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Original research article

Investigation of plasma cladded optical fiber for dynamic manipulations of its propagation properties

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ABSTRACT

Plasma cladded optical fiber (PCOF) is numerically investigated which exhibits tunable guiding properties. The effect of plasma frequency on mode field diameter, longitudinal propagation constant and modal dispersion are investigated thoroughly. It is shown that propagation features of PCOFs could be manipulated dynamically (online) by varying the plasma frequency; suggesting its potential applications in addressing coupling issues and dispersion management. Possibility of manipulation of propagation constant carries the potential for applications in delays and buffers. It is further observed that the nature of dispersion curve of HE₁₁ mode of PCOF is usual but could be made more flattened compared to the dielectric fiber by using appropriate plasma frequency which is promising for dispersion management. As fibers with tunable guiding properties have numerous potential applications in optical processing and integrated optics, proposed work should be of high interest from the fundamental as well as engineering point of view.

1. Introduction

The spectacular growth in the demand of high data transfer speed of audio/video signals and availability of higher bandwidth prompted the revolution in the field of optical communications. Dynamic (online) control (especially via electrical tuning) over optical characteristics e.g. dispersion remains favorable choice for multifold applications in integrated photonics [1,2]. To obtain desired guided mode properties (in the quest to mitigate the future demands of bandwidth), various improvements in fiber geometry and core-cladding materials have been introduced and analyzed [3–6]. Theoretical innovations in fiber geometry and core-cladding materials have put up some unconventional waveguide structures, e.g., helically cladded optical fiber (HCOF), which have been cited to be useful in externally manipulating the propagation characteristics of guided modes [7–13]. Such manipulations are possible through helix pitch angle- the angle made by helical turns with the normal on fiber axis. Such fibers have emerged as unconventional optical waveguides accompanying many distinct characteristics compared to the conventional optical fibers. However, the introduction of helical windings at the core-cladding interface displays a complex structure of the round optical fiber from manufacturing point of view. Optical fibers loaded with plasma either in its core or in cladding region, falls under unconventional optical waveguides, have been an emerging subject of research investigations.

In the core of the above-mentioned research investigations is the quest to manipulate the guiding properties of fiber by some

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Original research article

Investigation of coupled self-tapering/self-uptapering of soliton beams in nonlinear media

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ABSTRACT

Coupled tapering/uptapering phenomenon of two coaxially co-propagating mutually incoherent beams of same frequency with finite loss/gain is investigated in this paper for Kerr nonlinear medium. The phenomenon is investigated, in detail, for different situations and parameters for coupling coefficient equal to 2 and 2/3.

1. Introduction

Optical spatial solitons (or self-trapped optical beams) are due to a balance between diffraction and nonlinear focusing effects [1]. For a given nonlinear medium (i.e., nonlinear coefficient), proper choice of intensity and width of optical beams, creation of bright as well as dark spatial solitons is possible. A bright soliton is a self-trapped optical beam having bell shaped intensity profile, while, a dark soliton has a dip at the center of its intensity profile. Phenomenon of spatial solitons formation has been a subject of profound interest for scientists and technologists as those have been identified as potential candidate in all-optical gates and interconnects. There is one very interesting phenomenon in relation to the spatial solitons or self-trapped beams which is called as self-tapering/self-uptapering [2,3]. Self-tapering/self-uptapering of spatial solitons is the only means by which width of a self-trapped optical beam could be manipulated all-optically, i.e., without using any fabricated structure [2]. Self-tapering/self-uptapering of solitons has been investigated in recent past for one bright soliton beam in (i) Kerr medium [2], (ii) saturable medium [3,4], (iii) elliptic core fiber [5] and (iv) cubic-quintic medium [6]. In addition to self-tapering/self-uptapering of one beam, coupled tapering/uptapering of two bright soliton beams has also been investigated [7,8]. Further, coupled tapering/uptapering of two dark soliton beams has been recently investigated [9].

The potential applications of self-tapering/self-uptapering include optically induced waveguide tapers/uptapers [3], optically tunable adiabatic beam splitter [10] and small-scale self-focusing [11]. It is worth to add here that the phenomenon self-tapering/self-uptapering is equally valid in time domain and thus have potential applications in reshaping of Gaussian pulses in fiber amplifiers (gain media) and in optical fibers with finite (non-zero) losses.

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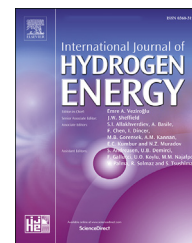
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Effect of addition of di-tert butyl peroxide (DTBP) on performance and exhaust emissions of dual fuel diesel engine with hydrogen as a secondary fuel

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HIGHLIGHTS

- BTE increased by 13% use of 5% DTBP at 69% load as compared to diesel fuel.
- BTE increased by 6% with 3% DTBP at 40% use of H₂ as compared to diesel fuel.
- NO_x reduced by 27% with 1% DTBP and 40% H₂ at 69% load as compared with DFD mode.
- DTBP reduces NO_x as well as the CO, HC and smoke opacity of the DFD engine.

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ABSTRACT

Today, the world faces a number of challenges on global level. The optimum replacement for fossil fuels is one of these challenges. Hydrogen in the past has been and continues to be used by numerous researchers in diesel engines. However, high NO_x emissions and low replacement of hydrogen fuel are the concern with many researchers. In the present study, di-tert butyl peroxide (DTBP) has been used as an additive in diesel fuel, to investigate the performance and exhaust emissions of the diesel engine working on dual fuel mode by using hydrogen as secondary fuel. At low, medium and high load conditions, the maximum increase in brake thermal efficiency was observed to be 87.50%, 14.68% and 5.89% respectively for 1%, 3% and 5% of additive (DTBP) by 40% of hydrogen fuel substitution, as compared to diesel fuel operation. Moreover, by addition of 4% di-tert butyl peroxide (DTBP) in diesel engine working on dual fuel mode showed 33.82%, 10.27% and 29.27% reduction in NO_x emission at low, medium and high load conditions respectively at 40% hydrogen substitution, as compared to dual fuel operation using hydrogen as secondary fuel without additives. By addition of 5% additive (DTBP) at 69% load condition and 40% hydrogen substitution, reduces CO emissions by 38.66% as compared to dual fuel operation, using hydrogen as secondary fuel.

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Shoreline changes and its impact on the mangrove ecosystems of some Islands of Indian Sundarbans, North- East coast of India

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ABSTRACT

This study aims to analyze the shoreline oscillations of three estuarine Islands in Sundarban delta and its impact on mangrove forests around the Islands. Six multi-temporal Landsat images spanning 42 years (1975-2017) have been used in the study. Band ratio was computed to discriminate the water line from the land, which was later digitized. Digital shoreline analysis system (DSAS) was employed for estimation and analysis of the shorelines changes by End point rate (EPR) model and Linear regression rate (LRR) model after laying transects offshore of the baseline. Sea level and topography of the islands have also been analyzed. To assess the mangrove health, time series Normalized Differential Vegetation Index (NDVI) analysis has been performed using the Mann Kendal Tau statistics and Sen's slope. Mangrove degradation maps were produced from the data and combined with evidences collected from field works. The results point to a very dynamic shoreline ensuing in erosion of mangrove forests while some areas do show encouraging trends due to sustained accretion especially in the southern and eastern parts. Overall erosion is higher than accretion in the Islands. Results show that NDVI has been decreasing along patches that are near to erosion hotspots irrespective of climatic trends. Thus it can be concluded that mangrove forests are under severe stress due to shoreline ingression and sea level rise and not climatic alterations. Going forward this work could provide significant information on the nature of shoreline changes and could assist in sustainable development for Sundarban biodiversity niche management.

Keywords: Shoreline, Mangroves, NDVI, Sea level rise, Time Series analysis, Mann-Kendall and Sen's Slope.

Folate-producing rhizobacteria of *Hippophae rhamnoides* L. from Indian trans-Himalaya low atmospheric zone

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Abstract: *Hippophae rhamnoides* L. is a plant of immense ethnopharmacological importance and is a known source for various valuable biochemicals and nutraceuticals. The production of folate, a vitamin involved in several vital functions, in this plant is rather poorly understood. Herein, we investigate the hypothesis that rhizobial bacteria serve the plant in this essential vitamin's biosynthesis. Bacterial strains of *Bacillus*, *Azorhizobium*, *Frankia*, *Paenibacillus*, *Brevibacillus* and *Pseudomonas*, were isolated from the rhizosphere of the plant. HPLC and LCMS were used to trace the production of intra and extra-cellular folate by representative rhizospheric bacterial strains *in vitro*. From the seventeen functionally characterized bacterial strains of the plant's rhizosphere, thirteen produced significant amounts of folate. *Azorhizobium* BR5401 produced the maximum amount of folic acid (424 µg/mL), and *Bacillus* GY779 was the only strain capable of producing both intracellular and extra-cellular folic acid. The Open Reading Frame coding for dihydroneopterin aldolase, an enzyme involved in folate biosynthesis, was found in one of the representative isolates. Our experimental findings help us to suggest that the folate synthesized by rhizobial bacteria is transported to the plant, highlighting a significant benefit of coexistence.

Keywords: Sea buckthorn; Rhizosphere; Folate; HPLC; Dihydroneopterin aldolase

Introduction

Plant roots impact the rhizospheric soil and microorganisms, which affect the plant's growth and survival. Numerous microbial populations residing in the rhizosphere get shelter and protection because of the convincing exchange made by them in return. This adjuvant exchange has been widely studied by scientists and researchers because they spotlight the chief molecules anchoring such a relationship. The plant *Hippophae rhamnoides* L., commonly known as "sea buckthorn" (SBT), is abundantly found in cold temperate regions of Europe and Asia. In the Indian subcontinent, it is found along the banks of the river Indus (or Sindh) and throughout the Himalayan region. The plant grows in the wild under adverse climate conditions and is also helpful in soil conservation because its well-developed root system fixes the soil horizontally. It offers highly desirable characteristics that find application in medicinal, food, and animal fodder sectors.



Pandemic induced lockdown as a boon to the Environment: trends in air pollution concentration across India

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Abstract

The present paper designed to understand the variations in the atmospheric pollutants viz. PM₁₀, PM_{2.5}, SO₂, NO₂, and CO during the COVID-19 pandemic over eight most polluted Indian cities (Mumbai, Delhi, Bangalore, Hyderabad, Lucknow, Chandigarh, Kolkata, and Ahmedabad). A significant reduction in the PM_{2.5} (63%), PM₁₀ (56%), NO₂ (50%), SO₂ (9%), and CO (59%) were observed over Major Dhyan Chand Stadium. At Chhatrapati Shivaji International Airport, a decline of 44% in PM_{2.5} and 50% in PM₁₀ was seen just a week during the initial phase of the lockdown. Gaseous pollutants (NO₂, SO₂ & CO) dropped up-to 36, 16, and 41%, respectively. The Air Quality Index (AQI) shows a dramatic change from 7% to 67% during observation at Chandigarh and Ballygunge during the inspection. Whereas, Ahmedabad, Worli, Income Tax Office, Talkatora, Lalbagh, and Ballygaunge have showed a significant change in AQI from 25.76% to 68.55%. However, Zoo Park, CST, Central School, and Victoria show relatively low variation in AQI in the range of 3.0% to 14.50% as compare to 2019 after lockdown. Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) analysis suggested that long range transportation of pollutants were also a part and parcel contributing to changes in AQI which were majorly coming from the regions of Iran, Afghanistan, Saudi Arabia, as well as a regional grant from Indian Gangatic plains and Delhi Non-capital region.

Keywords COVID-19 · Coronavirus · Air quality index · Back trajectories · India

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1 Introduction

The 2019-n COVID-19 (novel corona) is a pneumonia-like disease firstly reported to the World Health Organization (WHO) on 31 December 2019 which was originated in the Wuhan, China. It subsequently spread to other countries like Thailand, Italy, and USA etc. On 13 January 2020, WHO initiated a national capacity review tools for the current status of laboratories and equipment capabilities to screen the virus (Driggin et al. 2020). On 30 January 2020, the first infection of a novel coronavirus in India was reported in Kerala, with a patient having travel history to China. The second case was reported in the next four days, thus Kerala (State of India) declared the state emergency on 4 February 2020. India was experiencing the condition of the epidemic, which had already turned out as a pandemic across the globe, so a complete lockdown was ordered in India on 22nd march 2020 by Prime Minister Modi (Gautam and Hens 2020a). Approximately 10,187,772 positive cases and 147,665 reported deaths due to the pandemic on 27

An Approach Using Fuzzy Sets and Boosting Techniques to Predict Liver Disease

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Abstract: The aim of this research is to develop a mechanism to help medical practitioners predict and diagnose liver disease. Several systems have been proposed to help medical experts by diminishing error and increasing accuracy in diagnosing and predicting diseases. Among many existing methods, a few have considered the class imbalance issues of liver disorder datasets. As all the samples of liver disorder datasets are not useful, they do not contribute to learning about classifiers. A few samples might be redundant, which can increase the computational cost and affect the performance of the classifier. In this paper, a model has been proposed that combines noise filter, fuzzy sets, and boosting techniques (NFFBTs) for liver disease prediction. Firstly, the noise filter (NF) eliminates the outliers from the minority class and removes the outlier and redundant pair from the majority class. Secondly, the fuzzy set concept is applied to handle uncertainty in datasets. Thirdly, the AdaBoost boosting algorithm is trained with several learners viz, random forest (RF), support vector machine (SVM), logistic regression (LR), and naive Bayes (NB). The proposed NFFBT prediction system was applied to two datasets (i.e., ILPD and MPRLPD) and found that AdaBoost with RF yielded 90.65% and 98.95% accuracy and F1 scores of 92.09% and 99.24% over ILPD and MPRLPD datasets, respectively.

