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LASER- A boon for forensic Science (AbstractView.aspx?PID=2018-11-4-40)

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Electrical Energy Generated by Amorphous Silicon Solar Panels

Silicon

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Abstract

This paper presents studies carried out on amorphous silicon solar panels for electrical power generation in the city of Hassi Messaoud, Ouargla. The electrical power generation has been studied as a function of the amount of irradiation received and the angle of optimum orientation of the solar panels. An optimal angle of 32 degrees is chosen and the amount of solar radiation received is studied. A direct correspondence was observed between the incident solar radiation and the power generated. The maximum variable power is generated between the months of

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Study on Structural and Optical Properties of Sb_2S_3 and CdI_2 Composite Thin Films Deposited by Thermal Vapor Deposition

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Thin films of Sb_2S_3 and CdI_2 composites were deposited by thermal vapor deposition method on a glass substrate. The structural and optical properties have been investigated as a function of the film thickness. Three samples were deposited with thickness of 160 nm, 210 nm and 380 nm. The samples were characterized by X-ray diffraction (XRD), UV–visible (UV–Vis) absorption spectroscopy and photoluminescence (PL) spectroscopy. The XRD result confirms the orthorhombic structure of Sb_2S_3 peaks. The bigger crystals are formed with the increase of the thickness of the film. The band gaps of the deposited composite thin films were found to be in range 2.17–1.48 eV and suggest the possibility of band gap tunability in the visible region with the changing the thickness of the film. The PL study reveals the intense emission due to band to band recombination with emission in the red region corresponding to trap states.

Keywords: Antimony trisulfide; X-ray diffraction; optical band gap; photoluminescence.

1. Introduction

Recently, metal chalcogenides have attracted considerable attention due to their potential applications in electronic, optical and superconductor devices.[1,2] This is because they have adjustable optical band gap and structural properties. Among these antimony trisulphide (Sb_2S_3) is a popular semiconductor due to its high photosensitivity and high thermoelectric cooling power.[3,4] Sb_2S_3 is known to have an orthorhombic crystal structure with $a = 1.20$ nm, $b = 1.128$ nm and $C = 0.38$ nm.[3] Sb_2S_3 has coordinates with one-half of antimony surrounded with five sulfur atoms. The form of Sb_2S_3 thin films are of two types: amorphous and crystalline. They have different colors base on their forms and this also depends on their grain sizes, impurities and deposition methods. The crystalline form has grey color and the amorphous form has grey, black, yellow, red, purple and black. Generally, Sb_2S_3 deposited thin films are amorphous in nature and the annealed Sb_2S_3 films become polycrystalline[5] and it depends on the temperature at which the thin films are annealed.

Cadmium iodide (CdI_2) is found usually in the hexagonal layered structure. Both have band gaps in the UV–visible (UV–Vis) region. Both materials are used in optoelectronic applications as an optical sensor and as a phosphor material due to their

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Experimental Investigations and Exergetic Assessment of 1 kW Solar PV Plant

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ABSTRACT

The huge potential of solar energy and increasing demand of energy, made researchers to work on solar photovoltaic systems. In this paper, experimental investigations and exergy based thermodynamic assessment of 1 kW solar photovoltaic (SPV) plant have been carried out. The system is installed at Amity University Gurgaon, India. With the aim to assess the performance/efficiency of the plant, two exergy techniques have been applied based on concepts of thermodynamics and chemical/photonic energy of input solar insolation. The input energy and exergy at different wavelengths ranging from 0.4 μm-0.7 μm have been formulated and illustrated. The electrical and operating parameters of SPV plant includes short-circuit current, open-circuit voltage, temperature of photovoltaic (PV) modules, and fill factor are found, carrying an experiment on a sunny day of 5th October 2017. The variations of electrical exergy input at different fill factors have been computed which signifies its role in characteristic behavior of PV system. The energy/exergy efficiencies are found to be between 7.76% to 9.98% and 9.86% to 11.63% whereas the photonic energy/exergy efficiencies are found to be between 4.85% to 11.24% and 6.08% to 12.89%. It is also found that the temperature of SPV plays a vital role on exergy efficiency and it can be improved with a mechanism which removes the generated heat from the system. With the experimental results, it can be noticed that the exergy loss increases as the temperature of SPV module goes up.

Keywords: Chemical/Photonic energy, energy analysis, exergy analysis, electrical energy, solar insolation rate, solar photovoltaic system, thermal energy

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Performance Characteristics and Thermodynamic Investigations on Single-Stage Thermoelectric Generator and Heat Pump Systems

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ABSTRACT

The thermodynamic analysis of thermoelectric devices (TEs) discards the impact caused by heat leak between source and sink. It could lead towards the partial/incomplete modelling of TEs along with some analytical gaps in their performance evaluation. Conversely, appropriate agreement among different design constraints of TEs is a must to upgrade their operating characteristics. In view of this, the modelling of multi-element single-stage thermoelectric generator (TEG) and thermoelectric heat pump (TEHP) is carried out in matrix laboratory (MATLAB 9.2). The irreversibilities caused by heat leak between the source/sink along with Fourier/Joule effects are considered for the modelling and analysis. The power output/thermal efficiency and heating capacity/coefficient of performance (COP) of TEs are analytically derived and optimized on the basis of finite time thermodynamic principles. The predetermined thermoelectric couples are chosen to maximize the heating capacity/COP in proposed configurations. Moreover, the influence of design variables viz electrical current, thermoelectric couples on system throughput is analyzed and presented. The effects of geometrical parameters viz length and area of individual modules on the performance of TEG and TEHP are also discussed.

Keywords: Finite time thermodynamic, thermoelectric generators, thermoelectric heat pumps, (FTT), thermodynamic optimization

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INTRODUCTION

In today's era, the rapid rise in energy demand has led researchers/scientists to search for new resources of energy. As the conventional energy resources are coming to an end, innovative/smart energy conversion technologies are gaining wide

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Multicriteria optimization based comprehensive comparative analyses of single- and two-stage (series/parallel) thermoelectric generators including the influence of Thomson effect

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The thermodynamic investigations on the thermoelectric devices (TEs) discard the influence produced by the non-linear Thomson effect. It could direct the incomplete/partial modelling solutions laterally through some critical gaps in the performance evaluation of these devices. On the contrary, a suitable arrangement of several designing constraints for TEs is essential to improve their operating characteristics. In this context, the modeling of multi-element single- and two-stage thermoelectric generators based on the thermodynamic principles is done in MATLAB 9.2. The irreversibility due to Thomson influence along with Joule/Fourier effects are undertaken for the system modelling. The optimization of the generators is done in pursuance of obtaining the optimal values of four input parameters using two different evolutionary algorithms, viz., NSGA-II and MOEA/D. The optimum solutions from the Pareto front of two-/three- objective are found using different decision-making methods, viz., TOPSIS, Fuzzy, and LINMAP. It is observed that the proposed optimization yields trivial variances amongst ideal/obtained solutions, named as the deviation index, in comparison with the single/dual ones. In addition to this, sensitivity analysis is done to examine the impact of Thomson effect on the output power/thermal efficiency of the generators. The test results obtained through NSGA-II are in coherence with those of the data and figures reported in the available literature. *Published by AIP Publishing.* https://doi.org/10.1063/1.5019972

NOMENCLATURE

I	Working electrical current (A)
k	Thermal conductivity of a semiconductor leg ($W\ m^{-1}\ K^{-1}$)
K	Thermal Conductance of the semiconductor couple ($W\ K^{-1}$)
m	Pairs of thermoelectric elements of the bottom stage of the thermoelectric generator
M	Total number of pairs of thermoelectric elements of the thermoelectric generator
MOEA/D	Multi-objective evolutionary algorithm based on decomposition
n	Pairs of thermoelectric elements of the top stage of the thermoelectric generator
NSGA-II	Second version of the non-dominated sorted genetic algorithm
P	Power output of the generator (W)
PTEG	Two-stage thermoelectric generator in parallel configurations
Q	Rate of heat transfer (W)
R	Total internal electrical resistance of the semiconductor couple (Ω)
STEG	Two-stage thermoelectric generator in series configurations
S_{gen}	Entropy generation in $W\ K^{-1}$

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Featured Letter

Enhanced photoluminescence response of Ca^{2+}/Ba^{2+} substituted solid solutions of SrS:Ce phosphors

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ABSTRACT

The quest of improving luminescence efficiency in alkaline earth sulfide phosphors has been of great interest due to their applications in diverse areas. We synthesized SrS:$Ce_{0.05}$, $Sr_{0.75}Ba_{0.20}S:Ce_{0.05}$, $Sr_{0.75}Ca_{0.20}S:Ce_{0.05}$ and $Sr_{0.75}Ca_{0.10}Ba_{0.10}S:Ce_{0.05}$ phosphors using solid state diffusion method. X-ray diffraction patterns of all the samples were found similar to the cubic SrS phase except minor shifts in angles. To ascertain the valence state of Ce, near edge X-ray absorption fine structure spectroscopy was employed using synchrotron radiations. We simulated Ce $M_{5,4}$-edges of Ce^{3+} ions using atomic multiplet calculations, which agrees well with the experimental data, clearly suggesting that Ce enters as Ce^{3+} in all the samples. The photoluminescence spectra of synthesized phosphors exhibit blue-green emission assigned to the 5d-4f transitions in Ce^{3+} levels, with minor shifts in wavelength. Interestingly, Ca^{2+}/Ba^{2+}substitution in SrS:Ce phosphors increases the PL intensity considerably. In comparison to SrS:$Ce_{0.05}$, PL intensity of $Sr_{0.75}Ca_{0.10}Ba_{0.10}S:Ce_{0.05}$ phosphors was enhanced by 2.7 times, which may be exploited in many optical applications.

