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Characterization of fuzzy number fuzzy measure using fuzzy integral

D. Rajan[1]* and A. Beulah[2]

Abstract

By using the concepts of fuzzy number fuzzy measures [2] and fuzzy valued functions [3] a theory of fuzzy integrals is investigated. In this paper we have established the fuzzy version of Generalised monotone Convergence theorem and generalised Fatous lemma.

Keywords

Fuzzy number, Fuzzy-valued functions, Fuzzy integral, Fuzzy number fuzzy measure.

AMS Subject Classification

26E50, 03E72.

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Contents

1. Introduction

In this paper [2], we have introduced a concept of fuzzy number fuzzy measures, defined the fuzzy integral of a function with respect to a fuzzy number fuzzy measure and shown some properties and generalized convergence theorems. It is well-known that a fuzzy–valued function [3, 4] is an extension of a function (point-valued), and the fuzzy integral of fuzzy-valued functions with respect fuzzy measures(point-valued) has been studied [3]; so it is natural to ask whether we can establish a theory about fuzzy integrals of fuzzy valued function with respect to fuzzy number fuzzy measures, the answer is just the paper's purpose. In fact, it is also a continued work of [3]. Since what we will discuss in the following is a generalization of works in [2, 3].

Throughout the paper, R^+ will denote the interval $[0,\infty]$, X is an arbitrary fixed set, $\bar{A}$ is a fuzzy σ-algebra [1] formed by the fuzzy-subsets of X, $(X,\bar{A})$ is a fuzzy measurable space, $\mu : \bar{A} \to R^+$ is a fuzzy measure in Sugeno's sense, $\int_{\bar{A}} f d\mu$ is the resulting fuzzy integral [1]. Operation $E\{+,.,\hat{\wedge}\}$, $F(x)$ is the set of all $\bar{A}$-measurable functions from x to R^+, $M(x)$ denotes the set of all fuzzy measures, (R^+) denotes the set of interval-numbers, R^+ denote the set of fuzzy numbers [2, 3], $\bar{F}(x)$ denotes the set of all $\bar{A}$-measurable interval-valued functions [3]. $\tilde{F}(x)$ denotes the set of all $\bar{A}$-measurable fuzzy valued functions [3]. $\bar{M}(x)$ denotes the set of interval number fuzzy measures [2], $\tilde{M}(x)$ denotes the set of fuzzy Number fuzzy Measures [2], we will adopt the preliminaries in [2–4]. Here we omit them for brevity, for more details see [2–4].

2. Definitions and Properties

Definition 2.1. *Let $\tilde{f} \in \tilde{F}(x)$, $A \in \mathscr{A}$, $\bar{\mu} \in \bar{M}(x)$. Then the fuzzy integral of f and A with respect to $\bar{\mu}$ is defined as $\int_A f d\mu = [\int_A f^- d\mu^- \int_A f^+ d\mu^+]$ where $\tilde{f}(x) = \inf \tilde{f}(x)$ and $f^+(x) = \sup f^+(x)\bar{\mu}(x) = \inf \bar{\mu}(x)$ and $\mu\mu^+(x) = \sup^+(x)$.*

Definition 2.2. *Let $\tilde{f} \in \tilde{F}(x)$, $A \in \mathscr{A}$, $\bar{\mu} \in \bar{M}(x)$. Then the fuzzy integral of $\tilde{f}$ and A with respect to μ is defined as $\int_A f d\mu(r) = \sup\{\lambda \in (0,1] : r \in \int_A f d\mu\}$, where $f_\lambda x = \{r \in (0,1] : f(x)(r) > \lambda\}$ and μ_λ is similar.*

Theorem 2.3. *Let $\varepsilon \in \tilde{f}\tilde{F}(x), AA, \bar{\mu}\varepsilon\tilde{M}(x)$. Then $\varepsilon \int_A f^- d\mu^- R^+$ and the following equation holds:*

$$\left(\int_A \tilde{f} d\bar{\mu}\right)_\lambda = \int_A f_\lambda d\mu_\lambda \quad for \quad (0,1]. \tag{2.1}$$

Proof. The condition is sufficient. To prove that the condition is necessary it is enough to verity equation (2.1).

For a fixed $\lambda \in (0,1]$ let $\lambda_n = (1 - 1/n + 1)\lambda$ then $\lambda_n \uparrow \lambda$.

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Some ranking indexes of stochastic orders and their applications

D. Rajan [1*] and D. Vijayabalan [2]

Abstract

In this paper, we have recalled some of the known stochastic orders and the shifted version of them, and discussed their four relations and its properties. Also, we obtained some applications of proportional likelihood ratio ordering fuzzy hazard rate ordering and mean inactivity ordering and its applications.

Keywords

Fuzzy random variables, Fuzzy likelihood ratio order, Fuzzy Hazard rate order, Mean inactivity time order and their Shifted orders.

AMS Subject Classification

60E15, 62F07.

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Contents

1. Introduction

Stochastic orders have been proven to be very useful in applied probability, statistics, reliability, operation research, economics and other fields. Various types of stochastic orders and associate properties have been developed rapidly over the years. A lot of research works have done on, hazard rate and reversed hazard rate orders due to their properties and applications in the various sciences, for example hazard rate order is a well known and useful tool in reliability theory and reversed hazard rate order is defined via stochastic comparison of inactivity time. We can refer reader to the papers such as, Chandra and Roy [6], Gupta and Nanda [8], Nanda and Shaked [11], Kayid and Ahmad [10] and Shaked and Shanthikumar [13]. Ramos-Romero and Sordo-Diaz [12] introduced a new stochastic order between two absolutely continuous random variables and called it proportional Hazard Rate order (*PHR*) order, which is closely related to the usual Hazard Rate order. The proportional Hazard Rate order can be used to characterize random variables whose logarithms have log-concave (log-convex) densities. Many income random variables satisfy this property and they are said to have the increasing proportional Hazard Rate order (*IPHR*) and decreasing proportional Hazard Rate Order (*DPHR*) properties. As an application, they showed that the *IPHR* and *DPHR* properties are sufficient conditions for the Lorenz ordering of truncated distributions.

Jarrahiferiz et al. [9] studied some other properties of the proportional Hazard Rate Order, then extended hazard rate and reversed hazard rate orders to proportional state similar to proportional Hazard Rate order called them proportional (reversed) hazard rate orders, and studied their properties and relations.

Shifted stochastic orders that are useful tools for establishing interesting inequalities that have been introduced and studied. Also, they have been studied in detail four shifted stochastic orders, namely the up likelihood ratio order, the

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Solving transportation problem with Monalisha's approximation method under fuzzy environment

D. Stephen Dinagar[1]* and R. Keerthivasan[2]

Abstract

This work finds initial basic feasible solution and optimal solution to the fuzzy transportation problem by using Monalisha's Approximation Method (MAM). In this work the supply and demand are represented by the Interval-Valued Triangular Fuzzy numbers(IVTFNs). The solution procedure is illustrated with numerical example.

Keywords

Transportation Problem, Interval-Valued Triangular Fuzzy Number(IVTFN), Monalisha's Approximation Method.

AMS Subject Classification

90C08, 90C90.

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Contents

1. Introduction

Transportation Problem is a modern class of Linear Programming Problem in which supply and demand of the commodities transported from several sources to the different destinations. Nagoor Gani and Stephen Dinagar[4] studied a special note on solving linear programming in fuzzy environment. In[3] Monalisha Pattnaik introduced the Monalisha's approximation method for solving optimization problems. S. Vimala and S. Krishna Prabha[2] proposed a modified method for solving balanced fuzzy transpotation problem. S. Vimala and S. Krishna Prabha[1] solved Fuzzy Transportation Problem through Monalisha's Approximation Method. D.Stephen Dinagar and R.Keerthivasan[5] studied the fuzzy transportation problems with the aid of interval- valued triangular fuzzy numbers. In this paper, the fuzzy transportation problems using Interval- Valued Triangular Fuzzy Numbers(IVTFNs) with monalisha's approximation method have been studied.

The organization of this paper is structured as follows. In section 2, we introduce some basic concepts related to Interval- Valued Triangular Fuzzy Numbers(IVTFNs) and some arithmetic operation of the above said numbers. IVTFN-transportation problem is introduced in section 3. In section 4, the algorithm of the Monalisha's approximation method is given. A relevant numerical illustration is presented in Section 5. Finally the conclusion part is included in section 6.

2. Basic Concepts

Definition 2.1. *An interval – valued fuzzy number $\breve{A}$ on R is given by $\breve{A} = \{(x, [\mu\breve{A}^L(x), \mu\breve{A}^U(x)])\}$ for all $x \in R$, $0 \leq \mu\breve{A}^L(x) \leq \mu\breve{A}^U(x) \leq 1$ and $\mu\breve{A}^L(x), \mu\breve{A}^U(x) \in [0,1]$ and denoted by $\mu\breve{A}(x) = [\mu\breve{A}^L(x), \mu\breve{A}^U(x)], x \in R$ or $\breve{A} = [\breve{A}^L, \breve{A}^U]$.*

Definition 2.2. *The interval – valued triangular fuzzy number $\breve{A}$ on R represented by the two fuzzy numbers $[\breve{A}^L, \breve{A}^U]$, where $\breve{A}^L = (a_1^L, a_2^L, a_3^L; w_{\breve{A}}^L)$ and $\breve{A}^U = (a_1^U, a_2^U, a_3^U; w_{\breve{A}}^U)$:*

$$\begin{aligned}\breve{A} &= [\breve{A}^L, \breve{A}^U] \\ &= [(a_1^L, a_2^L, a_3^L; w_{\breve{A}}^L), (a_1^U, a_2^U, a_3^U; w_{\breve{A}}^U)]\end{aligned}$$

satisfying that $a_1^U \leq a_1^L$, $a_3^L \leq a_3^U$ and $w_{\breve{A}}^L \leq w_{\breve{A}}^U$ where $w_{\breve{A}}^U$ and $w_{\breve{A}}^L$ are the weights of $\breve{A}^U$ and $\breve{A}^L$ respectively.

Definition 2.3. Arithmetic Operations

Let $\breve{A} = [\breve{A}^L, \breve{A}^U] = [(a_1, b_1, c_1; w_{\breve{A}}), (a_2, b_2, c_2; W_{\breve{A}})]$, $\breve{B} = [\breve{B}^L, \breve{B}^U] = [(p_1, q_1, r_1; w_{\breve{B}}), (p_2, q_2, r_2; W_{\breve{B}})]$ be the IVTFNs.

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STEPHEN'S ALGORITHM FOR SOLVING ASSIGNMENT PROBLEMS

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Abstract

The aim of this paper is to present the efficient algorithm named as Stephen's Algorithm to find the optimal solution for assignment problems. This algorithm provides less number of iterations to reach the optimality. To validate this algorithm, a numerical example is solved and the results are compared with Hungarian method.

1. Introduction

An Assignment Problem is a subclass of transportation problem in which the ultimate aim is to assign a number of origins to equal number of destinations at a minimum cost or maximum profit. An Assignment problem is a variation of transportation problem with two characteristics (i) the cost matrix should be a square matrix and (ii) the optimum solution for the problem has only one assignment in a given row or column of the cost matrix.

Dutta and Pal [2] have developed modified version of Hungarian method. Stephen Dinagar and K. Palanivel [3] solved transportation problem in fuzzy environment. Sambasiva Rao and Maruthi Srinivas [4] proposed an effective algorithm to find the optimal solution of an assignment problem aiming to reduce computational cost. Sudha and Vanisri [5] have introduced an

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Keywords: Assignment Problem (A.P.), Hungarian method, optimal solution, Stephen's algorithm.
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AIR QUALITY ASSESSMENT IN AND AROUND COAL WASHERY COMPLEXES USING INTERVAL TYPE-2 FUZZY REASONING APPROACH

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Abstract:
This paper presents a model based on interval type-2 fuzzy reasoning approach for assessment of air quality in coal washery complexes. In the proposed model, emission rates of SPM and SO_2 from various sources and activities of coal washery complexes are estimated using fuzzy models. The presented models would be a pioneering work for the environmental researchers, engineers, policy makers and protection agencies to assess the impact of industrial activities in coal washery complexes. This approach would enable a better understanding of the pattern of environmental degradation through the sources and quantitatively assess to overcome the problem.

Keywords: Industrial coal washery complexes, Air Pollution, Air quality assessment, Interval type-2 fuzzy logic system, Air quality index.

2010 Mathematics Subject Classification: 68U07, 68U20, 68W01.

1. INTRODUCTION

The impacts of air pollution, in particular, the suspended particulate matters (SPM) are considerably severe in and around a coal washery complex. The dust is generated significantly due to different operational units such as screening, crushing, loading and unloading, exposed piles and stock yards, thermal dryers and the dropping points of conveyer belts etc. The particulate matters generated during its operations are being transported by wind in downwind direction and disperse both horizontally and vertically. Further the pollutants have an adverse impact on the buildings, plants and other valuable receptors. As a result, the whole eco-system is disturbed and the fertility status of the soil around the coal washery complex is significantly changed with unpleasant impacts [9]. Therefore it is very much warranted to estimate the emission of air quality from different sources of coal washery complexes using suitable mathematical approach. Further the air quality in and around coal washery complexes has to be predicted using an appropriate air quality model. Unfortunately less focus has been made for simulating the environmental impact due to coal preparation plants. Simulation of environmental scenario in and around coal washery complexes may help the industry in planning and implementing the control strategies

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Structural, Morphological, Optical and Photoluminescence Properties of Hafnium Oxide Nanoparticles Synthesized by Sol-Gel Method

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The novel HfO_2 nanoparticles have been synthesized using sol-gel method. The samples were characterized by X-ray powder diffractio scanning electron microscopy with elemental analysis, Fourier transform infrared spectrometer, UV-visible spectroscopy. The XR patterns revealed the transition of cubic to monoclinic phase and calculated particle sizes are 34.92 and 35.66 nm in cubic phase a increase in molar concentration increased the size to 60.31 and 60.33 nm. The optical band gap energy decrease with increasi molar concentrations. We expect that this sol-gel method may be extended to the preparation of nanostructures of other kinds of me oxides.

Keywords: Hafnium oxide, Nanoparticles, Sol-gel, Photoluminescence.