Keywords: Fuzzy set; imbalanced data; liver disease prediction; machine learning; noise filter

1 Introduction

Liver diseases are the leading cause of death in India and across the world. Approximately two million people die annually because of liver disease throughout the world. In India alone, 216,865 people died from liver disease in 2014, representing 2.44% of all deaths in the country. In 2017, the number of deaths increased to 259,749, representing 2.95% of all deaths [1].

Diagnosing liver disease in its early stages is a complicated task, as the liver continues to perform normally until it is severely damaged [2]. The diagnosis and treatment of liver disease are performed by medical experts. However, inappropriate treatment sometimes wastes time and money and causes the loss of life. Consequently, the development of an efficient and automatic liver disease prediction system is necessary for efficient and early diagnosis. Automated liver prediction systems take advantage of the data generated from the liver function test (LFT). This system can support the medical practitioner in diagnosing liver disease with less effort and more accuracy. The classification technique of a machine learning algorithm is applied when developing automated disease prediction systems [3,4]. The purpose of the classification algorithm is to predict the class label of an unknown instance [5] and work adequately when the instances of the dataset are uniformly distributed among all the classes (balanced) [6]. Most healthcare datasets, such as those for breast cancer [7,8], heartbeat [9], diabetes [10–13], kidney [14], and liver disorders [15–17], involve class imbalance. The standard classification performs



Hydroponic farming hotspot analysis using the Getis–Ord G_i^* statistic and high-resolution satellite data of Majuli Island, India

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ABSTRACT

Majuli is the world's largest Riverine Island, formed by the headward erosion and migration of the Brahmaputra River. It is a part of the floodplains, which causes loss of arable lands, crops and farmers' livelihood. To cope and adapt, farming communality adopted hydroponics farming. In this study, high-resolution satellite data (~3 m) were deployed to detect hotspots of hydroponics growing under flood conditions. A Getis–Ord G_i^* spatial statistics technique was employed along with vegetation indices. The spatial maps exhibit that at several locations of Majuli Island, hydroponics was detected during the monsoon season. In total, 14 major sites were identified under hydroponics with a total area of 5.6 ha. The accuracy of hydroponics was assessed using precision and recall with the F1 score of 0.94. Around six sites of hydroponics were also validated with the independent high-resolution Google Earth image. This study demonstrates the utility of spatial statistics technique and high-resolution data for hotspot analysis of hydroponics farming. The method can be adopted for making plans and policies to identify locations for the commercialization of hydroponics farming, which could assist in food security, employment and farmer's livelihood and has the potential to meet the second sustainable development goal (SDG).

ARTICLE HISTORY

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1. Introduction

The worldwide population is growing rapidly over the decades, and the population will exceed 9.7 billion by 2050 (United Nations 2019) or by 2064 (Vollset et al. 2020). The highest population increase will occur in developing countries (United Nations 2019), where major socio-economic, food insecurity and poverty are the major issues. Under the burgeoning global population and demand for food supply, an additional 60–70% of global food production may require to feed the population by 2050 (Fróna, et al., 2019). One of today's agriculture challenges is to produce and supply food production while making agriculture and food systems sustainable by efficiently utilizing natural resources. The natural resources include mainly arable land, water and air. Among them, water is a critical resource (Popp et al. 2014) whilst arable land is under

Nimbolide, a Neem Limonoid, Is a Promising Candidate for the Anticancer Drug Arsenal

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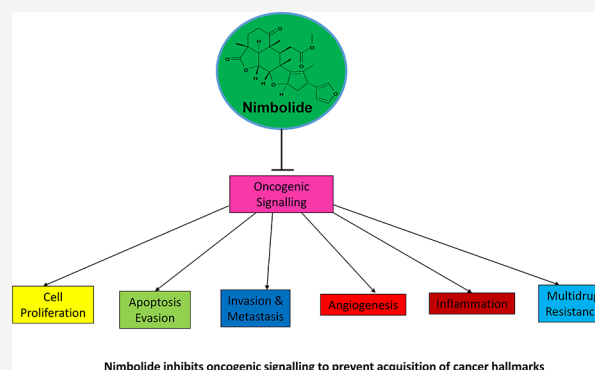
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ABSTRACT: Nimbolide, a major limonoid constituent of *Azadirachta indica*, commonly known as neem, has attracted increasing research attention owing to its wide spectrum of pharmacological properties, predominantly anticancer activity. Nimbolide is reported to exert potent antiproliferative effects on a myriad cancer cell lines and chemotherapeutic efficacy in preclinical animal tumor models. The potentiality of nimbolide to circumvent multidrug resistance and aid in targeted protein degradation broaden its utility in enhancing therapeutic modalities and outcome. Accumulating evidence indicates that nimbolide prevents the acquisition of cancer hallmarks such as sustained proliferation, apoptosis evasion, invasion, angiogenesis, metastasis, and inflammation by modulating kinase-driven oncogenic signaling networks. Nimbolide has been demonstrated to abrogate aberrant activation of cellular signaling by influencing the subcellular localization of transcription factors and phosphorylation of kinases in addition to influencing the epigenome. Nimbolide, with its ever-expanding repertoire of molecular targets, is a valuable addition to the anticancer drug arsenal.



1. INTRODUCTION

Cancer is the second most common cause of death worldwide and a major public health issue. Despite recent advances in treatment options, the morbidity and mortality due to cancer continue to increase.¹ Furthermore, toxicity and adverse side effects of chemotherapeutic agents as well as drug resistance pose serious challenges to oncologists. Recent research efforts on cancer drug discovery have therefore focused on natural products that exhibit high therapeutic efficacy with low toxicity and minimal side effects. A large number of phytochemicals from medicinal plants have emerged as promising anticancer drug candidates, and some of them have entered clinical trials.² Of late, limonoids from the neem tree have received increasing research attention for their potent antiproliferative effects.^{3,4}

Neem (*Azadirachta indica* A. Juss) is an evergreen tree of the Meliaceae family, ubiquitously found in the Indian subcontinent and widely distributed in Asia, Africa, and America. Neem has gained enormous importance for its applications in the agricultural and pharmaceutical industry, as well as for its well-established ethnomedicinal value.^{5–7} Neem has been used as a food and folklore medicine to treat a variety of human ailments and has won epithets such as “heal all”, “divine tree”, “village dispensary”, “nature’s drug store”, and “tree of the 21st century”. All parts of the neem tree have been documented to display a wide range of pharmacological properties including antiseptic, antiparasitic, analgesic, antimicrobial, antiulcer, hepatoprotective, antihyperglycaemic, orodental protection,

anti-inflammatory, immunomodulatory, and anticancer effects. The antiproliferative effects of neem extracts and constituents have been extensively documented in a wide array of cancer cell lines *in vitro* and in preclinical animal tumor models *in vivo*. Neem is recognized to inhibit the development and progression of cancer by multiple mechanisms ranging from prevention of procarcinogen activation and oxidative DNA damage, upregulation of antioxidant and carcinogen detoxification systems, inhibition of tumor cell proliferation, invasion, and angiogenesis, and induction of apoptosis.^{5,8}

The medicinal properties of neem have been attributed to the rich array of over 400 structurally diverse and chemically complex bioactive compounds, one-third of which are tetranortriterpenoids or limonoids.^{7,8} The major limonoids present in the neem tree include azadirachtin, azadiradione, epoxyazadiradione, gedunin, 6-desacetyl nimbinene, nimbidin, nimbin, nimolinone, and nimbolide. Nimbolide was found to be the major contributor to the antiproliferative effects of neem.⁹ In this review, we provide an overview of the

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Hydrogeochemical characteristics and quality appraisal of groundwater in Baramulla District, Jammu and Kashmir, India

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Abstract: Thirty groundwater samples from open wells (6 samples), hand pumps (15 samples) and springs (9 samples) were collected across District Baramulla, Jammu and Kashmir and analysed for major ions, to determine the processes controlling water chemistry and suitability of water for drinking, domestic and irrigation purposes. The water samples are slightly acidic to neutral in nature. The cations followed an order as $\text{Ca} > \text{Mg} > \text{Na} > \text{K}$ and anions as $\text{HCO}_3 > \text{Cl} > \text{SO}_4 > \text{NO}_3$. The dominant hydrogeochemical water type identified is Ca-HCO_3 , is due to the water rock interaction which leads to the easy weathering of carbonate rocks. Scatter plots of $\text{Ca} + \text{Mg}$ vs $\text{HCO}_3 + \text{SO}_4$, Ca/Na vs HCO_3/Na , $\text{Na} + \text{K}$ vs total cations and $\text{Ca} + \text{Mg}$ vs total cations clearly indicate the carbonate weathering playing a dominant role on groundwater chemistry. Chloro-alkaline indices indicate base exchange reaction between Na^+ , K^+ , Mg^{2+} and Ca^{2+} and are categorised as base-exchange hard water. The physical parameters and major ions are within the permissible concentrations as per WHO and BIS standards except for total hardness and conductivity. Ca^{2+} in 20 samples, Mg^{2+} in 14 samples, EC and TDS in 6 samples and K^+ in 3 samples is higher than the prescribed standards, suggesting the overall groundwater is suitable for drinking, domestic and livestock uses. The WQI values ranges from 29.24 to 50.2 with an average of 37.6 indicating the quality for drinking is excellent and is potable for humans. The groundwater is suitable for irrigation as per the quality parameters and plots including EC, sodium percent (Na%), sodium adsorption ratio (SAR) and Wilcox classification diagram.

Key words: Hydrogeochemical assessment, Groundwater Quality, Water Quality Index, Baramulla District.

Introduction

Groundwater is an integral part of the hydrological cycle that provide largest global resource of fresh water for drinking, domestic and agricultural purposes (McDonough, 2020; Megdal, 2018; Jasrotia *et al.*, 2019a; Khan *et al.*, 2020; Haque *et al.*, 2020; Sarkar *et al.*, 2020). The chemistry of the groundwater depends upon various geogenic factors such as geology of the area, degree of chemical weathering and anthropogenic factors like agriculture, urbanization and industrial activities (Bhat, 2019; Rao *et al.* 2018; Jasrotia *et al.* 2019b; Ravindra and Garg, 2007). In developing countries including India, the considerable reasons for deterioration of groundwater quality are population growth, uncontrolled urbanization and industrial development, high usage of fertilizers, mismanagement of wastes and lack of proper groundwater management strategy etc. (Ali *et al.* 2018; Adimalla and Taloor, 2020; Jeelani *et al.*, 2011; Jasrotia *et al.*, 2018; Adimalla *et al.* 2020). In addition, erratic rainfall, high

evaporation, over exploitation causes decline in groundwater levels. Thus, groundwater is being depleted faster than nature replenishes it, and its quality is being compromised. The demand for fresh and quality water has resulted water crisis in many parts of the country (Shekhar *et al.* 2020).

Recently, groundwater has been studied in different states of India to assess its quality using water quality indices (Banerjee and Srivastava, 2009; Gupta *et al.*, 2017; Verma *et al.*, 2019), controlling factors and influence of contamination factors. Adimalla and Taloor (2020) assessed the groundwater quality in Medak region of India using spatial distribution and water quality index. Rao *et al.* (2018) studied the groundwater quality using pollution index of groundwater (PIG) in a rural region of Wanaparthy, Telangana state, India and found that the PIG provides accurate information about the quality of groundwater for domestic purposes. In Himalayan region, Taloor *et al.*, (2020) evaluated the quality of spring water in Basantar watershed of Jammu Himalayas



Modification in crystal structure of copper ferrite fiber by annealing and its hyperthermia application

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Abstract

The copper ferrite fiber has been synthesized using the electrospinning technique by optimizing the electric voltage and viscosity of the polymer solution. Physical properties of copper ferrite fiber have been tuned with annealing at different temperatures (550, 750, and 950 °C for 2 h). The crystal structure has been confirmed by X-ray-diffraction pattern analysis and studied by using Rietveld refinement technique. The morphology of fibers was explored with the help of field emission scanning electron microscopy. The fibers annealed at 550 °C crystallize to cubic structure, and the tetragonal phase has been observed for 750 °C, and 950 °C annealed fibers. Sample annealed at 750 °C shows the highest magnetocrystalline anisotropy constant at 300 K (3×10^5 erg/cc). The SAR (Specific absorption rate) and ILP (intrinsic loss power parameter) of the 750 °C annealed fibers are 265 ± 5 W/g and 3.412 nHm²/Kg, respectively. The SAR value calculated by using non-adiabatic approach is 335 W/g.

