SEMANA VIDYA VA VAN VIKAS PRASHIKSHAN MANDAL, GADCHIROLI'S
Reg.No. F2203Gad.Dist.

Gramgeeta Mahavidyalaya

Arts, Commerce & Science (Granted)
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NAAC Accredited 'B' with CGPA 2.68

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Dr. Amir A. Dhamani
M.Sc.Ph.D.

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Ref.No.:

Date :

Academic session 2023-24

Notice

It is hereby informed to all members of college research committee, the meeting regarding the college research for the academic year 2023-24 is on 08/08/2023 at 12:00 am in principal office. All the members are requested to be present for the meeting.

Agenda for the meeting:

- Confermation of minutes of earlier meeting.
- Approval to send students for participation in Avishkar research Festival.
- Approval to send proposal of conference/workshop.

Convener
Dr. Y. G. Bodhe

Principal
Dr. A. A. Dhamani

Principal
Gramgeeta Mahavidyalaya
Chimur, Dist. Chandrapur

S. No.	Name of Members	Designation	Signature
1	Dr. Y.G. Bodhe	Convener	
2	Dr. M. I. Warhade	Member	
3	Dr. Mrs. V. V. Khati	Member	

SEMANA VIDYA VA VAN VIKAS PRASHIKSHAN MANDAL, GADCHIROLI'S Reg.No. F2301/Gad./Mah.

Gramgeeta Mahavidyalaya Chimur

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College Research Committee

Report 2023-24

The committee has been established to motivate faculty members to involve in research field and to encourage the professors for Ph.D. The committee enhances to update the faculty members in teaching and learning process for the college. Faculty and staff have staged more productions, published more research papers. Students and faculty Members are encouraged to participate in Avishkar, Seminars and Conferences organized by other institutions.

Achievements in the academic session 2023-24 are -

- Two faculty members awarded with Ph. Ds in this academic year.
- More than 13 research papers and one chapter in book published in different national and international journals and the papers were collected and were submitted to IQAC.
- Faculty members participated and presented papers in various International and National conference and seminar.
- Few Faculty Members submitted their application for Ph. D Supervisor.
- Four Faculty Members are granted as Ph. D Supervisor at Gondwana University, Gadchiroli.

Convener

Principal

Off. Principal/
Gramgeeta Mahavidyala
Chimur, Dist. Chandrapu

The Bioscan 18(1): 29-33, 2023

www.thebioscan.com

BIOSYNTHESIS OF COPPER OXIDE NANOPARTICLES USING *Uraria picta* (JACQ.) PLANT EXTRACT AND ITS CHARACTERIZATION

SARTAJ SHEIKH[1], ARVIND J. MUNGOLE[1]*, HARSHA P. KANFADE[1], A. P. PAWAR[2], MRUNAL I. WARHADE[3], SNEHAL BHANDAKKAR[4] AND A. N. YERPUDE[5]

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ABSTRACT

The complete plant extract from *Uraria picta* was used in the current study as a natural reagent to synthesize CuO nanoparticles. A large part of the synthesis in response to the plant extract served as a reducing and stabilizing agent, resulting in copper oxide nanoparticles (NPs) of different sizes and forms. The synthesized nanoparticles were characterized using XRD, FTIR, UV-Vis spectroscopy, SEM and TEM. Strong absorbance peaks at 294 nm in the UV-visible spectrum are caused by the formation of CuO. The synthesized CuO XRD diffraction peaks closely matched those of the previously published CuO XRD. According to FTIR studies, the Cu-O bond stretching can be seen in the absorption bands at 515.50 cm-1 and 625.64 cm-1. The SEM micrographs show that the CuO particles are spherically formed, densely packed together, and irregularly dispersed. The TEM picture showed an average particle size of 50 nm. In this study, copper oxide nanoparticles of Uraria picta (JACQ.) plant extract prepared using the biosynthesis and characterized.

INTRODUCTION

Biosynthesis of metal oxide nanoparticles, mediated by plant extracts has become a promising area of research due to their intensive applications in the environmental, pharmaceutical, nanofluids food and cosmetics industries (Chang *et al.*, 2011). Biological synthesis has received widespread attention as a reliable, sustainable, and environmentally friendly method for the synthesis of metal or metal oxide nanoparticles (Singh *et al.*, 2018). Nanoparticle biosynthesis is considered to be an important tool in reducing the destructive effects associated with traditional nanoparticle synthesis methods used in laboratories and industries (Jeevanandam, *et al.*, 2016 and Chauke *et al.*, 2020).