INTRODUCTION

Nanostructured materials have a lot of important applications in various fields because of their unique properties. Semiconductor nanoparticles have received much attention because of their special properties in comparison with those of bulk materials [1-3]. In particular, inorganic compound hafnium oxide (HfO_2) is an important group II-IV semiconductor with a wide band gap (5.7eV) [4]. Hafnium dioxide is a material with a number of technologically attractive properties such as high melting point (2758 °C), high dielectric constant (≈ 30), high chemical stability and high neutron absorption cross section [5]. It often plays an important role in the continuous down-scaling of integrated circuits since new insulating materials with a high dielectric constant are being researched to replace SiO_2 as a gate dielectric. In terms of structural characteristics, hafnium oxide exists in three polymorphic structures, namely monoclinic (m-HfO_2) at low temperature, tetragonal (t-HfO_2) above 2050 K and cubic (c-HfO_2) at around 2803 K. Each structure has different applications. In past years researchers have been fascinated with nanoparticles structure. Materials with their enormous potentials found in different ways of uses for example semiconductor, optics, magnetic data storage, catalysis ceramics and nano composites. Hafnium oxide has h refractive index and laser damage thresholds [6]. In previ years many ways prepared nanoparticles like, cobalt, platin germanium and gold have been embedded into the hafni oxide matrix to develop the interfacial and electrical propert of semiconductor-metal-oxide devices [7].

Many different ways have been reported for the produc metal oxides nanoparticles. We designed an experiment synthesize europium doped HfO_2 nanoparticles, using a s gel method. In the sol-gel method, the chemical reaction comparatively simple, low-cost and non-toxic compared other synthetic methods includes solvothermal [8], hydr thermal [9], non-hydrolytic synthesis [10]. The techniques precipitation method has many advantages, including low c and good composition process [11]. The possibility of usi HfO_2 as a high –k-dielectric [12] in capacitor devices in memo board such that dynamic random access memory (DRA applications stimulated a scientific and technique interest in [13]. The obtained HfO_2 NPs were characterized by X-ray dif raction (XRD) and Fourier transform infrared (FTIR) spectr scopy. The optical properties were studied by UV and photol minescence. The morphology and size of the HfO_2 NPs we evaluated by scanning electron microscope (SEM).

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A Strains Activity of CuO Nanoparticles using Copper Chloride Dihydrate by Sol-Gel Method

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Copper(II) oxide (CuO) nanoparticles synthesized by different molarities like 0.1, 0.2 and 0.3 M at calcinations temperature 450 °C. The XRD esults analyzed the prominent peaks corresponding to the monocrystalline nature of CuO nanoparticles and the average crystalline size f CuO nanoparticles size is decreased with increase of molarities. From SEM image of CuO nanoparticles, the particles are well scattered, which are well connected and consistent with the crystal system. The absorption spectra shows the blue shift which can be attributed to the mall size of CuO nanostructures. The FTIR spectra confirmed high intense broad band peaks at 496.96 cm^{-1} and assigned to characteristics and of monoclinic phase CuO nanoparticles were synthesized and calcined at 450 °C, and the particle size of the nanoparticles was found o be in the range of 19-23 nm. These sizes of integrated CuO nanoparticles is a cost-efficient, biological molecule capable of working vith antibiotics against *Staphylococcus saprophyticus*, *Bacillus subtilis*, *Pseudomonas aeruginosa* and *Escherichia coli*.

Keywords: CuO nanoparticle, Antibacterial activity.

INTRODUCTION

In original sense of nanotechnology refers to the research lity to construct items from the bottom up, using techniques l tools being developed every day to make complete highly anced product [1]. Nanotechnology as defined by the size urally very broad, including fields of science as diverse as face science, organic chemistry, molecular biology, semi-nductor physics, microfabrication, *etc*. Nanotechnology may able to create many new materials and devices with wide range applications such as in medicine, electronics, biomaterials l energy production [2]. On the other hand, nanotechnology es many of the same issues as any new technology. The ign, characterization, production and application of structure, ice and system by controlled manipulation of size and shape he nanoscale have the superior characteristics and properties. s phenomenon has been creating crazy stimulation to resea-ers in the nanotechnology [3].

Research interests in microorganisms are highly appre-ed for their phenomenal chemical and physiological aspects, their differing variants, such as diffusivity, power resistance, ctrostatic conductivity, strength and hardness, chemistry ciency and various vital biological functions make the difference and diversity [4]. These particles are widely used as medicinal catalysts, in clinical applications, in medical applications, in infections, antibiotics, fillers, catalysts, and semiconductors because they are very useful in the development of cosmetics and microelectronics [5].

The CuO is heavily convertible metal oxide by its attractive properties. It is used in various technology applications such as high temperature, tropical environments, gas sensors, and lighting applications [6]. Recently, it is used as an antimicrobial agent against various bacterial species. Copper(II) oxide crystal structures have a narrow gap, providing useful photocatalytic and photovoltaic properties [7]. Due to the various types of microorganisms, there is a problem in the microbial hybrid living conditions of air, water and soil and serious complications in health care. Due to spread of anti-antibiotic infections, the interest in alternative antimicrobial agents, such as small antibiotics, ketonic polymers, metal nanoparticles and antimicrobial peptides is increasing [8].

The synthesis method being an important parameter for control of particle size, morphology, crystallity and in order to achieve this goal CuO nanoparticles are investigated in different synthesis methods including precipitation such as sono chemical, sol-gel, hydrothermal, chemical path deposition

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Original research article

A sol-gel approach to the synthesis of CuO nanoparticles using *Lantana camara* leaf extract and their photo catalytic activity

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$CuCl_2 2H_2O$
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ABSTRACT

Copper oxide nanoparticles were synthesis by sol-gel method using *Lantana camara* extract as a mixture of $CuCl_2 2H_2O$ and NaOH. CuO NPs to be investigated by XRD, UV Spectra, SEM, FTIR, Photocatalytic activity. X ray diffraction revealed that they were crystalline in nature and the average size of nanoparticles was 17 nm as determined by Scherrer Formula. The photocatalytic performance of these nanoparticles was evaluated using methylene blue dye. The result showed that photocatalytic performance was 94.07% depending on the particle size of the CuO nanoparticles.

Introduction

Metal oxide nanoparticles are the most essential ingredients for nanotechnology research. They are important because of the ique features of catalytic, magnetic, optical, and electrical streams. The studies show that metal nanoparticles like silver, copper, d and iron are used. This research has focused on CuO metal nanoparticles which are considered as multi-task metal oxides having sical, chemical and biological properties. The oxidative nanoparticles are useful in a broad range of thermodynamics, optical, chanical, power, electromagnetic and gas sensitive applications [1,2]. The scientists determine to focus on the wide applications of O nanoparticles, their particle size and crystal transplant [3]. CuO nanoparticles are found in drugs, cosmetics, solar cells and niconductor applications. Furthermore, copper oxide nanoparticles act as antimicrobial agents for cells of many ailments. Com-ed to other nanoparticles, the CuO nanoparticles are less toxic and safe, so they can be used to treat certain diseases such as, fungi, ns, stomach, joints and urinary tract in microbiology applications [4,5].

Copper oxide has been modified as a significant semiconductor type in recent years due to the latest technical and technology elopment. Short band gap (1.7 eV) CuO nanopaticles are used to create certain properties such as, solar energy, gas sensors, mical absorbers, electrical and optical devices with its large properties, large injection power and excellent chemical stability [6]. size and crystalline changes in the particles of the CuO are also affected in nanoparticles. In recent years, CuO nanoparticles, mical and physical methods are the simplest and potential alternative, cheap, non-toxic and microbial environmental permanent cursor [7,8]. In addition, it has been obtained through the plant leaf [Kalita S et al.], flower [Ganjewala D et al.], and root juice of CuO nanoparticles [Sanjeeb Kalita et al.]. Biologically prepared nanoparticles are non-toxic and do not have environmental act [9,10].

Lantana camara (*L. camara*) is a Verbenaceae family. In recent history, this plant is accounted for various medicinal properties. *L. camara* plants of leaves, flowers and root were Studied to have antibacterial activity [11,12]. Different solvent extract of *L.*

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Solid state synthesis of cadmium doped ZnS with excellent photocatalytic activity and enhanced visible light emission

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Abstract
Pure and Cd-doped ZnS nanoparticles were synthesized by inexpensive solid state reaction method at different percentages (0.5, 1.0, 1.5 and 2.0 wt.%). The structural, functional, optical, morphological and photocatalytic properties were characterized by using X-ray diffraction analysis, Fourier transform of infrared (FT-IR) spectroscopy, UV–Vis spectroscopy, photoluminescence (PL) spectroscopy and scanning electron microscopy (SEM) were done using energy dispersive X-ray analysis. In XRD pattern crystalline size, microstrain, dislocation density and lattice constant were found and they confirmed the crystalline nature with cubic structure. SEM and TEM exposed the great quantity of sphere-shaped particles and the elements Zn, S and Cd were identified from EDS. The photo-degradation rate was sturdily inclined by activation of ZnS photocatalyst with photon and creation of hydroxyl radicals. This suggested that Cd doping enhanced catalytic activity in the ZnS lattice.

1 Introduction

In modern years, nanostructure materials have become as a main subject for the intensive research because of their potential application in the fabrication of nano devices. Due to their large exterior volume percentage and quantum confinement effects, the electronic, magnetic and optical properties of nanomaterials get appreciably distorted compare to their bulk counterparts [1]. Mostly, one dimensional nano structures have been prepared from II to VI and semiconductor group is prepared from III to V group semiconductor. Among these ZnS is a typical II–VI semiconductor composite with band gap energy of 3.6 eV and a small Bohr radius (2.4 nm). Cadmium has tremendous spacious bandgap. It is semiconductor substance with fascinating properties such as, photoluminescent phenomenon [2, 3]. which is composed of exceptional applicant for exploring the intrinsic recombination progression intense excitonic systems. Environment is polluted by organic contamination, which comes from toxic waste water and has attracted more attention in modern years [4–6]. Safe and clean technologies are now required to reduce pollution [7–9]. To resolve the above problem, semiconductor photocatalyst like Cd doped ZnS which is clean, easy to operate and with high efficiency is used in this work. The sunlight and the organic substance like methyl orange dye are used along with Cd doped ZnS photocatalysts to purify the contaminated water [10–13]. Many techniques such as, chemical vapour deposition [14] wet chemical route [15] co-precipitation [16] solvothermal synthesis [17] hydrothermal process [18] thermal decomposition method [19] radio frequency magnetron sputtering technique [20] and solid state reaction method are used to prepare ZnS nanoparticles. Solid state reaction method is cheap, non-toxic and echo-friendly. So this method is used in the present work for the production of ZnS and Cd -doped ZnS nanparticles at different concentrations (0.5, 1.0, 1.5 and 2.0 wt.%) and the photocatalytic property is studied for the prepared materials.

2 Experimental details

2.1 Solid state synthesis of Cd-doped ZnS nanoparticles

In this study, Zinc acetate dehydrate, thiourea and cadmium acetate of high purity were used to form Cd-doped ZnS nanoparicles. For typical synthesis, Zinc acetate dehydrates and thiourea were grounded by using agate mortar. To achieve Cd doping, different concentrations (0.5, 1.0, 1.5 and 2.0 wt.%) were added to the mixed powder and ground thoroughly. Finally, mixed powder was heated in a muffle

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Solid state synthesis of cadmium doped ZnS with excellent photocatalytic activity and enhanced visible light emission

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Abstract
Pure and Cd-doped ZnS nanoparticles were synthesized by inexpensive solid state reaction method at different percentages (0.5, 1.0, 1.5 and 2.0 wt.%). The structural, functional, optical, morphological and photocatalytic properties were characterized by using X-ray diffraction analysis, Fourier transform of infrared (FT-IR) spectroscopy, UV–Vis spectroscopy, photoluminescence (PL) spectroscopy and scanning electron microscopy (SEM) were done using energy dispersive X-ray analysis. In XRD pattern crystalline size, microstrain, dislocation density and lattice constant were found and they confirmed the crystalline nature with cubic structure. SEM and TEM exposed the great quantity of sphere-shaped particles and the elements Zn, S and Cd were identified from EDS. The photo-degradation rate was sturdily inclined by activation of ZnS photocatalyst with photon and creation of hydroxyl radicals. This suggested that Cd doping enhanced catalytic activity in the ZnS lattice.

1 Introduction

In modern years, nanostructure materials have become as a main subject for the intensive research because of their potential application in the fabrication of nano devices. Due to their large exterior volume percentage and quantum confinement effects, the electronic, magnetic and optical properties of nanomaterials get appreciably distorted compare to their bulk counterparts [1]. Mostly, one dimensional nano structures have been prepared from II to VI and semiconductor group is prepared from III to V group semiconductor. Among these ZnS is a typical II–VI semiconductor composite with band gap energy of 3.6 eV and a small Bohr radius (2.4 nm). Cadmium has tremendous spacious bandgap. It is semiconductor substance with fascinating properties such as, photoluminescent phenomenon [2, 3]. which is composed of exceptional applicant for exploring the intrinsic recombination progression intense excitonic systems. Environment is polluted by organic contamination, which comes from toxic waste water and has attracted more attention in modern years [4–6]. Safe and clean technologies are now required to reduce pollution [7–9]. To resolve the above problem, semiconductor photocatalyst like Cd doped ZnS which is clean, easy to operate and with high efficiency is used in this work. The sunlight and the organic substance like methyl orange dye are used along with Cd doped ZnS photocatalysts to purify the contaminated water [10–13]. Many techniques such as, chemical vapour deposition [14] wet chemical route [15] co-precipitation [16] solvothermal synthesis [17] hydrothermal process [18] thermal decomposition method [19] radio frequency magnetron sputtering technique [20] and solid state reaction method are used to prepare ZnS nanoparticles. Solid state reaction method is cheap, non-toxic and echo-friendly. So this method is used in the present work for the production of ZnS and Cd -doped ZnS nanparticles at different concentrations (0.5, 1.0, 1.5 and 2.0 wt.%) and the photocatalytic property is studied for the prepared materials.