Keywords Electrospinning · Magnetic hyperthermia · Intrinsic power loss · Box-Lucas model · Tetragonal crystal structure

1 Introduction

The spinel ferrite is represented by the empirical formula AB_2O_4 , where A is divalent cations (Cu^{2+} , Co^{2+} , Mn^{2+} , Ni^{2+} , and Zn^{2+}) and B is trivalent cations (Co^{3+} , Ni^{3+} , Fe^{3+}). The oxygen atoms constitute the face-centered cubic structure. The inverse, normal and mixed spinel structure depends upon the cation distribution on A-site and B-site. Copper ferrite is one of the spinel ferrite family members, popular for two different crystal structures cubic and tetragonal. The unit cell of cubic spinel ferrite material possesses eight empirical formula units. There are total 96 interstitial crystallite sites present inside the material. Out of 96 interstitial sites, 64 sites for tetrahedral sub-lattice and 32 for octahedral sub-lattice. Metal cations occupy only 24 sites,

and 32 sites occupied by anions constitute the crystal structure, i.e., total 56 atoms are present in one cubic unit cell. In the tetragonal phase, a unit cell possesses four formula units so that its volume and size are reduced in comparison with the cubic phase [1]. Crystal structure, morphology, and physical properties change with annealing temperature and synthesis method [2]. There are many techniques to fabricate the spinel ferrite magnetic materials, such as sol-gel method, co-precipitation method, electrospinning method, and hydrothermal method [3]. The nanomaterials exhibit different magnetic properties depending upon their morphology (spherical particles, nanotube, nanoflower, nanosheet, and thin-film) [4].

Spinel ferrite magnetic material has been extensively investigated due to its enriching physical properties, making it suitable for technological applications [5]. Among all the spinel ferrite materials, copper ferrite is a well-known soft magnetic material. Copper ferrite has theoretical and experimental aspects of the study because of its different crystal structures [6]. It has many applications in electronics, wastewater management (as an absorbent to remove the pollutant), magnetic sensors, drug delivery, and hyperthermia application [5–7]. Here, a short review has been presented on this material to justify the present research

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PAPER

Effect of different operating conditions on the conversion efficiency of triple-junction solar cell

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Durgesh Kumar¹, Dharmendra Kumar Dheer² and Lawrence Kumar¹ ¹ Department of Nanoscience and Technology, Central University of Jharkhand, Ranchi, Brambe-835205 India² Department of Electrical Engineering, National Institute of Technology, Patna, Patna-800005 IndiaE-mail: lawrencecuj@gmail.com**Keywords:** multi-junction solar cell, theoretical efficiency, detail balance limit, photovoltaics

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Abstract

In this work, a theoretical study based on the detailed balance limit has been carried out for the performance evaluation of series-connected triple-junction solar cell. The effect of different operating conditions on the conversion efficiency of the solar cell is evaluated by numerical modeling using MATLAB. The performance has been measured for three standard spectra (AM0, AM1.5D and AM1.5 G) and over a range of temperatures (273 K–523 K) under varying solar concentration. It has been observed that changes in operating conditions have a significant impact on conversion efficiency. The conversion efficiency is found to be highly sensitive to spectrum distribution. By selecting the appropriate bandgap combination as per the incident spectrum, conversion efficiency is improved significantly. The effect of temperature on the conversion efficiency is mitigated by increasing the ratio of solar concentration. The finding of the present study indicates that appropriate combination of bandgap and solar concentration can be an effective tool to improve the conversion efficiency. This study can further be extended for higher generation solar cells to evaluate their performance.

1. Introduction

Solar cell is a semi-conductor device that directly converts light into electrical energy. To explore the new designs of solar cells, limiting efficiency is often used. In 1961 W. Schlocky and H.J. Queisser introduced *detailed balance limit* theory to calculate the upper conversion efficiency of P-N junction solar cell [1]. In the proposed methodology the solar spectrum is approximated as a black-body spectrum with surface temperature of 6000 K. Radiative recombination is only responsible for the losses inside the solar cell. Other losses such as resistive, optical and thermal are not considered in this methodology. In the *detailed balance limit* model, the conversion efficiency of the solar cell is independent of material property and the device design [2]. It only depends upon the bandgap of the material, which limits the absorption of the solar spectrum [3]. In this calculation method, it was assumed that a photon having energy ($h\nu$) greater than semiconductor bandgap energy (E_g) generates an electron-hole pair with 100% quantum efficiency. The maximum calculated efficiency for single-junction solar cells employing the detailed balance limit is reported to be 30% close to the bandgap of 1 eV [1]. In the recent calculations, the solar spectrum at the earth's surface is defined by the American Society for Testing Materials (ASTM) [4]. At present, maximum conversion efficiency for single junction solar cell is reported to be 33.7% at band gap of 1.34 eV using the AM1.5D spectrum [5]. Over the years, several studies have been carried out for the estimation of maximum conversion efficiency of solar cells employing *detailed balance limit* with different assumptions. The detailed balance limit methodology has also been applied for different types of solar cells such as nanostructured solar cells, multiband solar cells and multi-junction solar cells [6–11]. Among them, Multi-junction solar cell appears to be one of the most promising designs to surpass the limiting efficiency of single-junction solar cells [12]. In multi-junction solar cells (MJSC), different semiconductor materials having different bandgaps are stacked monolithically in order to absorb a wide range of solar spectrum leading to high conversion efficiency [8]. The concept of multi-junction solar cell having double and triple junctions has been pursued extensively as reported in literature [13]. Based on the detailed balance limit, maximum theoretical

“Indigenous sovereignty” and right to self-determination in international law: a critical appraisal

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Abstract

It is worth recalling that the struggle of indigenous peoples to be recognised as “peoples” in true sense was at the forefront of their journey from an object to subject of international law. One of the most pressing concerns in their struggle was crafting their own sovereign space. The article aims to embrace and comprehend the concept of “indigenous sovereignty.” It argues that indigenous sovereignty may not have fixed contour, but it essentially confronts the idea of “empire of uniformity.” It is a source from which right to self-determination stems out and challenges the political and moral authority of States controlling indigenous population within their territory.

Keywords

Indigenous peoples, Indigenous sovereignty, self-determination, remedial secession, international law

Introduction

“Sovereignty,” one of the foundational principles of international law, has deep significance both from the vantage point of indigenous peoples “struggle for recognition” and its direct bearing on the science of international law. As a matter of academic study, advocacy, governance and sustenance of civilisation, sovereignty matters in consequential way to comprehend the political plans, policies and cultural outlook of indigenous peoples. Unfortunately, the scope of sovereign authority under traditional international law was purposefully restricted to “civilised” States (Shrinkhal, 2019; Singh, 2008). Indigenous peoples remained merely an object of international law and their struggle for sovereign autonomy is *raison d’être* of indigenous politics (Barker, 2005).

Sovereignty appears as a prized term within indigenous discourse to denote an agglomeration of legal, social, economic, political and cultural rights. “Indigenous Sovereignty” has varied meanings, ranging from formulation of rights to reverse continuing experiences of colonialism as well as to carry local efforts at the redemption of ancestral lands, resources, self-governance and preservation of cultural knowledge and practices (Barker, 2005). The present article aims to narrate and dissect the concept and scope of “indigenous sovereignty”. It also tends to explore the ontological status of indigenous peoples right to self-determination in international law. The author shows that the right to self-determination for indigenous peoples is still a derivative right within the State (geographical) sovereignty. Furthermore, the article dwells on the possibility of remedial secession for indigenous peoples in international law.

This article is further divided into six sections. The second section briefly displays how the concept of sovereignty has changed dramatically over the period of time. The third section tends to focus on the question of the utility of “sovereignty” as indigenous peoples struggle for distinct identity based rights. The fourth section explicates the scope and meaning of “indigenous sovereignty”. The fifth section critically analyses the scope and status of indigenous peoples’ right to self-determination. It is argued that indigenous peoples were categorically denied the collective right to self-determination by not considering them as “peoples” in international law. In addition, an overview is given of possible conditions under which indigenous peoples may seek remedial right to secession. The sixth section contains brief final remarks.

Sovereignty in a dynamic mode

The idea of “sovereignty” is multi-layered and difficult to define. The difficulty lies in its abstract formulation. However, no other concept in international law and politics has such strong influence in shaping the structure of the world. In general understanding, the term implies “[t]he

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Charged analogues of isotropic compact stars model with buchdahl metric in general relativity

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Abstract In this work, we examine a spherically symmetric compact body with isotropic pressure profile. In this context we obtain a new class of exact solutions of Einstein-Maxwell field equation for compact stars with uniform charged distributions on the basis of Pseudo-spheroidal space-time with a particular form of electric field intensity and the metric potential g_{11} . Taking these two parameters into account further examination has been done to decide unknown constants and to depict several compact strange star candidates. By the isotropic Tolman-Oppenheimer-Volkoff (TOV) equation, we explore the equilibrium among hydrostatic, gravitational and electric forces. Then, we analyze the stability of the model through adiabatic index (γ) and velocity of sound ($0 < \frac{dp}{c^2 dp} < 1$). We additionally talk about other physical features of this model e.g. pressure, redshift, density, energy conditions and mass-radius ratio of the stars in detail and demonstrated that our results satisfied all the basic prerequisites of a physically legitimate stellar model, showing density, pressure, pressure-density ratio, redshift and speed of sound are monotonically decreasing. The outcomes acquired are valuable in exploring the strength of other compact objects like white dwarfs, gravastars and neutron stars. Finally, we have shown that the obtained solutions are compatible with observational data for compact objects.

Keywords Isotropic fluids · Electric intensity · Reissner-Nordstrom metric · Compact star · General relativity

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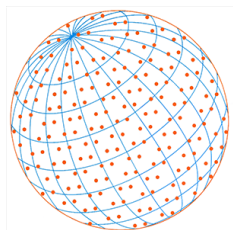
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1 Introduction

From the time of Sir Isaac Newton, our comprehension about gravity has dramatically progressed, however, mysteries still remain in physics. Einstein's theory of General Relativity (GR) is one of the best essential speculations of gravity in physics. In spite of its success, numerous expansions of the first Einstein condition has been researched to meet the present observational information on both cosmological and astrophysical scales quite satisfactorily. Observational information has educated us that the universe is experiencing a period of quickened extension. The microscopic structure and properties of a dense matter on phenomenal conditions are necessary to examine for compact objects. In a theoretical sense, stars are confined in gas and dust clouds with non-uniform matter circulation and scattered all through general cosmic systems. In astrophysics, compact objects are typically alluded to white dwarfs or neutron stars.

Also, the high exactness information from Type Ia supernovae (Betoule et al. 2014), the cosmic microwave background anisotropies (White et al. 1994), baryonic acoustic motions (Alam et al. 2016) and from gravitational lensing are helping us to construct more efficient stellar models. The information appears to show that the universe is directly overwhelmed by two obscure components, viz. pressure-less dark matter (DM) and dark energy (DE). Now one can think of incorporating and extending results derived for charged compact stars with isotropic profile in spherically symmetric space-time to the realm of dark matter and dark energy with effective modeling of spherically symmetric black holes. Zhang et al. (2014) and Heydari-Fard et al. (2007) obtained an interesting result for a static spherically symmetric black hole with dark matter. This is in light of the fact that at such uncommon densities, nuclear matter may include nucleons and leptons just as a couple of fascinating segments in their



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Lockdown to Contain the COVID-19 Pandemic: An Opportunity to Create a Less Polluted Environment in India

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ABSTRACT

Keeping aside the economic consequences, the imposition of strict lockdown in order to break the chain of deadly infection of SARS-CoV-2, has potentially improved the global environmental quality by facilitating a significant reduction in atmospheric pollution. In the present study, the level of atmospheric pollutants in India *viz.*, NO₂, AOD, and PM_{2.5} before and during lockdown 2020 were assessed and compared using standard methods. The study revealed a significant reduction in NO₂ i.e., > 10% change in 73.71% parts in India along with a high negative anomaly of AOD (< -1.0 in 32.92% parts in India) primarily in the Indo-Gangetic Plains, western, southern, and eastern parts during the lockdown. The five megacities observed a sharp decline in the daily mean concentration of PM_{2.5} (*ca.* 32% (Delhi) to 59.62% (Bengaluru) during the lockdown 2020 as compared to the analogous period of lockdown in 2019. The study exhibited the very less contribution of seasonal and meteorological variables in the abatement of pollution during the lockdown period. The findings may be useful in guiding future strategies to maintain environmental quality by adopting a well-planned lockdown strategy.

