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Measurement of Hubble constant: non-Gaussian errors in HST Key Project data

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Abstract. Assuming the Central Limit Theorem, experimental uncertainties in any data set are expected to follow the Gaussian distribution with zero mean. We propose an elegant method based on Kolmogorov-Smirnov statistic to test the above; and apply it on the measurement of Hubble constant which determines the expansion rate of the Universe. The measurements were made using Hubble Space Telescope. Our analysis shows that the uncertainties in the above measurement are non-Gaussian.

Keywords: cosmic flows, cosmological parameters from LSS, supernovas

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Structural And Spectroscopic Study Of Mechanically Synthesized SnO_2 Nanostructures

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Abstract. We report the single step synthesis of SnO_2 nanostructures using high energy mechanical attrition method. X-ray diffraction (XRD) pattern reveals the single phase rutile structure with appreciable broadening of diffraction peaks, which is a signature of nanostructure formation. The average crystallite size of SnO_2 nanostructures has been calculated to be ~15 nm. The micro-Raman study reveals the shifting of A_{1g} Raman mode towards lower wave number, which is correlated with the nanostructure formation.

Keywords: Mechanical attrition, Nanostructures, Raman spectra.
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INTRODUCTION

Transition-metal oxide materials [1-3] have aroused great attention in the scientific community owing to their unique physical and chemical properties and diverse potential applications in optical and electronic fields. Furthermore, nanostructure formation of bulk materials also provides a tool to tailor their properties as a result of quantum size effect and high surface to volume ratio. Of these, tin oxide (SnO_2) with the rutile structure is a promising functional n-type semiconductor material with a wide band gap (3.65 eV), which is used extensively in energy storage and conversion (solar cells and lithium ion batteries), catalysis, gas sensors, transparent conducting electrodes, and optoelectronic devices [4-5].

Generally, chemical techniques are not very useful for synthesizing samples in large quantity. Therefore, in the present work, we have used mechanical attrition method to synthesize SnO_2 nanostructures, which is based on top down approach. The synthesized samples were characterized by *x*-ray diffraction (XRD) and micro-Raman spectroscopy.

EXPERIMENTAL DETAILS

We have used mechanical attrition method to synthesize SnO_2 nanostructures. The commercially available bulk SnO_2 from Alfa Aesar was used as the starting material. Properly cleaned tungsten carbide vials and balls (10 mm) were used to avoid any contamination during mechanical milling. The balls to powder ratio was taken as 20:1. The milling of bulk SnO_2 was done in mechanical milling machine Fritsch Pulverisette-5 at 300 rpm for 24 hours. The resulting sample without any further treatment was used for characterization purpose.

X-ray diffraction was performed in θ-2θ geometry on X'Pert Pro Powder X-ray Diffractometer from PANalyitcal using a Cu K_α (1.54Å) source. The micro-Raman spectroscopy was performed on an InVia Raman microscope using 514 nm line of Ar laser with a maximum power of 50 mW.

RESULTS AND DISCUSSION

Figure 1 shows the XRD pattern of both commercially available and ball milled SnO_2. All the planes can be indexed with JCPDS card number, confirming the single phase rutile structure for milled SnO_2, which shows that milling does not introduce any impurity phase. An appreciable broadening in all the diffraction peaks has been observed in case of milled SnO_2 than its commercial counterpart, which is a signature of nanostructure formation. To confirm this, we calculated the average crystallite size of milled SnO_2 by using Debye Scherer's relation [6] given by

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Effect of Annealing on the Structure of Chemically Synthesized SnO_2 Nanoparticles

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Abstract. Tin oxide (SnO_2) nanoparticles have been synthesized by co-precipitation method. The synthesized nanoparticles were characterized by X-ray diffraction (XRD) and Raman spectroscopy. XRD analysis confirmed the single phase formation of SnO_2 nanoparticles. The Raman shifts showed the typical feature of the tetragonal phase of the as-synthesized SnO_2 nanoparticles. At low annealing temperature, a strong distortion of the crystalline structure and high degree of agglomeration was observed. It is concluded that the crystallinity of SnO_2 nanoparticles improves with the increase in annealing temperature.

Keywords: Tin oxide, Nanoparticles, Texture Coefficient, Annealing effect.

INTRODUCTION

In the recent past enormous efforts have been directed towards the development of nanometer sized oxide materials and their applications [1-2]. SnO_2 is a widely used and extensively investigated n-type wide bandgap semiconductor (~3.6 eV). It is well known that the practical performances of SnO_2 are relative to its crystallinity, morphology, crystallite size, crystal defects, and surface properties, etc. which ultimately depend on the preparation methods and preparation conditions [3-6]. Numerous studies have been available on tin oxide based gas sensors [7], dye-sensitized solar cells [8], electrode material for lithium cells [9] and photo-catalysts [10]. Apart from these applications, it has also been used in transparent conducting coatings [11], heat reflecting mirrors [12], energy storage devices [13] etc. The success in many of these applications relies on the ability in obtaining cost effective, high quality nano sized materials having uniform grain structures.

EXPERIMENTAL SECTION

SnO_2 powders were synthesized by co-precipitation method [14-15]. All chemicals were of analytical grade and used as received without further purification. In a typical procedure, $SnCl_2.2H_2O$ was dissolved in distilled water. The salt was then precipitated using ammonia solution and kept for stirring. The precipitates were filtered, thoroughly washed, and dried. Annealing treatments were performed at 250 °C and 500°C to obtain the final SnO_2 powders. The crystallographic studies of these nanoparticles was performed by using by X-ray diffractometer (PANalytical X'Pert pro) with CuKα (λ=1.54187 Å) radiations operated at the voltage of 45 kV and the current of 15 mA. The Raman spectra of SnO_2 nanoparticles were recorded at room temperature in a backscattering geometry by using Renishaw 1000 micro-Raman microscope. The spectra were taken by using 5-mW Ar-gas laser with exposure time of 20 sec and the spot size was fixed at 1.5 μm^2.

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Thermoluminescence Study of Gamma Irradiated Cr-Doped LiF Phosphors

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We have synthesized Cr-doped LiF phosphors by using modified co-precipitation. X-ray diffraction study confirms the single-phase cubic structure up to 0.05 mol.% of Cr in LiF; afterwards, a secondary phase of formation was observed. The field emission scanning electron microscope (FESEM) images revealed micro-cubic surface morphology of samples. The thermoluminescent (TL) behavior of the samples studied after irradiating them with gamma rays in the dose range 0.1–30 kGy. The TL glow curve of Cr-doped LiF comprises a prominent peak observed at 407 K and a broad band ranging from 448 K to 512 K at a fixed gamma dose of 10 kGy. The shape of the TL glow curve remained similar at all concentrations of Cr in LiF; however, TL intensity was found to vary with Cr concentration, and Cr (0.02 mol.%)-doped LiF sample exhibit highest TL response. The glow curve of the optimized sample as a function of gamma irradiation dose within the range 0.1–30 kGy shows an almost linear increase in TL intensity of the main glow peak up to 10 kGy, and afterwards it decreases. Further, at the high dose of 30 kGy, the intensity of the prominent TL glow peak at 407 K decreases and another broad peak starts growing at 468 K signifying the formation of new trapping sites. The kinetic parameters, namely activation energy, order of kinetics, and frequency factor of the optimized sample were evaluated by using Chen's peak shape method and glow curve deconvolution (GCD) functions based on Kitti's equations.

Key words: Surface morphology, thermoluminescence, irradiation, deconvolution

INTRODUCTION

Thermoluminescence (TL) is a reliable technique used to estimate the absorbed dose in a material. TL materials absorb energy during their exposure to certain types of ionizing radiation, such as x-rays, γ-rays, and electron beams,[1,2] and re-emit the same energy in the form of light upon heating such materials. The phenomenon involves the radiative recombination of thermally released charges (electrons or holes) trapped in the materials during exposure to ionizing radiation.[3] The plot of TL intensity versus temperature is called the thermoluminescence glow curve. A typical glow curve comprises one or more glow peaks, which contains valuable information regarding the nature of trapping states. Randall and Wilkins,[4] Garlick and Gibson,[5] May and Partridge[6] have given detailed analytical descriptions of such glow curves in three different situations, usually referred to as first-, second-, and general-order TL kinetics, respectively. The position, shape, and intensity of a glow peak relates to the properties of traps responsible for the

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Gamma induced thermoluminescence and color centers study of Dy doped LiF micro-cubes

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ABSTRACT

In this paper, we present the thermoluminescence and optical absorption studies of Dy-doped LiF phosphors. The phosphors were synthesized via co-precipitation method, in which the reactions were carried out at fixed pH value 8.00. X-ray diffraction (XRD) patterns revealed single phase structure of phosphors up to concentration (0.04 mol%) of Dy in the host lattice of LiF. The field emission scanning electron microscope (FE-SEM) images showed micro-cubical morphologies. The incorporation of Dy in LiF was confirmed from the results of electron dispersive spectroscopy (EDS) and XRD. The thermoluminescence (TL) glow curves of γ-irradiated samples in the dose range (0.1–50 kGy) revealed a main dosimetric glow peak positioned at 417 K. Moreover, at irradiation dose of 10 kGy and above, a broad TL band towards higher temperature side of main dosimetric peak also appeared. Using TLanal program, the complex TL glow curves were deconvoluted and TL kinetics parameters namely; the activation energies, frequency factors and order of kinetics were evaluated. The results revealed the formation of additional localized trapping sites of different values of activation energy and frequency factor in the forbidden band. The optical absorption study revealed the formation of radiation induced stable color centers (CCs) at room temperature. The concentrations of CCs were evaluated using Smakula's formula.