2 Experimental details

2.1 Solid state synthesis of Cd-doped ZnS nanoparticles

In this study, Zinc acetate dehydrate, thiourea and cadmium acetate of high purity were used to form Cd-doped ZnS nanoparicles. For typical synthesis, Zinc acetate dehydrates and thiourea were grounded by using agate mortar. To achieve Cd doping, different concentrations (0.5, 1.0, 1.5 and 2.0 wt.%) were added to the mixed powder and ground thoroughly. Finally, mixed powder was heated in a muffle

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ON SOLVING NEUTROSOPHIC LINEAR COMPLEMENTARITY PROBLEM

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Abstract:
The aim of this paper is to propose a methodology for solving Linear Complementarity Problem with Single Valued Trapezoidal Neutrosophic Numbers (SVTN). The effectiveness of the proposed method is illustrated by means of a numerical example. This problem finds many applications in several areas of science, engineering and economics.

Keywords: Linear complementarity problem, Neutrosophic Set, Single Valued Trapezoidal Neutrosophic Numbers, Lemke's Algorithm.

2010 Mathematics Subject Classification: 65K05, 90C90, 90C70, 90C29.

1. INTRODUCTION

Fuzzy systems (FSs) and Intuitionistic fuzzy systems (IFSs) cannot successfully deal with a situation where the conclusion is adequate, unacceptable and the decision maker declaration is uncertain. Therefore, some novel theories are mandatory for solving the problem with uncertainty. The neutrosophic sets (NSs) reflect on the truth membership, indeterminacy membership and falsity membership concurrently, which is more practical and adequate than FSs and IFSs in commerce, which are uncertain, incomplete and inconsistent in sequence. Single valued neutrosophic sets are an extension of NSs which were introduced by Wang and Wang [6] and further investigated by Peng and Wang in [7] where the latter authors also discussed the power aggregation operators. Although many researchers and scientists [1-5, 8-11] have worked in the neutrosophic methods and applied it in the field of decision making, there are, however, still some viewpoints regarding defining neutrosophic numbers in different forms, and their corresponding de-impreciseness is very important.

This paper provides a new technique for solving the linear complementarity problems with fuzzy numbers. The paper is organized as follows. In section 2, Single Valued Trapezoidal Neutrosophic numbers (SVTN) and the

Similarity Measure between Trapezoidal Intuitionistic Fuzzy Numbers with Value and Ambiguity

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ABSTRACT

In this paper we focused on the value and ambiguity of the trapezoidal intuitionistic fuzzy numbers. Based on these two notions we studied a ranking function for trapezoidal intuitionistic fuzzy numbers. Furthermore we proposed a similarity measure for these two trapezoidal intuituinistic fuzzy numbers using the value and ambiguity. Also we have studied a comparison between the centroid ranking and value, ambiguity ranking for the trapezoidal intuitionistic fuzzy numbers. Some results are justified and numerical example are demonstrated for our proposed formula.

Keywords: Value, Ambiguity, Ranking Function, Similarity measure, Ranking Comparison.

1.Introduction

The notion of fuzzy number were extended to develop the concept of intuitionistic fuzzy numbers by adding an additional non- membership function which is able to express more abundant and flexible information as compared to fuzzy numbers. Various definition of intuitionistic fuzzy number numbers and ranking method have been proposed by many author. The generalization of fuzzy set theory proposed by Zadeh [10] and the theory of intuitionistic fuzzy sets were introduced by Atanassov [1]. Chen and Hwang [2] introduced a ranking method based on scoring of intuitionistic fuzzy numbers. Ranking of intuitionistic fuzzy number was introduced by Mitchell [6] .The Geometric Aggregation over interval – valued intuitionistic fuzzy numbers are proposed by Xu and Chen [8]. The notion of fuzzy numbers were extended to develop the concept of intuitionistic fuzzy numbers by adding an additional non-membership function which is able to express more abundant and flexible information as compared of fuzzy numbers. Various definitions of intuitionistic fuzzy numbers and ranking methods have been proposed. The concept of Chen and Hwang have been later generalized by Nayagan et.al [4]. Further Wang and Zhang [7] defined the trapezoidal intuitionistic fuzzy numbers and gave a ranking method which transformed the ranking of trapezoidal intuitionistic fuzzy number into ranking of interval numbers. Li [5] developed a ratio ranking method for triangular intuitionistic fuzzy numbers and applied to multi attribute decision making. A method based on distance measure for interval – valued intuitionistic fuzzy numbers were studied by Xu [9]. Ranking of TRIFN has been proposed by De and Das [3]. Since Ranking of alternative plays an efficient role in decision making problems, ranking of trapezoidal intuitionistic fuzzy number has become a task of outmost importance when we deal with decision making problems based on intuitionistic fuzzy information. In this paper we proposed a similarity measure for two trapezoidal intuitionistic fuzzy numbers using value and ambiguity of the two fuzzy number and also we

SOLUTION OF FUZZY DIFFERENTIAL EQUATIONS BY RUNGE KUTTA METHOD

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Abstract

In this paper, numerical solution of second order fuzzy differential equation by Runge–Kutta method with an alternation in parameters in order to increase the order of accuracy of the solution is presented.

Keywords: Fuzzy initial value problem (FIVP), Fuzzy differential equations (FDE), Runge-Kutta method, higher order derivative approximations.

1 Introduction

In 1972, fuzzy derivative was first studied by Chang and Zadeh [6]. The extension principle was used in fuzzy differentiation was done by Dubois and Prade [7]. Further generalisations in fuzzy derivative concepts were proposed by Puri and Ralescu [13] and Goetschel and Vaxman [10] etc. The concept of fuzzy differential equation was used in the fuzzy dynamical problems first by Kandel and Byatt. The fuzzy differential equation, Cauchy problems were studied and developed Kaleva [11], Seikkala [14]. FDE has an application in various fields of Science, Computer Science, Engineering and Mathematics.

In this paper, we discuss about the method of finding numerical solution of FIVP $y'(t) = f(t,y(t))\,;\ t \in [a,b]\,, y(a) = y_0$ by Runge-Kutta second order methods with higher order derivative approximations.

SOME PROPERTIES OF 2-FUZZY 2-CONTRACTION AND 2-FUZZY 2-ALMOST ORBIT IN 2-FUZZY 2-NORMED LINEAR SPACES

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Abstract— In this paper, concepts like 2-fuzzy 2-contraction, 2-fuzzy 2-uniformly rotund (UR), 2-fuzzy 2-locally uniformly rotund (LUR), 2-fuzzy 2-Frechet differentiable norm, type(γ) fuzzy mapping, 2-fuzzy 2-almost orbits are introduced. Certain remarkable theorems relative to these concepts in 2-fuzzy 2-normed linear space are introduced.

Keywords— 2-fuzzy 2-contraction, 2-fuzzy 2-uniformly rotund(UR), 2-fuzzy 2-locally uniformly rotund(LUR), 2-fuzzy 2-Frechet differentiable norm, type(γ) fuzzy mapping, 2-fuzzy 2-almost orbits.

I. INTRODUCTION

The concept of fuzzy set was introduced by L.Zadeh[10] in 1965. In 1992, Felbin[3], introduced an idea of a fuzzy norm on a linear space by assigning a fuzzy real number to each element of the linear space so that the corresponding fuzzy metric associated to this fuzzy norm is of Kaleva and Seikkala type[5]. In 1994, Cheng and Mordeson[2] introduced another idea of a fuzzy norm on a linear space in such a manner that the corresponding fuzzy metric is of Kramosil and Michalek type[6]. The concept of fuzzy norm was introduced by T.Bag and Samanta[1], Rano and Bag [7] introduced the definition of fuzzy norm studied a critical analysis of the conditions of the redefined fuzzy norm and proved decomposition theorem of fuzzy norm into quasi-norm.

A satisfactory theory of 2-norm on a linear space has been introduced and developed by Gahler [4]. Somasundaram and Thangaraj Beaula [9] introduced the concept of 2-fuzzy 2-normed linear space or fuzzy 2-normed linear space of the set of all fuzzy sets of a set. Saadati and Vaezpour [8] have proved closed graph theorem on a fuzzy Banach space using fuzzy norm whereas in [9] the theorems are generalized in 2-fuzzy 2-normed linear space.

In this paper, concepts like 2-fuzzy 2-contraction, 2-fuzzy 2-uniformly rotund(UR), 2-fuzzy 2-locally uniformly rotund(LUR), 2-fuzzy 2-Frechet differentiable norm, type(γ) fuzzy mapping, 2-fuzzy 2-almost orbits are introduced. Certain remarkable theorems relative to these concepts in 2-fuzzy 2-normed linear space are introduced.

II. PRELIMINARIES

Definition 2.1

Let X be a universe of discourse, a fuzzy set is defined as $A = \{x, \mu_A(x): x \in X\}$ which is characterized by a membership function $\mu_A(x): X \to [0,1]$ where $\mu_A(x)$ denotes the degree of membership of the element x to the set A.

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alysis on biological importance of antiseptic drug, O-Benzyl droxylamine, by the application of spectroscopic and theoretical tools

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ABSTRACT

Biological importance of antiseptic drug, O-Benzyl hydroxylamine was explored using QSAR studies for ultimate usage for treating fungal infections. In this research work, the molecular spectroscopic tool and theoretical calculation method of analysis. The data acquired from both tools were evaluated and compared to validate structural and vibrational characteristics. Mulliken charge displacement around molecular site in order for exploring electronic properties to find out the cause of inducement of drug potential. The Lipinski rule of five was evaluated for the measurement of biological importance of the drug compound. The lipophilicity and topological surface area of the drug was monitored for determining biological process activity. The partial involvement of compositional bonds of the molecule was appraised for influential vibrational characteristics. The chemical environment for making chemical property was monitored from the uniform and asymmetrical chemical shift of core and allied carbons. The resultant oscillating potential orientation in the molecular site was identified and the residing zones were recognized to find out the origin of drug potential. The occurrence of CT complex process was studied and the CTC was found to be CC and C–N for generating drug activeness. The enhancement of hyper active polarization was measured in first and second order from which the charge level pulling on different entities were observed for ensuring the biological affinity of the compound. The enantiomer characteristics were thoroughly studied to measure the level of toxicity.

Introduction

The phenol is basically drug compound and particularly it is widely as an antiseptic. Normally, the Phenol is medically used as a pre- ative in special type of vaccines [1]. Here, the phenol is converted in ydroxyl methyl benzene and it is directly substituted with amine up and formed the O-Benzyl hydroxylamine. Usually, when N–O ded compound has peculiar structure which is significant type of mical species due to their special biological activity [2]. In this case, roxyl methyl group is protected by amine group which enhances the ical activity and thereby the species has multidimensional pharma- ical activity [3]. The present compound has attracted many organic ntists for the preparation of pharmaceutical products due to the logical activeness.

Recent days, the hydroxylamine derivatives intermediate are having ch attention due to usage of the preparation of Aziridines [4], b-Amino acids and Isoxazolidinones [5]. Since, the present chemical species is powerful inhibitors and have pharmacological and therapeutic effects; it is chemically used for the preparation of antibiotic, antiseptic and anti fungal compounds which provides better results when compared with other similar compounds [6, 7].

By screening the literatures as well as available pharmaceutical resources, it was clear that, the present drug; O-Benzyl hydroxylamine is fundamentally having drug potential and the medical data explained that, the part of the pharmaceutical applications of the compound was only briefed. It is necessary to explore the entire drug potential of the present compound in order to use this chemical species for fabricating new novel multifunctional drug. It is well known that, by examining the drug properties of the chemical species, the application of the drug compound can be determined. In order to expose biological property of the compound, biological as well as structural activity properties are to be studied. In this way, it is an attempt to study the entire physic-

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Analysis on biological importance of antiseptic drug, O-Benzyl hydroxylamine, by the application of spectroscopic and theoretical tools

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ABSTRACT

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1. Introduction

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By screening the literatures as well as available pharmaceutical resources, it was clear that, the present drug; O-Benzyl hydroxylamine is fundamentally having drug potential and the medical data explained that, the part of the pharmaceutical applications of the compound was only briefed. It is necessary to explore the entire drug potential of the present compound in order to use this chemical species for fabricating new novel multifunctional drug. It is well known that, by examining the drug properties of the chemical species, the application of the drug compound can be determined. In order to expose biological property of the compound, biological as well as structural activity properties are to be studied. In this way, it is an attempt to study the entire physic-

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Dependance of lanthanum ions on structural, magnetic and electrical of manganese based spinel nanoferrites

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ABSTRACT

Lanthanum doped manganese spinel nanoferrites ($MnLa_xFe_{2-x}O_4$) with X = 0.00, 0.02, 0.04, 0.06 and 0.08 were fabricated by sol-gel method. The cubic phase was confirmed by using X-ray diffraction technique. FESEM revealed that the prepared samples attain highly stable spherical morphology. Energy dispersive X-ray spectra confirm the presence of Manganese (Mn), Lanthanum (La), Iron oxide (Fe) and oxygen (O) element in desired proportion. Ultra-violent diffuse reflectance spectroscopy shows that absorbance spectra were inversely proportional to band gap energy. Room temperature magnetic hysteresis curves expose the ferromagnetic behavior with decreases of saturation (M_s) and increases of coercivity (Oe). The origin of ferromagnetism in La^{3+} doped manganese nanoferrites were elaborated with reverence to the allocation of Mn^{2+} and Fe^{3+} ion within the spinel lattice. An impedance spectroscopy of the samples were analyzed in the frequency ranges from 0 to 7 MHz at room temperature reveals the resistance of the grains and grain boundary were found to increase with La^{3+} ion. The dielectric constant and loss tangent decreases with increases of frequency. The obtained results confirm that the prepared samples were useful for better radiation-absorption properties.

1. Introduction

Nanomaterials have been showing excellent chemical and physical properties due to their smaller crystal size, high surface area, quantum confinement effect and high calcined ability. Recently, ferrite nanoparticles are used in many applications such as technological and fundamental reason [1]. So that, these materials are of most challenging as magnetic memories, high density storage media, transformer cores, analogue devices, electron transport devices, electron magnetic interchange devices, choke coil and even in high - frequency device are derived [2–4]. The properties attained by these ferrites are based on their cation distribution and chemical composition and in Octahedral B-sites and tetrahedral A-Site [5]. Mn nanoferrites are one of the most important soft magnetic materials due to its high coercivity and low core losses [6]. The rare earth iron plays vital role to change its magnetic properties involves large magneto crystalline anisotropy; a high magnetostriction and magnetic moment on adding of La^{3+} ions have high ionic radii at very low temperature because of its localized nature of 4f electrons [7]. La^{3+} ions replace Fe^{3+} ions at low concentration as they like to enter the octahedral site (B-site) [8,9]. Micro strains are developed due to variation in the ionic radii between La^{3+} and Fe^{3+} ions which may effect spinel structure that in turn influence the motion of domain wall. Lanthanum doped manganese nanoferrites are very helpful in preventing and extinguishing electromagnetic interference to electronic controlled system [10].