Keywords: NO₂, AOD, PM_{2.5}, Lockdown in India

1 INTRODUCTION

Coronavirus disease (COVID-19) caused by SARS-CoV-2 first reported in Wuhan, China in late December 2019 (Chen *et al.*, 2020). Subsequently, it spreads to the larger parts of the globe very rapidly through human transmission (WHO, 2020a). Globally 2,973,264 cumulative cases of infection with 6.95% (206,569) of deaths, and 29.22% (868,806) of recovery has been reported till 26 April 2020 (WHO, 2020b). In India, the first positive case of COVID-19 was reported on 30 January 2020 in Kerala, when a student arrived from China (Reid, 2020), and later a set of cases was recorded across Delhi with a tourist group of 14 Italian, and 01 Indian on 03 March 2020 (Perappadan, 2020). A major outbreak of COVID-19 started in the month of March 2020 through its increasing number of cases across the country leading to 5000 infected cases with 27 death tolls till 07 April 2020 (Jha, 2020), and it reached a total of 28,074 infected cases with 826 deaths by 26 April 2020 (MoHF, 2020; WHO, 2020b). A similar trend was also observed in the case of



Population structure and regeneration status of *Shorea robusta* and associated trees in Sal forests of Ranchi, Eastern India

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Abstract

The present study was aimed to study the detailed population structure of *Shorea robusta* and its four dominant associated tree species (*Diospyros melanoxylon*, *Buchanania cochinchinensis*, *Madhuca longifolia*, and *Butea monosperma*) in Sal forests of Ranchi, Eastern India. In addition, the regeneration status of all recorded tree species and anthropogenic disturbance of Sal forests were also studied. Girth class distribution showed a reverse J-shaped population curve in the present study, and there was a decline in tree density with an increase in girth class, and mature trees with higher girth (> 120 cm) were very few (9.30%), that signifies the ongoing natural regeneration as well as both natural and anthropogenic disturbances within the studied Sal forest stands. Out of the 103 recorded tree species, 50 species (48.54%) had shown the total absence of regeneration (no regeneration), while 23 species each (22.33%) showed poor and good regeneration, and rest 07 species (6.80%) showed fair regeneration in the studied Sal forests stand. On the other hand, the maximum studied Sal forest stands of Ranchi (42.39%) had shown fair regeneration of *S. robusta* followed by good regenerating forests (36.96%), and 17.39% forests showed no regeneration. Disturbance index had a weak statistically significant negative correlation with density (ind. ha⁻¹) ($r = -0.20$; $P < 0.05$), and tree basal area (m² ha⁻¹) ($r = -0.19$; $P < 0.05$), while, it had a weak statistically significant positive correlation with Pielou's evenness index ($r = 0.19$; $P < 0.05$). The growth, survival, and reproductive potential of all tree species will be at risk in the near future if the present trend of anthropogenic pressure continues. Thus, it is clear that protection from grazing and other anthropogenic disturbances are the foremost requirements for the conservation and management of Sal forests in Ranchi, Eastern India.

Keywords Disturbance index · Population structure · Regeneration status · *Shorea robusta*

Introduction

Sal forests occupy about 13.3% of the total Indian forests (Tiwari 1995), and its distribution control by climate and soil (Gautam and Devoe 2006). The continuous stretches of Sal forest in India start from the bank of the River Yamuna in the Kaleshwar forest of Haryana (Jain 1979) to eastwards along the sub-Himalayan tract in Darrang district of Assam, Meghalaya, and Tripura through Uttar Pradesh, and Bihar (Tiwari 1995). Sal forest of Ranchi is classified as north Indian moist deciduous forest (Subgroup 3C), and northern tropical dry deciduous forest (subgroup 5B) based on phenological characteristics (Champion and Seth 1968). It is rich

in many economic plant species used by the local people to fulfill their sustenance needs and livelihood security (Kumar and Saikia 2020a). *Shorea robusta* C.F.Gaertn. (Sal) is an IUCN red-listed, multipurpose tree species of India with excellent socio-economic prospects used mainly as timber, medicine, fodder, fuelwood, dry leaf for cooking, heating, fresh leaf for making plates, edible seeds, and also used for religious purposes (Kumar and Saikia 2020b). Ethnic people of Jharkhand celebrate a religious festival 'Sarhul' during March when this tree flowers (Kumar and Saikia 2020b). Natural population of *S. robusta* is distributed in Bangladesh, Bhutan, China, India, Nepal, and Pakistan and is globally assessed as Least Concern (Ashton 1998).

Natural regeneration is an essential process of tropical forest dynamics (Getachew et al. 2010) to preserve and maintain biodiversity (Rahman et al. 2011). The regeneration behavior of tree species in a forest could be revealed from the population structure (Tiwari et al. 2018). The

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1 **Kinetic and thermodynamic analysis of *Putranjiva roxburghii* (Putranjiva) and *Cassia***
2 ***fistula* (Amaltas) non-edible oilseeds using thermogravimetric analyzer**

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27 **Abstract:**

28 Kinetic triplets and thermodynamic parameters of the pyrolysis of *Putranjiva roxburghii* (PR)
29 and *Cassia fistula* (CF) non-edible oilseeds were studied using thermogravimetric analyzer.
30 The kinetic parameters were assessed using both model-free [Kissinger-Akahira-Sunose
31 (KAS), Flynn-Wall-Ozawa (OFW), Starink (STR), Li and Tang (LTA), Friedman (FRM),
32 Vyazovkin (VYZ), Kissinger (KN), Avrami (AVM), and Master-plot (MP)] and model-
33 fitting [Coats-Redfern (CR)] methods at four different heating rates (10, 25, 40, and 55
34 °C/min) somewhere in the range of 10% and 80% conversions. The reaction mechanisms
35 were found to be in good agreement with the experimental thermal analysis data.
36 Thermodynamic parameters (ΔG , ΔH , and ΔS) are also determined by model-free
37 isoconversional method. The kinetic and thermodynamic parameters recommended the
38 appropriateness of PR and CF non-edible oilseeds for pyrolysis process.

39
40 **Keywords:** Putranjiva and amaltas seed; Non-isothermal pyrolysis kinetics; TGA analysis;
41 Reaction mechanism; Thermodynamic analysis.

43 **1. Introduction**

44 Biomass is one of the most recognized sustainable resources for the production of renewable
45 and clean energy due to its capability to control the amount of toxic gases and carbon
46 emission in the environment. Biomass is a biological material which mainly contains carbon,
47 oxygen, hydrogen, least amount of sulphur and ash. Among all kinds of biomass, some
48 contain a notable amount of inorganic species. Due to geographical locations and climate
49 conditions, some variation has occurred in biomass composition and their properties [1].
50 India has a rich diversity of about 150 species of plant yielding, which can be the production
51 of fuels and other sources of energy. In the world, the third-largest source of energy is
52 biomass. The biomass availability of different sources of the globe is about 220 billion tons
53 per year [2]. Lignocellulosic biomass is a plentiful and inexpensive source of renewable
54 energy. *Putranjiva roxburghii* and *Cassia fistula* non-edible oilseeds are the examples of
55 lignocellulosic biomass available in India. *Putranjiva roxburghii* (Putranjiva) is an evergreen
56 tree of height up to 12m. Seeds of this plant usually stone pointed and very hard. The
57 extracted oil from this seed is used for renewable fuel while blending up to 30-40% with



Differential responses of thiol metabolism and genes involved in arsenic detoxification in tolerant and sensitive genotypes of bioenergy crop *Ricinus communis*

Rajani Singh¹ · Amarendra Narayan Misra^{1,2} · Pallavi Sharma¹

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Abstract

Castor, a non-food, dedicated bioenergy crop, has immense potential to be used for phytoremediation/revegetation of heavy metal contaminated sites. In the previous study, we identified arsenate [As(V)]-tolerant (WM) and As(V)-sensitive (GCH 2) genotypes of castor (*Ricinus communis* L.) with differential accumulation and tolerance of arsenic [As]. The role of thiols in As(V) toxicity and tolerance mechanism in the castor plant is not fully understood. On the one hand, thiol-dependent reduction of As(V) to As(III) by arsenate reductase (AR) makes it capable of reacting with thiol groups of protein leading to disturbed metabolic pathways; on the other hand, reduction of As(V) to arsenite [As(III)] by AR and then complexation of As(III) with phytochelatin (PCs) and compartmentalization of As(III)-PC complex are considered as the major detoxification mechanisms of As(V). In our study, the expression of *RcAR* increased in leaves and roots of As(V)-tolerant castor genotype WM but decreased in sensitive genotype GCH 2 due to 200 μ M As(V) treatment. The activity of glutathione reductase (GR) increased significantly in the tolerant genotype, whereas it remained same in the sensitive genotype. GSH/GSSH ratio declined substantially in the sensitive genotype. The increased expression of phytochelatin synthase 1 isoform 1 (*RcPCSIX1*) in roots, *RcPCSIX2* and metallothionein type 2 (*RcMT2*) in leaves, and c-type ABC transporter (*RcABCC*) in roots and leaves of WM was observed, but the expression of these genes declined or remained the same in GCH 2. Overall, our results suggest the essential roles of *GR*, *RcAR*, *RcPCS1*, *RcMT2*, and *RcABCC* in the tolerance of WM castor genotype to As(V) toxicity.

Keywords Arsenate · Castor · Glutathione reductase · Phytochelatin synthase · Metallothionein · ABCC transporter

Introduction

Arsenic (As) is a potent threat to all life forms. It is viewed as a pollutant of water and soil prominently in South and Southeast Asia, especially in India and Bangladesh (Meharg and Hartley-Whitaker 2002; Sharma et al. 2014; Kumar et al. 2019). The presence of As in soil, water, and sediments contributes to its biomagnification in the food chain leading to irreparable effect in humans and plants (Sharma et al. 2014; Kumar et al. 2019). Various common chemical forms (organic

and inorganic) of As are available in the environment among which inorganic forms, As(V) (arsenate) and As(III) (arsenite), are highly toxic and detrimental to environmental health (Mandal and Suzuki 2002; Sharma et al. 2014; Kumar et al. 2019). Because As(V) is a structural analog of phosphate, it induces toxicity by substituting phosphate in biomolecules. Inside plants, As(V) is easily converted to As(III) form. Sulfurtransferase (Str)/rhodanese enzyme groups having rhodanese homology domain (RHOD), a feature of arsenate reductase (AR) in eukaryotes (Bordo and Bork 2002; Mukhopadhyay and Rosen 2002; Sánchez-Bermejo et al. 2014; Most and Papenbrock 2015), catalyze the reduction of As(V) to As(III) using suitable donors of sulfur as a reductant (Bleeker et al. 2006). AR has been associated with As(V) tolerance as well as sensitivity in plants (Majumder et al. 2019). As(III) formed as a result of reduction of As(V) is highly toxic and reacts with thiol (–SH) groups of proteins and enzymes and thus affect various biochemical and physiological functions (Meharg and Hartley-Whitaker 2002; Shi

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Land deformation monitoring using optical remote sensing and PS-InSAR technique nearby Gangotri glacier in higher Himalayas

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Abstract

In the present study, we have introduced a strategic technique for interrelating between slow land surface movement (SLSM) and land susceptibility (LS) map of a higher Himalayan region nearby Gangotri, India by integrating geospatial techniques based on modified frequency ratio technique acquired by optical remote sensing for LS mapping. On the other hand, PS-InSAR technique acquired by microwave remote sensing has been used for monitoring the SLSM. As SLSM is one of the major geological hazard susceptible for highly undulating terrain like Gangotri glacier basin in higher Himalaya which is also a most attractive tourist region in Uttarakhand, India. With the integration of this technology, it would be possible for monitoring SLSM and mapping LS of any hazardous area. PS-InSAR technique allows efficient planning by providing meticulous data about SLSM. PS-InSAR technique is used for monitoring SLSM in scale small within approximately millimetre range. Further, we have used SAR imageries of C band of ENVISAT satellite for the duration of March 2004–May 2007 for nearby Gangotri region. This work also comprises using satellite imageries of Landsat 7, Sentinel 2 and SRTM data for LS mapping purpose. The result shows that in the vicinity of the Gangotri region, the land surface movement was observed around 2 to 18 mm. Also, the study showed that the SLSM affected regions come under the High-risk zone of LS and vice versa.

Keywords PS-InSAR · SLSM · LS · Geospatial technique · ENVISAT · DORIS · STaMPS

Introduction

Landslides are shallow mass movement procedures happening on a wide range assortment of spatial and worldly scales in numerous rugged areas. Landslides, depending on their spatial distribution, have various environmental impacts and the recurrence and magnitude of growth. (Peyret et al. 2008). Active microwave remote sensing sensor, synthetic aperture radar (SAR) satellite imageries are useful for land surface deformation monitoring. SAR imageries are produced by an electromagnetic spectrum of microwave region which has cloud, fog and haze penetration ability, unlike optical sensors (Kuri et al. 2016).

Therefore, in this study, we interrelate SLSM and LS model for the area nearby Gangotri glacier and the results

retrieved from the PS-InSAR and SBAS techniques in microwave remote sensing for SLSM model, compared with the results derived from modified bivariate frequency ratio method in optical remote sensing for determining land susceptibility model.

Numerous works have been done on SLSM model and LS model (Lu and Liao 2008; Greif and Vlcko 2013; Lanari et al. 2007; Shanker et al. 2011). Ciampalini et al. (2016) used PS-InSAR technique for SLSM map generation as well as many works done on modified bivariate frequency ratio techniques (Althuwaynee et al. 2014). PS-InSAR techniques are very useful for precise results with high accuracy in case of deformation of undulating terrain like volcanic terrain (Hooper et al. 2004).