1. Introduction

The phosphors materials based on oxides, sulfides, nitrides, fluorides, etc. are used extensively in diverse applications such as solid state lighting, light emitting diodes, optical memory devices, scintillators, plasma displays, CRT monitors, radiation dosimetry, medical imaging [1–8]. Radiation dosimetry is an important area in health physics, which deals with the evaluation of radiation doses absorbed. Thermoluminescence (TL) technique is widely used in radiation dosimetry [9]. The dosimetric characteristics of TL material are closely related to TL kinetic parameters and quantitatively describe the trapping-recombination centers responsible for TL signal. Therefore, evaluation of TL parameters namely; activation energy, order of kinetics and frequency factor is an active area of present research [8–10]. Based on the shape of experimental TL glow curve; various techniques have been proposed for analyzing it [11–15]. The glow curve in which the each glow peak (GP) is well isolated from others, the experimental methods such as initial rise method (IR), variable heating rate (VHR) and peak shape method, etc. are used in determining the TL kinetic parameters [16–18]. However, in a situation where, the experimental TL glow curve is actually composed of several overlapping peaks and is difficult to identify such peaks individually. In such cases, two different approaches are followed in the evaluation of TL parameters. In first approach, using partial thermal annealing treatment, all individual glow peaks are extracted from the complex glow curve and then analyzed individually. In second approach, the experimental glow curve is deconvoluted into number of well isolated glow peaks and thereafter, desired TL kinetics of each extracted peak can easily be determined [19,20]. In glow curve deconvolution (GCD) method, it is vital to decide the exact number and kinetic order of overlapping glow peaks contained in complex glow curve. After many trials with different number of peaks, the complex glow curve is finally deconvoluted into minimum number of peaks. The goodness of fitting is decided by value of the figure of merit (FOM). In the best fitting, its value falls well within acceptable limits [21].

Among wide band gap materials, LiF has been extensively investigated by many researchers for its use in thermoluminescence

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ARTICLE

Radiation Induced Color Centers in Cr-Doped LiF Phosphor

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ABSTRACT

The formation of several stable color centers (CCs) at room temperature have been found and investigated in Cr-doped LiF powder phosphors, irradiated in the selective gamma rays doses in the range (0.1–50 kGy). The field emission electron scanning microscope (FE-SEM) results confirms cubical surface morphology; get ruptured either on doping or at high dose irradiation or both. The incorporation of Cr in LiF lattice confirms from the electron dispersive spectroscopy (EDS) spectrum. In non-irradiated Cr-doped LiF lattice, several complex aggregate defects formed at room temperature. However, in gamma irradiated phosphors, F-color centers or F-absorption band at 250 nm and F_2 and F_3^+ color centers at 445 nm i.e., M absorption band are prominent. Among all samples, LiF: Cr (0.02 mol.%) shows maximum concentration of these CCs. On excitation with 325 nm laser sources, the photoluminescence (PL) emission spectrum of optimized phosphor shows broad emission at around 594 nm.

KEYWORDS: Color Centers (CCs), Irradiation-Photoluminescence.

1. INTRODUCTION

Wide band gap insulators featuring color centers, are considered in growing number of optical applications,[1] such as tunable solid state lasers,[2] and they have been investigated extensible since the 1950s.[3–10] Many different defects can be hosted by these materials, which are introduced by exposure of the crystal to high energy photons, charged particles, or neutrons. The LiF is a prototypical wide band gap insulator with the largest known band gap of 13.6 eV.[11] Dawson and Pooley,[12] Schwartz et al.[13] and Baldechini et al.[14] observed the maximum of its experimental absorption peak at 5.08 eV at 5 K, 4.98 eV at room temperature and 5.07 eV at room temperature by optical absorption spectroscopy, respectively. Moreover, Lithium fluoride (LiF), a member of alkali halides, possesses unique physical and optical properties. It is almost non-hygroscopic, relatively harder. It has effective atomic number $Z_{eff} = 8.04$ and is close that of biological tissues, $Z_{eff} = 7.4$ so its response slightly varies with photon energy. Thus, it is also known as tissues equivalent material. Several first principles theoretical investigations for color centers in LiF have been published in the past few decades. The color centers are lattice defects in crystals in which anionic vacancies are occupied by electrons. These calculations are either based on the density functional theory (DFT)[15,16] treating the extended system using periodic boundary conditions or on quantum chemical methods[16–19] explicitly treating a cluster.

A crucial problem concerning heavily irradiated LiF crystal is in the coexistence of several kinds of aggregate defects with often overlapping absorption bands, which make it difficult to evaluate the single contributions due to individual color centers. Other spectroscopic features, ascribed to several kinds of larger aggregate defects e.g., the absorption features located at around 315 nm and 380 nm are attributed to R_1 and R_2 transition of the F_3 defects. A F_3 defect consists of three adjacent F centers. The M-band spectral range, where the F_2 and F_3^+ absorption bands overlap, is further complicated by the presence of another broad absorption, which appears as a shoulder of the M band on the shorter side.[20,21] In the literature survey, we find that most of such experimental studies were either carried out on single crystal of LiF or on commercially available bulk LiF material. To the best of our knowledge, there is no study appeared in literature regarding color centers in Cr doped LiF in powder form

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Nanostructured Boron Nitride With High Water Dispersibility For Boron Neutron Capture Therapy

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Bikramjeet Singh[1], Gurpreet Kaur[1], Paviter Singh[1], Kulwinder Singh[1], Baban Kumar[2], Ankush Vij[3], Manjeet Kumar[4], Rajni Bala[5], Ramovatar Meena[6], Ajay Singh[7], Anup Thakur[8] & Akshay Kumar[1]

Highly water dispersible boron based compounds are innovative and advanced materials which can be used in Boron Neutron Capture Therapy for cancer treatment (BNCT). Present study deals with the synthesis of highly water dispersible nanostructured Boron Nitride (BN). Unique and relatively low temperature synthesis route is the soul of present study. The morphological examinations (Scanning/transmission electron microscopy) of synthesized nanostructures showed that they are in transient phase from two dimensional hexagonal sheets to nanotubes. It is also supported by dual energy band gap of these materials calculated from UV- visible spectrum of the material. The theoretically calculated band gap also supports the same (calculated by virtual nano lab Software). X-ray diffraction (XRD) analysis shows that the synthesized material has deformed structure which is further supported by Raman spectroscopy. The structural aspect of high water disperse ability of BN is also studied. The ultra-high disperse ability which is a result of structural deformation make these nanostructures very useful in BNCT. Cytotoxicity studies on various cell lines (Hela(cervical cancer), human embryonic kidney (HEK-293) and human breast adenocarcinoma (MCF-7)) show that the synthesized nanostructures can be used for BNCT.

Boron nitride (BN) exists in cubic, rhombohedral and hexagonal forms similar to carbon materials. Cubic is analogous to diamond with similar hardness. Rhombohedral exists rarely as in case of carbon[1] and hexagonal boron Nitride is equivalent to graphite[2]. Hexagonal boron nitride is one of the old powder metallurgical product shows outstanding electrical and thermal properties[3]. This material also wraps itself to form nanotubes. These nanotubes have improved properties as compared to carbon nanotubes in respect of their band gap. Band gap of BN nanotubes is independent of tube diameter[4]. Hexagonal BN exhibit a good resistance to corrosion, low density, higher melting point and excellent chemical stability[5] which renders this material as a prominent candidate for Boron Neutron Capture Therapy (BNCT)[6] in cancer treatment. Various *in vitro* and *in vivo* studies confirmed that Boron Nitride materials have shown better biocompatibility and lower cytotoxicity than their carbon counterparts[7–11]. One of the main challenges in respect to integration of nanostructures of BN into various biological systems was their poor suspension/hydroxylation in various biological solutions[12–14]. Various methods were tried to improve suspension ability/hydroxylation of these materials like surface functionalization[15,16] and wrapping by other molecules or interactions[17–23]. But these methods were unable to give desired results. One of the other major reasons for lacking of research on this material was synthesis conditions which include relatively very high temperature (1400 °C). Research on nanotubes of boron nitride and carbon started on the same year[24], but these tough synthesis conditions leave the research behind as compared to carbon[25]. Two different atom in the BN structure with electro negativity difference of about one unit make this material partial polar in nature more useful as compare to carbon based materials[26,27]. This structural variation can be exploited for many remarkable applications. Till

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Green Synthesis of Silver Nanoparticles Using Leaf Extract of *Helianthus annuus* & *Mentha longifolia* and Screening of their Antimicrobial Activity Against *Escherichia coli*

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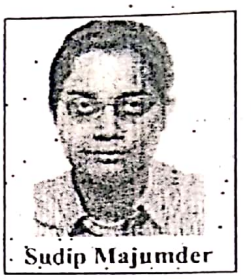
Sudip Majumder

Abstract: Eco-friendly synthesis of nanoparticles (NP) using plant extract has become very popular among nanoscience researchers. Here, we report synthesis of silver nanoparticles (AgNPs) using leaf extracts of *Helianthus annuus* and *Mentha longifolia*. These NPs were characterized by UV-Vis, TEM, XRD, Fluorescence and FTIR spectroscopy and were found to have roughly spherical morphology with average particle size of 10-25 nm in diameter. Thermal stability of the nanomaterial was estimated using TGA/DSC analysis. Antimicrobial activity of these AgNPs was also screened against *Escherichia coli* and the antibacterial effect was also monitored using SEM. The AgNPs were found to be better antimicrobial agent compared to standard antibiotics like ampicillin or kanamycin.

Keywords: Antimicrobial activity, biosynthesis, *Helianthus annuus*, *Mentha longifolia*, silver nanoparticle.

INTRODUCTION

The rapid growth of nanotechnology has driven interests for researchers at an exponential rate. Especially the metallic nanoparticles (NPs) have drawn arguably the most attention due to their ease of synthesis, unique physiochemical properties and wide application range. Metallic NPs are unique because of their extremely high surface area, high refractive index and considerable thermal stability [1]. They exhibit semiconductor, magnetic, electrical and optical properties which has enormous potential industrial application [2-6]. Moreover, many of these particles show antimicrobial property which needs to be studied rigorously from the perspective of future alternate medicine. Among all these metallic NPs silver NPs (AgNPs) probably have the widest application in the medicinal field. It has been already well established that AgNPs show significant antimicrobial properties against many microbes and bacterial strains present in medical and industrial wastes [7]. The application of AgNPs, as wound healing agents, in antiseptic cream and against burn injuries has already become very popular [8].