In recent years, the sol-gel method is used to prepare various mixed oxide, nanoporous oxides, nanoscale architectures, nanomaterials, inorganic and organic hybrids [11]. The sol-gel method has most admiring advantages such as small crystalline size and better homogeneity in the final product [12]. Samolia.et al. have reported magnetic and structural properties of Gd-doped Ni–Mn–Cr ferrites synthesized by sol-gel method and noticed that magnetization and coercivity decrease with the increase of Gd^{3+} ions [13]. The rare earth element of Nd^{3+} doped manganese zinc ferrite synthesized by using combustion method influence on the magnetic and structural properties and it is increase in saturation magnetization with increase of Nd^{3+} ions [14]. Lanthanum doped manganese ferrites are prepared by enormous synthesize methods such as micro-emulsion auto-combustion, co-precipitation technique, wet chemical and sonication method [15–17]. Systematic studies on structural, electrical, optical and magnetic properties of La^{3+}

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Zn doping on structural, morphological, optical and photocatlytic activity of CdO nanoparticles

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Abstract

The effects of surfactants on the optical, structural and morphological changes of pure and Zn (1, 3, 5 and 7 %) doped CdO nanoparticles have been characterized by X-ray Powder Diffraction (XRD), Scanning Electron Microscopy (SEM), Ultraviolet Visible (UV-Vis) Photoluminescence (PL) spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR) and photocatalytic activity. The influence of particle size on structural parameters such as Lattice parameter (a) Crystallite size (d), Dislocation density and Lattice constant (Å) were also determined. UV- visible region show blue shift as compared to pure sample. The emission of the pure and Zn doped samples were derived from PL spectroscopy. The structural bond vibrations of pure and Zn doped CdO nanoparticles were analyzed by FTIR spectroscopy. The photocatalytic activities of Zndoped CdO nanoparticles were evaluated by degradation of methylene blue dye in aqueous solution under sunlight. The photo degradation efficiency of 92% is attributed to the generation of oxygen species while doping.

Key words; Zinc acetate, Morphology, MB dye, Photocatlytic activity

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200 MeV Ag^{15+} swift heavy ion beam induced property modifications in Nb_2O_5 thin films by fluence variation

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Optical properties of materials

ABSTRACT

Swift Heavy Ion beam irradiation is capable of inducing a variety of modifications on the properties of thin films by high energy deposition. The Nb_2O_5 thin films deposited by spray pyrolysis technique were then irradiated with 200 MeV Ag^{15+} ions at fluence ranging from 5×10^{11} to 1×10^{13} ions/cm^2. The thickness of the deposited film was 308 nm and the irradiated area was 1x1 cm^2. The XRD pattern of the pristine film confirmed the tetragonal structure of Nb_2O_5. Upon irradiation, peak intensity decreased significantly and some peaks vanished due to irradiation induced defects. The subtle Raman peaks around 960, 223, and 126 cm^{-1} corresponds to edge shared octahedra, T_{2u} mode and Nb–Nb vibration respectively. After irradiation, complete suppression of vibration modes was observed except for 1×10^{12} fluence. For the 1×10^{12} ions/cm^2 fluence, Raman modes reappear with increased intensity due to irradiation induced recrystallization. Optical transmittance spectra showed a decreased trend as fluence increased due to the formation of optically absorbing centers. Both the direct and indirect band gaps showed a systematic red shift. The pristine AFM image revealed agglomeration of particles while a network like structure was observed after irradiation. Results of transport properties studied for both pristine and irradiated films at room temperature by Hall effect are also presented.

1. Introduction

Niobium pentoxide (Nb_2O_5) is a transition metal oxide which is abundantly available on earth's crust. It is thermodynamically and chemically stable having excellent properties and exhibits cathodic electrochromism [1]. The Nb_2O_5 has variety of polymorphs with different structural configurations originating from NbO_6 octahedral groups [2]. The Nb_2O_5 oxide finds versatile usage, especially in lithium batteries, solar cells, sensors, optoelectronics and electro-chromic devices [1]. Modification of physical and chemical properties of Nb_2O_5 is possible through doping [3–6] and post treatment like swift heavy ion (SHI) beam irradiation. Based on literature survey, hardly there are no reports are available on the investigation of Nb_2O_5 thin films by Ag^{15+} SHI beam irradiation. More exploration on the fascinating properties of Nb_2O_5 is a need for their usage in a wide range of applications.

In electronic devices, one can use Nb_2O_5 as a better alternate for SiO_2 to improve its storage capacity [7,8]. R.A. Rani et al., reviewed Nb_2O_5 thin film properties, preparation methods and its applications [2]. H. Mähne et al., observed that Nb_2O_5 phase transformed from amorphous to orthorhombic when annealed at 650 °C [9]. D.C. Castro et al., synthesized and explored behavior of mesoporous Nb_2O_5 thin films [10]. Avellaneda et al., reported that films of Nb_2O_5 synthesized by the sol-gel method was a promising candidate for electrochromic devices [11]. Different deposition methods, including dip-coating [12], anodization [13–15], DC magnetron sputtering [16], pulsed laser deposition [17,18], sol-gel [19,20] and spray deposition [21,22] were employed to prepare Nb_2O_5 thin films. Among these, spray pyrolysis is a versatile and efficient technique to deposit metal oxide thin films with several tunable parameters. The set-up is very simple and the equipment cost is relatively low. Various metal oxide thin films deposited by

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Structural, optical and electrical properties of copper composite ZrO_2 nanoparticles prepared via sol–gel method

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ABSTRACT

In the present work, pure and copper composite zirconium oxide nanoparticles with a different percentages of copper (0.02, 0.04, 0.06 and 0.08%) were successfully synthesized by a low cost sol–gel technique. It was found that as-prepared samples of copper-composite (zirconium oxide) ZrO_2 nanoparticles are in monoclinic phase. The copper-doped zirconium oxide (ZrO_2) NPs are present as spherical morphology and highly agglomeration confirmed by scanning electron microscopy and high resolution transmission electron microscope analyses. The synthesis samples exhibited two bandgap energy at 3.6 eV and 2.6 eV, 3.57 eV and 2.4 eV, 3.55 eV and 2.14 eV, and 3.5 eV and 2.1 eV. The presence of functional groups and the chemical bonding is confirmed by FT-IR spectra. PL spectra of the pure and Cu-doped ZrO_2 nanoparticles exhibited oxygen vacancies. Voltage–current characteristics of pure and composite ZrO_2 nanoparticles are studied at vary incident light intensity that show the negative photoconductivity.

1 Introduction

ZrO_2 (zirconia) properties namely high strength and hardness, good elastic modulus, corrosion resistance [1–9]. Thermal barrier coating [10], material refractor [11] bioceramics [12] catalysis [13]. Oxygen sensor [13] electrolye gate dielectric [14]. Zirconia doped with copper oxide receive good attention as anode materials [15] . Synthesis of methanol for catalysts [16–18] carbon oxidation [19] hydrocarbon no reduction [20] water–gas shift reaction [21, 22]. Basic hydroxyl groups and coordinatively unsaturated Lew is acid Zr^{+4}–O^{2} [23]. Zirconium oxide is a wide band gap in semiconductor materials [24]. Zirconium oxide (ZrO_2) exhibits three types of polymorphs such as Cubic (C-ZrO_2), monoclinic (m-ZrO_2), and tetragonal (t-ZrO_2). The Cubic (c-ZrO_2) phase is at stable > 2370 °C, tetragonal (t-ZrO_2) phase is

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Microwave-assisted green synthesis of nanoscaled titanium oxide: photocatalyst, antibacterial and antioxidant properties

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ABSTRACT

In the present work, microwave-assisted method is used to synthesize TiO_2 nanoparticles from *Wrightia tinctoria* leaf extract. The synthesized nanoparticles were characterized by X-ray diffraction (XRD), high-resolution transmission electron microscopy (HR-TEM), DLS, ZE, FT-IR, Raman, PL and ultraviolet (UV)–visible studies. The XRD analysis confirmed that the catalyst is composed of anatase tetragonal TiO_2 phase with crystallite size of 9.93 nm. The HR-TEM results show that the particles are in spherical shape with particle size of ~ 22 nm (TiO_2 nanoparticles). The UV–Vis (Tauc plot) spectrum (2.52 eV) of the prepared TiO_2 nanoparticles suggest that intrinsic band gap absorption of TiO_2 and electron transition is from the valence band to conduction band. Furthermore, photocatalytic degradation of organic dyes (methyl blue and methyl orange) was studied under sunlight irradiation using synthesized nanoparticles. The synthesized nanoparticles results show 99% degradation activity as in the case of methyl orange dye compared to methyl blue dye (97%) at 90 min. TiO_2 nanoparticles synthesized using *W. tinctoria* leaf extract have been found to exhibit more enhanced photocatalyst degradation of organic dyes as compared to other leaf extracts. In addition, the synthesized TiO_2 nanoparticles were tested at various concentrations and these results revealed potential antibacterial activities. Antioxidant activity carried out using DPPH free radical scavenging assay revealed lower IC_{50} μg/mL value 53.64 for the synthesized TiO_2 nanoparticles, respectively. The present work further suggests that it is an effort

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Significance of thermal interfacing in hematite (α-Fe_2O_3) nanoparticles synthesized by sol-gel method and its characteristics properties

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ABSTRACT

Hematite (α-Fe_2O_3) nanoparticles were synthesized through the cost-effective sol-gel method. The impact of temperature influenced in as-prepared and calcinated hematite nanoparticles was explored. To characterize the synthesized compounds with the help of X-ray diffraction (XRD), Thermogravimetric & Differential Thermogravimetric Analysis (TG-TDA), Fourier Transform Infrared spectroscopy (FT-IR), Ultra-Violet spectroscopy (UV-Vis), Scanning Electron Microscope with Energy Dispersive X-ray Analysis (SEM with EDAX), and Vibrating Sample Magnetometer techniques (VSM). The structural studies were confirmed rhombohedral structure with space group R-3c in C-2 NPs. The surface morphological analysis confirmed shape, size, and particle homogeneity were ensured with the arrival of temperature. The thermal analysis reported as the C-1 NPs shows excellent phase stability till reaching 1100 °C. FT-IR confirms the phase purity of the nanoparticles synthesized. The optical absorption at 534nm confirms the formation of red color α-Fe_2O_3 C-2 NPs and the optical bandgap values 1.92–1.97eV. The magnetometry steady was observed as a magnetic transition of paramagnetic to weak ferromagnetic magnetic behavior of NPs, which implies that several structural improvements are achieved by the thermal interfacing on the NPs surface.

1. Introduction

In the recent trends, Nanotechnology has attracted as one of the most stipulated things in the developing sectors. The exploration of magnificent performance in such predominant areas is material Science, Environmental engineering, bio-medicinal industries, etc., with outstanding properties. Nowadays, plenty of researchers prefer to work on nanoscale material production that would design at the atomic level. The size range of nanoscale particles having less than 100 nm in diameter [1]. Significantly particles in nano dimensions exhibiting extreme strange behaviors were attributed as coordination of a large number of atoms in surface compared to volume ratio and quantum confinement in electronic structure [2]. Among these reasons, the material shows altered physical, chemical, electrical, and thermal conductive properties compared to bulk materials. The most participative metal-oxide nano--structures materials have more and more attentiveness due to their exceptional stability, crystallinity, conductivity, etc. Remarkably Iron oxide-based nanoparticles were making great revolutions in diverse fields due to their ultra stability and biocompatibility. The generously mineral form of Iron oxide is available naturally with having different crystal structural forms as categorized as crystalline polymorphs (α-Fe_2O_3, β-Fe_2O_3, γ- Fe_2O_3, ε- Fe_2O_3). Among this hematite, α-Fe_2O_3 of n-type semiconducting material with a narrow bandgap of ultra-stable phased material was a consequence in a vast range of applications as gas sensor, magnetic storage devices, tunable biocompatibility and, some energy storage devices [3]. Several promising physical methods such as electron beam evaporation [4], sputtering techniques, laser ablation [5], etc. which routes are considered as facing more inconvenience, and chemical techniques are hydrothermal [6], co-precipitation, electrochemical [7,8], sol-gel method [9], etc. Among the following methods, sol-gel-based nanoparticle synthesis was a well-established approach for producing good quality α-Fe_2O_3 hematite material enable modification shape, size, and morphology related to the application.

Those Iron oxide structures are attaining their phases when achieving different calcination temperatures, which species has complete temperature depended. This present work aimed to synthesize hematite α-Fe_2O_3 nanostructures and investigate the importance and raising effects of coordination of calcination treatment in as-prepared Iron oxide NPs and determine the thermal stability, improving magnetic hysteresis curve and morphology by way of involvement of

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Effect of co-dopant proportion on the structural, optical and magnetic properties of pristine NiO nanoparticles synthesized by Sol–gel method

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ABSTRACT

In this present work, the pristine and the different percentages of co-doped NiO nanoparticles have been successfully synthesized through the sol–gel method. The X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), UV–Visible spectroscopy (UV-Vis), Fourier Transform Infra-Red Spectroscopy (FT-IR), and Vibrating Sample Magnetometer (VSM) were used to study the structural, morphological, optical, functional, and magnetic properties of the synthesized materials. The XRD patterns confirmed the formation of cubic phased NiO with their crystallite size, microstrain, dislocation density was estimated, and the average crystallite size increased with co-dopant inclusion. By introducing the co-dopant proportion in NiO lattice, the intensity of optical absorption was found to increase and the optical bandgap decreased from (E_g = 3.6, 3.54, 3.50 eV) due to quantum size effect. SEM result exhibits that the particles are spherical-shaped morphology. The VSM examination shows the magnetic transition of soft to hard-ferromagnetism in room temperature on Zn, Mn co-dopant ions occupying Ni translational symmetry.