It is important to note that the movement of the plates which cause the Himalayan upliftment by casual observations alone is very difficult to detect. Nevertheless, a new technology called the GPS has allowed even a slow motion of the plates to be measured. Previously, Holmes conjectured the sub-lithospheric mantle flow of the shield to the north to cause a double thickening of the crust below the Himalayas and the Tibetan Plateau. (Holmes 1945) while according

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Evaluating long-term variability in precipitation and temperature in eastern plateau region, India, and its impact on urban environment

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Abstract

In the present study, the long-term variability in precipitation and temperatures was analyzed in relation to the urban environment of Ranchi Metropolitan Region, eastern plateau region, India. The daily meteorological observations of 5 decades (1961–2010) indicated an increasing mean temperature (0.4 °C) and decreasing cumulative precipitation in the Ranchi, capital region of the state Jharkhand. The results exhibited a declining precipitation patterns in the recent decade as compared to the earlier 4 decades. The high daily monsoon rainfall intensity with low cumulative precipitation can be observed during post-2000 periods, which indicate a highly erratic nature of precipitation in the region. Temporal census data demonstrated that the Ranchi urban region faced enormous proliferation in the human population (21 times) during the period 1927–2010 and thereby induced the extensive alteration in land use/land cover and rapid built-up expansion (> 5 times) as evidenced by the temporal satellite-based observations. The increasing annual per capita land consumption (361.50%) together with annual per capita loss of heat sink zones (96.3% during 1927–2010) and high influx of vehicles (563% during 1997–2010) influenced the local and regional climatic variable in the region. The results indicate that the rapid and haphazard urban sprawl in the last few decades and increase in built-up and impervious surface largely contributed in increasing the land surface temperature (34–42 °C) as compared to the rural environment (30–38 °C), which perhaps could be the region for the changes in climate and weather pattern of the area.

Keywords Precipitation variability · Temperature anomaly · Land use/land cover · Urban growth

Abbreviations

CMR	Cumulative monsoon rainfall/precipitation
TRD	Total number of rainfall days
MJJASO	May, June, July, August, September and October
NRD	Number of rainy days (days with more than 20 mm of precipitation)
MDRI	Mean daily rainfall intensity

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Dynamic control over group speed of light in plasma cladded optical fiber: An analytical approach



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ABSTRACT

The ability of plasma frequency to tune the guiding properties of plasma cladded optical fiber is explored and numerically investigated. The identified parameter to manipulate the propagation characteristics of the investigated structure is electron-ion density which can be controlled by varying electric potential. It is shown that the curve of group index vs optical signal frequency can be manipulated significantly by manipulating plasma frequency. Judicious consideration of fiber's parameters and the values of plasma frequency allow for obtaining minimum or desired group velocity dispersion at a desired optical frequency. Further, ability of manipulation of the slope of group index vs signal frequency curve allows for dispersion management. Possibility of significant variation in group-index is the highlight of the present work and the most impressive feature is that it could be achieved in online condition (by varying plasma frequency with the help of tuning electric field). Since, ratio of plasma to signal frequency is the only important factor in manipulating the propagation properties, the idea presented here can be extended to frequency domains in the range of Terahertz, Microwaves etc. An optical modulator is proposed in the last section on the basis of present investigation.

1. Introduction

The analyses of varied propagation properties of optical signal in bounded structures has always remained of prime interests amongst scientists and engineers to explore its vivid applications in integrated optical devices and processing systems. Different kinds of optical waveguides with various schemes of cross-sectional geometries (Xiao et al., 2019; Kim et al., 1987; Singh and Kumar, 2009) and core-cladding materials (Anicin, 2000; Hu and Wei, 2001; Shen and Pao, 1991; Chatterton and Shohet, 2007; Mishra et al., 2013) were proposed and investigated by many researchers to address the recent applications related issues. Emphasis continues to design an optical waveguide structure that may efficiently transport image data, enables strong light-matter interaction, all optical computing and more importantly tunable guiding features.

Cylindrical optical waveguides loaded with unconventional materials such as chiral materials (Janeiro et al., 2002), metamaterials (Yamunadevi et al., 2016), semiconductors (Ballato et al., 2010), plasma etc. have shown to be very useful to design novel, chip-scale,

ultrafast devices for applications in terahertz wireless communications and in all-optical computing. However, efforts continue to identify some dynamic parameters (particularly with electrical tuning) that may manipulate the guiding properties online in order to make the fiber versatile with tunable guiding properties. Some authors have also explored the guiding properties of a bi-waveguide (Foteinopoulou and Vigneron, 2013) and reported some interesting results. This bi-waveguide consists of slabs of positive index and negative index materials.

Amongst various optical waveguide configurations proposed so far, there has been growing interest in optical fibers considering plasma either in its core (Shen, 1991) or in cladding (Singh et al., 2010; Hairong et al., 2007; Mishra and Singh, 2015) due to its electrically controlled frequency dependent refractive index. Considering plasma in the cladding – the so called plasma cladded optical fiber (PCOF), has potential to address the issues of two-fold coupling of propagating hybrid modes in image transferring fiber optic system (KianiMajd et al., 2018). Moreover, the unique feature of PCOF which distinguishes it from other optical waveguide structures is its ability to

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Alkali assisted hydrophobic reinforcement of coconut fiber for enhanced removal of cationic dyes: equilibrium, kinetics, and thermodynamic insight

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ABSTRACT

The present study illustrates enhanced removal of methylene blue (MB) and malachite green (MG) from water using alkali-activated coconut fiber (ACF) as adsorbent. Alkali activation effectively reduces the lignocellulosic components present within coco-fiber which in turn reinforces the coco-fiber to become more water-stable. The material was characterized by FTIR, SEM-EDS, BET, XRD, and pH_{ZPC} . BET surface area was found to be $10.901\text{ m}^2\text{ g}^{-1}$, whereas pH_{ZPC} of the material is 6.05. FESEM images reveal rod-like morphology. Batch experiments were optimized with respect to contact time (0–120 min), temperature (288–308 K), pH (3–10), dose (1–5 g) and input dye concentration ($10\text{--}50\text{ mg L}^{-1}$). The maximum adsorption coefficient was found to be 133.11 and 110.74 mg g^{-1} for MB and MG respectively. Adsorptions are best described by pseudo-second-order kinetics ($k_{MB} = 1.712$, $R^2 = 0.999$; $k_{MG} = 1.399$, $R^2 = 0.999$) and Langmuir isotherm model ($R^2 = 0.999$). Thermodynamic data suggests a spontaneous (ΔG , -14 kJ mol^{-1}) and feasible process. Spent material could be regenerated by using 0.5 M HCl . Up to 50% retention of activities was seen after five cycles. It can be concluded that alkali-activated coconut fiber is an economic and sustainable choice for dye removal.

Novelty statement: Spent coconut was converted into an effective biosorbent by simple alkali activation under ambient conditions to increase the hydrophobicity of the fibers by reducing the lignocellulosic components. Two cationic dyes; methylene blue and malachite green have been efficiently removed with adsorption capacities of 133.11 and 110.74 mg g^{-1} . The operation is simple, economically viable, and partially fulfills the principles of green engineering. Comparing with contemporary adsorbents, this material offers higher adsorption capacities with multi-cycle reusability and enhanced water stability.

KEYWORDS

Malachite green; methylene blue; coconut fiber; alkali; hydrophobicity

Introduction

Dyes are used by many industries such as food processing, pharmaceuticals, leather, plastics, paint, and textiles (Aksu *et al.* 2010; Etim *et al.* 2016; Jalil *et al.* 2012; Ooi *et al.* 2017; Yu *et al.* 2017). Discharge of dyes pose threat to human beings (Yang *et al.* 2011; Zhang *et al.* 2011; Ma *et al.* 2018). Both malachite green and methylene blue are mutagenic, carcinogenic, and cause genotoxic effects. Such issues demand the removal of dyes from contaminated water bodies (Nayak and Pal 2017). Among all available techniques, adsorption is an easy and cost-effective technique (Xu *et al.* 2016; Sahraei *et al.* 2017; Abu-Saqer and Lubbad 2019).

An advanced oxidation process is a costly one and difficult to operate, whereas bioremediation depends on the biological activity of the system and may suffer bio-fouling. The ion exchange process is costly and application is limited (Naushad 2014; Massoudinejad *et al.* 2015; Babaei *et al.* 2016; Jafari, Kakavandi, *et al.* 2016; Jafari, Kalantary, *et al.*

2016; Salimi *et al.* 2017; Kakavandi *et al.* 2018; Imran *et al.* 2019; Mironyuk, Gun'ko, *et al.* 2019; Murtaza *et al.* 2019; Sharma *et al.* 2019; Imran *et al.* 2021; Iqbal, Shah, *et al.* 2021). Wastewater treatment using bio-resources and agricultural waste as a scavenger for the removal of dyes (Cengiz *et al.* 2012). Naturally available biomaterial such as mahua seed, eucalyptus leaf, coconut-based adsorbents (Rani *et al.* 2017; Aljeboree *et al.* 2017; Kumari and Dey 2018, 2019; Kocaman 2020; Nguyet *et al.* 2020), reeds (El Abeer and Heikal 2018), macro-algal species, (*Ulva fasciata* and *Sargassum dentifolium*) (Moghazy *et al.* 2019), banana fiber, sawdust (Karthik *et al.* 2016), acorn peel (Kuppusamy *et al.* 2017) have been tested as green adsorbent. Food grade mucilage (Abubakar *et al.* 2019), persimmon fruit (Ayten and Tulay 2020), and related materials (Fathy *et al.* 2013) are also known. Recently we have demonstrated excellent dye removal using dewaxed honeycomb (Kumari *et al.* 2020).



Spatio-temporal Mapping to Investigate Coral Bleaching in Andaman and Nicobar Islands, India Using Geoinformatics

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Abstract

Andaman and Nicobar islands with vast variety of mostly endangered coral species are witnessing gradual coral bleaching. The present study focussed on temporal monitoring of various corals disposition along with impact of bleaching in two (North Reef and North Sentinel) islands of Andaman and Nicobar during the year 2010 and 2019. Floating algae index (FAI) and turbidity mapping was performed to evaluate the impact of excess macro algae on the coral reefs. The temporal coral mapping revealed that sand over reef, reefward front and exposed reef flat exhibit decrease by 2.23%, 18.55% and 33.86%, whereas algae over reef increased by 28.84%, respectively, in North Reef island. In case of North Sentinel island, exposed reef flat, sand over reef and reefward front decreased by 37.78%, 9.05%, 37.89%, whereas algae over reef increased by 55.81% during the observation period. FAI showed that in both islands concentration of macroalgae increased from year 2010 to 2019. Highest SST recorded for North Reef island was 35 °C in year 2017, whereas for North Sentinel island the highest value was 35 °C for year 2016. Turbidity values (11.86–44.53 NTU) clearly indicated pronounced effect of sedimentation and tourism activities in North Reef island which is corroborated by higher coral mortality conditions (24.70%) as compared to North Sentinel island (19.88%) reflecting increased bleaching on North Reef island. Accuracy assessment for coral classified image has been performed, for North Reef island overall accuracy of classified image for 2010 and 2019 is 86% and 84% for North Reef island, whereas for North Sentinel island overall accuracy of classified image for 2010 and 2019 is 83% and 82%.

Keywords Coral bleaching · FAI · Turbidity · Tourism · SST · Sea-level rise · Digital image processing

Introduction

Corals on account of their high sensitivity to their surrounding environmental conditions attracted attention as an indicator of climate change and global environment. Coral under stressed conditions turn white due to the expulsion of the symbiotic algae living in their tissue and this phenomenon is called coral bleaching, which can affect corals in terms of their morphology and mortality (Loya et al., 2001; Stuart-Smith et al., 2018). Globally the coral reefs are under threat because of overfishing, pollution, tourism, climate change, disease, aquatic invasive species, oil and

gas exploration (Bellwood et al., 2004; Briggs, 2005; Friedlander et al., 2005; Hodgson, 2000; Hughes et al., 2003), thermal stress and ocean acidification (Hoegh-Guldberg et al., 2007; Hughes et al., 2017) effecting the current coral reef conservation efforts (NOAA, 2009). Stress condition harms the corals and lowers the coral health by allowing proliferation of competitive macroalgae (Hughes et al., 2010). Contact with algae has been linked to coral bleaching, disease, and tissue death in adult corals (Nugues et al., 2004; Rasher & Hay, 2010), with excess algae cause the allelopathy, oxygen depletion, and destabilization of corals associated microbial communities (microbiomes) and harming the coral health by reducing nutrients and causing bleaching event (Rasher & Hay, 2010; Barott & Rohwer, 2012; Zaneveld et al., 2016; Morrow et al., 2017). Coral reef degradation generally involves the phase shift from reef dominated corals to reefs dominated by benthic algae (Done, 1992; Hughes, 1994;

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Greenhouse gas emission from rice fields: a review from Indian context

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Abstract

Agricultural soil acts as a source and sink of important greenhouse gases (GHGs) like methane (CH₄), nitrous oxide (N₂O), and carbon dioxide (CO₂). Rice paddies have been a major concern to scientific community, because they produce the threatening and long-lasting GHGs mainly CH₄ and N₂O. Around 30% and 11% of global agricultural CH₄ and N₂O, respectively, emitted from rice fields. Thus, it is urgent to concurrently quantify the fluxes of CH₄ and N₂O to improve understanding of both the gases from rice fields and to develop mitigation strategies for upcoming climate change reduction. An effort is being made in this review to discuss exclusively the emission of CH₄ and N₂O under normal and controlled conditions in different locations of India and also addresses the current synthesis of available data on how field and crop management activities influence CH₄ and N₂O emissions in rice fields. Making changes to conventional crop management regimes could have a significant impact on reducing GHG emissions from rice field. Environmental and agricultural factors related to soil could be easily altered by management practices. So, knowing the mechanism of CH₄ and N₂O production and release in the rice field and factors controlling the emissions is fundamental to develop well-organized strategies to reduce emissions from rice cultivated soil. This will help the regulatory bodies or policy makers to formulate adequate policies for agricultural farmers to refine the GHG emissions as well as minimize the global climate change.