However, recently the green synthesis of AgNPs using plant extracts has become immensely popular among researchers wide across the world. These methods are eco-friendly, rapid, cost effective & lead to no toxic bi-products. Therefore this approach of 'green nanotechnology' is slowly emerging as an effective alternative of traditional chemical synthesis of AgNPs (that requires use of stabilizers, capping agents and generates toxic bi-products). The mechanism of NP formation by plant extracts is still not totally understood, though it seems that the biological molecules present in those extracts act as a mild reducing agents and carry out M^+/M conversion. It

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MOLECULAR DOCKING AND ADMET STUDIES OF 3-PHENYL COUMARIN DERIVATIVES FOR THEIR ANTI-CANCER ACTIVITY

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ABSTRACT

Cancer is one of the most prevalent diseases worldwide. Research community is untirely working on prevention and control of this disease by targeting various enzymes and proteins via synthetic and natural products. In the present study novel 3-phenyl coumarin derivatives were designed. All the compounds of this series were subjected to molecular docking studies for inhibition of 5 different proteins. The molecular docking study results revealed that, all the designed ligands showed binding energy (ranging from -13.4 to -44.0) and docking score (ranging from -3.27 to -9.56). ADME-Toxicity prediction reported that all novel coumarin derivatives were in the acceptable range of various pharmacological parameters. Total seven novel ligands were studied on 10 pdb ID's of five different proteins. Out of seven ligands five ligands i.e. 3, 4, 5, 6 and 7 have shown excellent docking score ranging from -9.56 to -8.21 on two proteins i.e. Amine Oxidase and Protein kinase. All these five ligands showed good affinity than reference compound capecitabin and R-(-) –deprenyl. These in silico results can thus serve as a template for further *invitro* and *invivo* studies to have novel drug for cancer with minimum toxicity.

KEYWORD: Molecular Docking, ADME-Toxicity, Amine oxidase, Protein Kinase, Cancer, 3-phenyl coumarin derivatives.

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A Modeling on Frequency of Rectangular Plate

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ABSTRACT

A Modeling emphasises on natural frequency on non-uniform and non-homogeneous rectangular plate. For non-uniformity of material, thickness of plate is considered linear and for non-homogeneity in the plate, Poisson ratio vary circular which is not discussed earlier. To make the problem realistic, temperature variation is taken to be bi-parabolic in nature. Rayleigh Ritz technique is used for solving governing differential equation and to obtain both modes of natural frequencies. MAPLE software is used for all the calculations in the present study. A comparison of results with existing result is also done with the help of tables, which shows the importance, existence and usability in the further research.

Keywords: Circular Variation, Rectangular Plate, Vibration

1. INTRODUCTION

All the engineering structures (mechanical and electrical) have vibrational phenomenon while performing. It is desirable as well as undesirable (in machine tools). These days, studies based on vibrations have become a great interest among researchers and scientists. Tapered plates with temperature plays an essential role in moderen engineering structures like automobiles industries, nuclear reactor, misiles and power plants.

The main object of scientists and researchers are to optimize vibration and get desired frequency. For this, physical properties of material can not be disdain. Various studies based on effect of temperature (one dimensional) as well as non-homogeneity (linear or parabolic) have been done. However very less work is done on two dimensional temperatures and no work has been reported on circular or other variation as non-homogeneity effect.

Transverse vibration analysis of rectangular plate having edges elastically against rotation and having two direction variations in thickness is discussed by Laura et. al [1]. Vibrational analysis of rectangle plate having thickness variation (linear and parabolic) along both the axes is studied by Gupta and Khanna [2-3]. An effect of bi-directional exponential variation in thickness on vibrational modes using rectangle plate have described by Gupta et. al [4]. Lal and Dhanpati [5] have depicted the effect of non-homogeneity on vibration of orthotropic rectangular plates having varying thickness variation resting on pasternak foundation. Effect of temperature, variation in Poisson ratio as non-homogeneity and simultaneous variation in density as well as in Poisson ratio to vibrational behevior of rectangular plate have described by Khanna and Kaur [6-8]. The transverse vibrations on simply supported plate with an oblique cut and generalized anisotropy have studied by Avalos and Laura [9]. Gupta and Singhal [10] studied parabolic thickness and temperature effect on vibrational frequencies of non-homogeneous rectangle plate. Effect of variation in Poisson ratio

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Effect of Vibration on Orthotropic Visco-Elastic Rectangular Plate with Two Dimensional Temperature and Thickness Variation

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Abstract

As a result of the technological developments in civil, mechanical and aeronautical engineering, visco-elastic plate structures gained popularity in the 20th century. The mainstream of visco- elastic materials are receptive to heat in space technology, highly speed space flights, internal combustion engines, satellites, certain parts of mechanical structures have to man oeuvre under elevated temperatures consequently the state of affairs are thermal sensitive. It is observed that thermal effects are recurrently overlooked in most of the cases so far they have to be taken in to concern. In this paper effect of bi-parabolically variation in temperature is premeditated on vibration of an orthotropic rectangular plate:

$$\tau = \tau_0\left(1-\frac{x^2}{a^2}\right)\left(1-\frac{y^2}{b^2}\right)$$

and whose thickness also varies bi-parabolically as:

$$h = h_0\left(1+\beta_1\frac{x^2}{a^2}\right)\left(1+\beta_2\frac{y^2}{b^2}\right)$$

Frequency equation is derived by using Rayleigh–Ritz technique with a two-term deflection function. Time period, Deflection and Logarithmic decrement at different points for the first two modes of vibration are calculated for various values of thermal gradients, aspect ratio and taper constants. **Mathematics Subject Classification:** 2014 AMS Classification No. : 70j30

Keywords: Aspect Ratio, Frequency, Thickness, Taper Parameter, Vibration, Visco-Elastic

List of symbols

a – Length of rectangular plate	$\tilde{D}$ – Visco-elastic operator
b – Width of rectangular plate	η – Visco-elastic constants
x, y – Co-ordinates in plane of the plate	t – Time
h – Thickness of the plate at point (x, y)	w(x, y, t) – Deflection of the plate
α - Thermal constant	W(x, y) – Deflection function
E – Young's modulus	T(t) – Time function
G – Shear modulus	β_1, β_2 – Taper constants in x- and y-directions, respectively
ν – Poisson's ratio	Λ – Logarithmic decrement
D_1 – Flexural rigidity	K – Time period
ρ – Mass density per unit volume of plate material	

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Mathematical Modeling of Vibration on Parallelogram Plate with Non Homogeneity Effect

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Abstract: - A mathematical model established for the study of vibrational effect with 2D linearly varying temperature on non-homogeneous parallelogram plate whose thickness varies linearly in both the direction. Non homogeneity arises due to variation in density which is linear in one dimension. Two term deflection function with skew boundary condition for clamped plate is to be considered. We applied Rayleigh-Ritz technique for finding the solution of the problem. The effects of structural parameter such as aspect ratio, non-homogeneity constant, skew angle and taper constant have also been studied. Results are calculated with great accuracy and compare the present model with the other in literature with the help of tables.

Keywords: - Thermal gradient, non-homogeneity, parallelogram plate, vibration.

1. INTRODUCTION

Vibration is oscillating motion of machine. For making reliable structure's design it is required to study characteristic behavior of plate vibration with variable thickness. These plates are of many types such as square, rectangle, elliptical and trapezoidal etc. The first few modes of vibrations are very helpful for finalizing a design. To study such vibration mode a model is presented using parallelogram plate under temperature and non-homogeneity effect. A wide variety of application used parallelogram plate such as wings of aircraft, missiles, floor in bridges, ship hulls and buildings etc. In literature there are many researchers who studied the vibration behavior of homogeneous or non-homogeneous plates with variable thickness, with or without consideration of temperature effects.

Gutierrez and Laura [1] gave the study, how frequency of vibration acts on rectangular plate with anisotropy having discontinuous variable thickness. Hasheminead et.al [2] studied vibration and gave exact solution by taking eccentric elliptical plate. Tomar and Gupta [3-4] studied temperature effect on frequency by takingan orthotropic plate of variable thickness. Singh and Sexena [5] has discussed vibrational behavior of skew plates whose thickness varies. Kumud and Gupta [6] studied the vibration with temperature effect on non-homogeneous skew plate with linear thickness. They also studied [7] the non-homogeneous parallelogram plate having parabolic thickness with temperature effect. Gupta et. al [8] studied the discussed the vibrational behavior of non-homogenous parallelogram plate with one dimensional linear temperature variation and linear thickness in both the directions. The thermal gradient effect on visco-elastic plate with varying thickness is studied by Bhatnagar and Gupta [9-10]. Bozdogan and Ozturk [11] also studied free vibration analysis of a thin-walled beam with shear sensitive material.

It is well known from the study of plates that temperature field produce non-homogeneity in elastic bodies and the property of material are not remain constant but vary in random manner with the position. In the present model authors studied the two dimensional linear thermal effect of parallelogram plate with ends to be considered as clamped. The thickness of the plate is considered to be two dimensional linear. Rayleigh Ritz technique is used for obtaining frequency equation to evaluate frequency modes for various components of the model such as temperature field, aspect ratio, non-homogeneity, taper constants and skew angle.

2. ANALYSIS OF MODEL

2.1. Description of the Model

A thin, isotropic and non-uniform parallelogram plate having skew angle θ is to be assumed as shown in Figure-1.

Mathematical Study of Vibration on Non-Homogeneous Parallelogram Plate with Thermal Gradient

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ABSTRACT

A mathematical study is established for analysing vibrational frequencies of non-homogeneous parallelogram plate with varying thicknesses in both the direction under linear temperature consideration. Non homogeneity arises because of one dimensional linear variation in density. Two term deflection function which satisfying skew boundary condition is to be considered for clamped plate. Rayleigh-Ritz technique is applied for finding the solution of the problem. The other aspects such as tapering constants, skew angle, aspect ratio, non-homogeneity constant and thermal gradient have also been studied which play an important role to make the present problem to be realistic. Results are calculated for Duralium Material with high level computational software MAPLE and presented with the help of graphs. A study of non-homogeneous rectangular plates which is available in literature becomes a special case of the present study. A comparison is also made with the available literatures to the present study for the support of our findings.

Keywords - Thermal gradient, parabolic variation, vibration.