Nanoparticles with their unique size-dependent property have the ratio of the surface area to volume. The smaller the sized particles carry a greater aspect ratio *i.e.*, greater surface area compared to their volume. This increasing field of smaller nanoparticles enhances the nanoparticle's reaction with the surrounding molecules. Metal oxides at the nanoscale can restrict the movement of electrons due to their small size. They can tune their band gaps and can therefore control their light absorption and emission wavelengths (Mungole *et al.*, 2021). Potential applications of copper oxide nanoparticles (CuONPs) in field launch transmitters, agriculture, gas sensing, waste treatment, catalysis, batteries, food preservation, high-temperature superconductors, solar energy conversion, photovoltaic devices, dye removal, etc. have been established (Akintelu *et al.*, 2020). Due to CuO nanoparticle's high thermal conductivity, optical, magnetic, and electrical properties (Chandrasekar *et al.*, 2021) researchers are truly attracted to it. Besides these applications, CuONPs also have biomedical activities such as anticancer (Rehana *et al.*, 2017), antimicrobial (Ahamed *et al.*, 2014), and antioxidant as well as catalytic efficacy (Dobrucka *et al.*, 2018). The extensive application in wound healing by copper nanoparticles synthesized by *Falcaria vulgaris* leaf extract were examined by . Zangeneh, *et al.*, 2019). Weiss *et al.*, reviewed applications of nanoparticles in food nanotechnology also (Weiss *et al.*, 2006). Presently nanoparticles of various metals using different plants are synthesized with different goals (Pawar *et al.*, 2023; Dandapat *et al.*, 2023., Padhiary *et al.*, 2023).

For the synthesis of CuONPs, physical and chemicals methods used traditionally might be a tedious process (Akintelu *et al.*, 2021) and can give rise to hazardous chemical by-products (Ananda Murthy *et al.*, 2018). On the contrary, the biosynthesis of CuO nanoparticles has been carried out by various biological materials like bacteria, fungi, alga, and plant extract. Among all these methods of biosynthesis of copper oxide nanoparticles, the plant extract mediated approach is a comparatively simple and easy process to produce nanoparticles at a larger scale to bacteria and fungi-mediated

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AN ANALYTICAL SOLUTION OF TIME FRACTIONAL ORDER HYGROTHERMOELASTIC RESPONSE OF CYLINDER BY RAMP TYPE HEATING

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ABSTRACT:

In the context of fractional calculus, an analytical approach is suggested for resolving the coupled time-fractional order hygrothermoelastic equations for a non-simple cylinder. The transient response of an infinitely long cylinder subjected to ramp-type hygrothermal loadings at the surface is examined using the theory of fractional hygrothermoelasticity. Closed-form expressions for temperature and moisture have been derived in the Laplace domain using the Laplace transform method and introducing a new auxiliary function. Finally using the Riemann-sum approximation method, the solution is obtained in a time domain. The numerical findings of the transient response of the hygrothermoelastic fields are provided graphically to show the effect of the ramping time parameter inside the hygrothermal field.

Keywords :- Hygrothermoelasticity, Non-Simple Nano-Cylinder, Laplace Transform, Ramp Type Heating, Fractional Order Differential Equation

INTRODUCTION :

During initial manufacture, most buildings, particularly those made of porous composite materials, are frequently exposed to varying environmental factors including temperature and moisture. For a large range of materials, temperature and moisture are not independent of one another but rather are symbiotic. Determining how temperature and moisture affect these materials and structure's stresses and deformation is therefore of major interest. Many researchers have looked into the related hygrother mochanic issues.