1 Introduction

The essential dimensions of nanoscience-based nanostructured materials have tremendously emerged in the different technological development sectors. Extensively, it becomes too much in such current developing optical, energy-related, and magnetic materials-based industrial areas. One of the fantastic and reliable facts is that every metal and metal oxides in the Periodic Table, for instance, would turnover at the size of the nanoscale; it will ultimately be shown an enhanced and strangest

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$CoGd_XFe_{2-X}O_4$ ($0.00 \leq X \geq 0.08$) nanoferrites: effect of Gd^{3+} ions on structural, optical, magnetic, and dielectric properties

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ABSTRACT

Nanoferrites possessing very low dielectric loss and minimum magnetic saturation value finds its potential application in magnetic recording devices, magnetic shielding and microwave absorption devices, etc., Gadolinium (Gd^{3+})-doped cobalt nanoferrites ($CoGd_XFe_{2-X}O_4$, where X = 0.00, 0.02, 0.04, 0.06 and 0.08 mol%) were synthesized by effective sol–gel method. The structural effects of Gd doping in the nanoferrites were analyzed by X-ray diffraction (XRD), Raman and FT-IR spectroscopic techniques. With increasing doping (Gd^{3+}) concentration, the magnetic hysteresis curves revealed soft ferromagnetic nature with increases in coercivity (O_e) and decreases in saturation (M_s). The very low dielectric loss and minimum magnetic saturation have been obtained for synthesized nanoferrites about 13.03 emu/g and 0.028, respectively. The prepared sample shows prominent dielectric constant 32,630 and lowest electrical resistivity ranging from 0.29 to 0.42 $\Omega\ cm^{-1}$.

1 Introduction

In recent years, nanosized ferrites have immense applications in various fields with fast development microwave technology such as high frequency devices and their component, telecommunications devices, memory core devices, microwave absorption micro-oven, radar, antenna, sensor, magneto-resistive random access memory (MRAM) devices, targeted magnetic tunnel junction and spintronics devices and drug delivery [1–4]. In electronic society, the usage of telecommunication and electronic equipment's has increased due to the problem raised in electromagnetic interference [5] as it generates false image, reduces the life time and efficiency of the instruments and also destroy the safety operation of many electronic devices. To overcome these problems, all electronic equipment's must be aware of

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SIMILARITY MEASURES WITH VECTOR-LENGTH UNDER FUZZY ENVIRONMENT

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Abstract

In this article, we have proposed a similarity measures based on vector- length with the aid of trapezoidal intuitionistic fuzzy numbers. Distinct procedure as Type 1, Type 2 and Type 3 procedures and few relevant properties have also been discussed .Suitable illustrations are given for the proposed method. Finally a comparison have been made to justify the three types of similarities.

1. Introduction

Many real-world applications make use of similarity measure to see how two objects are related together. Over the last decades, many studies have been done on the concept of similarity measure between two intuitionistic fuzzy numbers. In [1] Atanassov defined various operators on intuitionistic fuzzy set which further enriched the theory for its applications to various area of decision sciences. This generalization of fuzzy set to intuitionistic fuzzy set gave a new dimension to optimization under uncertainty and envisaged a new area of optimization under intuitionistic fuzzy environment. On the one hand, the similarity measures were defined based on distance models, such as the hamming distance similarity method [2]. In [3] Li introduced a new similarity measures between the intuitionistic fuzzy set. Stephen Dinagar and Fany Helena [5, 6] proposed a similarity measures for generalized trapezoidal intuitionistic fuzzy number based on valued

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Research Article

Inverse Split Majority Dominating Set of a Graph

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Abstract. In this paper, we introduced an inverse split majority dominating set of a graph G. Inverse split majority domination number $\gamma_{SM}^{-1}(G)$ is determined for some classes of graphs. Some important results and characterization theorems on $\gamma_{SM}^{-1}(G)$ are established. Many Bounds on inverse split majority domination number and its relationship with other domination parameters are also obtained.

Keywords. Majority domination number, Inverse majority domination number, Split dominating (SD) set, Inverse Split Majority dominating (ISMD) set, Inverse Split majority domination number

Mathematics Subject Classification (2020). 05C69

1. Introduction

C. Berge presented domination as a graph theoretic notion [1] in 1958, and O. Ore [16] in 1962. In 1977, E. J. Cockayne and S. T. Hedetniemi produced a study on dominance [5], which was researched extensively in this article. T. W. Haynes and colleagues authored "Fundamentals of Domination in Graphs", has a variety of domination parameters [8]. Kulli and Sigarkanti [11] pioneered the unique parameter inverse domination in Graphs in 1991.

Graph theory may be used to depict any binary relationship. Both dominant sets and their inverses play key roles in domination. When D is a dominant set, $V - D$ is a dominating

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INTUITIONISTIC TRIANGULAR FUZZY THREE-DIMENSIONAL NUMBERS AND ITS APPLICATION TO MULTI-CRITERIA DECISION-MAKING PROBLEM

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Abstract

Intuitionistic triangular fuzzy three dimensional number (ITrFTD-number) is a special type of intuitionistic fuzzy number ona real number set. In the ITrFTD-number, criteria behind is the chance of the same or the different membership and non-membership values. In this paper, ITrFTD-numbers are defined based on multiple criteria decision making problems in which the inputs are considered as ITrFTD-numbers. Operational using t-norm, t-conorm is defined aggregation operators on ITrFTD-numbers are developed. The ranking order is defined correspondingly to the similarity with respect to the positive ideal solution.

1. Introduction

Atanassov [1] (1986) first introduced the theory of intuitionistic fuzzy set in order to study uncertainty. Many researches have been undergone on operations on intuitionistic fuzzy sets [2, 10], multi-criteria decision-making method on intuitionistic fuzzy numbers [11, 12], intuitionistic fuzzy

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STUDY ON OPERATORS IN 2-FUZZY 2-INNER PRODUCT SPACE

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Abstract

The study on operators in 2-fuzzy 2-inner product space is introduced in this paper. Notions such as self-adjoint fuzzy operator, normal fuzzy operator and unitary operator are coined and some properties of such fuzzy operators are discussed.

1. Introduction

In 1965, Zadeh [13] introduced the idea of fuzzy sets, that established a new revolutionary field in mathematics. Katsaras [6] introduced the concept of a fuzzy norm on a linear space in 1984. Chen and Mordeson [2], Bag and Samanta [1], and others have provided several definitions of fuzzy normed spaces. Somasundaram and Thangaraj Beaula [10] coined the notion of 2-fuzzy 2-normed linear spaces, and Thangaraj Beaula and Gifta [12] further developed some standard results. C. R. Diminnie, S. Gahler and A. White [3] introduced the idea of 2-inner product space. Further definitions of fuzzy inner product space [4, 7] and fuzzy normed linear space [5, 8, 9] were given

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Keywords: self-adjoint fuzzy operator, normal fuzzy operator and unitary operator.
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A STUDY ON FUZZY CRITICAL PATH WITH QUADRILATERAL FUZZY NUMBERS

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Abstract

We represent a way to identify the critical path utilizing critical activities of a quadrilateral fuzzy number (QDFN), which is a special instance of an octagonal fuzzy number, in this research (OCFN). Left skewed QDFN and right skewed QDFN membership functions have been defined, and both QDFN's arithmetic operations have been described. A numerical representation was presented separately for both left and right skewed QDFN to help grasp the concept.

In this paper, we use critical activities to determine the critical path of a quadrilateral fuzzy number (QDFN), which is a special case of the octagonal fuzzy number (OCFN). The left skewed QDFN and the right skewed QDFN membership functions have been defined, and the arithmetic operations of both QDFNs have been examined.

1. Introduction

The network diagram is critical in understanding the project completion time. Generally, a project will include a number of activities. Some activities are self-contained, while others may be dependent on others. Network analysis is a technique for determining the various sequences of activities associated with a project as well as its completion time. To solve decision

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Electrochemical Behavior of an Advanced $FeCo_2O_4$ Electrode for Supercapacitor Applications

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In this work, we report the synthesis of $FeCo_2O_4$ nanostructure electro-active material through a double-hydroxide medium via a facile hydrothermal method. The obtained product was subjected to structural and morphological studies. Morphological images of $FeCo_2O_4$ material revealed rod-like structures. Electrochemical properties of the modified electrode were evaluated by cyclic voltammetry, charge–discharge and electrochemical impedance spectroscopy techniques. The modified $FeCo_2O_4$ electrode delivered the highest specific capacitance of 393.5 F g^{-1} at a current density of 1 A g^{-1} in 2 M KOH aqueous electrolyte with battery-type faradaic behavior and excellent capacitive properties. Furthermore, the long cycling stability of the electrode was tested up to 1000 cycles under a constant current density of 2 A g^{-1}. The novel synthetic route of $FeCo_2O_4$ preparation is a convenient potential means of obtaining secondary energy material for supercapacitor applications.

Key words: Spinel oxide, hydrothermal method, supercapacitors, electrochemical properties

INTRODUCTION

In recent years, supercapacitors (SCs), as one of the most promising energy storage devices, have attracted increasing interest owing to their high-power density, safety properties and excellent cycling stability.[1–3] For the development of high-performance supercapacitors, greater attention has been paid to the design and synthesis of novel electrode materials. Among all available electrode materials, transition metal oxides (TMOs) such as Co_3O_4 and NiO have been widely investigated because of their excellent electrochemical behaviors. However, these oxides mainly suffer from high cost, toxicity or poor conductivity.[4–8] Hence, it is important to explore new low-cost and eco-friendly electrode materials with excellent electrochemical properties. Recently, researchers have considered AB_2O_4-based spinel oxide nanostructures as potential electrode materials for supercapacitors.[9–12] For example, according to our previous work, binary metal oxides such as $MnCo_2O_4$ are well-known battery-type electrode materials with a spinel structure possessing superior capacitive performance due to their stronger electrochemical activity and richer redox reactions compared with the single-component metal oxides such as Co_3O_4.[13] Hence, multicomponent oxides such as spinel cobaltite MCo_2O_4 (M = Mn, Ni, Cu, or Zn) have demonstrated promising properties in both Li-ion batteries and SCs, due to the substitution of Co content with other metals, resulting in increased electrical conductivity and improved electrochemical properties of the spinel material. It has also been shown to be important for reducing the cost of the electrode material and toxicity.[14,15] Among available metals,

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Structural, Optical, Electrical and Photocatalytic Degradation Properties of Cadmium Sulfide Nanopaticles by Sol Gel Methodd

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Cadmium sulfide (CdS) nanoparticles were synthesized *via* inexpensive sol gel method at different sintering temperature (350, 400 and 450 °C). The synthesized CdS nanoparticles have been characterized by X-ray diffraction, UV-visible spectroscopy, photoluminescence spectroscopy, scanning electron microscopy, high resolution transmission electron microscopy and Fourier transform infrared spectroscopy. The XRD pattern confirmed the formation of hexagonal Wurtzite structure for all the sintering temperatures. The crystallite size, microstrain and dislocation density have been evaluated using XRD data. SEM and HR-TEM analysis showed morphological transformation with better crystallite and spherical shaped CdS nanoparticles were observed. EDS is also performed to confirm the elemental composition of CdS nanoparticles. FT-IR analysis identified the absorption peaks of the Cd-S extension with moisture content. The UV-visible spectra showed absorption peak in the range of 223-257 nm and optical band gap decrease with increase of sintering temperatures. In addition the synthesized CdS nanoparticles were effectively used to degrade methyl orange dye under sunlight irradiation. The CdS nanoparticles were the potential candidate for optoelectronic applications.

Keywords: CdS, Sol-gel, Crystallite size, Photocatalytic, I-V, Methylene orange dye.

INTRODUCTION

Generally, nanoparticles can be defined as a particle ranging in size from 1 to 100 nm, meaning that it acts as a link between the macroscopic and the microscopic world. Heavy metal ions and additional inorganic and organic elements in metal-oxide nanoparticles are exceptional in their form, morphology, functional groups and electronic properties. Nanoparticles have established much interest due to their unique properties and their probable applications in different fields such as light emitters, transistors, optoelectronics and optical devices [1-4]. Semiconductor nanoparticles have characteristic optical, surface morphological and electronic properties and have been widely study for many relevant applications. In parti-cularly, electrical properties of semiconducting nanoparticles as a occupation of particles size, shape, capping agent, optical band gap, *etc.* holds a significant importance in the research of nanoscience and technology. Influence of different external parameters like precursor concentration temperature, types of doping on the electrical properties of semiconductors is widely investigated by many researchers for the past years [5]. Nanostructures sulfides and selenides (CdS, CdSe, ZnSe and ZnS) have been extensively investigated to determine the relationship between structure, size and optical properties. These sulfides are used for a variety of applications such as, photo detector, light emitting diode, solar cells, photovoltaic, sensors, photoluminescence and transistors due to size reduction and cost effect. Among various semiconductor materials cadmium sulfide (CdS) is an II-VI, n-type semiconductor having direct bandgap energy of 2.4 eV at room temperature. Cadmium sulfide (CdS) nanoparticles have attracted a great attention for their potential application in variety fields such as field emitters, gas sensors, varistors and solar cells. Recently, there has been growing interest in photocatalytic applications of CdS. The confinement effect is observed for CdS nanoparticles when sizes are equal to or less than 50 Å [6]. The CdS exits in three types of crystalline structure namely hexagonal Wurtzite, zinc blend and high pressure rack salt phase. The total Wurtzite system is a thermo-

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Short communication

Green synthesis of cerium oxide nanoparticles using *Calotropis procera* flower extract and their photocatalytic degradation and antibacterial activity

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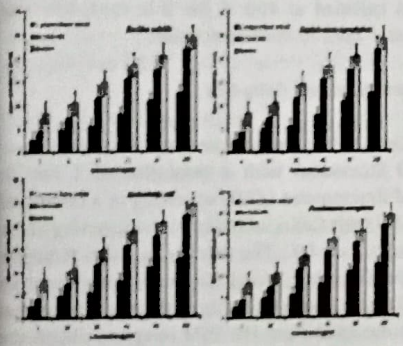
GRAPHICAL ABSTRACT

Antibacterial activity of *C. procera* flower extract and biosynthesized CeO_2-NPs.