LIST OF SYMBOLS USED

a – Length of parallelogram plate
b – Width of parallelogram plate
ζ, ψ – Coordinate in plane of plate
t – Thickness of the plate at point (ζ, ψ)
α – Thermal gradient
Y– Young's modulus N/m^2
ν – Poisson's ratio
D – Flexural rigidity
ρ – Density of mass per unit volume of the plate material kg/m^3
$\Phi(\zeta, \psi)$ – Deflection function
β_1, β_2 – Taper constants in ζ and ψ directions
θ – Skew angle
α_1 – Non-homogeneity constant
a/b – Aspect ratio of the plate
λ – Frequency parameter
τ – Temperature of plate

1. INTRODUCTION

In modern world, all engineering structures are working under temperature environment such as rockets, submarines and missiles etc. Because of temperature field, it is obvious that plates undergo some vibrations. Also most of the structural designs need variable thicknesses to fulfil the requirement of modern world. Therefore, for making trustworthy structural design and to optimize vibration, it is necessary to study plate characteristic during vibration under temperature fields and thickness variation. The geometry of the plates can be square, rectangle, elliptical and trapezoidal etc. For finalizing the final structural design, the first few modes of vibrations play an important role. Therefore for studying such vibrational mode a problem is presented using parallelogram plate under non-homogeneity and temperature effect. As non-homogeneity in plates are useful because of their high temperature resistance characteristics, strength, low cost and high durability.

Parallelogram plates are used in a wide variety of application such as aircraft's wings, missiles, bridge floor, ship hulls and buildings etc. There are many researchers available in literature who studied the vibrational behaviour of plate with homogeneity or non-homogeneity, variable thickness and with or without consideration of temperature effects.

Analysis of free vibration of non-homogenous trapezoidal plate with 2D varying thickness and thermal effect

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Abstract.
The present of goal investigation is to study the effect of 2D linearly varying temperature on the vibrations of non-homogeneous trapezoidal plate whose thickness also varies linearly in both directions and density varies linearly in one direction. Boundary condition which is C-S-C-S with two term deflection is taken into consideration. Rayleigh-Ritz method is used to find the solution of the problem. The effect of other plate parameters such as non-homogeneity constant, taper constant and aspect ratios have also been studied. Results are calculated with accuracy and presented in tabular graphical form.

Keywords: thermal gradient, non-homogeneity, vibration, trapezoidal plate, thickness.

1. Introduction

Plate theory has been applied to reduce vibration and noise in structures since the end of the 19th century where it began with the work of German physicist Chladni, who discovered various modes of free vibrations experimentally.

Since then, it has developed into an escalating and expansive field with a wide variety of theoretical and empirical techniques, dealing with increasingly complicated problems. In marine and aerospace engineering fields, where lightweight structural elements with orthotropic materials are of primary importance, orthotropic trapezoidal plate has extensive application. They are essentially thin plate structures which provide enhanced stiffness and stability characteristics. Hey also have widespread application in many other branches of modern civil, mechanical and structural engineering and, in these applications, they are regularly subjected to static and time varying loads. Hence, analysis of orthotropic trapezoidal plate under different conditions has always been an area of immense interest to researchers. Research work on the dynamic characteristics of orthotropic trapezoidal plate has a long history as different researchers have employed different methodologies to perform dynamic analysis of such structures.

Plates of variable thickness are used in nuclear reactor structures, naval structures, and aeronautical fields, electro mechanical transducers for the electronic telephones

Vibrational Study of Square Plate with Thermal Effect and Circular Variation in Density

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Abstract: - The paper deals with the study of vibration on the non-homogeneous square plate under temperature environment. It is considered that plate has bi-parabolic temperature variation along the axes. The plate's thickness is to be considered as exponentially along x-axis. All the available literature has been dealt with the assumption that the density varies either linearly or parabolically, but none of them considered other situation. In this paper, the author considered that plate's density varies circular along x-axis. In this study, Rayleigh Ritz technique is applied to obtain the vibrational frequency under different combination of parameters which are involved either in the geometry or property of the material. High-level computational software MAPLE does all the calculations. The results are represented with the help of tables, and a graphical comparison is also made for current study with the existing result in the literature for the support of our study.

Keywords: - Circular variation, Vibration, Non-homogeneity, Taper constant, Square plate.

1. INTRODUCTION

Measurement of a periodicity of oscillations on an equilibrium point is known as vibration. The most of the engineering applications or structures have vibrational phenomena as it plays the crucial role in its working. Researcher and scientist are keen in the vibrational phenomena because of the progress of technology, especially space technology or materials. For better performance of the mechanical structure, the optimization of vibration is necessary. Now days, plates with different geometrical or material play a significant role in making the complex structural design. There is a compelling interest to the scientist to study effects of high temperatures on non-homogeneous square plates with variable thickness. The prominent reasons for it is because of engineering applications such as power plant, aerospace industry and machines are working under high temperatures. Videlicet the effect of temperature cannot be disdain. A lot of accessible leaflets contain only one-dimensional variation in temperature, but remote work is endowed on two-dimensional temperature variations by literature

Leissa [1] gave numerical data about vibration of plate in his monograph. Huang and Leissa [2] analyzed the vibration of rectangular plate using Ritz method with crack sides. Xing and Liu [3] gave new exact solution of vibration on orthotropic rectangular plate which is thin in structure. Gupta and Khanna [4] studied the vibrational effect on rectangular plate. They assumed that plate have linearly varying thickness in both the directions. Khanna and Sharma [5] also studied the vibrational analysis of non-homogeneous tapered square plate with bi-parabolic temperature variations. Khanna and Sharma [6] discussed frequency vibration on square plate under temperature effect which is taken in both the directions. Sharma et. al. [7] discussed mathematical study of vibration of non-homogeneous parallelogram plate with thermal effect. Wu and Lu [8] worked on rectangular plate with internal column

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TWO UNIT COLD STANDBY SYSTEMS WITH AUXILIARY UNIT AND DAMAGED SWITCHING DEVICE

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Abstract

This paper deals with a two unit standby system consisting of a main unit, an auxiliary unit and a damaged switch. The standby is substitute of a main unit only, failure time distributions are taken as negatively exponential, while repair time distributions are general.

Keywords: *reliability, repair time, regenerative point technique etc.*

Subject Classification: *(2010) 26A33, 34A37, 35F25*

Notation & States of The System

$E0$: State of system at $t = 0$

E: Set of regenerative states

E: Set of non- regenerative states.

h_1: constant failure rate of main unit

h_2: constant failure rate of auxiliary unit

$g_1(t)$ $G_1(t)$: p.d.f & c.d.f of repair time of main unit

$g_2(t)$ $G_2(t)$: p.d.f & c.d.f of repair time of auxiliary unit

p: probability that switch is perfect

q: probability that switch is Imperfect

p_{ij}: Transition probability from regenerative state S_i to S_j

$P_{ij}^{(k)}$: Probability that the system transit from regenerative state s_i to s_j passing through non-regenerative state S_k

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Pointwise convergence of prolate spheriodal wavelet expansion in $L^2(R)$ space

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Abstract: **In this paper we shall study the point wise convergence of prolate spheroidal wavelet expansions in L2 (R). Here the sinc function is replaced by one based on prolate spheroidal wave functions (PSWF's) which have much better time localization than the sinc function. The new wavelets preserve the high energy concentration in both the time and frequency domain inherited from PSWF's**

Keywords and Phrases: **Orthonormal basis, Prolate spheroidal wavelets , L2(R) spaces and multidimensional resolution.**

I. INTRODUCTION

Wavelet expansions have been the focus of many research papers. One of the reasons for their popularity in that they provide a more efficient representation of functions than other orthogonal expansions. Y. Meyer studied the convergence of orthogonal wavelet expansions. He showed that if the mother wavelet is r−regular, the orthogonal wavelet expansion of a function will converge to it in the sense of $L^p(R)$, $1 \le p < \infty$, and in the sense of some Sobolov spaces.

A function $g(x)$, $x \in R^d$, $d \ge 1$, is said to be r−regular (in the sense of Meyer) if

$$|D^{\alpha} g(x)| \le \frac{K_{\alpha,m}}{(1+|x|)^m}$$

for all α with $|\alpha| \le r$ and $m = 0, 1, 2, \ldots$, where $K_{\alpha,m}$ are constants. Here $\alpha = (\alpha_1, \ldots, \alpha_d)$ is a multi-index with $\alpha_i (i = 1, \ldots, d)$ being a non-negative integer and $|\alpha| = \sum_{i=1}^{d} \alpha_i$, and

$$D^{\alpha} = \frac{\partial^{|\alpha|}}{\partial x_1^{\alpha_1} \ldots \partial x_d^{\alpha_d}}$$

S. Kelly, M. Kon and L. Raphael ([1],[2]) extended Walter's results by proving point wise convergence of orthogonal wavelet expansions in n dimensions. The key of their proofs is the following definition.

Definition 1.1 A bounded function $w : [0,\infty) \to R^+$ is a radial decreasing L^1 – majorant of a given function h defined on R if $|h(x)| \le w(|x|)$ and w satisfying the following conditions: (i) $w \in L^1([0,\infty))$, (ii) w is decreasing, (iii) $w(0) < \infty$.
The boundedness of w follows from (i) and (ii).

In all above work on point wise convergence it is essential that the summation kernel of the wavelet series given by

$$P_m(x,y) = \sum_k \varphi_{m,k}(x)\,\varphi_{m,k}(y)$$
$$= 2^m \sum_{k\in Z} \varphi(2^m x - k)\,\overline{\varphi(2^m y - k)}$$
$$= 2^m K_{\varphi}(2^m x, 2^m y),$$

where $\varphi_{m,k}(x) = 2^{m/2}\varphi(2^m x - k)$ and $K_{\varphi}(x, y) = \sum_{k\in Z} \varphi(x-k)\,\overline{\varphi(y-k)}$, be absolutely bounded by redial decreasing L^1 – majorant dilation kernel i.e.