A. Kilbas, H. M. Srivastava, and J. J. Trujillo [1] investigated sequential and non-sequential fractional order linear differential equations as well as systems of linear fractional differential equations connected to the Riemann-Liouville and Caputo derivatives. A. Chowe [2] proposed a diffusion equation for fractional derivatives that produces the Levy statistics. In his hygrothermomechanical bending analysis of variable-thickness thin rectangular plates, A.M. Zenkour clamps two of the plate's opposite edges while leaving the other two opposite edges unsupported [3]. In order to understand how the presence of two unique temperatures permits dependency on higher gradients, Chen, P.J., Gurtin, M.E., and Williams, W.O. turn to a theory that incorporates mechanical effects [4]. In light of a fresh analysis of heat conduction with fractional order, H. H. Youssef developed a novel thermoelasticity theory model, and its uniqueness theorem has been confirmed [7]. The characterization of the quality factor resulting from the viscic processes in the traditional Caputo and Caputo-Fabrizio fractional thermoelastic micro microbeam is studied by H.M. Youssef, A.A. El-Bary, and K.A.M. Al-Lehibi [8]. Povstenko [10] uses the time-fractional diffusion equation to describe the radial diffusion in a cylinder with radius R. In a multilayer plate subjected to hygrothermal loadings at the external surfaces, R. Chibi and

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RESEARCH ARTICLE

Optical properties of $Ca_{12}Al_{14}O_{33}$: RE (RE = Dy^{3+}, Sm^{3+}, Tb^{3+}) phosphor prepared by combustion method

Sunil Kumar R. Bhelave[1] · A. S. Vergade[2] · S. J. Dhoble[3]

Received: 10 August 2021 / Accepted: 21 October 2021

Abstract The $Ca_{12}Al_{14}O_{33}$: RE (RE = Dy^{3+}, Sm^{3+}, Tb^{3+}) phosphor was synthesized by a simple combustion technique. The X-ray diffraction study reveals that phosphor was synthesized successfully. Rietveld refinement parameters obtained using the Full-Prof software. The photoluminescence characteristics were studied for various concentration from 0.5, 1.0, and 1.5 mol% of Dy^{3+}, Sm^{3+}, and Tb^{3+}, where the concentration quenching occurs for 1.0 mol%. The major excitation peak was observed for the $Ca_{12}Al_{14}O_{33}$: Dy^{3+} phosphor at 348 nm which is attributed due to $^6H_{15/2} \rightarrow {}^6P_{7/2}$ while the peak obtained at 366 nm is due to $^6H_{15/2} \rightarrow {}^4I_{13/2}$. In comparison, $Ca_{12}Al_{14}O_{33}$: Sm^{3+} phosphor showed the two excitation peaks at 405 nm and 471 nm noted due to $^6H_{5/2} \rightarrow {}^4H_{7/2}$ and $^6H_{5/2} \rightarrow {}^4D_{3/2}$ and $Ca_{12}Al_{14}O_{33}$: Tb^{3+} phosphor excitation peaks obtained at 351 nm are assigned by $^7F_6 \rightarrow {}^5L_9$ transition whereas 378 nm are caused by $^7F_6 \rightarrow {}^5D_3$. The two emission peaks were noticed for Dy^{3+} ions at 424 nm (Blue) and 513 nm (Orange) regions due to the $^4F_{9/2} \rightarrow {}^6H_{15/2}$ and $^4F_{9/2} \rightarrow {}^6H_{13/2}$. Two intense emission peaks were noticed for Sm^{3+} ions at 564 nm (Orange) and 601 nm (Red) due to the $^4G_{5/2} \rightarrow {}^6H_{7/2}$ and $^4G_{5/2} \rightarrow {}^6H_{9/2}$. The emission peaks were noticed for Tb^{3+} ions at 490 nm (Blue) and 545 nm (Green) regions due to the $^5D_4 \rightarrow {}^7F_6$ and $^5D_4 \rightarrow {}^7F_5$. The particle size and chemical constituents of prepared phosphor. The band gap is obtained using UV-visible spectroscopy. CIE color chromaticity coordinate was calculated which shifted in Blue, Red, and Green regions for respective rare earth ions (RE = Dy^{3+}, Sm^{3+}, Tb^{3+}). The photoluminescence property of the $Ca_{12}Al_{14}O_{33}$: RE (RE = Dy^{3+}, Sm^{3+}, Tb^{3+}) phosphor reveals that the given phosphor has good caliber for solid-state and green light application.

