current interest.

Fluorescent organic nanoparticles (FONs) of low molecular weight functional compounds found special interest because of high variability and flexibility in materials and method of nanoparticles preparation[14-15]. Organic nanoparticles (ONs) occupy the intermediate state between isolated molecules and the bulk crystal. It is observed that most of the fluorescent organic materials belonging to the class of polynuclear aromatic hydrocarbons (PAHs) are water insoluble and gives their monomer emission in lower wavelength regions. PAHs are used as a fluorescent probe for the fluorescence quenching process[16-18]. Among the PAHs, Perylene and Pyrene are popular because of their large lateral π-orbital stacking between molecules and are most widely used probes

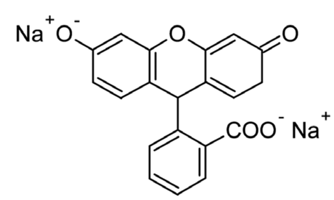

Fig. 1 — Structure of fluorescein sodium.

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