ARTICLE INFO

Keywords:
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Photocatalyst
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ABSTRACT

The eco-friendly synthetic approach for preparing CeO_2-NPs using *C. procera* flower extract. The synthesized CeO_2-NPs were studied for their UV–Vis, XRD and HR-TEM. The X-ray diffraction studies confirmed the cubic structure of synthesized CeO_2-NPs with an average crystallite size of 7 nm. High Resolution Transmission Electron Microscope (HR-TEM) images showed that the CeO_2-NPs possessed spherical shape and particle size of 21 nm. The photocatalytic degradation of methyl orange (MO) dye under sunlight irradiation by biosynthesized CeO_2-NPs was analyzed. The synthesized CeO_2-NPs exhibited 98% degradation activity against MO dye. Furthermore, antibacterial activity of *C. procera* flower extract and biosynthesized CeO_2-NPs were studied. The biosynthesized CeO_2-NPs exhibits a important antibacterial activity against Gram negative bacteria *Escherichia coli* and *Pseudomonas aeruginosa* than Gram positive bacteria.

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Investigations of structural, morphological and optical properties in Pure SnO_2 and (Cu-Zn) equally co-doped SnO_2 nanoparticles

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ABSTRACT
Pure $SnO_2$and $Sn_{0.96}Cu_{0.02}Zn_{0.02}O_2$co-doped SnO_2nanoparticles are synthesized via Co-precipitated method. The PXRD pattern of synthesized samples have identified as a tetragonal structure, and crystal size found to be 13-11 nm. SEM morphology shows the grain shapes of synthesized samples. The elemental analysis has confirmed by EDAX analysis, which affirmed the purity of the samples. Chemical bonding's of prepared samples verified by FTIR analysis. UV-Vis spectroscopy studies used to find the energy gap of pure $SnO_2$and $Sn_{0.96}Cu_{0.02}Zn_{0.02}O_2$ co-doped SnO_2 nanoparticles were being around 3.45eV, and 3.18 eV, respectively.
Keywords: Tin oxide nanoparticles, Co-precipitation method, Morphological, Elemental Analysis, Optical.

1. INTRODUCTION

Metal oxide semiconductor (MOS) nanoparticles are having much interesting because of their novel physical and chemical properties [1]. They were various semiconductors such as ZnO [2], NiO [3], TiO_2 [4], SnO_2 [5, 6] have been synthesized materials. Among them, SnO_2 is an n-type semiconductor [7] with a wide bandgap (E_g = 3.6 eV) [8]. It's having great attention for their applications in optical [9, 10], magnetic [11], lithium batteries [12], solar cells [13], gas sensors [14, 15], storage device [16], spintronic devices [17], optoelectronic device [18], etc. The SnO_2 nanoparticles have been synthesized experimentally in many forms such as nanorods [19, 20], nanoparticles [21-24], nanobelts [25], nanowires [26], nanotubes [27]. Hence, the efficacy of the SnO_2 further improves by doping process and which is a simple way to improve the property of semiconductors. Transition metals (Al, Co, Ni, Mn, Cu, Zn and Fe) doping with SnO_2nanoparticles will be improving the structural, chemical and optical properties along with lattice structure, the morphology of SnO_2 nanoparticles was already reported [28-35]. Among them, Cu and Zn ions have designated for the doping process owing to its remarkable properties. PawanChetri et al. established the Cu doping prompted variations in the structural and optical properties of SnO_2 nanoparticles [36]. Mishra et al. reported the structural, optical and electrical analysis of Zn-doped SnO_2 nanoparticles[37]. Numerous chemical methods have been conventional to obtain transition metal ions doped SnO_2. Such as microwave-assisted solvothermal method [38], chemical co-precipitation routes [39] and sol-gel [40]. Among the diverse techniques, the co-precipitation is most vital procedures to prepare the nanoparticles on a vast scale with low cost. In this work, the synthesized pure SnO_2 and (Cu, Zn) Co-doped SnO_2 nanoparticlesprepared by simple co-precipitation method. Further, the properties of the materials characterized by Powder X-ray diffraction (PXRD), Scanning Electron Microscopy (SEM) with Energy Dispersive X-ray analysis

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NMR, UV-Visible and theoretical studies on 9-(Methylaminomethyl) Anthracene crystal

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ABSTRACT

The chemical reactivity for the base compound was identified and the reactivity was alternated by the suitable substitutional group and the molecular NLO kinematics was studied. The restoring chemical potential and parametric oscillation was keenly noted from the chemical shift around the core and allied carbons. The conjugative π and δ-orbital interaction on hybrid cascading orbital system was noted and the exchange of quantum of chemical energy was measured. The strong and consistent dipole bonding system for operating dielectric potential was routinely observed and scattering capability of light propagation was verified and the respective refractive index for different planes were measured. The kubo gap for IR and UV-Visible regions were estimated and they support all the NLO activity and it can be tuned for enhancing photonic laser activity. The VCD simulation spectral pattern was recorded and the dipole versus quadruple conjugation mechanism was identified to recognize NLO operating condition.

Keywords: 9-(Methyl aminomethyl) Anthracene, NLO kinematics, dielectric potential, quadruple conjugation, NLO activity.

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Some aspects of 2-fuzzy 2-metric projection operator of 2-fuzzy 2-Banach spaces

Thangaraj Beaula[1]* and R. Abirami[2]

Abstract

In this paper, continuous homogeneous selection and continuity for the set valued 2-fuzzy 2-generalized inverse in 3-strictly 2-fuzzy 2-convex space are investigated using fuzzy continuity of metric projection. Hence approximative compactness of 2-fuzzy 2-Banach space is not necessary for the 2-fuzzy 2-upper semi continuity of the set valued 2-fuzzy 2-metric generalized inverse.

Keywords

2-fuzzy 2-H-Property, 2-fuzzy 2-Continuous Selections, 2-fuzzy 2-Chebyshev Subspace, 2-fuzzy 2-Metric Generalized Inverse.

AMS Subject Classification:

03E72, 46A19, 46B20, 46B50.

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Contents

1. Introduction

The concept of fuzzy set was first introduced by L.A. Zadeh [13] in 1965. Many mathematicians considered fuzzy metric in different views [3, 6–8, 13]. George and Veeramani [6] defined fuzzy metric space in a new way. Various definitions of fuzzy norms on a linear space were introduced by different authors [1, 2, 4, 9, 10]. Rano and Bag [11] introduced the definition of fuzzy norm following the notion introduced by Bag and Samanta[1].

A satisfactory theory of 2-norm on a linear space has been introduced and developed by Gahler[5]. Somasundaram and Thangaraj Beaula [12] introduced the concept of 2-fuzzy 2-normed linear space and gave the notion of α-2-norm using the ideas of Bag and Samanta [1].

In this paper, continuous homogeneous selection and continuity for the set valued 2-fuzzy 2-generalized inverse in 3-strictly 2-fuzzy 2-convex space are investigated using fuzzy continuity of metric projection. Hence approximative compactness of 2-fuzzy 2-Banach space is not necessary for the 2-fuzzy 2-upper semi continuity of the set valued 2-fuzzy 2-metric generalized inverse.

2. Preliminaries

Definition 2.1. *Let X be a universe of discourse a fuzzy set is defined as $A = \{x, \mu_A(x) : x \in X\}$ which is characterized by a membership function $\mu_A(x) : X \to [0,1]$ where $\mu_A(x)$ denotes the degree of membership of the element x to the set A.*

Definition 2.2. *Let X be a non empty and $F(X)$ be the set of all fuzzy sets in X. If $f \in F(X)$ then $f = \{(x,\mu)/x \in X$ and $\mu \in (0,1]\}$. Clearly f is bounded function for $|f(x)| \leq 1$. Let K be the space of real numbers then $F(X)$ is a linear space over the field K where the addition and scalar multiplication are defined by*

$f+g = \{(x,\mu)+(y,\eta)\} = \{(x+y),(\mu,\eta)/(x,\mu) \in f$ *and* $(y,\eta) \in g\}$

and

$$kf = \{(kf,\mu)/(x,\mu) \in f\}$$

where $k \in K$.

The linear space $F(X)$ is said to be normed space if for every

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SCALENE TRIANGULAR FUZZY NUMBERS AND ITS OPERATIONS

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Abstract

Generalized Fuzzy number is a new concept obtained by removing the property of normality. In this paper we introduce the notion of scalene triangular fuzzy number and discussed the algebra of this fuzzy number by developing all arithmetic operations.

1. Introduction

The concepts of fuzzy numbers and fuzzy arithmetic were introduced by Zadeh [7]. Since, then general authors have investigated properties and proposed applications of fuzzy numbers. Practical problems require effective fuzzy arithmetic which would enable solving uncertain linear ones. Fuzzy numbers are used in statistics, computer programming, engineering and experimental science. The concept of fuzzy number has been defined as a fuzzy subset of real line by D. Dubois and H. Prade [3]. possibility theory (Zadeh 1978; Dubois and Prade 1988), formal concept analysis (FCA) (Ganter and Wille 1999), extensional fuzzy sets (Hohle 1988) and rough sets (Pawlak 1991)[8].

In general, the arithmetic operations on fuzzy numbers can be approached either by the direct use of the membership function or by the equivalent use of the cuts representations. The fuzzy calculations are not immediate to be performed and in many cases they require to solve mathematically or computationally hard sub problems for which a closed

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Keywords: Scalen triangular Fuzzy Number, Arithmetic Operations.
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FULLY FUZZY ECONOMIC INVENTORY MODEL WITH BACKORDERS USING GENERALIZED QUADRILATERAL FUZZY NUMBERS

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Abstract

In every business scenario, inventory plays a vital role to maximize the profit and to minimize the expenditure. In every classical case, some of the inventory models are existed for different situations. When the situations become vague, it is very difficult to optimize the problems through classical inventory models. In this paper, we reviewed the concept of generalized quadrilateral fuzzy numbers (GQFN) and its arithmetic operations. We construct the fuzzy economic inventory model with backorders through GQFN's in the fully fuzzified manner. Also few numerical examples are provided to analyze the inventory model.

1. Introduction

Inventory models are the essential tools for the businessman to run the business successfully. It is simply a mathematical model to maintain the level of inventories. The model can be established for the two main sectors such as what are the materials to order and how many units to order. In every classical inventory models, the major objective is to minimize the total cost by

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Keywords: generalized quadrilateral fuzzy number; classical equivalent fuzzy mean; Karush Kuhn-Tucker conditions; fuzzy order quantity; fuzzy shortage quantity.
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Diagonally Implicit Runge-Kutta Method for Fuzzy Initial Value Problem

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Abstract

Solving the Fuzzy initial vale problem by using diagonally implicit Runge–Kutta method, the co-efficient are taken from the Butcher's table.

Keywords: Initial Value Problem (IVP), Fuzzy initial value problem (FIVP), Diagonally Implicit Runge-Kutta method (DIRK), Butcher's table.

1. Introduction

In 1974, Norsett [13] where first introduced the Diagonally Implicit Runge Kutta (DIRK) method to solve the Ordinary differential equations further this method is developed by Alexander [2] in 1977 and by Cash [6] in 1979 and suggested embedded DIRK formulae. In 1984, Norsett and Thompson [14] continued the work, where they established a Semi diagonally implicit Runge Kutta method [SDIRK] of order two embedded in the method of order three. In continuation, Al-Rabeh [4] derived a SDIRK method of third order embedded in the fourth order. In this paper we have generalised the DIRK method of fourth order for solving Fuzzy Initial value problems with Butcher's coefficients is established.

2. Preliminaries

Definition 2.1

A fuzzy number $\tilde{u} = \{u \mid u : R \rightarrow [0,1]\}$ and satisfies the following

1. $\tilde{u}$ is upper semi-continuous.
2. $\tilde{u}$ is fuzzy convex, if $u(\lambda x + (1-\lambda)y) \geq min\{u(x), u(y)\}$ $\forall\, x, y \in R$, $0 \leq \lambda \leq 1$.
3. $\tilde{u}$ is normal, $\exists\, x_0 \in R$ for which $u(x_0) = 1$

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Solution of Fuzzy Differential Equations by Range Kutta Method with Geometric mean

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Abstract

This paper describes the numerical solution of first order Cauchy's problem by Runge–Kutta method of order five with an alternation in parameters. The formula is involved with geometric mean of five quantities $k_i's$. The efficiency and accuracy of the proposed method is illustrated by an example.

Keywords: Fuzzy initial value problem (FIVP), Runge-Kutta method of order five, Fuzzy triangle number.

1 Introduction

S.L. Chang, L.A. Zadeh [4] was first introducing the concept of fuzzy derivative. Further it was extended by D. Dubois, H. Prade [5], who used the extension principle in fuzzy number representations. The Cauchy problem and the fuzzy initial value problem were regularly studied by O. Kelva [10] and by S. Seikkala [13] et.at. The numerical method for solving fuzzy initial value problem is introduced by M.Ma, M.Friedman, A. Kandel [11] by the Euler Method and Taylor method. In this paper, the numerical solution of the fuzzy initial value problem by using the 5th order Runge Kutta method with geometric mean of five quantities is presented.

2 Preliminaries

Definition 2.1

A triangular fuzzy number u is defined by three numbers $a < b < c$, where the base of the triangle is the interval $[a, c]$ and vertex $x = b$. Fuzzy triangle number will be written as $u = (a, b, c)$ and its membership function is given by

$$u(x) = \begin{cases} 0, & x < a; \\ \frac{x-a}{b-a}, & a \le x \le b; \\ \frac{c-x}{c-b}. & b \le x \le c; \\ 0, & x > c, \end{cases}$$

And have,

(1) $u > 0$ *if* $a > 0$; (2) $u \ge 0$ *if* $b > 0$;
(3) $u < 0$ *if* $c < 0$; (4) $u \le 0$ *if* $c \le 0$.