1. Introduction

The phenomenon of luminescence with its varied aspects has been fascinating field of pure and applied research all over the world. Alkaline earth sulfides (AES) have been known for a long time as excellent phosphor materials [1–3]. Although the AES materials are wide band gap semiconductors, however the capacity to accept a variety of extrinsic impurities over a considerable concentration range on substitutional sites render them suitable for a large number of applications such as multicolour thin film electroluminescent devices, infrared sensors, radiation dosimetry, photoconductive devices, optical storage media etc. [3–7]. It has been observed that luminescence properties of phosphors can be tuned by changing various parameters such as particle size, nature of dopant, crystal filed strength of host matrix etc. We have previously investigated SrS based phosphors in detail and shown that photoluminescence properties can be tuned by doping SrS with various activators such as Ce, Sm, Mn etc. [1,8,9]. Further, substituting the host lattice cations with other cations can alter the crystal field, and leads to redistribution of dopant energy levels which subsequently alter the luminescence properties [10]. Therefore the effect of cations substituted host lattice on the luminescence of phosphors should also be investigated for their complete understanding.

Here we have investigated the luminescence of Ca^{2+}/Ba^{2+} substituted SrS:Ce phosphors by retaining the cubic phase of SrS. The solid solutions of SrS:Ce phosphors were synthesized using solid state diffusion method and characterized by X-ray diffraction and reflectance spectroscopy. The effect of varying crystal field of cations substituted phosphors on the nature of dopant was investigated by probing the local electronic structure of dopant using element specific near edge X-ray absorption fine structure (NEXAFS) technique. We performed NEXAFS spectroscopy at $M_{5,4}$-edges of Ce, which are dominated by 3d–4f transitions, and hence are extremely sensitive to the 4f occupancy. To ascertain the valence state of Ce in solid solutions, the experimental results were compared with the simulated $M_{5,4}$-edges of Ce^{3+} using atomic multiplets calculations. Finally the effect of solid solutions of SrS:Ce phosphors on the photoluminescence emission and excitation was investigated.

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Full Length Article

Role of Cu in engineering the optical properties of SnO_2 nanostructures: Structural, morphological and spectroscopic studies

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ABSTRACT

We have carried out a systematic study to investigate the effect of Cu doping on the optical properties of SnO_2 nanostructures synthesized by chemical route. Synthesized nanostructures were characterized using X-ray diffraction (XRD), Field emission scanning electron microscopy (FE-SEM), High resolution transmission electron microscopy (HR-TEM), Energy dispersive X-ray spectroscopy, Raman spectroscopy, Fourier transform infrared (FTIR) spectroscopy, UV–visible and Photoluminescence (PL) spectroscopy. The Rietveld refinement analysis of XRD patterns of Cu-doped SnO_2 samples confirmed the formation of single phase tetragonal rutile structure, however some localized distortion was observed for 5 mol% Cu-doped SnO_2. Crystallite size was found to decrease with increase in dopant concentration. FE-SEM images indicated change in morphology of samples with doping. HR-TEM images revealed that synthesized nanostructures were nearly spherical and average crystallite size was in the range 12–21 nm. Structural defects, crystallinity and size effects on doping were investigated by Raman spectroscopy and results were complemented by FTIR spectroscopy. Optical band gap of samples was estimated from reflectance spectra. We have shown that band gap of SnO_2 can be engineered from 3.62 to 3.82 eV by Cu doping. PL emission intensity increased as the doping concentration increased, which can be attributed to the development of defect states in the forbidden transition region of band gap of SnO_2 with doping. We have also proposed a band model owing to defect states in SnO_2 to explain the observed PL in Cu doped SnO_2 nanostructures.

1. Introduction

Tin dioxide (SnO_2) has been intensively investigated among the metal oxides because of its structural, optical and electrical properties and large number of applications in commercial devices [1–9]. SnO_2 has become a promising material due to its unique properties such as high electrical conductivity and high optical transparency in the visible part of the electromagnetic spectrum [1–3]. SnO_2 is an n-type, direct band gap semiconductor having band gap, E_g = 3.6 eV at 300 K in its bulk form [10]. Also named as cassiterite, SnO_2 has a space group P42/mnm. It has a tetragonal-rutile structure in which Sn atoms are present at corners as well as in the body centre of the unit cell. Each Sn atom is coordinated by six O atoms and each O atom is coordinated by three Sn atoms as shown in Fig. 1. Inherent oxygen vacancies in the SnO_2 are responsible for its n-type conductivity. This metal oxide has wide range of applications in low emissivity glass, electrodes, organic light emitting diodes, optoelectronic devices, lithium batteries, gas sensors, heat reflectors and polymer based electronics [4,7–9,11–13].

To control and optimize different properties of SnO_2 nanoparticles different methods of synthesis can be utilized. Various method have been used to synthesize SnO_2 nanostructures such as co-precipitation, sol-gel, chemical vapour deposition, pulsed laser deposition, plasma based evaporation, spray pyrolysis and hydrothermal method [9,14–19]. Researchers are actively trying to achieve different morphologies of tin oxide because the change in surface morphology leads to change in surface reactivity which ultimately affects its electrical, optical, structural and magnetic properties [20].

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Synthesis of ZrO_2 nanoparticles using reactive magnetron sputtering and their structural, morphological and thermal studies

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HIGHLIGHTS

- ZrO_2 Nanoparticles were synthesized by novel magnetron sputtering technique.
- Studied the effect of sputtering power over structural, morphological and thermal properties.
- This technique gives highly purity, narrow size distribution, and possible small size of ZrO_2 nanoparticles.
- XRD and Raman spectra exhibit the tetragonal phase of ZrO_2 nanoparticles.

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ABSTRACT

Intensive and extensive research is focused on the synthesis of ZrO_2 nanoparticles being used in different applications such as photocatalysis, sensors, coatings and wastewater treatment. In the present work, we report the synthesis of ZrO_2 nanoparticles using novel reactive magnetron sputtering technique and then investigated the sputtering power (40, 60, 80 and 100 W) effect on structural, morphological and thermal properties. The characterizations of the synthesized nanoparticles were carried using powder X-ray diffraction (XRD), Raman spectroscopy, Fourier transform infrared spectroscopy (FT-IR), Field emission scanning electron microscopy (FE-SEM), Energy dispersive X-ray analysis (EDXA), Transmission electron microscopy (TEM), Selected area electron diffraction (SAED) and Thermogravimetry analysis (TGA). XRD analysis confirmed the formation of pure tetragonal phase with an increase in average crystallite size as a function of sputtering power. EDXA and Raman analysis also confirmed the formation of high purity tetragonal phase. FE-SEM and TEM results displayed spherical type morphology in aggregated form having a particle size less than 10 nm. TGA results indicated that the weight loss was only due to desorption of water molecules and is inversely proportional to the particle size.

1. Introduction

From the last few decades, the scientific community expressed great interest in the synthesis of transition metal oxides nanomaterials of different sizes and morphologies because of their potential applications in different fields. Among various metal oxides nanomaterials, ZrO_2 nanostructures materials demonstrate intriguing much attention of researchers due to their unique physical, chemical, optical, and electrical and thereby applications in different fields such as photocatalysis [1], sensing [2], coatings [3], wastewater treatment [4], fuel cells [5], advanced ceramics and catalysis [6,7]. ZrO_2 exhibits three important polymorphic forms, depending on the temperature range; monoclinic (room temperature–1172 °C), tetragonal (1172–2347 °C) and cubic (above 2347 °C) [8]. In these different states, metastable tetragonal (t-ZrO_2) form exhibits particular interest, which is supposed to have superior catalytic and mechanical properties to those of monoclinic phase (m-ZrO_2) [9]. For the preparation of stable tetragonal phase

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Thermal Induced Vibration of non Homogeneous Tapered Square Plate

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Abstract: A mathematical model is presented to study the effect of circular variation in density (as a non-homogeneity parameter) and linear variation in thickness to natural vibration of square plate on clamped (C-C-C-C) boundary condition under temperature enviornment. It is considered that the temperature variation along both the axes are parabolic. To obtain frequency modes, Rayleigh Ritz technique has been applied. All the results are presented in the form of tables. Comparison of the result with existing result (in literature) is also presented in the form of figures.

Key words: Tapered square plate, thermal induced, vibration, circular variation, homogeneity, temperature variation, Rayleigh Ritz

INTRODUCTION

Non homogeneous tapered plates are extensively used in structural components of engineering. To avoid the failure of structures or to increase the reliability of structures, it is required to have better understanding of vibration characteristic of plate. For modal analysis of structures, it is essential to calculate natural frequencies and mode shapes. These parameters play an essential role in the designing of structures and determine the dynamic characteristics of existing structures.