Keywords Photoluminescence · Combustion method · Absorbance · Phosphor

Introduction

In recent decades, need and consumption of energy have risen rapidly all over the world. Accordingly, conventional energy sources have been unable to fulfill it is demand also

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Sunilkumar R. Bhelave[1], A. N. Yerpude[2], S. J. Dhoble[3]

Photoluminescence study of $Sr_3Al_2O_{12}$:Eu^{3+} phosphor for Solid state lighting applications

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$Sr_3Al_2O_{12}$:Eu^{3+} phosphor prepared successfully by simple combustion method. Prepared matrix synthesized for different percentages of composition for rare earth Eu^{3+} = [illegible]. Photoluminescence property was taken for the given doped phosphor which shows the excitation peak at [illegible] nm and [illegible] nm respectively. Emission peaks were observed at [illegible] nm and [illegible] nm for excitation wavelength [illegible] nm and for same emission peak observed for excitation wavelength [illegible] nm was compared [illegible]. The phase of the synthesized phosphor confirmed by X-ray diffraction spectroscopy (XRD). Scanning electron microscopy (SEM), and Photoluminescence (PL) property shows that the given matrix is one of the potential [illegible]

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ORIGINAL

Nagesh Dhere · Lokdeep Khullar · Vinod Varghese

Hygrothermoelastic analysis of non-simple nano-beam induced by ramp-type heating

Received: 25 January 2021 / Accepted: 9 May 2021

Abstract This study investigates a two-temperature hygrothermoelastic model to describe the effects of coupled temperature and moisture in a non-simple nano-beam subjected to hygrothermal loading. This paper analyses the hygrothermal distributions of an Euler–Bernoulli beam with a rectangular cross-section beam. A closed-form solution for temperature, moisture, displacement and hygrothermal stresses is obtained using the decoupling and integral transform methods along the thickness direction. A numerical example with porous composite material in the picosecond scale has been calculated to illustrate the effect of the ramping time parameter within the hygrothermal field. The relevance of the influence of various characteristics is examined. The appropriate discussions and conclusions are reached.

Keywords Hygrothermoelasticity · Non-simple nano-beam · Finite Fourier transform · Euler–Bernoulli equation · Ramp-type heating

1 Introduction

Over the past two decades, scientific study has focused a lot on nanoscale structures because of their superior electrical and mechanical properties. Nano-structures are becoming increasingly valuable for scientists in various sectors, including sensor technology, composite materials, and electromechanical systems. It may be due to the hygrothermoelastic responses of composite nanostructures possessing many advantageous qualities [1]. But on the other extreme, the interactions between temperature, moisture, and thermoelastic deformation are more complicated during calculation. Many researchers have investigated the related hygrothermoelastic problems in this regard; however, just a few of these investigations may be listed here as a brief survey.

Using the integral transform approach, Chang and Wang [2] presented a linear hygrothermoelastic theory to analyze transient responses in various structures subjected to hygrothermal loading. Under the specified surface temperature and moisture load, Sugano [3] obtained analytical solutions for the heat and moisture equation and its associated hygrothermal stress in a functionally graded material plate. Chiba and Sugano [4] studied the heat and moisture equation in a multilayer plate subjected to hygrothermal loads. The effects of hygrothermal loading on the bending of two-dimensional, multilayered composite plates on Carrera's Unified Formulation framework were investigated by Brischetto [5]. Ishihara et al. [6] considered nonlinear

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ORIGINAL PAPER

Naresh Dhiman · Lokbirgh Khalsa · Vinod Varghese

Transient hygrothermoelastic damping analysis of cylindrical nanobeams within a fractional order system

Received: 14 July 2023 / Revised: 15 September 2023 / Accepted: 27 September 2023 / Published online: 31 October 2023

Abstract The interactions between temperature and moisture/ dampness or structural mobility are relatively significant in environments with high heat and humidity levels. This study uses a fractional order framework to build a coupled hygrothermoelastic model with non-Fick and non-Fourier effects by taking into account two temperatures, conductive and thermodynamic heat flux. The hygrothermoelastic damping behavior of the cylindrical nanobeams is modelled using the Euler–Bernoulli beam theory, and an explicit solution is obtained using Laplace transform and modal analysis. The inverse Laplace transforms are computed numerically using a method based on Fourier expansion techniques. The numerical results for various aspect ratios and supports are examined. The effects of the temperature discrepancy factor due to heat flow on the damping and frequency shift within the hygrothermoelastic nano-cylindrical beam are illustrated graphically. The numerical findings show that moisture availability increases the damping of the nanoscale beam, resulting in increased energy dissipation.