Keywords Greenhouse gases · Nitrification · Denitrification · Nitrous oxide emission · Methane emission · Lowland rice

Introduction

Climate change, caused by the increase in concentrations of greenhouse gases (GHGs) in the atmosphere, is the most vital challenge faced by humanity. The concentration of GHGs such as methane (CH₄), carbon dioxide (CO₂), and nitrous oxide (N₂O) has been increased by 150%, 40%, and 20%, respectively, since the pre-industrial time (IPCC 2014).

Agriculture is one of the important economic sectors and responsible for both food and nutritional security. However, it impacts directly or indirectly towards the global climate change by emitting greenhouse gases and contributes about 16% of the total greenhouse gas emissions in the country (MOEF 2018; Panchasara et al. 2021). Among the different GHGs, the non-CO₂ gases N₂O and CH₄ comprise a large share of agricultural emissions with relative global warming potentials (GWP) of 34 and 298 times higher than carbon dioxide (CO₂) respectively, on a 100-year time horizon (Myhre et al. 2013; IPCC 2013). Apart from being dynamic GHG, CH₄ affects the oxidation of the atmosphere by controlling the concentrations of tropospheric hydroxyl radicals (Holmes 2018), and N₂O contributes to the stratospheric ozone depletion (Ravishankara et al. 2009). Carbon dioxide also largely contributes to global climate change and accounts for 60% of the total greenhouse effect (Liu et al. 2013).

Rice (*Oryza sativa*) is major and nutritious staple food primarily in Asia and is considered the second biggest (745 Tg in 2013) cereal crop produced in the world (FAOSTAT 2014).

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Degradations of endocrine-disrupting chemicals and pharmaceutical compounds in wastewater with carbon-based nanomaterials: a critical review

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Abstract

Although water occupies 75% of the earth's surface, only 0.0067% of the total water is available for human activities. These statistics further decline with the population growth and consequent multiplication in the amount of annual waste produced. The demand for clean and safe drinking water has always been a prime concern in the global scenario. Among various types of waste materials, endocrine-disrupting chemicals (EDCs) and pharmaceutical effluents have become a constant threat to the aquatic ecosystem and possess challenges worldwide. Endocrine-disrupting chemicals (EDCs) are a mixed group of emerging concern chemicals with the ability to mimic the mechanisms of biosynthesis, transport, and metabolism of hormones. These chemicals pose various health threats such as early puberty, infertility, obesity, diabetes, reproductive disorders, cancerous tumors, and related disorders (immune cells, hormones' activity, and various organs). On the other hand, pharmaceutical compounds such as antibiotics also harm the natural environment, human health, and soil microbiology. Their low concentration, ranging from a few ng/L to µg/L, gives rise to a micro-pollution phenomenon, which makes it difficult to detect, analyze, and degrade in wastewater treatment plants. Activated carbons (ACs) and other adsorbents, including naturally occurring materials (wood, keratin) are considered as nanomaterials (NMs) reference for the separation of organic pollutants. It is generally acknowledged that mass-transfer phenomena control sorption kinetics at the liquid/solid interface, with retention controlled by the sorbent/sorbate properties. Therefore, the type of interaction (strong or weak van der Waals forces) and the hydrophilic/hydrophobic properties of the adsorbent are two crucial factors. Besides, EDCs and pharmaceutical compound sorption on such kinds of nanoporous solids depend on both the molecule size and charge density. The applications of nanomaterials on non-conservative methods, like advanced oxidation processes or AOPs (e.g., photocatalysis and Fenton reaction), are contemplated as more apt in comparison to conservative technology like reverse osmosis nanofiltration, and adsorption, etc. One of the reasons is that AOPs generate free radicals (hydroxyls), which are strong oxidants for the demineralization of organic compounds and the extreme case that hydroxyl radicals can attack any kinds of pollutants with the generation of only water and carbon dioxide as final products. AOPs may imply the use of NMs as either catalysts or photocatalysts, which improve the selective removal of the target pollutant. Therefore, various literature reviews have revealed that there is a timely need to upgrade the efficiency of the remediation approaches to protect the environment against EDCs and pharmaceuticals adequately. There is currently a lack of definitive risk assessment tools due to their complicated detection and associated insufficiency in the health risk database. Hence, our present review focuses on applying carbon-based nanomaterials to remove EDCs and pharmaceuticals from aqueous systems. The paper covers the effect of these pollutants and photocatalytic methods for treating these compounds in wastewater, along with their limitations and challenges, plausible solutions, and prospects of such techniques.

Keywords Endocrine-disrupting compound · Pharmaceutical waste · Carbon-based materials, Advance oxidation processes

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Implementation of National Water Policy by eastern states of India—A review and analysis

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Abstract

The mainstay of this study is to highlight the implementation of recommendations of the National Water Policy (NWP) of India. All the policy documents advocate the adoption of a volumetric system of water pricing, the Integrated Water Resource Management (IWRM) approach, and the creation of River Basin Organizations (RBOs). IWRM needs to be redefined, reconsidered, and recalibrated and should be explicit. Except for Odisha, no state has constituted the RBOs. The reasons for nonformation of RBO are public resistance, not understanding the basic principle of RBO, and limitation and lack of expertise to handle large river basin organization activities. Revenue collection records are very poor except Odisha. Water pricing was not revised frequently and no water pricing regulatory body had been constituted as per the recommendation of NWP, 2012, by all the eastern states. Odisha has formulated a water policy in line with NWP and has implemented it well. All the north-eastern states have adopted their own water policy recently but have not implemented effectively. The existing system of assessment based on crop-wise irrigated areas must be rationalized and simplified. The revenue collection system needs mechanization. The revenue collection needs to be increased in all the eastern states.

KEYWORDS

anthropogenic impacts, Ganga river basin, phytoplankton, water quality, water resource management



Research Article

Geoinformatics-based assessment of land deformation and damage zonation for Gorkha earthquake, 2015, using SAR interferometry and ANN approach



Tannu Priya¹ · Arvind Chandra Pandey¹

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Abstract

The Gorkha earthquake 2015 was one of the largest disastrous events that occurred in the main Himalayan thrust (MHT) region with epicenter at Gorkha region and magnitude of 7.8 which caused severe causality to life as well as property. The spatial statistics on vertical displacement and extent of damage zone is still too scarce to provide strong evidences of its hazard potential. In the present study, quantitative assessment on surface deformation has been carried out to compare land displacement of two different regions of Nepal (the Central Nepal and the Eastern Nepal), which are located at different distances from the epicenter, using InSAR technique on post- and pre-earthquake images from Sentinel 1A SLC product. The Central Nepal experiences an upliftment of 1.1 m and land subsidence of -0.61 m, whereas for the Eastern Nepal the estimated upliftment and subsidence were 1.0 m and -0.33 m, respectively. Further a regional earthquake-prone zone map was generated using the historical earthquake epicenter data and geographic information system (GIS) to understand the major vulnerability zones in the area. A total of 564 earthquake events were reported by USGS in Nepal region during 2000–2019, of which 476 (84.39%) were of magnitude greater than 4 on Richter scale and 376 events (66%) occurred at depth greater than 15 km. The damage assessment was done using machine learning (artificial neural network) back-propagation model in which the satellite imagery retrieved from the optical satellite Landsat 8 OLI sensor and digital elevation model was used to map slope, aspect, relief, drainage and lineament to be used as input layers to generate damage proxy map. The result obtained from ANN illustrated that despite being located comparatively at more distance from epicenter, the Eastern Nepal exhibited more damage-prone area (587 sq. km) in comparison with Central Nepal with 457sq. km damage prone in similar zone. Central Nepal evidences more damage-prone areas over compact build-up in contrast to Eastern Nepal, making greater risk potential in urban areas of Central Nepal during earthquake activity.

Keywords Earthquake · Synthetic aperture radar · InSAR · ANN · Damage assessment · Surface deformation · Satellite images · GIS

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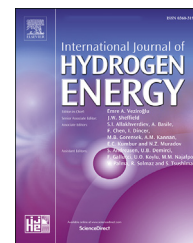




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Surface polar charge induced Ni loaded CdS heterostructure nanorod for efficient photocatalytic hydrogen evolution

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HIGHLIGHTS

- Visible light active Ni–CdS nanorods photo-catalysts is prepared.
- Ni successfully tunes the platelets shapes of CdS particles to nanorods structure.
- Ni enhances eight folds specific surface area of CdS (from 4.19 to 34.83 m² g⁻¹).
- Ni@NiO layer on CdS efficiently separate photo-generated charge carriers in CdS.
- Ni@NiO–CdS shows fifty times more H₂ evolution than CdS, i.e. 0.180 mmol to 9.0 mmol.

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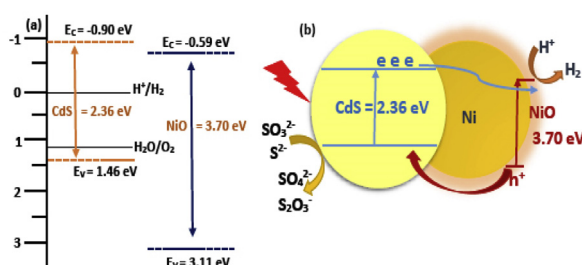
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GRAPHICAL ABSTRACT



ABSTRACT

Designing of artificial heterostructure photo-catalysts to crop solar energy for H₂ evolution from water is of great importance nowadays. The ultrafine Ni (0.5, 1.0, 2.0 and 5.0 wt%) particles loaded CdS nanorods were synthesized by a simple chemical process. XRD shows the crystalline phase of CdS with increase in size from 17 to 28 nm with 10.19% and 10.06% enhancement in the lattice strain and the dislocation density for Ni (0.5–5.0 wt%). The XPS peaks observed at 854.88 eV and 861.07 eV for Ni²⁺ with energy separation of 6.18 eV confirmed the existence of NiO on Ni surface. The Raman bands for pure CdS and Ni (1.0 wt %)-CdS nanorods were observed at 300 cm⁻¹ and 293 cm⁻¹ for 1LO phonon and 601 cm⁻¹ and 586 cm⁻¹ for 2LO phonon, respectively. The Ni loading tuned the CdS band gap from 2.36 to 2.20 eV. The eight fold enhancement in the CdS specific surface area i.e., from 4.19194 m² g⁻¹ to 34.8343 m² g⁻¹ was achieved. After Ni loading, the synergetic effect of efficient electron separation and transportation was observed by the continuous

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A review on bacteriocin nanoconjugate for effective delivery system

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Abstract

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Abstract

There are certain restrictions that create limitations on the function of bacteriocins like efficacy, sensitivity to proteolytic enzymes and target delivery. These problems are overcome by the interaction of bacteriocins with nanoparticles. Nanoparticles are ultra-fine materials used as a potential drug delivery system that protects bacteriocins from degradation and enhances their antimicrobial activity and stability. It also improves bacteriocins physicochemical properties and specifies target delivery to prevent undesirable interactions. This interaction has emerged as a promising source that expands the bacteriocin uses in the field of medicines and food safety. Several established nanotechnological approaches are used for the interaction of bacteriocins with organic and inorganic nanoparticles. This review enlightens the hurdles regarding bacteriocin utility and clearing these limitations by the use of different nanotechnological practices like incorporation, encapsulation and conjugation and also the production of bacteriocin via internalization of nanoparticles into antimicrobial peptides producing bacteria. © 2021 World Research Association. All rights reserved.

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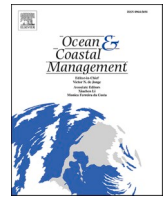
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Characterization and impact assessment of super cyclonic storm AMPHAN in the Indian subcontinent through space borne observations

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ABSTRACT

Tropical cyclones can cause extensive damage in coastal regions as a result of high winds, storm tide, and intense rainfall. The West Bengal state in India was severely affected by a recent cyclonic storm 'Amphan' a 'super cyclone' with a high wind speed of above 220 km/h. The present study aimed to assess the impact of the cyclone *Amphan* in the potential impact zone covering the two states of India (Odisha and West Bengal) and the west coast of Bangladesh. The present study analyzed the land use land cover, rainfall variability, and potential storm surge along the cyclone track to assess the possible impact on the coastal landscape as well as community. The cyclone *Amphan* was formed in the Northern Indian Ocean near Equatorial Easterly wave over south Andaman Sea and adjoining southeast Bay of Bengal (BoB) at 10° N 87° E on 16 May 2020 as deep depression and moved toward the north direction and had land fall at the coast of West Bengal on 20 May 2020 as an extremely severe cyclonic storm with the wind speed 155 km/h and central pressure of 960hpa. The cyclone devastated the coastal districts of West Bengal due to the high intensity of precipitation along with the extreme storm surge. About 100 people lost their lives and ~20 million people severely affected in West Bengal alone. Within the West Bengal state, around 7877 sq km area was observed under the potential storm surge zone. Cropland was observed as the most surge affected land cover with 5191 sq km area (65.9%), followed by wetlands (1635.2 sq km (20.75%) along with 38.34 sq km (0.48%) of built up land under the potential surge impact zone. The cyclone more severely affected the west Medinapur and South 24 Parganas, which were also the most affected by COVID-19 which resulted in slow evacuation, delay in medical support and concomitant increase in loss of life. The present study provided near real time cyclone hazard and risk assessment to help in prioritization of coastal mitigation and planning.