Leissa (1969) provided vibration of different structures (plates of different shape) on different boundary (clamped, simply supported and free) conditions in his excellent monograph. Liew *et al.* (1993) studied the transverse vibration of thick rectangular plate. Kalita and Haldar (2015) discussed parametric study on vibration of thick plate using FSDT. Thermal effect on vibration properties of double layered nanoplates at small scale has been studied by Wang *et al.* (2011). Leissa and Nartia (1980) studied natural frequency of simply supported circular plate. Tariverdilo *et al.* (2013) derived natural frequencies for clamped circular plate with incompressible fluid. Khanna *et al.* (2015) discussed the effect of temperature on free vibration of non homogeneous and non uniform square plate. Zhou (2002) provided the vibrations of point supported rectangular plate with variable thickness using a set of static tapered beam functions. Sharma *et al.* (2016a, b) studied the vibration of isotropic and orthotropic non homogeneous rectangular plate with two dimensional temperature effects. Sharma and Sharma (2016) provided a mathematical modeling on vibration of parallelogram plate with non-homogeneity effect. Sharma *et al.* (2016a, b) studied the vibration of square plate with thermal effect and circular variation in density. Hosseini-Hashemi *et al.* (2013) provided a mathematical model to study free vibration of stepped circular and annular FG plates. Khanna and Kaur (2016a, b) studied the vibration of non homogeneous of rectangular plate with exponential variation in non-homogeneity parameter with temperature effect. Kazerouni *et al.* (2010) presented an exact solution for thin functionally graded simply supported (two opposite edges) rectangular plate. To obtained stability equation they used the principle of minimum total potential energy. Buckling behavior of moderately thick functionally graded rectangular plates resting on elastic foundation subjected to linearly varying in plane loading has been investigated by Bodaghi and Saidi (2011). They used first-order shear deformation plate theory and the neutral surface concept to obtained the equilibrium and stability equations. Alibakhshi (2012) studied the effect of anisotropy on the free vibration of laminated rectangular (simply supported) plate supporting a localized patch mass. The equation of motion is derived by calculus of variation. Baferani *et al.* (2012) investigated buckling analysis of functionally graded annular thin and moderately thick plates under mechanical and thermal loads by using classical and first order shear deformation plate theory. An Analytic approach to free vibration and buckling analysis of functionally graded beams with edge cracks using four engineering beam theories have been provided by Sherafatnia *et al.* (2013).

In available literature, authors/researchers focused on linear, parabolic and exponential variation in non-homogeneity (density) but none of them considered circular variation. Here, researcher studied the effect of circular variation in density. Here, researcher also studied the effect of tapering parameter and thermal gradient on vibrational frequency modes. The first two vibrational modes are calculated for different values of plate's parameters. To validate the result of present study, research compared frequency modes with (Khanna *et al.*, 2015) corresponding to taper constant β and non-homogeneity m.

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Synthesis, Characterization of Novel PLGA Encapsulated Indole Nanoparticles and Study of its cytotoxic potential against A549 lung cancer cell line

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Nanoparticles, biomaterials, polymers, sustained release, cytotoxicity.

ABSTRACT

Objectives: Indole and its derivatives are gaining importance because of their anti-cancer activity. Here, we have reported the synthesis and characterization of novel polymeric poly D, L-lactide-co-glycolide (PLGA) indole nanoparticles, and investigated their cytotoxic potential against A549 lung cancer cells. **Materials and methods:** Nanoparticles were synthesized by solvent emulsion-diffusion-evaporation method. Size determination was done by Transmission Electron Microscopy (TEM), encapsulation efficiency using UV-Vis spectra, release kinetics using dialysis, measurement of drug-polymer interaction by Fourier Transform Infra Red Spectroscopy (FTIR) and surface charge by zeta potential. Cell viability of lung cancer cells (A549) was determined by (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay and morphological analysis. **Results:** Nanoparticles were spherical in shape with an average diameter of 65 nm, encapsulation efficiency was found to be about 78% and zeta potential was −15.2mV. Drug-loaded nanoparticles showed sustained release kinetics fitting well in exponential Higuchi and Zero order Model. FTIR studies showed a broadening of the peak of PLGA indole nanoparticles at 2100-3400 cm^{-1} indicating the formation of drug-loaded nanoparticles. These nanoparticles showed about 95% cytotoxicity against A549 lung cancer cell lines. Results were supported by visible morphological changes in cells. **Conclusion:** PLGA encapsulated Indole nanoparticles were stable, having sustained release and good cytotoxic potential.

INTRODUCTION

Cancer has emerged as a debilitating complex disease over the last many decades. Although advances in research in some cancers have led to the successful prognosis of the disease, in most cases especially in advanced stages, it continues to remain incurable. Development of new generation of drugs with minimal side effects continues to be the mainstay of all research work undertaken to combat this deadly disease. The advent of nanotechnology has brought new hope in cancer treatment by targeted delivery, increased half-life, better stability and sustained release of the drug and hence helped in mitigating the problem of side effects (Hariharan *et al*., 2006). There are reports of different classes of nanoparticles that might serve as potential anti-cancer agents themselves. The class of nanoparticles ranges from transition metal oxides (Pandey *et al*., 2016; Tarnuzzer *et al*., 2005; Sankar *et al*., 2014), chitosan derivatives (El-Sayed *et al*., 2017) to ceramics (which includes hydroxyapatite nanoparticles) (Kundu *et al*., 2013). However, an alternate and popular approach in the field of nanomedicine is by either encapsulating the anti-cancer agent or adsorbing it in delivery vesicles i.e. nanoparticles (Mirza and Siddiqui). The agents that are used for encapsulating the drugs

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Green Synthesis of Cobalt Oxide Nanoparticles by a Starch-Assisted Method

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Full Length Article

Optimization of optical characteristics of $In_{0.29}Ga_{0.71}As_{0.99}N_{0.01}$/GaAs straddled nano-heterostructure

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ABSTRACT

Designing of a nanoscale Quantum Well (QW) heterostructure with a well thickness of ~60 Å is critical for many applications and remains a challenge. This paper has a detailed study directed towards designing of $In_{0.29}Ga_{0.71}As_{0.99}N_{0.01}$/GaAs straddled nanoscale-heterostructure having a single QW of thickness ~60 Å and optimization of optical and lasing characteristics such as optical and mode gain, differential gain, gain compression, anti-guiding factor, transparency wavelength, relaxation oscillation frequency (ROF), optical power and their mutual variation behavior. The outcomes of the simulation study imply that for the carrier concentration of ~2×10^{18} cm^{-3} the optical gain of the nano-heterostructure is of 2100 cm^{-1} at the wavelength is of 1.30 μm. Though the obtained gain is almost half of the gain of InGaAlAs/InP heterostructure, but from the wavelength point of view the InGaAsN/GaAs nano-heterostructure is also more desirable because the 1.30 μm wavelength is attractive due to negligible dispersion in the silica based optical fiber. Hence, the InGaAsN/GaAs nano-heterostructure can be very valuable in optical fiber based communication systems.

1. Introduction

Recently, III-Nitride compound semiconductors based heterostructures, especially nano-scaled heterostructures, have attracted researchers belonging to optoelectronic community due to their potential applications such as light emitting diodes (LEDs), field effect transistors [1–4], detectors, solar cells and laser diodes [5,6]. Nano-heterostructures are ubiquitous of nano-semiconductor devices and have brought drastic changes in our routine life and are considered as heart for optoelectronic devices. The III-nitride based semiconductors, for examples: GaN, InN, AlN and their alloys, have been found to provide unique electrical, electronic, optical and mechanical properties which can be utilized for designing of future photonic and optoelectronic devices [7–9]. Since these semiconductors have wide band gap ranging from 1.9 eV to 6.2 eV, and, therefore, these materials can be used in the fabrication of optoelectronic devices operating in visible-to-ultraviolet regime. Examples are green, blue lasers and photo detectors. To date, III-nitrides based photodetectors operating in ultraviolet regime have exhibited promising output. In addition, III-nitrides based LEDs have been commercialized due to emission of a super bright blue and green light. Moreover, these materials have some exceptional physical properties which make the devices ready for applications beyond the data storage and imaging [10]. These materials are also useful in high temperature electronics and space applications because these are physically and chemically strong. This property makes them ideal for operation in cruel environment.

For the last three decades a lot of experimental and theoretical work has been carried out on III-nitride heterostructures and demonstrated their working with efficient characteristics successfully. For example, in 1982, first time Yoshida *et al.* [11] had fabricated GaN/AlN heterostructure and demonstrated that by using AlN buffer layer the cathode luminescence efficiency of the overlaying GaN could be improved. The main success in the history of III-nitride materials was achieved by a p-type doping in a GaN technology. Since, in general the n-type doping has been much easier than the p-type doping in these materials. The reason behind this fact is that the III-nitride materials have the tendency to show the n-type conductivity during their growth. The n-type doping in

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Influence of cobalt substitution on structural, optical, electrical and magnetic properties of nanosized lithium ferrite

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Abstract

A series of Co^{2+} substituted $Li_{0.5}Co_xFe_{2.5-x}O_4$ (x = 0.1, 0.3, 0.5) has been prepared by a citrate precursor method. The distribution of cations on A-site and B-site was studied by X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Mössbauer Spectroscopy. XRD confirmed the formation of ordered α-phase with prominent peaks at (220), (311), (400), (422), (511), (440). SEM and TEM confirmed the homogeneous formation of cubic phase with an average crystallite size of 50 nm. From FTIR studies, the bands at 603.78, 606.14 and 610.08 cm^{-1} confirmed the formation of Fe^{3+}–O^{2-} bond at tetrahedral (A-site), whereas bands at 477.25, 474.84 and 471.69 cm^{-1} confirmed the formation of Fe^{3+}–O^{2-} bond at octahedral site (B-site); shifting in frequency was observed with an increased amount of cobalt doping. Further, Raman spectra revealed the distribution of cations at tetrahedral and octahedral site by means of modes A_{1g}, T_{2g}, E_g. Mössbauer spectra with two magnetic sextets confirmed two different environments of Fe^{3+} ions. With an increase in cobalt doping, the crystallite size was observed to increase and hence an increase in relative area B/A ratio confirming the occupancy of Co^{2+} at B-site. The temperature dependence of DC resistivity was found to decrease with an increase in temperature. With an increase in cobalt substitution, DC resistivity was observed to increase from 2.32×10^6 to 3.46×10^7 Ω cm. A decrease in activation energy is noticed in the present investigation and this observed semiconducting behavior makes these nanomaterials suitable in NTC (negative temperature coefficient) devices. These observations were explained on various models and theories.