1 Introduction

Classical continuum theory is often quite prevalent and cannot provide a good prediction for small scales. Thus, the size-dependent continuum theories, such as the strain gradient theory, couple stress theory, micropolar theory, nonlocal elasticity theory, were developed to characterize the size dependence effect in the nanostructures by introducing an intrinsic length scale. MEMS/NEMS devices have high sensitivity as well as fast response. It is necessary to know how the parameters affect their physical properties and mechanical properties. Unfortunately, a lot has been consistently observed that energy dissipation increases with size decreasing significantly. It has been verified that thermoelastic damping is a significant loss mechanism near room temperature in MEMS/NEMS devices. The complex relationship between heat, moisture, and deformation poses various engineering challenges with significant real-world implications. The transient nature of the boundary circumstances will determine the degree to which these consequences are linked. They may, therefore, be used to produce considerable coupling effects or boundary conditions change in circumstances where coupling effects are relatively insignificant by obtaining them from current experimental data. This can be done in cases where the coupling effects are relatively small. It makes it feasible to investigate with a greater degree of precision

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Assessment of air quality around the thermal power plant area, Chandrapur, Maharashtra, India

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ABSTRACT

Air is the critical main constituent of life on the earth due to respiration phenomenon. Chandrapur city is well known for mining activity and industrial area. Thermal power plant, mining activities, factories and so many industries are established in Chandrapur district. Present study examines the ambient air quality around the thermal power plant for compliance parameters viz. Particulate Matter less than 10 microns and 2.5 microns size (i.e., PM_{10} and $PM_{2.5}$), as well as gaseous pollutants like Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x), Ozone (O_3), Ammonia (NH_3), specific contaminant pollutants involving Hydrocarbons (HCs) and Carbon Monoxide (CO), and heavy metals such as Nickel (Ni), Lead (Pb), Arsenic (As), and Benzo [a] pyrene (BaP) at different areas around Thermal Power Plant, Chandrapur, Maharashtra (India). The National Ambient Air Quality Standard (NAAQS) 2009 was compared to the resultant situations. The results showed that although the levels of toxins and other pollutants near the thermal power plant were designed to be below permissible limits, they are nonetheless at alarmingly high levels from a health perspective.

Introduction

Due in large part to the presence of poisonous trace metals in the atmosphere as a result of rapid industrialization and widening of good moving companies, air pollution has recently become a severe environmental problem (Borbely *et al.*, 1999; Clarke *et al.*, 1996; Vadjic and Fugas, 1997; Ahamad *et al.*, 2022). The adverse health consequences of air pollution are caused by the way the atmosphere behaves (Almeida *et al.*, 1995; Schrabpour *et al.*, 1999; Tsai *et al.*, 1997). Ambient air pollution is a major cause of respiratory health problems in industrial regions worldwide, and children are more vulnerable to it than adults are. Children are more susceptible to air pollution than adults are due to their greater susceptibility to air pollution (Gawande *et al.*, 2016). There are many different natural and manmade sources that contribute suspended particles to the atmosphere, but urban and industrialized regions are the main suppliers (Borbely *et al.*, 1999; Bhatiani *et al.*, 2021). Transportation, industry, burning biomass, and agrarian activities are among the well-known anthropogenic processes causing airborne particulate pollution (Harrison *et al.*, 1997; Him *et al.*, 2001; Arditsoglou and Samara, 2005; Valavanidis *et al.*, 2006; Ruhela *et al.*, 2022a&b). Particulate matter (PM) comprises a wide range of biological and inorganic composites of different sizes and with different elemental properties (Cheng and Lin, 2010). According to Dockery and Pope (1994), elevated PM exposure has been linked to higher rates of death and morbidity in civic populations. Fine aerosol particles, especially those with diameters smaller than 2.5 micrometres, have a significant negative impact on a person's health because they cause lung epithelial shell inflammation-like symptoms (Dockery & Pope, 1994). Studies have been conducted to determine the relationship between the elemental concentrations in urban areas and the size distribution of PM (Fang *et*

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A study on Diversity of Birds in Nawargaon Lake in Maregaon Taluka of Yavatmal District. MH. India.