$\sum_{k\in Z} w(|x-k|)w(|y-k|) \le c w\left(\frac{|x-y|}{2}\right)$ $x, y \in \mathbb{R}$, C is some constant depends on w. There are, however, some mother wavelets that does not satisfy these conditions. The summation kernel associated to scaling function $\varphi(t) = \frac{\sin \pi t}{\pi t}$ is seen to be

$$\frac{\sin \pi(t-y)}{\pi(t-y)} = \sum_{k=-\infty}^{\infty} \frac{\sin \pi(t-k) \sin \pi(y-k)}{\pi(t-k)\pi(y-k)}$$

It is clear that this kernel not belongs to $L^1(R)$. Hence this can not be absolutely bounded by radial decreasing L^1−majorant function.
The point wise convergence of the Shannon wavelet series can be studied directly but it is very special case and of less interest. In this paper we shall study the point wise conver- gence of prolate spheroidal wavelet expansions in $L^p(R)$, $1 \le p < \infty$. Here the sinc function

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Application of Numerical Method to Wave Equation

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Abstract—*In this paper, the finite – difference approach, the continuous problem domain is "discretized", so that the dependent variables exists only at discrete points. Derivatives are approximated by differences, resulting in an algebraic representation of the partial differential equation (PDE). Hence a problem involving calculus transforms into an algebraic problem.*
Multiple considerations determine whether the solution so obtained will be a good approximation to the exact solution of the original PDE. Among these considerations are truncation error, round off error and consistency, all of which is discussed in the current paper. There are two types of numerical method for solving mathematical equations. The first type approximates the unknown function in the equation by a simple function often a polynomial or piecewise polynomial function, chosen to closely follow the original equation. The second type of numerical method approximates the equation of interest, usually by approximating the derivatives of integrals in the equation. Such numerical procedures are often called finite difference methods. Most initial value problems for ordinary differential equations and partial differential equation are solved using this method Numerical method for solving differential and integral equation involves both approximation theory and the solution of large and non linear system of equations..

1. INTRODUCTION

In this paper, basic concepts and techniques needed in the formulation of finite – difference and finite – volume representations are developed. In the finite – difference approach, the continuous problem domain is "discretized", so that the dependent variables are considered to exist only at discrete points. Derivatives are approximated by differences, resulting in an algebraic problem.

The nature of the resulting algebraic system depends on the character of the problem posed by the original PDE. Equilibrium problems usually result in a system of algebraic equations that must be solved simultaneously throughout the problem domain in conjunction with specified boundary values. Marching problems result in algebraic equations that usually can be solved one at a time (although it is often convenient to solve them several at a time). Several considerations determine whether the solution so obtained will be a good approximation to the exact solution of the original PDE. Among these considerations are truncation error, round – off and consistency, all of which will be discussed in the present work

Finite Differences

One of the first steps to be taken in establishing a finite – difference procedure for solving a PDE is to replace the continuous problem domain by a finite difference mesh or grid. As an example, suppose that we wish to solve a PDE for which u(x, y) is the dependent variable in the square domain $0 \le x \le 1$, $0 \le y \le 1$. We establish a grid on the domain by replacing u(x, y) by u (iΔx, jΔy). Points can be located according to values of i and j, so difference equations are usually written in terms of the general point

2. DIFFERENCE REPRESENTATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Truncation Error

As a starting point in our study of T.E., let us consider the heat equation

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2} \quad (3.1)$$

Using a forward-difference representation for the time derivative ($t = n\Delta t$) and a central-difference representation for the second derivative, we can approximate the heat equation by

$$\frac{u_j^{n+1} - u_j^n}{\Delta t} = \frac{\alpha}{(\Delta x)^2}\left(u_{j+1}^n - 2u_j^n + u_{j-1}^n\right) \quad (3.2a)$$

However, we noted that T.E.s were associated with the forward and central-difference representations used in Eq. (3.2). If we rearrange Eq. (3.1) to put zero on the right-hand side and include the T.E.s associated with the difference representation of the derivatives,

Wave Equation

The one-dimensional (1-D) wave equation is a second-order hyperbolic PDE given by

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PETRI NET BASED ALGORITHMIC APPROACH FOR VECHICAL ROUTING PROBLEM

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ABSTRACT

In this paper, we consider the Vehical Routing Problem (VRP). Where VRP is modelled as a VRP-graph, in which each edge is treated as a parallel combination of oppositely directed edges. We model VRP-graph as a Petri Net-graph, where Petri Net- graph is an underlying graph of VRP-graph. Then solve VRP by defining suitable binary operation on elements of columns in sign incidence matrix representation of Petri Net-graph. In Petri Net-graph, we find a set of places which is both Siphon and Trap with minimum sum of capacities, whose set of input transitions equals to the set of output transitions, and both of them are equal to the set of all transitions in Petri Net. Then edges in VRP-graph corresponding to these places in Petri Net-graph will form a shortest route for the seller to return the point of origin, after traversing all the cities exactly ones. For the solution of VRP, we describe a new algorithm, based on siphon-trap and bounded-ness property of the Petri Nets. ***2000 Mathematics Subject Classification:*** *68R10, 90C35, 94C15.*

Keywords: Travelling Seller's Problem, Weighted Directed Graph, Spanning Cycle, Petri Net, Siphon and Trap.

I. INTRODUCTION

The Vehical Routing Problem (VRP) is one of the most intensely studied problems in computational mathematics [5]. Mathematical problems related to the VRP were treated in the early nineteenth century by W.R Hamilton and British mathematician T. P. Kirkman. Although there are many algorithms given for the solution of VRP [6, 7, 8, 13, 14], yet no effective solution is known for the general case for the VRP. In this paper, we address the same problem with a different approach, using Petri Net model. Here we present a new algorithm to solving a VRP using the siphon-trap and bounded-ness property of the places in the One-one Petri Net model of given VRP-graph. For the VRP we find a set of places in Petri Net, which is both Siphon and Trap [1, 3], with minimum sum of capacities, having the property that set of input transitions equals to the set of output transitions, and both of them are equal to the set of all transitions given in the Net. Then edges in VRP-graph corresponding to these places form a shortest route for the seller.

In Petri Net theory, Petri Net is a formal tool which is particularly well suited for discrete event systems. Its application has emerged from the initial seminal PhD thesis of C. A. Petri, so C.A. Petri is considered as the originator of Petri Net applications [10, 11]. The computational algorithmic aspects of graph theory are

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Experimental Study and Analysis on Novel Thermo-Electric Cooler Driven by Solar Photovoltaic System[1]

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Abstract— Experimental study and analysis on thermoelectric cooler driven by solar photovoltaic system has been carried out. Here the research attention is on testing of system performance under solar insolation. Experimental results revealed that unit could maintain the temperature in the cooler at 10–15°C and have a coefficient of performance (COP) of about 0.34. Analysis of thermoelectric cooling system has been conducted on the basis of COP, cooling capacity and environmental issues. Further investigations verified that the performance of the system is a function of solar insolation rate and temperature difference of hot and cold sides of thermoelectric module etc. There subsist most favorable solar insolation rate which allows COP and cooling production to be maximum value respectively. It is anticipated that the cooler would have prospective for cold storage of vaccine, food and drink in remote and rural areas or outdoor conditions where electricity is not available.

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1. INTRODUCTION

Refrigeration is closely related to the demand for cooling foodstuffs and many commercial-domestic life applications. Conversely, we cannot have the ease provided by refrigeration when we take outdoor activities, such as geological panorama, archaeological study, etc. Solar refrigeration is assumed to be as one of the best way out to deal with this issue, because of its good match to the deviation of solar radiation; as input solar energy and the cooling output of a solar refrigeration system accomplish its maximum levels at the same time. Solar thermoelectric refrigeration system, which has the virtues of being low weight, unswerving, low noise, rugged and lessexpansive if production is done at a large scale, uses electrons rather than refrigerant as a heat carrier and is reasonable foroutdoor functioning in collaboration with solar photovoltaic system, in spite of the fact that its coefficient of Performance is not as high as for a vapor compression cycle. In last few years, many new outcomes have been reported on thermoelectric cooling and its analysis [1–7]. It has done [8] a comparative study on the performance of vapor compression, thermoelectric and absorption refrigerators. In [9] it was investigated thermoelectric refrigerators, which has the merits of being light, reliable, noiseless, rugged and low cost in mass production, uses electron rather than refrigerant as heat carrier, low starting point and is feasible to be used in solar cells, in spite of that fact the its coefficient of performance is not as high as for a vapor compression cycle. In [10] it was considered a solar assisted automobile thermoelectric air-conditioner and carried out its parametric analysis. In the recent few years, research and investigations on solar photovoltaic thermoelectric devices are done by number of researchers [11–20]. Solar thermoelectric coolers are greatly required in remote rural areas for cold storage of vaccines and food, since electric power supply is not rich enough in these areas. The authors have undertaken research and investigation on the development of solar driven thermoelectric cooler for remote rural areas and accounted its experimental results while analyzing the system performance.

2. SYSTEM DESCRIPTION

A prototype of a solar cell driven, thermoelectric cooler, which is mainly build up with solar photovoltaic panel, charge controller, storage battery, rectifier and thermoelectric cooler, is shown in Fig. 1a where as Fig. 1b shows the schematic of solar driven thermoelectric cooler. During sunshine hours in a day, solar photovoltaic system receive solar energy and convert it into electric power supplied to the thermoelectric cooler by means of the photovoltaic effect. If the amount of electric power production is more than sufficient, the power surplus can be accumulated in a storage battery, alongside driving the cooler. If the

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A niche market of wound care products and emergence of nanotechnology – A short review†

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Abstract : Wound healing is a complex, specific, physiological, and biological process. Wound healing progresses through a series of tightly regulated, cascades events that starts at a time of injury and continues till recovery. In wound healing, a dressing material plays a crucial role. That is why selection of dressing materials according to wound condition is of paramount importance. Otherwise, acute wound may convert into chronic wound and thus, the normal function of wound healing cycle would get disturbed. This article has summarized information about various types of wounds, phases of wound healing, and wound dressing materials. In addition, it has also highlighted the role of nanotechnology in fabricating improved wound care products.

Keywords : Wound, wound healing, nanotechnology, wound care products.