1 Introduction

Lithium ferrites ($Li_{0.5}Fe_{2.5}O_4$) are the ferrimagnetic oxides exhibiting inverse spinel structure. The distribution of metal cations is given by (Fe^{3+}) $[Li_{0.5}Fe^{3+}{}_{0.5}Fe^{3+}]$, where small and square brackets indicates the cation distribution in the tetrahedral (A-site) and octahedral (B-site) at the interstitial sites of oxygen anion lattice [1, 2]. There are 8 A-sites and 16 B-sites in the spinel cubic structure of ferrites; having structural formula $[AB_2O_4]$ which are occupied by iron and divalent metal cations such as Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+} and Mg^{2+} etc. [3–5]. But in case of lithium ferrite ($Li_{0.5}Fe_{2.5}O_4$), as the lithium ion is monovalent, therefore the distribution is such that; $0.5Li^+ + 0.5Fe^{3+}$ randomly occupy the octahedral (B) site and tetrahedral (A) site constituting the inverse spinel cubic structure. These materials are the class of soft magnetic materials with square hysteresis loop, high saturation magnetization and high electrical resistivity having technological importance in microwave frequency applications [6, 7]. Therefore, lithium ferrites and doped

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Role of polyvinyl pyrrolidone as a capping agent in the synthesis of magnetite (Fe 3 O 4) nanoparticles

Experiment Findings · September 2018

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Experimental investigation of plasma instabilities by Fourier analysis in an electron cyclotron resonance ion source

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The plasma instabilities play an important role in an electron cyclotron resonance (ECR) ion source for the production of intense heavy ion beams in high charge states for particle accelerators. The geometrical and operational constraints of ECR sources hinder the trapping of ions for a sufficient time to get fully ionized with maximum efficiency. This problem is looked at in detail by studying the plasma instabilities in ECR ion sources. The ECR environment is full of complex rearrangements of various electric and magnetic fields to define a sustainable trap for the ions. The maximum frequency of plasma instability has been observed to be of 122.5 kHz under a set of sustainable plasma parameters. However, this limit may be pushed further if the plasma is overdriven in terms of source parameters. The instabilities cover a full regime of few tens of Hz to few hundreds of kHz under various operating conditions of radio frequency (rf), negative bias voltage, rf power and injection gas pressure. The rigorous details of frequencies and amplitudes of plasma instabilities are being reported by studying the Fourier spectrum of extracted and analyzed beam intensity. The plasma instabilities are attributed as drift waves in an inhomogeneous ECR plasma generated by the application of radio-frequency fields.

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I. INTRODUCTION

Electron cyclotron resonance (ECR) ion sources [1,2] are one of the best sources to boost the performance as well as the efficiency of modern particle accelerators and colliders in different fields of physics, especially fundamental research on heavy ions such as nuclear and atomic physics, etc. It is an ongoing quest to develop an ion source which maximizes the ion charge state, beam current and minimizes the beam emittance. Being capable of producing high beam currents and high charges states of heavy ions, the ECR sources are the main injectors for heavy ion accelerators. The production of highly charged ions is strictly governed by the inherent and induced plasma instabilities in the ECR ion sources. They can kill or enhance a particular charge state fraction depending on the freedom of recombinations for the species on the ECR surface, a magnetic confinement region where the Larmor frequency of electrons is equal to injected radio-frequency waves. The energy of electrons is boosted maximum to few keV by ECR mechanism and these energetic electrons also known as hot electrons, produce ionization by successive impacts to heavy ions. It demands longer plasma confinement time, high ionization rates and significant population of hot electrons to get a good fraction of fully stripped heavy ion beams. Thus, there is a quest to boost the magnetic field confinement by superconducting magnets and accordingly radio frequency using highly efficient klystrons in modern ECR technology. Electron beam ion trap sources are also known for generating higher charge states nearly fully stripped for heavy ions but lack in beam currents. On the other hand, ECR sources are productive for higher beam currents of high charge states of heavy ions but not for fully stripped ions. Thus, for ECR sources, in order to obtain the maximum current of fully stripped ions, the plasma instabilities have to be investigated under the complete range and combinations of its tuning parameters.

Plasma instabilities are studied experimentally in Q-machines and theoretically by various groups worldwide in the last six decades but there are few reports in the literature to study them in detail as per the multiple tuning

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Study of effect of annealing on morphology of hydrothermally synthesized potassium titanate fibers

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The potassium titanate fibers have been synthesized using TiO_2 and KOH as startup materials in one step hydrothermal method. The thickness of synthesized fibres ranges from 20 to 100 nm whereas the length varies from 200 nm to 200 microns. The effect of annealing at various temperatures on the synthesized nanofibers has also been investigated by characterization using XRD, SEM, TEM, Raman and FT Raman. The annealing at 800 °C has been found to yield a pure $K_2Ti_6O_{13}$ phase when its XRD peaks have been compared with the standard XRD data. The growth of nanowires is along the (010) direction. However, when annealed at 400 °C, 600 °C, 800 °C and 1000 °C the samples show the transformation into several other structural phases. However, annealing above 800 °C causes all the structures of nanowires to transform into $K_2Ti_6O_{13}$. The TEM image shows that the product formed contains a large quantity of fibres with almost uniform thicknesses but with varied lengths.

Keywords: Potassium titanate, Hydrothermal synthesis, Characterization

1 Introduction

Titanates belong to the class of inorganic compounds composed of titanium oxides. These materials are insoluble in water and possess high melting point and show diamagnetic nature[1-4]. The unique properties of the material such as high chemical stability and corrosion resistance make these superior from the other metal oxide materials[5-8]. In the past decade one dimensional nanostructures have attracted extraordinary attention for their novel physical properties[9-10] and potential applications in constructing nanoscale electronic and optoelectronic devices[11,12]. The wide range applications of potassium titanate in different fields are due to its controllable particle size, morphology and crystalline structure[13-16]. Titanate nanotubes and nanowires are particularly interesting because they have large specific surfaces and may enhance the photolytic activity[17-19], leading to the higher potential applications in whisker-reinforced plastics and metals[20].

Various techniques have been used to prepare potassium titanate such as chemical vapour deposition, sputtering, hydrothermal and sol-gel processes[21-23]. Potassium titanate belongs to a wide family of crystals with different morphologies that are of great interest owing to their tunnel or layered type crystalline structures[24-28]. Hydrothermal synthesis is a promising low cost method for potassium titanate synthesis due to the combined effects of solvent, temperature and pressure on the ionic reaction equilibrium that can stabilize desirable product while inhibiting the formation of undersirable compounds[18,19]. Moreover, hydrothermal synthesis yields highly pure, homogeneous whiskers at a considerably lower temperature compared to the solid state reaction. Hydrothermal growth is a one-step, environment friendly and inexpensive way in which the morphology, size and purity of the product can be controlled under moderate conditions. It is also possible to have high production efficiency in the formation of nanosized particles or nanowires. In present work synthesis, characterization and annealing of potassium titanate nanofibers is discussed.

2 Experimental

The samples are prepared by hydrothermal method using TiO_2 (99% pure anatase phase) as the Ti source and KOH as potassium source. Both materials used

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Ultrasonic attenuation in thorium monopnictides

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The ultrasonic attenuation due to phonon-phonon interaction have been computed along <100>, <110> and <111> directions at room temperature. For the evaluation of attenuation, we have also evaluated higher order elastic constant, ultrasonic velocity and acoustic coupling constant. The Coulomb and Born-Mayer potential has been applied to find out the higher order elastic constants in the temperature range 0-300K. Some mechanical constant were also computed for predicting for futuristic performance of the chosen materials. The behaviour of ultrasonic attenuation has been considered in correlated with other thermo-physical properties of thorium monopnictides.

Keywords: Thorium monopnictides, elastic properties, ultrasonic properties.

Introduction

Ultrasonics are the versatile tools for the study of properties of different types of the materials. Monochalogenides and monopnictides of the lanthanides and actinides play important role for engineering and technological applications. Kholia *et al.*[1] have been investigated the structural phase transition and elastic characteristic at high pressure of thorium pnictides. Kumar *et al.*[2] have been calculated the electronic density of states and dielectric properties for the thorium monopnictides with the help of linear muffin tin orbital process not beyond atomic sphere approximation and investigated result have been compared with the accessible experimental data. The high-pressure structural characteristics of a thorium monopnictides have been investigated by using of the all-electron full potential linear muffin-tin orbital process by Kanchana *et al.*[3]. The structural, electronic and elastic belongings of thorium monopnictides using first principles calculation have been investigated by Amari *et al.*[4]. The phonon dispersion curves, two phonon density of states, variation of specific heat, anhormonic characteristic and high pressure phase transition study of ThSe by the application of three-body force shell model and three-body force rigid ion model have been investigated by Dwiwedi *et al.*[5]. The phase transition pressures and volume drop obtained from improved interaction potential model (IIPM) show a better agreement with the available experimental than theoretical results and also achieved elastic moduli, anisotropy factor, Poisson's ratio, Kleinman parameter, shear and stiffness constants on the basis of the calculated elastic constants of thorium monopnictides (ThX; X = N, P, As and Sb) have been investigated by Kapoor *et al.*[6]. Aynyas *et al.*[7] have investigated the structural and elastic characteristic of thorium monopnictides by applying suitable interionic potential at high pressure of thorium pnictides. Gupta *et al.*[8] have inspected the phase transition, elastic and thermophysical properties of thorium pnictides apply by a modified charge-transfer potential model.

In this present paper, we extend the application of elastic and ultrasonic characteristics of thorium monopnictides at different physical condition like temperature and crystallographic directions to make the materials for their futuristic applications.