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ABSTRACT

The present investigation was carried out to document the avifauna in and around the Nawargaon Lake near Maregaon taluka located in the Yavatmal district of Maharashtra State from Feb. 2023 to Jan. 2024 in which 35 species of birds were recorded of 11 different Orders and 24 families during the study. Among the recorded species 26 were residential, 8 were residential migratory and 1 is residential migratory common. Maregaon taluka have immense variety of avifaunal diversity due to because of availability of abundance of food as well as various stagnant freshwater bodies respectively. Near Nawargaon Lake of Maregaon Taluka have found various species of birds due to availability of food and favorable environmental conditions for breeding purpose so far. Various migratory and residential birds have been visited to Nawargaon Lake and nearby areas of forest sanctuary which is famous for Conservation of Tiger. Birds are crucial animal assemblage of an environment and maintain a trophic level. In Nawargaon Taluka farmers mainly take cotton crop during kharip season and birds are easily located in flocks on cotton fields to eat insects and crops especially. During winter season, many migratory birds visited to Nawargaon Lake in search of their food and breeding purpose. The present study was commenced to travel around avifaunal diversity, seasonal abundance of birds and their migratory pattern in and around the study area. There are abundant species of birds found in a variety of surroundings all around the world. Birds are one of the most prosperous clusters of animals on the planet earth as they generally have their habitat (the atmospheres) to themselves. Therefore, detail study on avifaunal diversity and their natural balance is important to guard them.

Keywords: Avifauna, breeding, season, Habitat and avifaunal diversity.

INTRODUCTION

The lake harbor a large number of fauna which attract the birds shown that the entire lake basin is highly dynamic and conductive to all kinds of birds. The Nawargaon Lake is harbors a number of aquatic unwanted plant in the underwater as well as fluctuating state on which increase a large number of organisms. The bank of this lake is infested with weed *Ipomea aquatica* which provide appropriate latent place for the birds. Apart from this, lakes boundary is covered with bushes and trees which provide suitable surroundings for many

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STUDY OF FISH FAUNA DIVERSITY ON PITICHUA LAKE IN CHIMUR TALUKA, DISTRICT. - CHANDRAPUR, (M.S.) INDIA.

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ABSTRACT

This study has been undertaken to investigate the fish faunal diversity which is a decent sign of condition of water biota. A virtuous piscine multiplicity characterizes the well-adjusted environment. Compelling this hooked on deliberation the fish variety of Pitichua Lake is considered during present study. The fishes are one of the most essential vertebrate, providing rich protein sources for human and several animals and important elements in the cheap of many states. Fish variety of Pitichua Lake basically denotes the fish faunal multiplicity. Pitichua Lake preserves a rich variety of fish species which supports the profitable fisheries in Chimur Taluka, District Chandrapur. For the very purpose monthly time series data has been arranged from keeping in the view, the diversity of fish fauna of the Pitichua Lake in Chimur Taluka in Chandrapur District, Maharashtra, has been studied from the period Nov.2022 to Dec.2023. The aim of the study was to explore the fish fauna of Pitichua Lake. In the course of investigation, four sampling spots were selected viz., SPOT-A, SPOT-B, SPOT-C and SPOT-D of Pitichua Lake respectively.

Keywords: Ecosystem, Diversity, Economy, Aquatic, Protein and Source.

I. INTRODUCTION

The productivity of fish species has fascinated the courtesy of distinguished scholars and state has a good involvement in stirring the information group on the water biodiversity of the nation. Some of the earliest studies on the aquatic biodiversity of the state were carried out by Hora and Nair (1941) reported 42 species of fishes in Rihand River of state. Motwani and David (1957) reported 95 species of fishes belonging to 20 families from the some drainage. Dubey and Mehra (1962) recorded 70 fish species in River Chambal. Vyas *et. al.*, (2012) recently studied the aquatic biodiversity of ponds and Rivers of Madhya Pradesh and reported the presence of 86 fish species in different River basin of Madhya Pradesh.

The state of Maharashtra is one of the imperative aquatic biodiversity hotspots of the state, having presented with a large number of water bodies both lotic and lentic, the state assertions of a rich fish biodiversity. Pitichua Lake is by far the most substantial water properties of the state of Maharashtra. The Pitichua Lake is the most essential environmental hub for aquatic biodiversity in Chandrapur District and has therefore been the epicenter of the biodiversity studies.