Introduction

The advent of nanotechnology has provided a great opportunity to fabricate nanocomposite wound dressings that significantly accelerate the healing process. Nanoparticles possess many exciting properties such as strong adsorption, high surface reactivity, and small size ranging between 1 and 100 nm[1]. Nanoparticles have a high surface to volume in proportion to their mass. An increased surface area of nanoparticle, typically enhances cellular and biological activity by mass compared to bulk material. The novel properties (such as antimicrobial properties, mechanical properties, etc.) of materials at the nano range have explored numerous opportunities for their tremendous applications in the pharmaceutical and biomedical field, especially in wound healing. A wound dressing protects the wound from microbial attack that is responsible not only for causing infection but also for delaying healing process, which in turn, causes a serious problem to public life[2]. According to the literature survey, it has been known that there are numerous types of wound dressings available in the today's market. Depending on the conditions of wound and healing system, proper wound dressing material is needed in order to achieve complete healing[3]. Therefore, it may be regarded that one dressing material can never be prescribed for all types of wounds. Selection of wound dressings plays a pivotal role in wound healing process because they not only improve healing but also manage infected wound nicely. Moreover, wound care products should be customized according to the nature's of wound that can significantly accelerate the progress of healing. Here, we have discussed about the types of wound and their various phases relating to progress of healing; wound dressings; and role of nanotechnology towards fabrication of new wound care materials.

Types of wounds and wound healing cycle

A wound is defined as the disruption of the integrity of anatomical structure and function subjected to its exposure to any factor. Wounds are categorized on the basis of various parameters namely level of exudates, microbial contaminations, layers involved, and tissue loss[4-6]. These are shown in Fig. 1.

Basically, wound healing is a complex process in which various cellular as well as biochemical components play a pivotal role in repairing tissue. Wound healing progresses through a series of interdependent and overlapping stages in which a variety of cellular and matrix components acts

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Transition metal oxide nanoparticles are effective in inhibiting lung cancer cell survival in the hypoxic tumor microenvironment

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ABSTRACT

Background: The transition metal oxide nanoparticles are in focus for their anti-cancer potential. In this study we have synthesized and characterized CuO, NiO and Fe_2O_3 nanoparticles and, investigated their cytotoxic potential in the heterogeneous tumour microenvironment.

Methods: Nanoparticles were synthesized by aqueous precipitation method and characterized with UV-Visible spectrophotometer, Fourier transform infrared spectroscopy (FTIR), Scanning electron microscopy (SEM) and X-ray diffraction (XRD). Cell viability of lung cancer cells (A549) grown in normoxia (18%O_2) and hypoxia (1%O_2) was determined for all nanoparticles. The mechanism of cell death was assessed by nuclear morphological analysis, flow cytometry analysis and western blotting. Generation of intracellular ROS in treated cells and its contribution to cell viability was determined.

Results: The synthesized metal oxide nanoparticles were successfully characterized with SEM, spectroscopy and X-ray diffraction patterns. Cell viability of lung cancer cells was compromised in both normoxia and hypoxia. ROS generation was shown to contribute to cellular toxicity in CuO, but not NiO and Fe_2O_3.

Conclusion: We have shown the therapeutic potential of CuO, NiO and Fe_2O_3 nanoparticles in non small cell lung cancer cells cultured in hypoxia, a relevant feature of solid tumors along with normoxia. The newly synthesized nanoparticles showed efficacy in both conditions.

General significance: Hypoxia drives metabolic alterations and epigenetic modifications in the tumor microenvironment. By using conditions that mimic tumour microenvironment, this study expands the possibility of using metal oxide nanoparticles as a therapeutic agent for lung cancer treatment.

1. Introduction

Advent of nanotechnology over the last two decades has opened up the horizon of research in the field of nanomedicine. Nanoparticles of specific compositions have been found to exhibit antibacterial, antifungal and anti-cancerous properties [1–5]. There has been no major breakthrough in cancer treatment and it continues to be a 'lifestyle epidemic' [6]. The side-effect associated with most anti-cancer therapy has pre-empted researchers to constantly explore different therapeutic modalities. Unique physiochemical properties of nanoparticles like antioxidant action, response properties based on external stimuli such as infrared radiation or magnetic impulse have made them highly valuable agents for their potency in combating diseases, including cancer [7]. Among the various nanoparticles showing anti-cancerous properties transition metal oxide nanoparticles are gaining credibility. Spherical Iron (III) oxide (Fe_2O_3) nanoparticles are now medically accredited by EU as a medical device for magnetic tumor hyperthermia in brain and prostate cancer, in combination with radiotherapy or chemotherapy [8–11]. Cerium oxide nanoparticles have been reported to selectively increase the oxidative stress and apoptosis in cancer cells while protecting the normal tissue [12,13]. Zinc oxide nanoparticles have been found very effective against T98G cancer cells [14], whereas copper (II) oxide (CuO) nanoparticles synthesized

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Performance optimisation of two-stage exoreversible thermoelectric heat pump in electrically series, parallel and isolated configurations

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Abstract: A configuration of the behaviour of an exoreversible two-stage semiconductor thermoelectric heat pump (TEHP) in three different modes, i.e., electrically series, electrically parallel and electrically separated is devised. The TEHP performance assuming Newton's heat transfer law is evaluated through a combination of finite time thermodynamics (FTT) and non-equilibrium thermodynamics. A formulation based on the heating load versus working electrical current and coefficient of performance (COP) versus working electrical current is applied in this study. For fixed total number of thermoelectric elements, optimisation of number of thermoelectric elements of the top stage for maximising the heating load and COP is done here. The complete analysis of effects of various design parameters on the performance of TEHP is formulated. Three thermodynamic models for multi-stage TEHP system considering internal irreversibilities are developed in the matrix laboratory Simulink environment. For typical operating conditions of TEHP system with total 30 thermocouples, the maximum value of COP is improved from 4.56 to 5.20 for same current in electrically parallel mode. This analysis will be helpful in designing the actual multistage TEHPs.

Keywords: two-stage semiconductor thermoelectric heat pump; finite-time thermodynamics; non-equilibrium thermodynamics; optimisation.

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Research Paper

Thermodynamic modeling and multi-objective optimization of two stage thermoelectric generator in electrically series and parallel configuration

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HIGHLIGHTS

- ee performance parameters of thermoelectric generator are optimized with NSGA-II.
- Optimal values of various input parameters are obtained.
- Comparison of electrically series and parallel configurations are reported.
- *I–V* characteristics of electrically series and parallel configurations are presented.
- Effects of various input parameters on triple objectives are reported.

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ABSTRACT

Two-stage exo-reversible thermoelectric generator considering internal irreversibilties is developed in electrically series and electrically parallel configurations in matrix laboratory simulink environment based on finite time thermodynamic analysis. Simultaneous optimization of proposed system for maximizing power output, thermal efficiency and minimizing entropy generation is employed based on second version of non-dominated sorting genetic algorithm, where working electrical current, number of thermoelectric elements in top and bottom stage, temperature of hot side and cold side are considered as design variables. The present work explores optimal values of above performance parameters and design variables with the comparison of two-stage thermoelectric generator in two modes. For triple and dual objective functions, Pareto frontier is obtained and using four decision variable techniques viz. Fuzzy Bellman–Zadeh, Shannon's entropy, LINMAP and TOPSIS best optimal solution is selected. With the current study, it has been proved that triple-objective optimization gives much lower difference between ideal and obtained solution, termed as deviation index, as compared to the dual objective optimization.

1. Introduction

Semiconductor thermoelectric generator (TEG) based on Seebeck effect have various advantages over conventional power generators and their applications are constantly growing in various areas of military, aerospace, instrument biology, industrial or commercial products, etc. [1]. If the efficiency is significantly improved, thermoelectric devices can be an important part of the solution to today's energy challenge [2]. As TEG has no moving parts which makes it reliable, rugged and applicable in number of fields with exceptional potential output [3]. But due to continuous thermal cycling these thermoelectric (TE) modules can experience performance reduction and mechanical failure due to which figure of merit can reduce up to 4–5% in approximately 45,000 thermal cycles [4]. Extensive research is being carried out to improve thermal, electrical and physical properties of thermoelectric materials as well as manufacturing techniques for thermoelectric modules [5]. The designing of high performance thermoelectric devices can be done by system analysis and optimization with respect to various parameters along with the improvement of thermoelectric materials and modules [6]. For performance analysis of single stage or multi-stage TEG, non-equilibrium thermodynamics is generally used [7,8]. Multi-stage TEG has improved performance with range of advantages over the single stage configuration [9]. Finite time thermodynamic (FTT) [10] is a strong tool for performance analysis and optimization of practical thermodynamics processes. Performance analysis and single objective optimization of two stage

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MECHANICAL ENGINEERING

Multi-objective thermodynamic optimization of an irreversible regenerative Brayton cycle using evolutionary algorithm and decision making

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Abstract Brayton heat engine model is developed in MATLAB simulink environment and thermodynamic optimization based on finite time thermodynamic analysis along with multiple criteria is implemented. The proposed work investigates optimal values of various decision variables that simultaneously optimize power output, thermal efficiency and ecological function using evolutionary algorithm based on NSGA-II. Pareto optimal frontier between triple and dual objectives is obtained and best optimal value is selected using Fuzzy, TOPSIS, LINMAP and Shannon's entropy decision making methods. Triple objective evolutionary approach applied to the proposed model gives power output, thermal efficiency, ecological function as (53.89 kW, 0.1611, −142 kW) which are 29.78%, 25.86% and 21.13% lower in comparison with reversible system. Furthermore, the present study reflects the effect of various heat capacitance rates and component efficiencies on triple objectives in graphical custom. Finally, with the aim of error investigation, average and maximum errors of obtained results are computed.

1. Introduction

Brayton cycles have been broadly used in gas power plants, airplanes, ship propulsion and numerous industrial usages. Intercooler compression, reheater expansion, regeneration and isothermal heat addition are few amendments [1–20] which have been acknowledged theoretically to upgrade the performance of Brayton cycles. In recent years, significant consideration has been given to single objective optimization of Brayton heat engine through range of objective functions

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Multi-objective thermo-economic optimization of solar parabolic dish Stirling heat engine with regenerative losses using NSGA-II and decision making

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ABSTRACT

The proposed work investigates optimal values of various decision variables that simultaneously optimize power output; overall thermal efficiency and thermo-economic function of solar driven Stirling heat engine with regenerative heat losses, conducting thermal bridging losses using evolutionary algorithm based on second version of non-dominated sorting genetic algorithm (NSGA-II) in matrix laboratory (MATLAB) simulink environment. Effects of design parameters as absorber temperature, concentrating ratio, radiative and convective heat transfers are considered for the investigation. Pareto frontier is obtained for triple and dual objectives and the best optimal value is selected through four different decision making techniques viz. Fuzzy Bellman-Zadeh, Shannon's entropy, LINMAP and TOPSIS. The optimum values of average absorber temperature and concentrating ratio are found to be 1168 K and 1300, respectively. Triple objective evolutionary approach applied to the proposed model gives power output, overall thermal efficiency and thermo-economic function as (38.96 kW, 0.2392, 0.3124) which are 17.09%, 35.09% and 10.74%, respectively lower in comparison with reversible system. With the objective of error investigation, the average and maximum error of the obtained results are reckoned at last.