Theory

The second and third order elastic constant, which depend on temperature have been calculated by applying Coulomb and Born Mayer potential for thorium monopnictides material. The formula of interionic

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Mechanical and thermophysical properties of actinide monocarbides

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This paper describes the mechanical and thermophysical properties of actinide monocarbides AnCs (An=Np and Cm) as a function of temperature and crystallographiic direction. The temperature-dependent second- and third-order elastic constant (SOECs and TOECs) have been computed first using Coulomb and Born–Mayer potential up to second nearest neighbor. SOECs have been applied to find out mechanical constant such as bulk modulus, shear modulus, tetragonal modulus, Poisson's ratio and Zener anisotropy for the prediction of futuristic performance of the NpC and CmC. We also found the value of G/B > 0.59 for the chosen materials, which indicates that NpC and CmC have brittle nature. The computed elastic constants are further applied directly to indirectly find out the ultrasonic velocity, Grüneisen parameters, pressure derivative, Debye temperature, micro-hardness, Breazeale's nonlinearity parameter, thermal relaxation time and thermal conductivity. These evaluated parameters were finally used to compute ultrasonic attenuation of the NpC and CmC along ⟨100⟩, ⟨110⟩ and ⟨111⟩ directions at room temperature. The behavior of the obtained results of this investigation has been compared with similar type of materials.

Keywords: Actinide monocarbides; elastic properties; ultrasonic properties; thermal properties.

1. Introduction

Ultrasonics has been used to inspect objects, measure distances, cleaning, detect invisible flaws, mixing and to accelerate chemical processes. The actinides play an important role in nuclear fission technology, medical diagnostics and treatments.

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RESEARCH ARTICLE

Elastic and Ultrasonic Properties of Rare-earth Lutetium Monopnictides

Devraj Singh[1] · Amit Kumar[2] · Ram Krishna Thakur[2] · Raj Kumar[3]

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Abstract We present ultrasonic properties of lutetium monopnictides (LuPn: Pn = As and Sb) with the help of second and third order elastic constants in the temperature range 100–300 K. These elastic constants have been computed using Coulomb and Born–Mayer potential with the help of two basic parameters i.e., nearest neighbor distance and hardness parameter. First these elastic constants are applied to compute some mechanical constants such as bulk moduli (B), shear moduli (G), tetragonal moduli (Cs), Poisson's ratio (v) and Zener anisotropy ratio (A). The fracture to toughness ratio i.e., G/B was found greater than 0.57, therefore LuAs and LuSb are brittle in nature. In second part of present investigation we evaluated ultrasonic properties such as wave velocities for longitudinal and shear modes, Debye average velocity, Debye temperature and Grüneisen parameters, thermal relaxation time, thermal conductivity, acoustic coupling constants and ultrasonic attenuation due to phonon–phonon interaction along ⟨100⟩, ⟨110⟩ and ⟨111⟩ orientations. The achieved results of present work are compared and discussed with other rare-earth monopnictides.

Keywords Monopnictides · Elastic constants · Ultrasonic velocity · Grüneisen parameters · Ultrasonic attenuation

1 Introduction

The elastic and ultrasonic properties are crucial and valuable for in depth learning of solid materials. Although, these studies are considered in various solid materials but it has not satisfactorily explored in rare-earth materials. A precise evaluation of elastic and ultrasonic properties has key applications in ultrasonic non-destructive testing (UNDT) and electronic instrumentation purposes. Here liaison between ultrasonic properties and material's parameters acts as an important tool and is being widely used by scientists, engineers and researchers. The investigation of electronic, magnetic, structural and mechanical properties of rare-earth monopnictides has become quite prominent in recent years due to their futuristic applications in the geophysical, industrial and technological areas. The rare-earth monopnictides exhibit B_1-type crystal structure at ambient pressure. The rare-earth monopnictides have been received attention by the researchers due to their anomalous behaviour at different physical conditions for last three decades [1–20]. A critical review on lattice dynamical properties studies in rare-earth monopnictides has been presented by Jha et al. [4], Neupane et al. [5] performed systematic angle resolved photoemission spectroscopy (ARPES) measurement on NdSb single crystals covering the entire area of the Brillouin zone. By applying ARPES with first principle, Lou et al. [6] investigated electronic structure of LaBi and Zeng et al. [7] observed Fermi surface topology and band structure of

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Natural vibration of parallelogram plate with circular variation in density

AMIT SHARMA [1]

Abstract. In this paper, author studies the natural vibration of non-homogeneous tapered parallelogram plate along with temperature variation. For tapering and non-homogeneity, author considered two-dimensional linear thickness variations and one-dimensional circular variation in density parameter. Author also assumed two-dimensional linear temperature variation on the plate. In order to solve differential equation of motion for vibrational frequencies, Rayleigh–Ritz technique is used on clamped boundary conditions. The results are presented in tabular form. Comparison of results with existing results are also given to support the present study.

Key words. Parallelogram plate, natural vibration, circular variation, density.

1. Introduction

The non-homogeneous plates with variable thickness have the vast applications in engineering like aeronautical engineering, mechanical engineering, marine engineering, and ocean engineering because of versatility, usability and high tensile strength. In order to make trustworthy design, it is essential to study vibrational characteristics of plates because first few modes of vibration play tremendous role. Almost all engineering structure worked under great influence of temperature. Therefore, without consideration of temperature effect, the study of vibration means nothing. A significant work has been reported in these directions.

Leissa [1] provided plate vibration of different geometry with different edges in his excellent monograph. Sharma and Verma [2] studied free vibration of tapered square plate (orthotropic and non-homogeneous) on clamped edge under temperature field by using Rayleigh–Ritz method. The effect of non-homogeneity on natural vibration of orthotropic rectangular plates with variable thickness resting of Pasternak foundation has been analyzed by Lal and Dhanpati [3]. The effect of elastic foundation on the mode shapes and natural vibration of rectangular plates on simply supported edges have been discussed by Raju and Rao [4]. Wang and Xu [5] presented an analysis on natural vibration of beams and rectangular plates with free edges us-

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Effect of linear variation in density and circular variation in Poisson's ratio on time period of vibration of rectangular plate

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Abstract. In this paper, a theoretical analysis is carried out to investigate the effect of linear variation in density and circular variation in Poisson's ratio on time period of frequency modes of rectangular plate with variable thickness under temperature field. The thickness variation is considered to be circular and temperature variation on the plate is assumed to be bi-linear. Rayleigh Ritz method is used to solve the differential equation. All the results (time period for first two modes of vibration) are presented with the help of tables.

Keywords: density, Poisson's ratio, rectangular plate, time period.

1. Introduction

The study of vibration of non-homogeneous plate is essential in these days because non-homogeneous plate with variable thickness are used in almost all engineering structures such as power plants, wings of an aircrafts, machines, bridges etc. Plates with variable thickness along with non-homogeneity have great impact when compared to homogeneous plate with uniform thickness because of their efficiency and strength. The first few modes of vibration provide us good information about the behavior of systems/structures. Therefore, in order to design perfect structures/systems, it is essential to determine natural frequencies and mode shapes. A significant work has been reported in these directions.

The natural vibration of cantilever plates with variable thickness is analyzed by using mixed boundary grid method (FBGM) [1] and obtained characteristic equation and frequency parameters. A model [2] is presented to analyze the nonlinear vibrations of visco elastic thin rectangular plates by using von Kármán nonlinear strain–displacement relationships and obtained fundamental modes of a simply supported square plate with immovable edges. The nonlinear damping of visco elastic rectangular plate [3] is studied and equation of motion is derived using Lagrange equations. The results are also obtained theoretically as well as experimentally. Vibration analysis of rectangular plates with rectangular cutouts is investigated by using extended Hencky bar-net method (HBM) [4]. Method of reverberation ray matrix (MRRM) and golden section search (GSS) algorithm [5] is applied to obtain the exact solution of rectangular plates with arbitrary boundary conditions. Accurate analytic solutions for natural vibration of thick rectangular plates with a free edge is presented in [6]. Natural vibration of thick rectangular plate [7] without two parallel simply supported edges is studied and new analytic solutions are obtained. The effect of crack defects and temperature on vibration of thin isotropic and orthotropic rectangular plates is studied in [8]. The effect of circular variation in density and exponential variation in Poisson's ratio on vibrational frequency of parallelogram plate under temperature field is examined in [9]. The effect of two-dimensional thickness and temperature effect on natural vibration of parallelogram plate on clamped edges is studied using Rayleigh Ritz method [10]. Rayleigh Ritz method [11] is used to analyze the natural vibration of isotropic rectangular plate

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GENERALIZED $F_\delta-$ CONTRACTIONS AND MULTIVALUED COMMON FIXED POINT THEOREM

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ABSTRACT. In this paper, using Wardowski technique, we mainly study common fixed point theorem for pair of multivalued mappings with δ-distance satisfying generalized $F_\delta-$ multivalued contraction in complete metric spaces. Our main result extend the result of Wardowski (Fixed Point Theory and Applications 2012 (2012), Article Id:94), and generalize the result of Acar (Abstract and Applied Analysis, 2014 (2014), Article ID:497092, 5 pages).

2000 MATHEMATICS SUBJECT CLASSIFICATION. 47H10, 54H25..

KEYWORDS AND PHRASES. Fixed-point, multivalued, pair-maps, generalized $F_\delta-$ contraction, metric-spaces.

1. INTRODUCTION AND PRELIMINARIES

Banach fixed point theorem is one of the pioneer findings of nonlinear analysis. Since its appearance, Banach [1] result extended and generalized in several directions for mappings in different metric space for various types of contractions, see [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14]. Nadler [15], on using Pompeiu-Hausdorff metric, employed the notions of multivalued contraction mapping and derive that such types of map preserve fixed-point in metric space. On other side, Fisher [16] defined the notion of δ -distance between the pair of subsets of Y which are bounded and, derived various type of invariant results for multivalued mappings. Some results on δ -distance and multivalued mappings, can be found in [17, 18, 19, 20].