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Voltammetric Kinetics of Bromination of the Regio-Isomers of Nitrophenol by N-Bromosuccinimide in Aqueous Solution

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Abstract: *The rapid bromination kinetics of the regio-isomers of nitrophenol in aqueous solution by N-bromosuccinimide at 1.0 x 10^{-2} ionic strength has been studied by the rotating platinum electrode (RPE) techniques. The specific reaction rates for the bromination of the ortho, meta and para nitrophenol have been found to be 40.0, 5.67 and 20.0 $m^3x^{-1}s^{-1}$ at 25 ^{0}c respectively. The energy of activation, e_a and frequency factor, a, are evaluated. presumably due to rapidity of the reactions in aqueous solution necessitated a special technique ype to measure unreacted NBS which is the only electro reducible species in the reaction. The kinetic data provides the relative substrate reactivity. The thermodynamic parameters are calculated.*

Background: *In voltammetry, dropping mercury electrode can not be used in rapid reactions due to its markedly positive potential of 0.4 volt against saturated calomel electrode because at this potential oxidation of mercury takes place. In place of dropping mercury electrode an inert platinum electrode can be used to extend the range of voltammetric measurements. The attainment of the steady diffusion current is very slow with stationary platinum electrode. This difficulty has been overcome by rotating platinum electrode at constant speed. In order to establish relation between diffusion current and concentration of the reactant, the speed of stirring must be kept constant during the reaction. The relative reactivity during bromination of regioisomers of nitrophenol were studied voltammetrically.*

Materials And Methods: *In this kinetic study the three regio-isomers of nitrophenol namely o-nitrophenol, m-nitrophenol and p-nitrophenol were subjected to bromination using the brominating reagent N-bromosuccinimide at temperature range of 15 to 30 °C. The voltammetric technique was used with the employment of rotating platinum electrode at 600 rpm. The various kinetic parameters such as specific reaction rates, k, frequency factor, A, energy of activation, E_a, were evaluated. The thermodynamic parameters such as enthalpy of activation, $\Delta H^{\ddagger}$, entropy of activation, $\Delta s^{\ddagger}$ and free energy of activation, $\Delta G^{\ddagger}$ were also determined.*

Results: *The relative reactivities of the regio-isomers of nitrophenol have been speculated quantitatively. The quantitative assessment was declined due to the rapidity of these reactions. Hence rotating platinum electrode was used to evaluate the specific reaction rates. The specific reaction rates of bromination of o-nitrophenol, m-nitrophenol and p-nitrophenol by NBS in aqueous solution at 25 °C were found to be 40.0 m^3x^{-1}, 5.67 m^3s^{-1} and 20.0 m^3x^{-1} respectively.*

Conclusion: *The relative reactivity for the bromination of regio-isomers of nitrophenol is $k_{m\text{-}nitrophenol} < k_{p\text{-}nitrophenol} < k_{o\text{-}nitrophenol}$. The bromination of nitrophenol by NBS is overall second order reaction. The probable mechanism for this reaction is proposed. The RPE technique has been conveniently used rather than DME technique to study the rapid bromination reactions of regio-isomers of nitrophenol.*

Key Word: *Bromination; Kinetics; Voltammetry; Nitrophenol; Rotating Platinum Electrode (RPE).*

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I. Introduction

Organic compound containing bromine molecules are of considerable commercial importance. They can be used as potential antiviral, antineoplastic, antifungal, antibacterial, antitumor and autooxidising agents. They can also be used as industrial intermediates in manufacture of agrochemicals, pharmaceuticals and other products such as medicinal, herbicides, pesticides and flame retardants[1-4], such compounds are also playing key role in preparation of organometallic reagents[5-12] and transition metal coupling reactions.[13-15]

Use of all the halogenated compounds in organic synthesis is well known.[16] Generally, halogenations of organic compounds are electrophilic aromatic substitution reactions.[18] Among these, electrophilic aromatic bromination are important reactions known to organic chemist, Brominations are rapid as compared to iodinations[19]. Therefore, it is necessary to study halogenation of aromatic compounds.

In present study, we have studied the kinetics of bromination of regio-isomers of nitrophenol by N-bromosuccinimide in aqueous medium (Figure -1) using (1 x 10^{-2} M) potassium chloride as supporting

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VOLTAMETRIC KINETICS OF BROMINATION OF REGIO-ISOMERS OF CHLOROPHENOL BY N-BROMOSUCCINAMIDE IN AQUEOUS SOLUTION

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Abstract: The rotating platinum electrode, RPE[1] has been used much less frequently than the Dropping Mercury Electrode in voltametric measurements. Nevertheless, it is for the study of the kinetics of fast reactions. The bromination of phenols and their derivatives are usually very fast and their kinetics have been studied only by indirect methods. Since these reactions follow second order kinetics, their half-lives can be made long enough for convenient kinetic measurements by making the solutions dilute enough and since, by means of RPE, it is possible to measure even very low concentrations of N-Bromosuccinimide (NBS), the course of such reactions can be directly followed. As typical instances, the kinetics of bromination of o-chlorophenol, m-chlorophenol and p-chlorophenol in aqueous solution have been studied. In these reactions only NBS is reducible at the RPE among the reactants and products.