Introduction

Solar energy is one of clean renewable source of energy which reduces dependability of human needs on fossil fuels and hazards caused to environment with usage of these fuels [1]. The idea of using solar energy as input energy source for heat engines has been applied by coupling solar concentrators with Stirling heat engine for useful power output [2]. The use of solar driven Stirling engine for power output source is continuously increasing because of its environment friendly nature compared to internal combustion engines. Blank et al. [3] performed power optimization of endoreversible Stirling heat engine. They estimated maximum possible power output of real engine under predetermined circumstances. Chen et al. [4] studied solar driven Stirling heat engine to find out its maximum possible efficiency. Kaushik et al. [5–8] implemented finite time thermodynamic approach on endoreversible [5] and irreversible [6–8] Stirling/Ericsson cycles and found that at regenerator effectiveness of one, Stirling heat engine could perform as Carnot heat engine provided both are operating in endoreversible mode. They also found that maximum power output of Ericsson and Stirling engines are independent of heat losses due to regenerator, effectiveness of regenerator and direct heat leak between heat source and heat sink. Tyagi et al. [9] incorporated internal irreversibility parameter while defining ecological function of Stirling and Ericsson cycles implementing finite time thermodynamic approach. They carried out analysis of the impact caused by internal irreversibility parameter on ecological function, power output and thermal efficiency of both cycles. Kongtragool and Wongwises [10] investigated Stirling heat engine and found that maximum power output and corresponding thermal efficiency decreases with increase in irreversibilities in the system. Thili et al. [11] developed theoretical model for calculating net-work output, thermal efficiency and heat addition in view of first law of thermodynamics with internal irreversibility. Furthermore, Thili [12] evaluated Stirling heat engine through endoreversible mode for maximum power conditions implementing finite time thermodynamic approach. Costea et al. [16] analyzed the effect of

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Simulation of Optimal Exergy Efficiency of Solar Flat Plate Collector

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Abstract

Exergy analysis identifies potential factors responsible for thermodynamic losses and leads to efficiency improvements. In the present paper, exergy efficiency is expressed as a function of dimensionless mass flow rate and outlet fluid temperature. A computer program was developed for determining the optimal performance parameters for maximum exergy efficiency in a flat plate collector. The study was conducted for six collectors of different areas, having a different overall loss coefficient and a heat removal factor. It is observed that for given values of incident solar radiation, inlet fluid temperature and ambient temperature, the optimal mass flow rate varied from 0.0019 -0.0022 kg/s and exergy efficiency varied from 5.2- 8.2% for the collectors depending on its gross area, overall heat loss coefficient and heat removal factor.

Keywords: *Optimization, Exergy Efficiency, Outlet Fluid Temperature, Mass Flow Rate, Flat Plate Collector.*

Nomenclature

A_c	Gross area of the collector, m^2.
A_p	Absorber plate area, m^2
c_p	Specific heat of the heat transfer fluid, J/ kg°C.
F_R	Heat removal factor of the collector, dimensionless.
F'	Collector efficiency factor, dimensionless.
H_a	Absorbed solar radiation per unit area of the collector, W/m^2.
H_t	Incident solar radiation per unit area, W/m^2.
$\dot{m}$	Mass flow rate, kg/s.
M	Mass flow number, dimensionless.
T_a	Ambient temperature, °C.
$T_{f,in}$	Inlet fluid temperature, °C
$T_{f,out}$	Outlet fluid temperature, °C
T_p	Absorber plate temperature, °C
$T_{p,max}$	Stagnation temperature, °C
T_s	Apparent temperature of Sun, °C.
U_L	Overall heat loss coefficient, W/m^2°C.

Greek Symbols

α	Absorptance of the absorber plate, dimensionless.
τ	Transmittance of the cover, dimensionless.
θ_{in}	Dimensionless inlet fluid temperature.
θ_{max}	Maximum collector temperature, dimensionless
θ_{out}	Dimensionless outlet fluid temperature.
θ^*_{out}	Dimensionless optimal outlet fluid temperature.
θ_s	Dimensionless apparent temperature of Sun.
η_I	Energy efficiency of collector, dimensionless.
η_{II}	Exergy efficiency of collector, dimensionless.

1. Introduction

Solar flat plate collectors are devices used for low temperature applications. The heat absorbed by absorber is partly transferred from absorber plate to the fluid flowing in the tubes and the rest is lost to ambient. Heat transfer irreversibility decreases with the increase in fluid flow rate but this increases losses due to fluid friction. To optimize heat transfer to fluid form the absorber plate, an optimal mass flow rate of the fluid needs to be determined which takes care of both heat transfer irreversibility and losses due to fluid friction.

In recent past, various methods have been applied to optimize the design of a collector. Analysis of a solar collector was conducted by Howell and Bannerot [1] in order to determine the optimum outlet temperature for a given solar collector that would maximize the work output for various idealized heat engine cycles. The analysis demonstrated the effect of the radiative and convective heat losses from the collector. Second law analysis for the optimization of flat plate solar air heaters was performed

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Luminescence study of ZnSe/PVA (polyvinyl alcohol) composite film

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Soft computing based multi-objective optimization of Brayton cycle power plant with isothermal heat addition using evolutionary algorithm and decision making

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ABSTRACT

An irreversible regenerative Brayton cycle model considering internal and external irreversibilities is developed in matrix laboratory (MATLAB) simulink environment and thermodynamic optimization based on finite time thermodynamic analysis along with multiple criteria is implemented. Evolutionary algorithms based on second version of non-dominated sorting genetic algorithm (NSGA-II) and multi-objective evolutionary algorithm based on decomposition (MOEA/D) are employed to optimize power output and thermal efficiency simultaneously where isobaric-side heat exchanger effectiveness (ε_H), isothermal-side effectiveness (ε_{IH}), sink-side effectiveness (ε_L), regenerator-side effectiveness (ε_R), and working medium temperature (T_5) are taken as design variables. The optimal values of aforementioned design variables are investigated. Pareto optimal frontiers between dual objectives are obtained and the final optimal values of power output and thermal efficiency are chosen via LINMAP, fuzzy Bellman–Zadeh, Shannon's entropy and TOPSIS decision making approaches. The obtained results are compared and the best one is preferred. An improvement in thermal efficiency from 18.29% to 21.10% is reported. In addition to this, variations of different input parameters on the power output and thermal efficiency are conferred and presented graphically. With the goal of error investigation, the maximum and average errors for the obtained results are designed at last.

1. Introduction

Power and thermal efficiency are important performance parameters of Brayton heat engine cycle and, in practice, influence the operating cost of the system. In simple heat addition (Rayleigh flow), temperature increases along frictionless constant area duct as compressible fluid flows through it with subsonic velocity. In simple area change (isentropic flow), temperature decreases along frictionless adiabatic decreasing area duct as a compressible fluid flows with subsonic velocity along it. Rayleigh flow and isentropic flow may be combined to get an isothermal heat addition process [1] where any small decrement in temperature due to simple area change is exactly compensated by simple heat addition. According to law of conservation of energy, as the temperature of gas is constant in isothermal process, the kinetic energy must increase. In order to achieve ideal isothermal process, air is assumed as working fluid in Brayton heat engine cycle. Veccguarelli et al. [1] proposed hypothetical modification of gas turbine engines with two heat additions may result in efficiency improvement with respect to conventional engines. Kaushik et al. [2] observed an enhancement of around 16% in the first law efficiency of an irreversible Brayton heat engine and optimized the power output with respect to working medium temperature while analyzing irreversible regenerative Brayton cycle with isothermal heat addition. Significant improvement in thermal efficiency of Brayton cycle with isothermal heat addition is also reported by Goktun and Yavuz [3] and Ebray et al. [4]. Tyagi et al. [5] considered the effects of isothermal heat additions on the performance of Brayton cycle. They also performed parametric study to analyze the effect of various factors including effectiveness of heat exchangers, heat capacitance rates, component efficiency on power output, thermal efficiency and ecological function. Chen et al. [6] integrated intercooler with regenerated Brayton cycle to maximize power output and efficiency of developed model through finite time thermodynamics method. Hence,

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Computation of Vibrational Frequency on Trapezoidal Plate with Non Homogeneity Effect

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***Abstract*—The central key of the present paper is to compute vibrational frequency using non-homogeneous trapezoidal plate. under 2D temperature. It is assumed that the plate's thicknesses vary parabolic in one direction and linear in other direction. The density of the plate is taken linear in one dimension as the plate is non-homogeneous. Two term deflection function with boundary condition (C-S-C-S) is taken into account. Rayleigh-Ritz technique is used for finding vibrational frequency. The effects of other parameters on vibration have also been studied. Results are calculated using software MAPLE and presented in tabular form.**

Keywords*— *parabolic thickness; thermal gradient; non-homogeneous; vibration; trapezoidal plate

I INTRODUCTION

The phenomena of vibration in mechanical structure or engineering are common but not always unwanted. The study of vibrations becomes essential in these days because of requirement of heavily structural design for modern world. The plates become important aspects for making these structures. These plates are of different types or sizes having variable varying thicknesses with or without temperature consideration. A wide variety of civil or mechanical engineering application used plate's structures such as bridges, ships, wings of aircraft etc.

In the modern era, effect of high temperatures on vibration becomes an interesting factor on non-homogenous trapezoidal plate because of their wide variety of application in the field of engineering. The main reason for the study of temperature is, as most of the engineering structures working under high temperature such as nuclear reactor, power plant and motors in machines etc. In literature, there are so many studies available for vibration of plates with varying thickness and 1D temperatures but slight work is found in two dimensional temperature variations.