1. Introduction

Coast and ocean extensively contribute towards Industrial development along with rich biodiversity and natural resources (Gallup et al., 1999). Coastal regions are frequently affected by various natural disasters viz., cyclone, tsunami, storm surge, sea-level rise, and shoreline changes, etc., rendering large populations at risk. Small changes in the coastline may lead to permanent inundation in the low lying area, and impact coastal ecosystem and habitat (Apeaning Addo et al., 2011; Lam et al., 2017; Kumar et al., 2020). Therefore study on the coastal ecosystem and its environment is very significant in current situation of cyclonic impacts on coastal areas. East coast of India is frequently threatened by recurrent cyclonic phenomenon largely reflecting regional climate change impacts. This entails proper coastal zone management and monitoring in the eco-sensitive zones. There are several

studies carried out on the Indian coast and vulnerabilities associated with climate variations and extreme events (Mahendra et al., 2010, 2011; Rao et al., 2009). As a result, coastal vulnerability assessment methods have been developed and used to monitor and manage coastal vulnerability along the Indian coast. Advanced remote sensing and geospatial techniques are being used for making strategies for reducing risk and vulnerabilities while decision-making (Basheer Ahammed and Pandey, 2019a,b).

Indian coast had experienced devastating coastal disasters during the last four decades, especially in the eastern coast, due to impacts by Tsunami, Cyclone, and Storm surge, affecting the livelihood as well as economic development, along with negative impacts on ecosystem and biodiversity in the coastal zone. Peninsular India comprises nine populous states (Krishna, 2005) where most of the economic activities (Economic Zone around 2 million km²) and the population is

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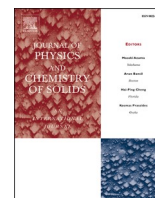
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Optimization of structure-property relationships in nickel ferrite nanoparticles annealed at different temperature

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ABSTRACT

In this report, a detail analysis of the impact of annealing temperature on the structural, elastic, morphological, optical, and magnetic behavior of NiFe₂O₄ nanoparticles prepared by the citrate sol-gel method is presented. Analyzing the XRD patterns by the Rietveld method confirms that all the annealed samples have been crystallized to cubic spinel structure belonging to $Fd\bar{3}m$ space group with a single phase. Rietveld analysis demonstrates the change in structural and microstructural parameters and movement of cations from tetrahedral to octahedral sites and vice-versa upon annealing. The quantitative estimation of Ni²⁺ & Ni³⁺ and Fe²⁺ & Fe³⁺ has been carried out using XPS analysis. Decreases in peak broadening and shift of five Raman active peaks towards higher frequency upon annealing have been analyzed using the phonon confinement model. The variation in elastic parameters with annealing temperature has been assessed by FTIR analysis. The UV analysis reveals the increase of the optical energy band gap and the decrease of Urbach energy with annealing temperature enhancement. A noticeable sharp absorption band at 748 nm in UV spectra is attributed to ${}^3A_{2g}(3F) \rightarrow {}^3T_{1g}(3F)$ electronic transition. Room temperature magnetic hysteresis loops exhibit an increase of saturation magnetization upon annealing which is discussed with reference to finite size effects and disorderly surface spins. The estimated value of magnetocrystalline anisotropy constant by Law of Approach to saturation (LAS) theory as well as coercivity value elucidates the annealing effect in changing the magnetic single domain state of the particle to a multi-domain state. Analysis of ZFC and FC magnetization curve measured at 100 Oe in the temperature range 400 K–60 K reveals the significant impact of annealing temperature on magnetic anisotropy, inter-particle interaction, and blocking temperature. Exploring the magnetic hysteresis loop measured in the temperature range 60–400 K over field strength of ± 3 T demonstrates the significant role of annealing on magnetic exchange interaction. Temperature dependent behavior of saturation magnetization and coercivity has been analyzed using modified Bloch's law and Kneller's relation. The magnetic heating efficiency examined by the induction heating system reveals that the sample has enough potential for hyperthermia application.

1. Introduction

In recent years nanostructured spinel ferrites possessing general formula MFe₂O₄ (M represents a divalent metal cation like Mg, Mn, Ni, Co, Cu, and Zn) has drawn significant attention because of their technological applications in diverse fields and very helpful in understanding the fundamental of magnetism at the nanometer scale [1]. Among the nanostructured spinel ferrite family, nickel ferrite (NiFe₂O₄) is a

versatile and thoroughly investigated material owing to its several interesting characteristics like high electrical resistivity, low magnetic coercivity, low magnetostriction, high Curie temperature, low magnetic anisotropy, moderate saturation magnetization, low eddy current loss, high permeability in RF region, high electrochemical and thermal stabilities [1,2]. These properties make it appropriate for wide applications in many fields including, electronic devices, ferrofluid technology, magnetocaloric refrigeration, magnetic guided drug delivery,

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Exploring spatial and temporal trends of diurnal temperature range in the region of the Subarnarekha river basin India

Shashank Shree¹ · Manoj Kumar¹ · Ajai Singh²

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Abstract This study analyzed the spatial and temporal trends of diurnal temperature range (DTR) for 35-years (1983–2017) in the region of the Subarnarekha river basin of Jharkhand, India. The daily data of maximum temperature (T_{\max}) and minimum temperature (T_{\min}) were habituated to compute the DTR, whereas rainfall data is used to measure its relationship with DTR, on a monthly annual and seasonal basis. Mann–Kendall test and Sen’s slope method has been used to detect the increasing or decreasing trends in climatic data with their statistical significance. The annual mean DTR of the basin is 11.97 °C With a maximum in pre-monsoon (16.36 °C) and minimum in monsoon (6.94 °C). A significant negative trend (-0.31 °C/decade) was observed in annual DTR over the basin. On a seasonal basis, all four seasons show a negative trend in DTR with the largest significant decreasing trend in the pre-monsoon season (-0.49 °C/decade). On an annual and seasonal basis, a significant negative correlation between DTR and rainfall is found, indicating that rainfall has a significant impact on the variation of DTR in this basin. A concomitant increase in rainfall might be one of the possible causes of the decreases in DTR in the basin.

Keywords Trend analysis · Diurnal temperature range (DTR) · Mann–Kendall test · Sen’s slope estimator · Spearman’s correlation test

1 Introduction

For many decades, the mean temperature is considered as an important climatic index for studies of climate variability, but not sufficient to show the complicated variations of climate in the present scenario of climate change [1]. Some scientists found the temperature increase was not same throughout the day and noted a significant increase in daily minimum temperature (T_{\min}) relative to daily maximum temperature (T_{\max}) [2, 3]. The variation in mean temperature was due to the variations of trends in either T_{\max} or T_{\min} , or relative trends in both. In recent years, surface warming was correlated with a significant rise in minimum temperature as compared to maximum temperature [2, 4]. Thus, the diurnal temperature range (DTR), which is the measure of the difference between the T_{\max} and T_{\min} , has reduced over the large terrestrial area of the globe. Therefore, DTR is a vital climatic parameter and receiving considerable attention in recent years across different regions of the world to study the characteristics of the DTR, because it elaborated well as compared to mean temperature and the mean temperature is not sufficient to reflect the climate change/variability at global and regional scale [4–6]. A downward trend of -0.06 °C/decade has been discovered in global mean DTR during 1950–2004 [7]. A significant increasing trend in T_{\min} as compared to T_{\max} has been observed which resulted in a significant decreasing trend in DTR over the different parts of the globe [8] but, over several regions of the globe, T_{\max} has dropped substantially relative to T_{\min} [9]. A negative trend in DTR is seen in Europe [10], China [11], The United States [12] and India [13] while at the same time period an upward DTR trends developments have been noticed in eastern and western mountainous geographical regions of the Himalaya [5, 14]. There are numerous mechanisms to

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Migrant women and geography of remittance

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Abstract

Status of women empowerment can be measured in terms of sending remittance. Sending remittance is conventionally a male domain because mostly male migration takes place for the employment purpose that is embedded in Indian patriarchal society. In contrast, the National Sample Survey data 64th round ‘Migration in India’ reveals that large numbers of the female also remit. The study focuses on how remittance restructured gender relations even it also breaks the stereotype perception for the women in the society. On these backdrops, the paper tries to find out the geographical pattern and socio-economic backgrounds of the women remitter in India. The data show that women and men of the first-quartile class has remit more than the others. A woman of the economically backward states has remits more, except south India, than other states of the country.

Keywords Out-migration · Gender · Remittance and geography · Socioeconomic status · Female remitter

Introduction

The research on the impacts of migration and remittances sent by the female is mostly ignored. The household approach for the study of remittance is undermined women remitters (Haas 2007). Rodenburg (1997) stated that it ruled out the intrahousehold power inequality and individual decision-making process. Crivello (2003) study based on the Moroccan Rif found that the women migrants out of the country might increase their roles as remittance sender to the families who are left behind. It also reduces the stigma attached to female migration. In Indian context, such a works, yet not getting much attention. The paper aims to study the socioeconomic background of women remitters in India. It focuses on place of residence of the remitters whether they are inter-state, intra-state migrants or migrated out of country. Further, the emphasis has given to the urban and rural base of the women remitters and their origin states have thoroughly investigated.

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Phase wise spatial and temporal variations of nitrogen dioxide during and pre COVID-19 lockdown period in tier-1 cities of India

Kumar Ashwini¹ · Gautam Kumar Saw² · Ajai Singh³

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Abstract The novel coronavirus (COVID-19) pandemic disrupted basic lifestyle of everyone across the globe. To stop the conveyance of the coronavirus into the human body and to flatten the transmission rate curve, almost every country imposed a lockdown. In India, the emergency lockdown was imposed on the 24th of March 2020 which created an economic crisis in the country but proved a boon in disguise for the environment to improve its quality. The study analysed the statuses of air quality with respect to NO₂ in pre and during the COVID-19 lockdown period in eight districts of India where tier I cities are located. Nitrous Oxide concentration was determined through Sentinel 5P satellites imagery and Central Pollution Control Board ground station data. The lockdown across the country has helped the environment to regain, and therefore, more studies are required to assess other parameters to explore the implementation of the provision of the well-planned lockdown of 1-week duration in a year for giving enough time to the environment to recuperate. These results show that the study areas (Ahmedabad, Hyderabad, Delhi, Kolkata, Mumbai, Chennai, Bengaluru,

and Pune) have witnessed a significant drop in nitrogen dioxide (14–62%) as compared to the same period in 2019. This propose an idea that the devilish, COVID-19 lockdown has proved to be an unknown tool for tranquillizing air pollution (NO₂) during a lockdown within the Territory of Indian.

Keywords Sentinel 5P · COVID-19 · Nitrogen dioxide · Lockdown phases · Air pollution · India

Abbreviations

COVID-19	Coronavirus Disease 2019
WHO	World Health Organisation
CPCB	Central Pollution Control Board
NO ₂	Nitrogen dioxide
NO	Nitrogen oxide
SO ₂	Sulphur dioxide
PM	Particulate matters

1 Introduction

COVID-19, primarily a pneumonia symptom disease which bears similarity with early erupted SARS and MERS, emerged in Wuhan city of China in December 2019 [1]. Soon, it became a global public health crisis after World Health Organisation (WHO) announced it as an international public health emergency on 30th January 2020. This categorized COVID-19 into a high-risk disease facing a vulnerable health care system with a mortality rate of 3.4% worldwide [2, 3]. In India, the first case of COVID-19 was officially declared in Kerala on late January 2020 [1].

Many countries including India had implemented lockdown in order to reduce the human-to-human interactions

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Spatio-temporal variability of monsoon precipitation and their effect on precipitation triggered landslides in relation to relief in Himalayas

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Abstract Orography of Himalaya governs the regional weather system and monsoon of Indian sub-continent. The intense persistent precipitation in the form of rainfall during monsoon season causes landslides which are the most frequent naturally occurring hazards in the Himalaya. This study attempts to investigate the spatio-temporal variability of precipitation and their effect on precipitation triggered landslides during monsoon season (June–September) in relation to relief in Himalayan region by utilizing satellite-derived precipitation products (GPM) over the span of 2000–2018 in addition to NASA Landslide Viewer, Global Landslide Catalog and Global Risk Data Platform data for landslides and ASTER DEM for elevation. The results exhibit that the Eastern Himalayas received the highest amount of precipitation of 2385 mm with intensity of 19.5 mm/day, followed by the Central Himalayas with 1860 mm and intensity of 17.5 mm/day and the least in the Western Himalayas with 1400 mm and intensity of 15 mm/day, respectively. The monsoon precipitation in the lower elevations (below 2600 m) are mostly responsible for causing a vast majority of the precipitation induced landslide events with a maximum of 68.66% in the Central Himalayas followed by the Western Himalayas at 62.23% and the least in the Eastern Himalayas at 41.16%. The overall accumulated precipitation and intensity during monsoon season and landslide distribution were strongly correlated with relief pattern. This comprehensive study signifies how relief regulated the occurrences of landslides in monsoon season and recommends vegetation cover and

least interference of human-induced land use to alleviate the landslides.