Keywords - Regio-isomers, Bromination, Voltametry, N-Bromosuccinimide, Rotating Platinum Electrode.

Introduction

Halogenated compounds are very important in organic synthesis.–These compounds are often used in preparation of organometallic reagents[2,3] and coupling reactions[4-9]. They are also used as pesticides, disinfectants[9], herbicides and other commercially available products[10]. Halogenations of aromatic compounds are electrophilic aromatic substitution reactions[11]. Electrophilic aromatic bromination is an important reaction known in organic chemist. Among these bromination reactions are rapid as compared to iodination reactions[11].

In present study, kinetics of bromination of regioisomers of chlorophenol has been carried out. Since the reactions are too rapid to be studied by conventional techniques, it has been studied by the use of rotating platinum electrode (RPE)[12-17]. RPE operates on the principle of zero potential versus saturated calomel electrode. At this principle, only N-Bromosuccinimide yields diffusion current equal to its concentration during the course of reaction. Neither the solvents nor the products of the reaction yield any diffusion current. Hence, the course of reaction can be followed by the monitoring the concentration of unreacted NBS by measuring diffusion current at various intervals of time.

The kinetic measurement of the bromination of o-chlorophenol, m-chlorophenol and p-chlorophenol by NBS has been carried out at four different temperatures. The specific reaction rate, K, energy of activation, E_a, and Arrhenius factor, A, has been found out. Hence, the thermodynamic parameters such as enthalpy of activation, $\Delta H^{\ddagger}$, entropy of activation $\Delta S^{\ddagger}$ and free energy of activation, $\Delta G^{\ddagger}$ have been evaluated.

Material and Methods

Chemicals

Analytical grade chemicals were used in the present study. Stock solutions of 5.0×10^{-3} M NBS, o-chlorophenol, m-chlorophenol and p-chlorophenol were prepared in double distilled water. 1.0×10^{-2} M potassium chloride was prepared as the supporting electrolyte. Required concentrations of reactants was prepared from stock solutions.

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Silver nanoparticles in water treatment: a review on Synthesis, Applications and Mode of Action

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ABSTRACT

Silver nanoparticles have emerged as a promising disinfectant in recent years due to their unique properties and effectiveness against a wide range of microorganisms. The use of silver nanoparticles as disinfectants is gaining popularity in various fields, including healthcare, food industry, and water treatment. It shown to have excellent antimicrobial properties and can be used to kill bacteria and viruses in water. These nanoparticles can be used in various forms, including as coatings on surfaces or as additives in water treatment plants. The use of silver nanoparticles has been shown to be effective in reducing microbial growth in water systems and improving the quality of drinking water. This review article describes various applications of Silver nano-material against a variety of water pollutants and also emphasizes on the study of various methods of synthesis and its mode of action.

Keywords: Antimicrobial activity, Mode of action, Silver nanoparticles, Synthesis, Water treatment

1. Introduction

Water is an essential resource for all living organisms, and the quality of water is crucial for human health and the environment. However, the increasing population and industrialization have led to the contamination of water with microorganisms, heavy metals, and organic pollutants. Therefore, there is a need for effective water treatment methods that can remove these contaminants and provide safe drinking water.

The sustainable growth of any civilization is in directly proportion with developing new methods for the organization of its environmental excellence. Use of Nanomaterials for water and wastewater treatment is highly efficient, modular, and multifunctional in nature, and they provide high performance, reasonable water and, wastewater treatment solutions. Numerous studies have shown that nano-materials can effectively remove various pollutants from water and wastewater thus has been successfully applied in water treatment.

Nanotechnology has emerged as a promising field for water treatment due to the unique properties of nanoparticles. These are the particles with a size range of 1-100 nanometers, and their small size and large surface area make them suitable for various applications in water treatment. In recent years, research has focused on the use of nanoparticles for water purification, including removal of pollutants, disinfection, and