Saliba [1] studied the transverse free vibration on symmetrical trapezoidal pate. In this author assumed the plates are fully clamped. Orris and Petyt [2] discussed vibrational frequency on trapezoidal plate using finite element method. Gupta and Sharma [3-5] gave the study of vibration on trapezoidal plate under thermal effect. They studied the variation in thickness linear as well as parabolic for different combination of variation of parameters and other aspects which play an important role to estimate how frequencies behave when the parameters are changed. Gupta and Sharma [6-8] studied vibration of homogenous as well as non-homogeneous trapezoidal plate under linear and parabolic variation in thickness of the plates. In some cases they studied the temperature effects orthotropic material of the plates and gave numerical data how frequency acts. Quintana and Grossi1 [9] studied free vibrations of a Trapezoidal plate with an internal line hinge restrained against rotation. Authors used the combination of Ritz and Lagrange multiplier method for obtaining the frequency modes. Sharma, Sharma, Kumar and Raghav [10] discussed the vibrations of orthotropic rectangular plate and find the deflection function, time period and logarithmic decrement for the various values of the parameters.

In this paper, authors dealt with bi- linearly varying temperature with the combination of variable varying thicknesses in the directions of both the axes. Authors assumed that thickness varies linearly in one direction and parabolic in other direction with 1D linearly varying density as plates is to be assumed non-homogeneous. The present work provides the behavior of frequency when the parameters such as non-homogeneity, taper constant, thermal gradient and aspect ratio have been studied. The vibrational frequencies for both the modes are obtained for C-S-C-S non-homogeneous trapezoidal plate by Rayleigh-Ritz method and display in the form of tables.

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Role of Salt bridge formation in the conformation change of proteins

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***Abstract*—The role of salt bridge formation is very crucial in the conformation change of the proteins. Our earlier work had also confirmed the presence of salt bridge formations on the conformation change of the proteins in particular Calmodulin (CaM) protein. In the present study we perform the simulations of this protein at different temperatures and observe a crucial role of salt bride formations on the conformation changes observed. Parallel clusters are used to perform these simulations using the facilities of Inter University Accelerator Centre (IUAC), New Delhi, India. The present study is performed using computational facilities having namd package installed on the parallel clusters. Parallelization of this molecular dynamics (MD) package significantly helps to improve the computational time of the simulation.**

Keywords—Calmodulin protein; Molecular Dynamics; Conformation

I. INTRODUCTION

A. Proteins

Proteins play a very important role inside the human body like in muscle contraction, calcium signaling etc [1,2,3,4,]. For sample protein Myosin helps in muscle contraction and Calmodulin (CaM) protein (shown in Fig.1) helps in calcium signaling inside the cells in human body. External factors play a very important role in the functioning of these proteins.

Our earlier work discussed the conformation change of CaM protein in different environmental conditions such as pH, calcium ion concentration , ionic strength etc [5,6]. In this paper we discuss a study performed to understand the role of salt bridge formations on the overall dynamics of the proteins. As a first step we perform this study on the CaM protein at room temperature and atmosphere pressure Molecular dynamics technique is used to perform the simulations.

Fig. 1. Calmoduln protein consisting of N-,C-lobes and linker shown in green, cyan and purple color respectively [6]

B. Computational facility used

Good computational facilities are always a boon in the protein simulations as a large number of atoms and a long simulation time requires a very good computational facility. With the advancement in the configuration of the clusters and servers, it has now become possible to perform protein simulations of the order of micro seconds.

In this work we have used the parallel clusters available at Inter University Accelerator Centre (IUAC), New Delhi, India for performing these simulations. The facility provided us parallel clusters with NAMD [7] installed in them. Simulations of the order of 100 ns are performed where each simulation took nearly 2 weeks time to complete.

II. SIMULATION SETUP

Various computational techniques are used to prepare, represent and analyze our system. Most importantly, we used

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ORIGINAL ARTICLE

Effect of heat treatment on the structural properties of tungsten carbide coatings deposited by RF magnetron sputtering

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Abstract A systematic study on the effect of heat treatment on the structural properties of tungsten carbides coatings deposited by RF magnetron sputtering on steel substrate (XC70) was carried out. These coatings were subjected to heat treatment in vacuum at various temperatures ranging from 500 to 1000 °C for 25 min. Structural analysis of the as-deposited and heat-treated coatings was performed by means of X-ray diffraction (XRD) and optical microscopy. The XRD analyses indicated the presence of nanocrystalline grains with (222) preferential orientation. The grain size varied from 8 to 15 nm. The presence of two different phases WC and W_2C was observed in the coatings heat treated at 1000 °C. The effect of the annealing temperature on the surface morphology of the coatings was studied using optical microscopy.

Keywords Heat treatments · RF magnetron sputtering · Tungsten carbides · Steel (XC70) · Coating

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1 Introduction

Tungsten carbide has been used for number of industrial applications because of its high resistance to wear, high temperatures stability, and high hardness. Deposition of the tungsten carbide coatings on different materials have shown to enhance the tribological properties such as surface hardness and toughness significantly and the materials systems have shown to outperform many steel product equivalents [1]. Tungsten carbide also has better durability against heat loads and particle/ion bombardments [2, 3]. Thin films prepared from tungsten carbide have been grown using magnetron sputtering [4], non-reactive DC magnetron sputtering [5], reactive sputtering [6–9], chemical vapor deposition [10, 11], physical vapor deposition [12], solid-phase reaction [13, 14] and ion beam synthesis [15–17], etc. As the effect of heat treatment on the structure and phase compositions is very important for preparation of tungsten carbide coating, this study examined the effect of heat treatment in vacuum at temperatures ranging from 500 to 1000 °C for 25 min on the structural properties of tungsten carbide coatings deposited by RF magnetron sputtering on steel substrate (XC70).

2 Experimental

The different tungsten carbide coatings were deposited by RF magnetron sputtering on steel substrate (XC70) at the 2 Kw discharge power, the bias voltage was fixed at 400 V, and the deposition rate is about 1350 Å/min depending on the conditions. The thickness of the tungsten carbide coatings is about 5 μm approximated from the time of the deposition which is 35 min in a vacuum of 10^{-7} mbar at the substrate temperature of 500 °C. The substrate-target distance was set to 150 mm during the deposition.

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Synthesis and Characterization of Transition Metal Oxide Nanoparticles and Their Application as Heat Transfer Fluids

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Abstract: *Objective of the study was to synthesize and characterize transition metal oxide nanoparticles (iron oxide, nickel oxide, copper oxide) and to examine their efficiency as Heat transfer fluids. Metallic oxide nanoparticles (Nickel oxide, ferric oxide, copper oxide)have been rapidly synthesized by precipitation method using ammonia as precipitating agent and are characterized by X-ray Diffraction (XRD), Thermal Gravimetric Analysis (TGA/DSC), UV-Visible absorption (UV), Fourier Transform Infrared spectroscopy (FTIR) and Scanning Electron Microscopy (SEM). SEM and XRD data confirmed the formation of nanosized metal oxides. TGA verifies that the synthesized nanoparticles were thermally stable upto 1000 °C. Metallic oxide nanoparticles coupled with different base fluids such as water, mobile oil and engine oil showed better rate of heat transfer and heat discharge, indicating their potent applicability as an ingredient of nano fluids.*

1. INTRODUCTION

With the advent of nanotechnology over the last two decades transition metal oxide nanoparticles have gained considerable attention due to their wide application in various fields starting from semiconductor devices, magnetic materials, storage batteries and medicinal purpose [1-6]. Recently transition metal oxide nanoparticles have found a new application as a component for heat transfer fluid [7-8]. Where, they are mixed with the normal high energy heat transfer fluids like mobile oil, engine oil and these nano fluids are found to work with higher efficiency and better heat transfer properties. Here, in this article we report the synthesis and characterization of Iron (III) oxide (Fe_2O_3), Nickel oxide (NiO) and Cupric oxide (CuO) nanoparticles and their influence on the rate of heat transfer and rate of heat discharge of mobile oil and engine oil. Our study revealed that truly nano-sized, crystalline transition metal oxide nanoparticles were synthesized (that were characterized by UV-Visible spectroscopy, Fourier transform Infrared (FTIR) spectroscopy, X-Ray dIffractometry, Scanning Electron Microscopy (SEM) and Thermal Gravimetric Analysis (TGA)). These nanoparticles mixed with mobile oil and engine oil in different concentrations exhibited better rate of heat transfer and heat discharge. Showing promises for becoming potential ingredients of heat transfer fluids

2. MATERIALS AND METHOD:

2.1 REQUIREMENTS:

- Chemicals such as compound salt precursor and reducing agent were purchased from CDH chemicals used as such without further purifications.
- Freshly prepared conductivity water was used for preparing aqueous solutions.
- Ethanol was used for washing of precipitates.

2.2. SYNTHESIS OF NANOPARTICLES:

CuO, NiO and Fe_2O_3 nanoparticles were synthesized from their congener salts copper sulphatepentahydrate ($CuSO_4$. $5H_2O$), Ferrous Sulphateheptahydrate ($FeSO_4$. $7H_2O$) and nickel chloride hexahydrate ($NiCl_2$. $6H_2O$) respectively as starting material by aqueous precipitation method by using NH_3 as precipitating agent. 5.0 grams of each of these salts were dissolved in distill water to make a clearly solution. Then the solutions were heated up to 60° to 70°C with continuous stirring using a magnetic stirring for 1 hr. after that slowly liquor ammonia solution was added from a burette to the reaction mixture at a rate 0f 0.2ml/minute with simultaneous stirring and heating. After the complete addition of liquor NH_3, the solution was filtered and the residue was washed repeatedly with acetone followed by distill water, then dried at a hot air oven at 100°C. Finally the dried residue was calcinated at a muffle furnace at 400°C for 3 hours. The fine coloured powder of metallic oxide nanoparticles (black colour for CuO, brown Fe_2O_3 and black NiO) were obtained as the end product.

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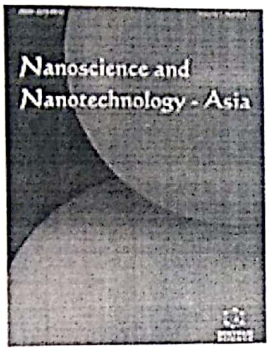

Research Article

Green Synthesis of Silver Nanoparticles Using Leaf Extract of Helianthus annuus & Mentha longifolia and Screening of their Antimicrobial Activity Against Escherichia coli

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