Let $\mathcal{F}$ be the set of all functions $F : (0,\infty) \to \Re$ satisfying the conditions:

(F_1) $\forall\ \gamma, \lambda \in (0,\infty)$, F is such that $\gamma < \lambda$, implies $F(\gamma) \leq F(\lambda)$.

(F_2) for every sequence of positive numbers $\{b_n\}$, $\lim_{n\to\infty} b_n = 0$ if and only if $\lim_{n\to\infty} F(b_n) = -\infty$.

(F_3) there exists $0 < k < 1$ s.t. $\lim_{\gamma\to 0^+} \gamma^k F(\gamma) = 0$.

Definition 1.1. [17] *Let (Y,d) be a metric space and let $P : Y \to Y$ be a mapping. Given $F \in \mathcal{F}$, we say that P is F-contraction, if there exists $\kappa > 0$ such that for all $u, v \in Y$*

$$d(Pu,Pv) > 0 \implies \kappa + F(d(Pu,Pv)) \leq F(d(u,v)).$$

Some beautiful examples of F-contraction are given in [17, 19]. Wardowski[17] also mentioned that every F-contraction P is a contractive mapping, and so it is continuous. Wardowski[17] also gave a real generalization of Banach results.

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Research Article

Biogenic Synthesis of Copper and Silver Nanoparticles Using Green Alga *Botryococcus braunii* and Its Antimicrobial Activity

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The spread of infectious diseases and the increase in the drug resistance among microbes has forced the researchers to synthesize biologically active nanoparticles. Improvement of the ecofriendly procedure for the synthesis of nanoparticles is growing day-by-day in the field of nanobiotechnology. In the present study, we use the extract of green alga *Botryococcus braunii* for the synthesis of copper and silver nanoparticles. The characterization of copper and silver nanoparticles was carried out by using UV-Vis spectroscopy, Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and scanning electron spectroscopy (SEM). FTIR measurements showed all functional groups having control over reduction and stabilization of the nanoparticles. The X-ray diffraction pattern revealed that the particles were crystalline in nature with a face-centred cubic (FCC) geometry. SEM micrographs have shown the morphology of biogenically synthesized metal nanoparticles. Furthermore, these biosynthesized nanoparticles were found to be highly toxic against two Gram-negative bacterial strains *Pseudomonas aeruginosa* (MTCC 441) *and Escherichia coli* (MTCC 442), two Gram-positive bacterial strains *Klebsiella pneumoniae* (MTCC 109) and *Staphylococcus aureus* (MTCC 96), and a fungal strain *Fusarium oxysporum* (MTCC 2087). The zone of inhibition was measured by the agar well plate method, and furthermore, minimum inhibitory concentration was determined by the broth dilution assay.

1. Introduction

Nowadays, nanotechnology is a notable efficacious field for research work [1]. Nanotechnology is the branch of science and technology, which deals with the production of substances in size less than 100 nm scale as nanoparticles [2]. Among other nanoparticles, metal nanoparticles have raised attention over the last few decades because they have larger surface area per weight or to volume and many characteristics; biological, thermal, chemical, dielectric, electrical, physical, mechanical, electronic, magnetic, and optical properties make them attractive tools for research work [3]. Therefore, nanoparticles are studied as the building blocks of the next generation of technology with applications in different industrial areas. In particular, metal and metal oxide nanoparticles are receiving optimum attention in a large variety of applications [4]. Nanoparticles of transition metals are an important class of semiconductors, which have applications in magnetic storage media, solar energy transformation electronics, gas sensors, and catalysis [5–7]. The nanoparticles play up the most important role in different disciplines such as health care, screening and medicines, drug delivery system, antisense, tissue biotechnology, cosmetics, applications of gene engineering, and in many other fields [8, 9].

Currently biological species like algae are in great use for the nanoparticles synthesis. Both live and dead biomass of algae is used for the biogenic synthesis of nanoparticles that is why they are called as bionanofactories. Algae have good metal uptake capacity, and thus, the biological method with the use of algae is cost-effective and ecofriendly [10]. Algae contain large amount of the reducing agent which reduces metal salts to their respective metal nanoparticles without any hazardous by-products. Aqueous extract of algae contains secondary metabolites such as polysaccharide, proteins, tannins, and steroids as bioactive molecules [11–13].

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Comparative prevalence and pattern analysis of liver abscesses in alcoholic and non-alcoholic patients

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Abstract

The hepatic abnormalities are the major concern in the developing countries like India due to poor hygiene and lower socioeconomic status of the people. The consumption of alcohol adds on to worsen the case. As the treatment essentials are different in amoebic and pyogenic liver abscess, the identification and enhancing factor identification is necessary to carry out the treatment. The study was based on the serological, clinical, biochemical and radiological examinations of the patients. It was observed that the chances of multiple abscesses were higher (35%) in case of alcoholic patients in comparison to that of non-alcoholic patients (5%). The presence of *Entamoeba histolytica* was comparatively high in the alcoholic patients. Though, negative correlation with weight loss was observed in this study.

Top

Keywords

Liver abscesses, Amoebic liver abscesses, Pyogenic liver abscesses.

Top

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Determination of the Sequence of Strokes Made from the Same Color and Type of the Ink

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Abstract

Investigation of the sequence of strokes is an integral part in Forensic Questioned Document Examination. With the modernization, forgers are also using modern methods for forging the documents and hence making the examination process more tedious. The present study focuses on investigating the sequence of two intersected lines made from same type and color of the ink using Confocal microscope and Docucenter Nirvis. Oil-based and liquid based inks in the color black was used for making the sample. All the intersections made were homogenous in nature. The samples were first analysed under Docucenter Nirvis and then finally examined under Confocal microscope for more accuracy. It was found that the Confocal microscope covered all the area in which the Docucenter Nirvis lacked in the analysis and gave more confident result. The three dimensional feature of Confocal microscope aided the study and the authors was able to find the correct sequence of the lines placed on the writing surface.

Keywords

Homogenous Strokes, Three-Dimensional Analysis, Ball Point Pens, Gel Pens.

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Short Communication

Electrical Performance of $CuInSe_2$ Solar Panels Using Ant Colony Optimization Algorithm

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Electricity is an essential factor of economic development for all the countries. In recent years the share of renewable energy in electricity production is growing significantly all over the world. Among these solar energy plays a vital role in the production of power. In this work an Ant Colony Optimization (ACO) technique is proposed which successfully tracks the global peak and thereby improving the performance of PV array. The suggested work is realized in MATLAB/Simulink and simulation results of ACO.

Keywords: Electricity production, CIS Cells, Ant Colony Optimization, Photovoltaic module.

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1. INTRODUCTION

A Copper indium selenide ($CuInSe_2$) cells based thin film solar cells are used in electric power generation from abundantly available sunlight. Unlike conventional crystalline silicon cells based on a homojunction [1-5], the structure of CIS cells is a more complex heterojunction system [6-10]. $CuInSe_2$ (CIS) is one of three mainstream thin film PV technologies, the other two being cadmium telluride (CdTe) and amorphous silicon [11-13]. Like these materials, CIS various layers are thin enough to be flexible, allowing them to be deposited on flexible substrates. However, as all of these technologies normally use high-temperature deposition techniques, the best performance normally comes from cells deposited on glass, even though advances in low-temperature deposition of CIS cells have erased much of this performance difference.

This paper presents the simulation studies on the energy generated by a CIS photovoltaic (PV) module as a function of the amount of irradiation received and the angle of optimum orientation of the panels placed in Tebessa, Algeria. The calculations were made for the city of Tebessa, Algeria. It has a hot desert climate with long and extremely hot summers whereas winters are short, warm with little rainfall throughout the year [14, 15].

2. THEORY

The ant colony optimization (ACO) is a probabilistic algorithm used to determine the global optimal solution for all nonlinear problems. The ACO implemented in [16. 17] has formulated to operate continuously and easily adjust to changing in environmental conditions. The major benefit is, it needs only one combination of voltage and current sensors that increases the system reliability and at considerably lower cost and it increases the efficiency of the PV system, even though is not applied to the distributed MPPT controllers. It is a set of associated parameters with graph components which either nodes or edges whose values are modified at runtime by the ants.

An ant will move from node i to j with probability:

$$P_{ij} = \frac{T_{ij}^{\alpha}\eta_{ij}^{\beta}}{\sum T_{ij}^{\alpha}\eta_{ij}^{\beta}},$$

where T_{ij} is the amount of pheromone on edge i, j; α – a parameter to control the influence of T_{ij}; η_{ij} is the desirability of edge I, j (typically $1/d_{ij}$); β is a parameter to control the influence of η_{ij}.

Amount of pheromone is updated according to the equation:

$$T_{ij} = \rho \cdot T_{ij} \cdot (t-1) + \Delta T_{ij} / t = 1, 2, 3 \ldots T,$$

where ρ is pheromone concentration rate (0-1); T_{ij} is the amount of pheromone deposited.

Since the output from Solar panels is a DC voltage, DC/DC converter is used to provide the flexibility to amend the DC voltage or current at any point in the circuit. The buck converter is designed to step down a fluctuating solar panel voltage to a lower constant DC voltage. It uses voltage feedback to keep the output voltage constant. These are often preferred as they are smaller, light weight, and provide a high quality output, and more efficient than the traditional linear power regulators and more compatible with battery loads. The fundamental equation of buck converter is given:

$$D = (V_{out}/V_{in});\ I_{out} = (I_{in}/D);\ R_0 = (R_{in}/(1-D^2)).$$

where V_{out} is output voltage of the converter; R_0 the output resistance, V_{in} is input voltage of the converter; R_{in} is the input resistance; D is duty cycle of the switch.