Definition 2.2

A fuzzy number $\tilde{u}$ is a fuzzy set of maps $u : R \to [0,1]$ which satisfies:

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The impacts of interfacing phytochemicals on the structural, optical and morphology of hematite nanoparticles

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ABSTRACT

Nowadays, the phytochemical approaches of metal oxide NPs have been appraised as the best choice and eco-friendly because various biomolecules are acting as multiple responsibilities have to form nanostructures. The present work focused on synthesizing the most stable α-Fe_2O_3 Nanostructures using medicinal valuable W. Tintoria aqueous leaf extract at (5 ml,10 ml, and15ml) concentrations. Synthesized samples were characterized by X-ray diffraction, Fourier Transform Infra-red spectroscopy, Field Emission Scanning Electron Microscope, UV-Visible spectroscopy, and X-ray Photoelectron Spectroscopy. The structural analysis reveals that the single phase of α-Fe_2O_3 with fine crystalline quality, besides the average crystallite sizes are gradually decreased to 28.8 nm from 39.4 nm, with increasingof leaf extract. The UV–visible analysis has reported the maximum absorption at 287 nm for 15 ml of α-Fe_2O_3 NPs, and the energy bandgap will be increased from 2.1 eV to 3 eV while increasing leaf extract. The FT-IR analysis gives surety for the contribution of different biomolecules on the sample surface and the formation of Fe-O bonding. FE-SEM studies exposed rhombohedral, sewed rhombohedral morphology with good particle uniformity achieved by the optimistic 15 ml - α-Fe_2O_3. In addition, the XPS analysis clearly shows the binding energy 712.7 eV to 726.1 eV for Iron and 534.3 eV for oxide elements. Moreover, the standard method of the phytochemical test confirms the incorporation of phenols, flavoooids, alkaloids, etc. Eventually, considering our research reports, the bio-mediated α-Fe_2O_3 NPs is appropriate for environment cleansing application because Fe^{3+}configuration may act as a scavenger role and notably morphology, bandgap was caused by the interfaced phytochemicals which are highly suitable for semiconductor applications.

1. Introduction

Recently, the dimensionality of nanostructured crystalline materials exposed a revolutionary potential in nanoscience and technology. It would prodigiously impact numerous areas such as material science, energy science, biomedical sciences, space industries, electronic and optical science-related zones. Thus, materials were reaching nanometre size, which explored extraordinary dimensions and behaviours by achieving the quantum mechanical confinement, let to modify as well as to control the fraction of atoms are contributes in the desired materials which enlarging the surface area, by the way, material occurring exceptional electrical, mechanical, chemical, catalytic activity, and magnetic properties. Most researchers have studied several kinds of metal oxide nanomaterials such as ZnO – (Zinc Oxide), CuO – (Copper (II) Oxide), Fe_2O_3 – (Iron oxide), SnO – (Tin Oxide), TiO_2 – (Titanium dioxide), because of their outstanding performance in several applications; the categorized was strongly expect can have a future. Significantly, the iron oxide material having more and more attention in different developmental scientific areaswould offer exceptionalfunctional areas. The most reliable, multifunctional iron oxide is a naturally occurring mineral in various forms.Moreover, itis classified by its structural, magnetic behavior, redox behavior and to characterized by its crystal phases are (α-Fe_2O_3–Hematite), (γ-Fe_2O_3–Maghemite), (β-Fe_2O_3), and (ε-Fe_2O_3) these made up of closely bounded by iron-cation and oxygen-anion in the interstitial crystalline sites and also having different oxidation states in the ambient environment [1]. Remarkably hematite is a thermodynamically persistent polymorph which forms in a rhombohedral geometry only with space group R-3c in compound state. In addition, the Fe_2O_3 is ordinarily made as small nanoparticles in the constancy polymorph maghemite, it shows a cubic - space group $P4_332$ or tetrahedral - space group $P4_12_12$ geometry. Once

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energy fuels

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Article

Ameliorating the Energy Storage Performance of Lithium–Sulfur Batteries via Sulfur-Intercalated Titanium Carbide ($Ti_3C_2T_x$) MXene

Soorya Srinivasan, M. Jothibas,* and Noel Nesakumar

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ABSTRACT: Theoretically, batteries based on lithium–sulfur have a high energy density. However, involuntary dendritic growth at the anode and poor high-loading performance at the cathode have plagued the practical implementation of Li–S batteries. However, capacity fading occurs due to the lithium polysulfide shuttle effect, while its redox nature should also be improved. Therefore, titanium carbide MXene ($Ti_3C_2T_x$ MXene) with a layered-stacked structure is used as an ideal host material for the sulfur cathode, with the sulfur content affecting the electrochemical performance of the composites consisting of sulfur nanoparticles and $Ti_3C_2T_x$ MXene. When the reactant has a 1:4 MXene-to-sulfur mass ratio, it gorges the layered-stacked structure equally. Additionally, the surface terminal groups exhibit a high degree of $LiPS_n$ adsorption. As a result, the S@MXene composite (68 wt %) demonstrated a superior cycling performance of 1034 mAh g^{-1} even after 100 cycles and an initial reversible capacity of 1231 mAh g^{-1} at 0.5C, respectively. This study establishes a platform for developing improved cathode materials based on sulfur for lithium–sulfur batteries.

INTRODUCTION

As a result of the energy consumption and environmental devastation, we are transitioning to clean energy sources such as nuclear, marsh gas, wind, and solar energy. Despite their intermittency, it is vital to establish energy storage systems to ensure that they can be utilized to their full potential. One such sophisticated commercial technology is lithium-ion batteries (LIBs). Unfortunately, there is a significant gap between current energy density and the ever-increasing demand from the growing markets for electric-powered vehicles, portable electronics, and stationary storage devices despite their popularity. However, the cost-effective and inherent health hazards associated with LIBs keep them from being widely used in electric vehicles.

As a consequence of this paradigm shift in energy storage, alternative high-energy electrochemical systems need to be investigated.[1−4] Among several viable renewable technologies, lithium–sulfur (Li–S) batteries pave the way for the construction of enhanced energy storage systems. For lithium–sulfur batteries, Liang et al. developed Ti_2CT_x/S in 2015. Since then, MXenes in metal–sulfur batteries have become a hot topic of investigation.[5] Unfortunately, most research focuses on MXene-based composite materials, leaving little focus on terminations and polysulfides. Lithium and sulfur interact multielectronically in Li–S batteries to produce a theoretically higher gravity energy density of 2,600 Wh kg^{-1}, nearly double that of LIBs.[6−8] Apart from its lack of toxicity, low cost, and natural abundance, sulfur is manufactured in vast amounts due to petroleum refining daily, allowing it to be used in a broad spectrum of industrial applications.

Certain advanced battery manufacturers, including Oxis Energy and Sion Power, are taking the first steps toward commercializing sulfur-based energy systems.[9] However, Li–S battery technology continues to face significant challenges, including short shelf life and limited cycling lifetime. These issues obstruct the path to mass manufacturing and commercialization on a widespread basis. On the other hand, rechargeable Li–S batteries have garnered substantial research interest owing to their increased energy density and capacity. Despite their numerous advantages, the lithium–sulfur batteries (LSBs) have several significant issues. Primarily, when lithium sulfide is converted from elemental sulfur, it undergoes a significant volume change of approximately 80%, resulting in cathode structure degeneration, thereby shortening the battery's cycle life. Second, since sulfur and its discharged product polysulfides (Li_2S_x) have limited electronic and ionic conductivities, the battery's internal resistance increases, resulting in suboptimal high-rate performance. Third, as a result of the negative "shuttle effect", the diffusion and dissolution of polysulfide in organic electrolytes can induce capacity discoloration as well as a decrease in Coulombic efficiency.[10,11] To overcome these impediments, it is necessary

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Scrutiny of the magnetic properties of ZnO nanoparticles by solid state reaction method

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ABSTRACT

In this work, pure ZnO nanoparticles were prepared by the method of solid state reaction in different temperatures using zinc acetate as a pioneer material. The synthesized ZnO nanoparticles were characterized by the various spectrographic tools. The crystallinity nature and lattice parameters are studied through the XRD patterns and the average crystallite size is found to be 34.5 nm. The absorption peak in the FTIR spectra confirms the presence of functional group, whereas a UV–Vis spectrum is used to determine the optical properties of the sample. Furthermore, surface morphology, electronic structure and the magnetic properties of the ZnO nanoparticles were studied by using the SEM, Photoluminescence and VSM studies respectively. This particular method of synthesis is simple and easiest method to obtain the pure ZnO nanoparticles with high crystallinity in nature. The obtained ZnO, have potential, engineering applications as materials for UV filtering shields with high transparency, luminescent materials without any toxic nature.

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1. Introduction

Zinc oxide nanoparticles have numerous applications in various fields due to its extremely large exciton binding energy [1]. They are used in the manufacturing of paints, solar cells, LEDs, gas sensors, luminescence materials [2] and in skin care products [3]. Moreover, the nanoparticle of ZnO reveals good luminescence properties, which are mainly used in the bio imaging sectors. ZnO nanoparticles shows many noble properties such as transparency, luminescence in room temperature, chemical and photochemical stability, better electron mobility [4]. Additionally their superior antibacterial, antimicrobial with excellent UV- blocking properties, makes them to use in fabrics manufacturing. In the recent past, some of the various methods have been carried out in preparation of ZnO nanoparticles such as precipitation [5], thermal decomposition [6], spray pyrolysis [7], sol–gel [8], hydrothermal [9], wet chemical methods [10], sonochemical [11], microwave [12], and CVD [13] methods. Nevertheless, all the above methods undergo calcinations or sintering process at the end to obtain the crystalline nanoparticles. Besides, most of the synthesis method involves high operating temperature for long time, usage of complex apparatus and toxic residues. Furthermore, controlling shape and size of growing nanoparticles are the main constraints of the widespread of applications of ZnO nanoparticles. So, there is need of looking for toxic less, easiest, cost effective with better yield synthetic methods for preparing nano sized ZnO particles are being intensely searched.

There are several reports on the synthesis and characterization of ZnO nanoparticles. Eva de Lucas et al., synthesized ZnO/Clay nano composite through chemical route and obtained ZnO nanoparticles with good antifungal property which was suggested for paint manufacturing applications [14,15]. BouSouraa et al., had studied the optical and structural properties of ZnO thin films prepared via solid state method and deposited on Si- based substrates. They had used Zinc acetate dehydrate and 2-methoxyethanol and mono ethanolamine as precursors [16]. Nickel doped ZnO nanoparticles were prepared by guruvammal et. al., through solvothermal

Abbreviations: XRD, X-Ray Diffraction; SEM, Scanning Electron Microscope; VSM, Vibrating Sample Magnetometer.

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Synthesis and characterization of nanohydroxyapatite (nHAp) from Meretrix Meretrix Clam shells and its *in-vitro* studies for biomedical applications

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ABSTRACT

Recycling of massive waste into valuable products promotes two in one advantages of waste recovery and a pollution-free environment. Preparation of Nanohydroxyapatite (nHAp) and its polymer composites using waste sea shells (natural precursor) are effectively useful in making artificial bone implants, bone cement, and toothpaste additives. The present work is focused to obtain nHAp with good crystalline nature and better biocompatibility using *Meretrix Meretrix Clam shells* as raw materials by the Co-precipitation method. To enhance the physio-chemical properties, polymers were used as capping agents. The functional group, particle size, thermal stability, phase transition, surface morphology, and electronic transition of atoms of the synthesized samples have been analyzed by spectrographic tools such as FT-IR, XRD, TG/DTA, FESEM/EDAX, XPS and HR-TEM with EDAX mapping respectively. Furthermore, the bacterial sensitivity of the sample against bacteria, the efficiency of the sample towards the formation of an apatite layer over the surface and its hemocompatibility nature were studied by antibacterial, SBF analysis and hemolysis assay respectively. This method of synthesis is free from hard chemicals and harmful by-products. Thus, the report of the present study suggests that it is promising to achieve nHAp with enhanced surface modification which indirectly promotes bone-bonding capability with natural living bone.

1. Introduction

Bones are the structural building block of the human body. In addition, it protects the internal organs from damage and also it aids to store essential nutrients. Due to lifestyle changes, the number of people suffering from bone-related problems such as tooth decay and osteoporosis was increasing day by day. A life-long deficiency of calcium plays an important part in the development of osteoporosis [1]. Lack of sufficient intake of calcium leads to lessened bone density which puts up to an increased threat of fracture. On comparing with men, women are in a risky zone for the possibility of developing osteoporosis, due to hormonal changes [2]. In ancient days, people who suffered from irrecoverable bone damage were undergone in fixing plates of metallic alloys to support body movements. But those metallic implants lose their biocompatibility after a certain period, their lifetime is depending upon their alloys which leads to creating some irreversible side effects in the human body. The substances prepared from biomaterials serve a better platform for bio-implants with everlasting biocompatibility and good osteointegration [3]. Hydroxyapatite (HAp) and its composites are the most versatile bioactive ceramic materials which can be used for biomedical applications [4]. Hydroxyapatite is the mineral component of calcium orthophosphates with a Ca/P ionic ratio in the range of 1.0–1.7, in which the structural component of human bone and teeth was analogous to hydroxyapatite [5]. The structure of HAp is hexagonal and it is a stable compound that decomposes between the range 900–1200 °C [6]. The atomic arrangement of the hydroxyapatite unit cell is shown in Fig. 1.

HAp is one of the leading human implantable materials based on its biocompatibility nature, degree of bioactivity and Osteoconductivity [7]. Additionally, its efficacy to create quick bonds with host bones makes it an exclusive material for bone repairment and artificial bone substitution [8]. The bioactive nature of HAp supports the growth of bone and osteointegration, while used in dental, orthopedics and maxillofacial applications [9]. HAp in the form of porous blocks,

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Dynamic photocatalytic degradation of organic pollutants employing co-doped ZnS nanoparticles synthesized via solid state reaction method

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Keywords:
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ABSTRACT

Because of their excellent optical and catalytic capabilities, ZnS with different co-doped proportions of metals has numerous applications. Their practical uses are limited due to their low photon efficiency and significant photo corrosion. Constructing heterojunctions and advanced structures with appropriate transition metal ions doping are active ways of improving semiconductor characteristics. The Pure and different dopant concentrations of Ni and Cd doped ZnS NPs were effectively synthesized via the solid-state reaction method. The influence of Ni and Cd doping concentration on the microstructure, morphology, and optical properties of pure and Ni-doped ZnS nanocrystals was characterized by X-ray diffraction, Scanning Electron Microscopy, ultraviolet-visible absorption spectroscopy, Energy Dispersive Absorption Spectroscopy, Fourier transform infrared spectroscopy, photoluminescence spectra, and the Photocatalytic studies. X-ray diffraction studies show that the average crystallite size increased to 3.30 nm from 2.64 nm upon integrating Ni ion, then decreased to 3.01 nm for $Ni_{0.05}Cd_{0.01}$ dopant level. SEM analysis reveals that a significant number of nanoparticles have a larger surface area and seem to be spherical. The active vibration frequencies of the Zn–S interaction were observed between 600cm^{-1} and 500cm^{-1} in the cubic structure of ZnS Metal oxide. The $(ZnS_{0.95}Ni_{0.05}Cd_{0.01})$ sample shows Excellent photocatalytic degradation activity on the organic pollutants of the wastewater sample, about 96.67% for Methylene Blue. The reported findings demonstrate the dynamic degradation of organic dyes for minimal doping concentrations.