2854. Effect of density and Poisson's ratio on thermal induced vibration of parallelogram plate

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Abstract. The present paper provides mathematical model for the study of natural (free) vibration of non homogeneous tapered parallelogram plate on clamped boundary condition. Here non homogeneity (in material) of the plate's means that the density and Poisson's ratio varies circularly and exponentially respectively. For tapered, we assumed that thickness of the plate varies linearly in one direction. Bi parabolic temperature (parabolic in ζ-direction and parabolic in ψ-direction) variation on the plate is being viewed. Rayleigh Ritz method is used to solve the model (governing differential equation of motion).

Keywords: parallelogram plate, density, thermal induced, vibration, circular variation.

1. Introduction

The study of vibration of tapered (non uniform) plates with non homogeneity in the material (non homogeneous plate) is the vast area of research due to its utility in various engineering applications like marine engineering, ocean engineering, optical instruments and mechanical engineering. Non homogeneous tapered plate plays significant role in engineering structures because of high tensile strength, durability and elastic behavior. All the engineering structure worked under great influence of temperature which causes non homogeneity. Therefore, with-out consideration of temperature the study of vibration means nothing. A significant work has been reported in these directions.

An excellent work on vibration of plates with various shapes has been described by Chakraverty [1]. Chen et al. [2] discussed the free vibration of cantilevered symmetrically laminated thick trapezoidal plates. Gupta and Mamta [3] studied non linear thickness variation of non homogeneous rectangle plate using spline technique. Free vibration has been discussed by Gupta and Sharma [4] on trapezoidal plate with thickness variation under temperature effect. Rotary inertial effect in isotropic plates (uniform and tapered thickness) has been carried out in two companion papers by Kalita et al. [5, 6]. The study of vibration of non uniform and non homogeneous rectangular plate with temperature effect has been studied by Khanna and Kaur [7-9] with exponential variation in non homogeneity. Leissa [10] provided vibration of plates (of different shapes) on different combination of boundary (clamped, simply supported and free) conditions in his excellent monograph. Leissa et. al. [11, 12] studied approximate analysis of the forced vibration response of plates and vibration of completely free triangular plates. Transverse vibration and instability of an eccentric rotating circular plate is studied by Ratko [13]. Sharma et al. [14-16] discussed natural vibration on orthotropic non homogeneous of rectangular plate, non homogeneous square plate (with circular variation in density) and non homogeneous trapezoidal plate with temperature effect.

The literature shows that the significant work has been done on vibration of non uniform (tapered) and non homogeneous plates with thermal gradient. Literature also emphasis on that, for non homogeneity either density or Poisson's ratio varies linearly, parabolic and exponentially. But none of the researcher focused on other variation. This aspect provides good motivation to us to study the effect of circular variation in density as a new interesting aspect to frequency modes.

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Investigation of local atomic structure of Ni doped SnO_2 thin films via X-ray absorption spectroscopy and their magnetic properties

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Abstract

Nanostructured Ni (10 at.%) doped SnO_2 thin films were grown on Si (100) substrate via pulsed laser deposition technique in ultrahigh vacuum (UHV) chamber and oxygen partial pressure (Po_2) environment. The influence of UHV and Po_2 growth conditions on the ferromagnetic (FM) ordering, electronic states and short-range structure around Ni ions embedded in the SnO_2 network has been investigated. Synchrotron X-ray diffraction results revealed the single-phase nature of SnO_2 rutile structure without any foreign peak, and the mean crystallite sizes <D> were found to be 12 and 25 nm for UHV and Po_2 deposited films respectively. The crystal growth in UHV chamber, introduced deliberately the oxygen vacancy (Vo) and reduced partially the valence state of Sn^{4+} (SnO_2) ions to Sn^{3+} (Sn_2O_3), whereas the Po_2 environment optimized the crystallinity and enhanced the oxygen stoichiometry (O:Sn = 2:1) by healing the oxygen vacancies. These details have been obtained by means of Raman spectra, near edge X-ray absorption fine structure at Ni $L_{3,2}$, O K edges and XANES spectra at Ni K edge. The films showed FM response and the saturation moments increase clearly from 4.4 emu/cm^3 (0.33 μ_B/Ni) for Po_2 deposited film to 5.9 emu/cm^3 (0.45 μ_B/Ni) for the film grown in UHV condition. Hence, the enhanced magnetization in UHV condition gives clear evidence on the importance of oxygen vacancies to activate the FM ordering. The role of Vo^{2+}, in the first-shell of oxygen coordination around Sn/Ni ions, to achieve the FM response has been discussed on the basis of bound magnetic polaron and charge transfer percolation mechanisms.

Keywords SnO_2 thin film · Defects · Synchrotron XRD · XANES spectra · Magnetism

1 Introduction

The nanostructured materials have drawn a great attention of the research community working in the area of nanoscience and nanotechnology due to their distinctive characterizations. Among the nanostructured metal oxide semiconductor, tin dioxide (SnO_2) has gained strong attention because of its unique and useful properties like high thermal and chemical stabilities, direct wide band gap (E_g = 3.6 eV), optical transparency and owing to its actual and potential applications in many technical devices like solar cell, transparent conducting electrodes, oxygen gas sensors, optoelectronic devices, photo-catalytic activity and host semiconductor based diluted magnetic semiconductors (DMSs) [1–3]. The DMS system is referred to substitution of transition metal (TM) ions for a few percent of cations of host semiconductor. This kind of materials has emerged as a great deal for generating interest in the scope of material science research due to their potential use in spintronic devices [3].

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Mixed transition and rare earth ion doped borate glass: structural, optical and thermoluminescence study

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Abstract

The present work report on physical, structural, optical and thermoluminescence properties of Dy^{3+} doped manganese potassium borate glasses. The conventional melt quenching technique is used to prepare the glass samples. The amorphous nature of the prepared glass sample is confirmed by X-ray diffraction study. The different B–O vibrational bands and change in the coordination number of boron ($BO_3 \rightarrow BO_4$) with the inclusion of Dy^{3+} ions in the prepared glasses were analyzed through FTIR. The physical parameters such as density, molar volume, average molecular weight, ion concentration, polaron radius, internuclear distance and optical parameters have been determined. The optical analysis reveals that the optical band gap energy decreases with the increase of dysprosium oxide concentration. The TL glow curve of gamma irradiated samples showed single prominent peak in the temperature range 425–460 K with varying concentration of Dy_2O_3. Analysis of kinetic parameters reveals that the glasses demonstrate second order kinetics.

1 Introduction

Borate is generally favored in glass making because of its high thermal stability, low melting point, different coordination numbers, good solubility of rare earth ions and excellent transparency [1–3]. But the hygroscopic nature of borate glasses has an adverse effect on their performance as they absorb moisture and become unstable [4]. The addition of alkali and transition metals as network modifiers improve their physical and spectroscopic properties upto a large extent. At lower concentration the addition of modifier in the glass matrix results in the conversion of BO_3 to BO_4 units without the formation of non bridging oxygen (NBO's). The number of BO_4 units reaches a maximum value with the increasing concentration of modifiers and subsequently BO_4 units start decreasing due to the formation of BO_3 units combined with NBO's [5].

Borate glasses are suitable materials for radiation dosimetry applications in view of the fact that their effective atomic number is very close to human soft tissue ($Z_{eff} = 7.42$). This make them appropriate materials for environmental, radiotherapy and medical dosimetry [6, 7]. The inclusion of rare earth impurities in the host materials may cause the changes in its thermoluminescence (TL) features as well as absorbed dose amount [8]. In case of rare-earth doped samples, TL sensitivity is dependent on the trivalent dopant, which may form complex defects in borates by creating hole or electron trap centres depending on the boron–oxygen arrangement in the glass structure [9]. Amongst the different rare earths, the Dy^{3+} ion is recognized as an active luminescence centre as it form some electron trapping levels in the intra band gaps of the host material [10, 11].

The current work aims to investigate the physical, structural and optical properties of the dysprosium doped borate glass through evaluation of different parameters such as density, molar volume, ion concentration, polaron radius, field strength, refractive index, reflection loss, molar refractivity

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Asymmetric cryptosystem using double random-decomposition in fractional Fourier transform domain

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Abstract

Motivated by recent research on asymmetric cryptosystems, a novel asymmetric scheme for image encryption that uses double random-decomposition technique in the fractional Fourier transform domain is proposed. The scheme endures the Special Attack as against conventional asymmetric cryptosystems based on phase-truncated Fourier transform (PTFT), and equal modulus decomposition. In the proposed scheme, an input image is bonded with a random phase mask and then it is subjected to a fractional Fourier transform. The resulting image is decomposed into two components using the random-decomposition technique. One of them will act as the first private key and the other component is subjected to the second fractional Fourier transform followed by another random-decomposition. Again, two new components are obtained, one will act as the second private key and the other is phase-truncated before subjecting it to LU decomposition followed by affine transform to get the encrypted image. The new scheme possesses enlarged key-space consisting of private keys obtained from random-decomposition, orders of fractional Fourier transform, affine transform parameters and permutation matrix of LU decomposition, thereby having a much greater capability to resist brute force attack. A sensitivity analysis has been carried out with respect to the encryption parameters. In addition to its resistance to the Special Attack, the scheme is immune to the basic attacks such as known-plaintext attack, chosen-plaintext attack, ciphertext-only attack, by virtue of its asymmetric nature. The above analysis along with statistical analysis through 3D plots and correlation distribution establish the strength of the proposed cryptosystem.

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Asymmetric encryption algorithm for colour images based on fractional Hartley transform

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ABSTRACT

This paper presents a new scheme for encryption of single-channel colour images. The scheme uses amplitude- and phase-truncation approach to introduce non-linearity for enhanced security. Further, the colour image encryption is performed in the fractional Hartley domain, which is relatively less investigated. The encryption starts with an affine transform of each channel of the input colour image. Thereafter, one of the channels is considered as the input amplitude image while the other two are used as phase masks, one in the spatial and the other in the frequency domain. A detailed analysis of the scheme's sensitivity to various encryption parameters has been carried out. In addition, security analysis of the scheme against attacks establishes the scheme's robustness. The combined use of the affine transform and phase-truncation approach for colour image encryption in the fractional Hartley domain is attempted for the first time in this study. It is shown that the proposed scheme resists the special attack.