1. Introduction

Water pollution is amongst the most critical issues adversely influencing human and aquatic life. The outflow of industrial effluents, which include primarily harmful compounds and entail a severe threat to life processes, is the principal source of water contamination. Generally, these pollutants are mutagenic and carcinogenic; removing them using conventional approaches is difficult. Coagulation, precipitation (heavy metals eviction), flotation (oil separation), activated carbon adsorption, ion exchange, membrane techniques, and reverse osmosis have been employed to remove organic molecules [1]. In today's globe, there are a large variety of economically active dye species. Because of their adhesion characteristic, the methyl groups of colouring compounds are still engaged. The category comprising Methyl Blue and Methyl Orange dye is highly commercially wanted; yet, these have harmed bio-organisms, and it produces nausea, abdominal and precordial pain, dizziness, headache, profuse perspiration, mental confusion, and the development of methaemoglobin, which may irritate the eyes, skin, and respiratory system. Several proportions of people are still adversely harmed by discharged untreated dye wastes, and we are converting polluted water streams to decontaminated useable quality. Several classic dye removal procedures are accessible but are not viable and inefficient. Amongst the drawbacks, contemporary researchers focus on light stimulation based on dye deterioration. To overcome several inconvenient and ineffective in removing dye contamination. As a result, different approaches must be introduced to remove these chemicals from wastewater properly. Because of their suitability as a pollution mediator, advanced oxidation processes (AOPs) employing

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ORIGINAL PAPER

Visible light-interfaced organic dye degradation by Mn-doped CdO nanoparticles

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Abstract

One of the most severe health issues in the recent era is the scarcity of clean water. One of its most prevalent chemicals that render water unsafe is industrial dyes. Methylene blue is one of those dyes that are toxic, cancer-causing, and non-biodegradable, posing a significant threat to human health and environmental standards. Recently, numerous researchers have engaged in solar visible light-based catalytic materials synthesis because solar light is a renewable, clean energy source. This research presents different percentages of Mn-ion-doped CdO NPs synthesized via the co-precipitation method. The Mn-heterojunction in CdO nanostructures was significant due to their better structural and catalytic features. Then, the X-ray diffraction, scanning electron microscopy, ultraviolet–visible absorption spectroscopy, energy-dispersive X-ray spectroscopy, Fourier transform infra-red spectroscopy, photoluminescence analysis, and photocatalytic studies were used to examine the effect of Mn-ions doping concentration on the crystalline structure, morphological characteristics, and optical absorption of pristine CdO nanocrystals. The photocatalytic degradation activity of the 5 wt% of Mn-doped CdO NPs on the methyl blue dye suspended water sample seems excellent, with 96.55%. The findings show that organic dyes degrade dynamically and declare that the 5 wt% of Mn is a promising heterojunction candidate for CdO photocatalyst.

Keywords Photocatalysis · Methyl blue · Nano-catalyst · Dye degradation · Solar irradiation

Introduction

Water is the most valuable renewable resource in the environment and is vital for any living being to survive. Thus, the thing was to be most significant to all humans on the earth. However, it is now severely contaminated by numerous industrial dye pollutants directly discharged into water sources like streams, pools, surface, and underground aquifers, dramatically impacting urban and rural areas. Unfortunately, renewable water resource was dramatically contaminated because it contains many toxic chemical compounds, including dyes, that are detrimental to humans and the ecosystem. Volatile color dyes are stable organic chemicals extensively applied in cloths, printmaking, and agricultural products manufacturing industrial areas. Synthetic colored dyes are deadly toxic and have no chance of degrading in a biological approach; they have significantly adversely impacted the ecosystem, mainly in the food web. Also, these extremely toxic compounds, in general, are highly detrimental to human health, and some conventional and biological methods are used to degrade and eliminate them from the water available. Nanomaterials with a large surface area have become increasingly popular in recent years. Very notably, the methylene blue (MB) is a chemical derivative of phenothiazine molecular compound that is applicable for processing clothes and dying and thus is deadly noxious and dangerous and also causes some carcinogenic. A basic aromatic heterocyclic dye is MB, one well cationic and primary thiazine dye with the empirical formula $C_{16}H_{18}N_3ClS$, and has a molecular weight of 319.85 g mol. MB is a positively charged material belonging to the polymethine dyes group with an amino autochrome unit, and [3,7-bis (dimethyl amino) phenothiazine chloride tetra methylthionine chloride] is its chemical name, as per the International Union of Pure and Applied Chemistry (IUPAC). Due to its high dissolution rate, it can, at room temperature, be mixed with water streams to form a stable contaminated medium. Remarkably, aquatic animals are caused significantly because of

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Dependance of gadolinium ions on structural, magnetic and dielectric properties of manganese nanoferrites

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HIGHLIGHTS

- Gadolinium doped Manganese nanoferrites $MnGd_xFe_{2-x}O_4$ with series X = 0.00 to 0.08 were fabricated by sol-gel method.
- The variation of impedance spectra decreases with increase of frequency of the applied field.
- Dependence of dielectric constant with frequency is described by Maxwell-Wagner interfacial polarization.
- It obtain high dielectric constant and low dielectric loss, suitable for EM shielding devices.
- The decrease of magnetic saturation is attribute to the weakening of exchange interaction.

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ABSTRACT

Gadolinium doped manganese nano ferrites ($MnGd_xFe_{2-x}O_4$) (X = 0.00, 0.02, 0.04, 0.06 and 0.08) for microwave absorbers and storage devices was synthesized by using an effective sol-gel method. The structural parameters analyzed using X-ray diffraction (XRD) revealed a well crystalline cubic phase with crystallite size being smaller in Gd doped nanoferrites. Spherical morphology occurred with lesser agglomeration and because of the dopant driven synergistic effect influence the bandgap. The magnetic hysteresis curves demonstrated soft ferromagnetic nature with increasing coercivity (Oe) and decreasing saturation (M_s). Gd co-doping altered the grain and grain boundaries resistance of nano ferrites and better dielectric characteristics were formed with increasing Gd^{3+} concentration as AC frequency increased (voltage). The result shows the lowest dielectric loss of 1.8542 with the highest dielectric constant of about 1574426.14 for manganese nano ferrites influenced by Gd^{3+} ion.

1. Introduction

Ferrites are defined as materials that have both magnetic and electrical properties. Ferrites contain metallic oxides (such as MnO, CeO, ZnO, NiO, and others) and ferric oxides (such as Fe_2O_3). Man has known about the benefits of ferrites for millennia. The Chinese were well-versed in the use of inorganic substances in navigational compasses to signify a heavy load [1]. In recent years spinel ferrites are well known magnetic material having various tremendous magnetic and electrical properties. These features enable a wide range of applications in science and technology, including microwave devices, electronics power transformers, spintronics, antenna rods, gas sensors, and medication delivery, magnetic resonance imaging (MRI) magnetic amplifier, electrical generator, biomedicines, transformer cores, and electromagnetic interference (EMI) [2–4].

The rare earth elements belong to the lanthanide's series, are act as good electrically insulator substrates with high resistivity [5]. Comparing various spinel ferrite ($MnFe_2O_4$) is a particular type of soft ferrite material that is achievable at high frequencies, with low coercivity and low dielectric losses. The substitution of smaller rare-earth ion in ferrite nanoparticles affects its physical property such as structural, morphological, electrical and dielectric properties [6]. Rare-earth ions are well known for the strong spin-orbit coupling but for Gd^{3+} ions, due to half-filled 4f shell S (4f), the total magnetic moment has occurred from the unpaired spin part [7]. Doping of rare-earth ions hinders crystal growth, thereby reducing the nano ferrite due tothe significant size effect.

In general, ferrite nanomaterials were synthesized from soft feasible method such as sol-gel [8], co-precipitation [9], solid-state reaction technique [10], hydrothermal [11] and sono chemical method [12].

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Surface modification of coral skeleton derived nanohydroxyapatite using polymers and its *in-vitro* studies for bone substitute applications

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ABSTRACT

Reprocessing waste things into a functional product gives two-edged benefits, an eco-friendly environment and waste management. Nowadays, Ceramic materials based on calcium phosphates, which include Nano-hydroxyapatite (nHAp) and Tri-calcium Phosphates (TCP) were extensively used in biomedical applications for their outstanding biocompatibility and bioactivity properties. In this work, nHAp (pure) and its polymeric composites were prepared through the precipitation method using the coral skeleton as a calcium precursor. Besides, to change the surface functional characteristics, the polymers were utilized as a capping agent. The synthesized samples were examined by spectrographic tools such as XRD, FT-IR, SEM/EDAX, TG-DTA, XPS and HR-TEM to find the phase, functional groups, size, morphology and thermal stability together with phase transition as well as bonding types which present in the prepared samples respectively. In addition, Simulated Body Fluid (SBF) analysis, antimicrobial assay and hemolytic test were intended to test the apatite-forming ability, antimicrobial effectiveness and hemocompatibility of the prepared samples. Therefore, the present findings suggest the possibility of developing novel HAp polymeric nanocomposites that exhibit improved biocompatible, osteoconductive which impersonates the structure of natural human bone. So, that can use for making bone and dental implants using corals skeleton as a precursor at a lesser cost.

1. Introduction

In human anatomy, the Skeleton system is one of the major systems that offer structural support and protection to vital internal organs like the heart, liver, brain, etc. [1]. Calcium phosphate-based bioceramics have acquired substantial attention from researchers as bone implant substitutes due to their excellent bioactive properties. Besides, Hydroxyapatite [HAp -Ca10(PO4)6(OH)2] is a vital inorganic mineral that contains minerals comparable to those found in living human bones in their natural state with Ca/P molarity 1.67 [2]. HAp is highly biocompatible as well as biodegradable and possesses better compressive strength with less frictional properties [3]. The combination of several ions such as Na, Mg, F, and CO32- accommodates the inorganic matrix of hydroxyapatite which promotes bone rigidness [4]. The accommodating site of carbonate ions in the HAp matrix decides the type of hydroxyapatite, which is distinguished as A-type (carbonate ions occupy OH- sites), B-type (carbonate ion occupies PO43- places) and AB-type (carbonate resides in both the sites of OH- and PO43-ions) of HAp. However, these types of substitution decrease the crystallite size, crystallite nature, change in lattice dimensions, and solubility nature of the apatite matrix, at the same time they are essential to enhance the bio-activeness and osteointegration [5].

Nanohydroxyapatite (nHAp) shows special features like a massive surface area and well as their fine texture in resembles natural apatite, which tends to kindle the interaction between implanted material and living host bone [6]. Owing to its remarkable features like compatibility with living tissue and its ability of bone-forming nature (osteoconduction), it is expansively used as a bone substitute in dental and orthopedic sectors [7]. Additionally, they are also used in various fields like cosmetics, additives in toothpaste, and water treatment [8]. The fast bone regeneration efficiency of nHAp aids to form a direct link with adjacent living human bone without intermediary connectives [9]. Nowadays, Nanosized hydroxyapatite has been extensively used as a substitute and remineralizing component for enamels [8]. It is due to the

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Reprocessing waste things into a functional product gives two-edged benefits, an eco-friendly environment and waste management. Nowadays, Ceramic materials based on calcium phosphates, which include Nano-hydroxyapatite (nHAp) and Tri-calcium Phosphates (TCP) were extensively used in biomedical applications for their outstanding biocompatibility and bioactivity properties. In this work, nHAp (pure) and its polymeric composites were prepared through the precipitation method using the coral skeleton as a calcium precursor. Besides, to change the surface functional characteristics, the polymers were utilized as a capping agent. The synthesized samples were examined by spectrographic tools such as XRD, FT-IR, SEM/EDAX, TG-DTA, XPS and HR-TEM to find the phase, functional groups, size, morphology and thermal stability together with phase transition as well as bonding types which present in the prepared samples respectively. In addition, Simulated Body Fluid (SBF) analysis, antimicrobial assay and hemolytic test were intended to test the apatite-forming ability, antimicrobial effectiveness and hemocompatibility of the prepared samples. Therefore, the present findings suggest the possibility of developing novel HAp polymeric nanocomposites that exhibit improved biocompatible, osteoconductive which impersonates the structure of natural human bone. So, that can use for making bone and dental implants using corals skeleton as a precursor at a lesser cost.

1. Introduction

In human anatomy, the Skeleton system is one of the major systems that offer structural support and protection to vital internal organs like the heart, liver, brain, etc. [1]. Calcium phosphate-based bioceramics have acquired substantial attention from researchers as bone implant substitutes due to their excellent bioactive properties. Besides, Hydroxyapatite [HAp -Ca10(PO4)6(OH)2] is a vital inorganic mineral that contains minerals comparable to those found in living human bones in their natural state with Ca/P molarity 1.67 [2]. HAp is highly biocompatible as well as biodegradable and possesses better compressive strength with less frictional properties [3]. The combination of several ions such as Na, Mg, F, and CO32- accommodates the inorganic matrix of hydroxyapatite which promotes bone rigidness [4]. The accommodating site of carbonate ions in the HAp matrix decides the type of hydroxyapatite, which is distinguished as A-type (carbonate ions occupy OH-sites), B-type (carbonate ion occupies PO43- places) and AB-type (carbonate resides in both the sites of OH- and PO43-ions) of HAp. However, these types of substitution decrease the crystallite size, crystallite nature, change in lattice dimensions, and solubility nature of the apatite matrix, at the same time they are essential to enhance the bio-activeness and osteointegration [5].

Nanohydroxyapatite (nHAp) shows special features like a massive surface area and well as their fine texture in resembles natural apatite, which tends to kindle the interaction between implanted material and living host bone [6]. Owing to its remarkable features like compatibility with living tissue and its ability of bone-forming nature (osteoconduction), it is expansively used as a bone substitute in dental and orthopedic sectors [7]. Additionally, they are also used in various fields like cosmetics, additives in toothpaste, and water treatment [8]. The fast bone regeneration efficiency of nHAp aids to form a direct link with adjacent living human bone without intermediary connectives [9]. Nowadays, Nanosized hydroxyapatite has been extensively used as a substitute and remineralizing component for enamels [8]. It is due to the

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