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KEYWORDS
Colour image; affine transform; optical image encryption; fractional Hartley transform

1. Introduction

Security is a critical component in information exchange over public networks. Owing to parallel processing and multidimensional capabilities of optical technology, it has witnessed increased attention of researchers in the last two decades or so. After the pioneering work by Refregier and Javidi (*1*) in the field of optical image encryption based on double random phase encoding (DRPE), various optical encryption schemes have been described. The DRPE scheme has been further strengthened by extending it from the Fourier domain to other domains such as the Hartley (*2*), Fresnel (*3*), gyrator (*4*), and many others, and the fractionalized versions of some of them. DRPE-based encryption systems are linear symmetric cryptosystems, as the encryption and the decryption keys are same. They are vulnerable to many attacks such as known-plaintext attack (KPA), chosen-ciphertext attack (CCA), and chosen-plaintext attack (CPA). However, it has also been pointed out that the symmetric approaches suffer from the problems of key distribution and key management in addition to their vulnerability to attacks. In order to overcome these problems, Qin and Peng (*5*) proposed a phase-truncated Fourier transform-based asymmetric cryptosystem where encryption and decryption keys are different. They generated real-valued ciphertext which looks like a stationary white noise. Non-linear operation introduced through phase truncation was aimed at providing resistance to KPA, CCA, and CPA. A basic issue was raised by He et al. (*6*) regarding terming such schemes as truly asymmetric since the decryption keys depend on the encryption keys and the plaintext. Every attempt to encrypt a given plaintext using new encryption keys will generate different decryption keys. A clarification to this issue was provided by Liu et al. (*7*) stating that optical asymmetric cryptosystems need not have the same terminology, structure, and algorithms as that of general digital cryptography.

Most of the asymmetric encryption studies after the Qin and Peng study (*5*) followed the one-way trapdoor function based on the phase-truncation approach in the input and the frequency planes, which makes the system nonlinear. Many of them considered double-image (*8–12*) and multiple-image (*13–20*) encryption. Others have presented encryption schemes for colour images (*21–33*). Wang and Zhao (*34*) developed an iteration-based special attack for which the asymmetric cryptosystem based on the phase-truncated Fourier domain is vulnerable. Their special attack method is a two-step iterative algorithm which is based on amplitude retrieval approach. They and many others attempted

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Fabrication of 3D Self-Assembled Nonmulberry *Antheraea Mylitta* (tasar) Fibroin Nonwoven Mats for Wound Dressing Applications

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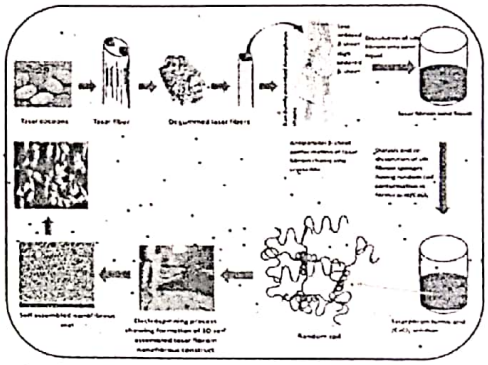
Abstract: This research was focused on the two-step regeneration of *Antheraea mylitta* (tasar) fibroin in the form of electrospun 3D self-assembled nanofibrous nonwoven mats using ionic liquid and formic acid/$CaCl_2$.The self-assembled structure of tasar nanofibrous nonwoven mats was dependent on the silk fibroin concentration and spinning voltage. The secondary conformation of tasar fibroin protein before and after electrospinning was analyzed by Fourier transformation infrared spectroscopy. The morphology of the nanofibrous mat was studied by scanning electron microscope. The self-assembled 3D tasar nonwoven nanofibrous construct was a highly porous and spongy structure with high water absorption and water vapor transmission. Highly porous 3D self-assembled tasar nonwoven nanofibrous construct favored good growth and proliferation of L929 skin fibroblast cells. Based on these properties, 3D self-assembled tasar nonwoven nanofibrous construct is a promising material for skin tissue engineering and wound dressing applications.



Keywords: tasar fibroin, self-assembled nanofibrous mat, electrospinning, skin tissue engineering.

1. Introduction

Wound healing is a very complex phenomenon involving several integrated biological and molecular events such as cell migration, proliferation, extracellular matrix (ECM) deposition and remodeling[1] that may get altered under certain pathophysiologic and metabolic conditions.[2] The ideal wound dressing should have following properties such as good exudates absorption ability, provide moist environment, biocompatible, biodegradable, porosity, non-adherent nature, water vapor and gas permeability, soft and comfort and adequate mechanical properties. There are different types of wound dressings available commercially, namely foam, hydrocolloids, alginate, hydrogel, iodine and silver impregnated dressings. The choice of particular wound dressing must be on the basic nature of wound. Nanofibrous mats have been successfully utilized in wound management. The highly porous architecture of nanofibrous mats allows the materials to absorb the large amount of exudates, promote higher adherence, growth, proliferation and migration of cells. This is achieved due to the high surface area, roughness, permeation of gases and water vapors as well as ease passage of metabolites & nutrients which is essential for the growth of neo-tissue and regeneration of damaged tissues. Due to high surface area, porosity and structural similarity of natural extracellular matrix, these cells seeded nanofibrous scaffolds may be good substitute of autografts, allografts and xenografts.[3,4]

Electrospinning is a straightforward and proficient technique to produce the polymeric nanofibers with size ranging from submicron to nano range. The nanofibrous mats produced by electrospinning have very high surface area and microporous architecture. This makes them an ideal matrix for cells growth and its proliferation.[5] Recently, electrospinning is used for producing self-assembled architectures for biomedical applications.[6,7] The concept of self-assembled nanofibers yarn by electrospinning was given by Okuzaki *et al.*[8] The presence of the low molecular weight salt in the spinning solution was considered as the main prerequisite for initiation of the self-organization process. The diameter of the yarns was also depended on the salt and polymer concentration. In general, the self-assembled nanofiber yarns are not stable and collapsed once the high electric field is removed. This generates a highly porous and spongy 3D nanofibrous matrix.[9]

Tasar fibroin protein has been explored as potential biomaterial due to its very good biocompatibility, controlled biodegradability and tuned mechanical properties.[10] The higher biocompatibility of nonmulberry tasar silk fibroin protein over mulberry silk fibroin protein is due to the presence of tripeptide sequences (Arg(R)-Gly(G)-Asp(D), which promotes proliferation of fibroblast and remodeling of epithelial tissues.[6] Nanofibrous 2D

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Charge calculation studies done on a single walled carbon nanotube using MOPAC

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Article
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Abstract

Dipole symmetry of induced charges on DWNTs are required for their application as a nanomotor. Earlier a molecular dynamics analysis was performed for a double-walled carbon-nanotube based motor driven by an externally applied sinusoidally varying electric field. One of the ways to get such a system is chemical or end functionalization, which promises to accomplish this specific and rare configuration of the induced charges on the surface of the carbon nanotube (CNT). CNTs are also a promising system for attaching biomolecules for bio-related applications. In an earlier work, ab initio calculations were done to study the electronic and structural properties of the groups –COOH, –OH, $–NH_2$ and $–CONH_2$ functionalized to an (8, 0) SWNT. The systems were shown to have a very stable interaction with the CNTs. The exterior surface of the SWNT is found to be reactive to NH_2 (amidogen). In this work, charge calculations are done on a CNT using MOPAC, which is a semi empirical quantum chemistry software package. As a first step, we calculate the effect of NH_2 functionalization to a (5,0) SWNT of infinite length. The symmetric charge distribution of the bare SWNT is observed to be disturbed on addition of a single NH_2 in the close proximity of the SWNT. A net positive and opposite charge is observed to be induced on the opposite sides of the nanotube circumference, which is, in turn, imperative for the nanomotor applications. The minimum and maximum value of the charge on any atom is observed to increase from − 0.3 to 0.6 and from − 0.3 to − 1.8 electronic charge as compared to the bare SWNT. This fluctuation of the surface charge to larger values than bare CNT, can be attributed to the coulomb repulsion between NH_2 and the rest of the charge on the surface which results into minimizing the total energy of the system. No such opposite polarity of charges are observed on adding NH_2 to each ring of the SWNT implying addition of a single amidogen to be the most appropriate configuration to produce a DWNT configuration suited to act like a nanomotor.

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Extraction of RBM frequency of a (10, 0) SWNT using MATLAB

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Cryptosystem based on devil's vortex Fresnel lens in the fractional Hartley domain

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Research Article
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Abstract

A new encryption scheme using phase masks based on devil's vortex Fresnel lens (*DVFL*) has been presented in this study. The encryption is performed using fractional Hartley transform (*FRHT*) in both spatial and frequency domains. Prior to subjecting the plaintext to operations of the conventional *4f* system, it is made to undergo Arnold transform (*AT*) for additional security. The scheme is validated for grayscale amplitude images. In its optical realization, the use of *DVFL* eliminates the problem of axis-alignment. The parameters of *DVFL*, and the orders of *FRHT* in addition to *AT* order serve as encryption keys. The scheme has been tested for its sensitivity to these parameters. Also, the scheme is evaluated for its robustness against the occlusion and noise attacks. The use of multiple encryption parameters adds to security of the scheme.

Keywords

Devil's vortex Fresnel lens Image encryption Fractional Hartley transform Arnold transform

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