Keywords Monsoon · Precipitation · Landslides · Elevation · Himalayas

1 Introduction

The Himalayas display great topographic variability and act as a barrier to atmospheric circulation for both the summer monsoon and the winter westerlies. The summer monsoon dominates the climate, lasting 8 months (March–October) in the eastern Himalayas, 4 months (June–September) in the central Himalayas, and 2 months (July–August) in the western Himalayas [1]. The monsoon rainfall is mainly of an orographic nature, resulting in distinct variations in rainfall with elevation between the southern slopes of the Himalayas and the rain shadow areas on the Tibetan Plateau [2]. A substantial portion of the annual precipitation falls as snow, particularly at high altitudes (above 3000 m asl) feeding the Himalayan glaciers. The high Himalayan and inner Asian ranges have the most highly glaciated areas outside the polar regions [3, 4].

In the Himalayan region, both increasing and decreasing trends of precipitation have been detected over the last few decades. Various studies have documented significant decreasing trends in the seasonal monsoon rainfall over India because of associated changes in the monsoon circulation [5, 6]. On the meso-scale, the impacts of climate are mainly due to local topographic characteristics [1]. From a climate point of view, India receives more than 75% of rain during the monsoon (June–September) season. A shift in precipitation pattern can have a profound impact on agriculture, forestry and water resources in India [7].

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Improvement in air quality and its impact on land surface temperature in major urban areas across India during the first lockdown of the pandemic

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ABSTRACT

The SARS CoV-2 (COVID-19) pandemic and the enforced lockdown have reduced the use of surface and air transportation. This study investigates the impact of the lockdown restrictions in India on atmospheric composition, using Sentinel-5Ps retrievals of tropospheric NO₂ concentration and ground-station measurements of NO₂ and PM_{2.5} between March–May in 2019 and 2020. Detailed analysis of the changes to atmospheric composition are carried out over six major urban areas (i.e. Delhi, Mumbai, Kolkata, Chennai, Bangalore, and Hyderabad) by comparing Moderate Resolution Imaging Spectroradiometer (MODIS) Aerosol Optical Depth (AOD) and land surface temperature (LST) measurements in the lockdown year 2020 and pre-lockdown (2015–2019). Satellite-based data showed that NO₂ concentration reduced by 18% (Kolkata), 29% (Hyderabad), 32–34% (Chennai, Mumbai, and Bangalore), and 43% (Delhi). Surface-based concentrations of NO₂, PM_{2.5}, and AOD also substantially dropped by 32–74%, 10–42%, and 8–34%, respectively over these major cities during the lockdown period and co-located with the intensity of anthropogenic activity. Only a smaller fraction of the reduction of pollutants was associated with meteorological variability. A substantial negative anomaly was found for LST both in the day (−0.16 °C to −1 °C) and night (−0.63 °C to −2.1 °C) across select all cities, which was also consistent with air temperature measurements. The decreases in LST could be associated with a reduction in pollutants, greenhouse gases and water vapor content. Improvement in air quality with lower urban temperatures due to lockdown may be a temporary effect, but it provides a crucial connection among human activities, air pollution, aerosols, radiative flux, and temperature. The lockdown for a shorter-period showed a significant improvement in environmental quality and provides a strong evidence base for larger scale policy implementation to improve air quality.

1. Introduction

The COVID-19 outbreak is believed to have initially emerged during December 2019 in Wuhan, China (WHO, 2020). Since this time, the pandemic has affected over 196 countries (Wang et al., 2020) with more than 107.9 million COVID-19 cases and 2.3 million deaths (~2.1% mortality rate) worldwide as of February 12, 2021 (JHU, 2021). The WHO declared COVID-19 to be a global public health emergency on January 30, 2020, which follows a number of other health emergencies, including Zika (2016), H1N1 (2009), Polio (2014), and Ebola (2014, 2019). One of the major causes for the rapid spread of the Coronavirus is

the ease and widespread use of local, regional and global travel (Munster et al., 2020). As a result, countries around the world implemented travel bans and enforced 'lockdowns' to restrict the population movement in order to reduce the spread of the virus. The enforced lockdowns resulted in a rapid decrease in economic activity due to workplace restrictions, which affected industrial production, non-essential business, transport systems, education establishments, offices, and citizen mobility. Consequently, the use of surface and air transportation reduced globally by 50% and 75%, respectively against the 2019 average (IEA, 2020). The dates at which lockdowns were implemented differed between countries, but most occurred in March (2020) except Hubei, China

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Explored Publication Pattern of the Top Twenty Nirf-2020 Ranked Indian Institutions: an Evaluative Study

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Abstract

Institutions ranking are getting more attention nowadays, as it shows institutions' status globally and influences students' decisions in selecting Institutions for admissions. Open access publications in scholarly research communication are important, but its significance in institutions' ranking is yet to explore. In this study, the authors tried to demonstrate and compare open access and commercial publication documents of the top twenty institutions (overall category) as per the National Institutional Ranking Framework (NIRF) 2020 report. According to NIRF-2020, maintaining their last year's positions, IIT Madras and IISc Bangalore bagged the first two ranks, followed by IIT Delhi on the third position among educational institutions with the score of 85.31, 84.18, and 81.33, respectively. In the study, it came out that in comparison to commercial publications open access publication perform better on the parameters of international collaboration, industry collaboration, the article in Q1 journals, citation impact, category normalized Citation Impact and Percentage of the document cited. Having the opinion that ranking provides an effective way of inspiring universities to continue, and hopefully increase, their commitment to open scholarship, this paper propose a parameter for open access publication to evaluate the ranking. This study may help ranking agencies evaluate approaches or a new policy for parameters weighted and researchers interested in research in this field. © 2021. All Rights Reserved

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SERB-SURE scheme in India: early indicators and recommendations

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Application of multi-criteria decision making (MCDM) and electrical resistivity tomography (ERT) techniques for identification of groundwater recharge zone(s) in granitic hard rock aquifer

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Groundwater recharge is a hydrological process where water flows from sub-surface layers to the water table of the aquifer and is the backbone of the hydrogeological system. The present study is carried out in a granitic hard rock aquifer region within and surroundings of the CSIR-NGRI campus, Hyderabad. The aim of this study to identify the potential groundwater recharge zone(s) using GIS based multi-criteria decision making (MCDM) along with sub-surface mapping from Electrical Resistivity Tomography (ERT) technique. The assigned weight of the different thematic layers of surface and sub-surface parameters and their specific characteristics was determined based on their relative contribution to the groundwater recharge and thus the normalized weight was computed using MCDM technique. These thematic layers were integrated with the help of ArcGIS to accurately identify the recharge zones within the study region. The resulting recharge map has been categorized into five classes viz., very poor, poor, moderate, good and very good. Numerically 23.11% of the study area is in a moderate zone of recharge, 4.97% in good and very good zone, while 71.92% falls under the poor and very poor zone, i.e., unsuitable for groundwater recharge. The recharge zone map of the study area is found to be in agreement with 2D inverted resistivity models for two different time periods, which revealed distinct geological features and thus identified the near surface recharge property, where recharge zone resistivity values lie between ~20 and 70 Ω .m up to 11 m depth. Thus, the integrated results from the present study delineated groundwater recharge zone(s) for sustainable groundwater resources in the granitic hard rock system.

Keywords. Multi-criteria decision making (MCDM); electrical resistivity tomography (ERT); groundwater recharge; granite; Hyderabad; India.

1. Introduction

Groundwater is one of the most important components of a hydrological cycle and found below the earth surface in the cracks and the porous space of the soil, sediment and rocks (Al-Garni 2009; Das 2019). It is the exhaustible and confined natural

resources, which is being utilized for farming, industry and domestic purposes. The rapid growth of population and urbanization had enhanced the demand for groundwater, which led to a global water shortage, especially in India, as India is the biggest user of groundwater in the world that utilizes 260 km³ of water every year (Bhanja *et al.*



Measurement of transit-oriented development (TOD) using GIS technique: a case study

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Abstract

The renewed enthusiasm for sustainable development and interest in transit needs to prompt the advancement of new transit-oriented development (TOD). Under the “smart cities” mission, smart growth development is being built globally. Government initiates many programs to increase ridership in public transport. However, investment in infrastructure such as for TOD without understanding the existing situation is complex. In any case, there are only a few studies that emphasize station-level planning. Our study mainly focuses on the measurement of station-level TOD on a quantitative scale. A case study of Bhopal, India, has been done. This study considers seven criteria: density, diversity, mixed-use of land, walkability, travel behavior of TOD residents, street block pattern, and economic development. The study presents an approach based on a geographical information system (GIS) for sustainable urban development. Multi-criteria evaluation (MCE) is utilized to determine the level of TOD for Bhopal based on the chosen criteria. MCE results show the quantitative value of performance measures, which can be used to rank and compare different stations accordingly. Measuring the TOD level is helpful for efficient, sustainable planning. This examination will provide sustainable station-level planning for the urban planner.

Keywords Station-level planning · India · Multi-criteria evaluation (MCE) · TOD index

Introduction

Transit-oriented development (TOD) is an urban development approach that keeps land use and transportation system under

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one umbrella (Khare et al. 2020a). TOD is a powerful tool to help shape and assess urban development. It refers to the moderate to high-density, mixed-use of land designed to maximize access by public transit and non-motorized vehicle, with other features to encourage transit ridership (Ewing and Cervero 2001). Automobile dependency, urban sprawl, congestion, long trip length, poor health, and pollution concerns are among the main drivers of sustainable urban planning (Bibri 2018). TOD is an answer to the unsustainable, automobile-dependent, and poor urban sprawl that has characterized the growth of cities worldwide (Khare et al. 2020b). TOD could be considered as a useful approach for the development of cities. From the perspective of new urbanism, there are many definitions of TOD. TOD is a pedestrian-friendly, compact, mixed-use development surrounding a transit station (TS) (Calthorpe 1993; Newman and Kenworthy 2006; Khare et al. 2020b). TOD is acquainted with assistance both the public transport and to utilize the openings that such a system may give (Belzer and Autler 2002). A couple of assessments have prescribed that organized land-use plans around public transportation can provoke an increase in ridership (Li et al. 2019). TOD is not just any improvement near transit; it is a development that grows territory capability so



Experimental investigation of microalgal harvesting with low cost bottom ash: Influence of temperature and pH with zeta potential and thermodynamic function



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ABSTRACT

This study was aimed at harvesting of microalgae, *Chlorella pyrenoidosa*, by using Bottom ash (BA). Utilization of an inexpensive and an easily available BA as a flocculant can be the alternative solution for reducing the harvesting cost of the microalgae and on the other side best way to utilize the unused waste from coal based thermal power plants. Herein, aimed flocculation process was evaluated and optimized through the statistical method, response surface methodology (RSM) with Box Behnken Design (BBD). Optimized conditions for harvesting were found to be best with BA concentration of 100 mgL⁻¹, temperature (50 °C), pH (6.5), and incubation time (60 min) for achieving a maximum yield of 97.9%. The results obtained indicated that BA is a promising flocculant that requires low dose, temperature, and time for a high coagulation and agglomeration of the microalgae. BA is a cost effective and an environmentally friendly flocculant that could neutralize the Zeta potential (ζ) of surface charge of the microalgal cell surface. The morphological changes of microalgae were also analyzed on various temperatures with scanning electron microscopy (SEM), and elemental composition on surface by energy dispersive X-ray spectroscopy (EDS) images with and without flocculant.

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1. Introduction

In the current time, more than 80% of global energy demand is derived from the fossil fuel resources (Ahmad and Zhang, 2020). With increasing population and lavished lifestyle, the demand of energy is increasing at an exponential rate. The fixed stock of petroleum reserves and an increasing environmental concern of global warming and climate change have led to the exploration for sustainable sources of energy. There has been accelerating research in the production of biofuel for serving Ecological, Economical, and Environmental (3E) purpose (Singh and Patidar, 2018). A liquid fuel

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Safe, efficient, and economically beneficial remediation of arsenic-contaminated soil: possible strategies for increasing arsenic tolerance and accumulation in non-edible economically important native plants

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Abstract

Anthropogenic activities, geological processes, and biogenic sources have led to the enhanced concentration of arsenic (As), a toxic metalloid in water and soil. Non-edible, economically important plants can be employed for safe As phytoremediation in addition to generating extra income. However, these plants may get affected by stressful local environmental conditions. Native plant species are adapted to local environmental conditions and hence overcome this problem. Native non-edible economic plant species which show high As tolerance and accumulation are promising candidate for safe, efficient, and economically beneficial phytoremediation of As-contaminated sites. The current review discusses the potential of native economic plant species that can be used in As phytoremediation programme. However, since their phytoremediation potential is moderate, possible strategies for increasing As tolerance and accumulation, especially genetic modification, have been discussed in detail. Knowledge gained from the review can be used for the development of As tolerance and accumulation in non-edible economic native plants.

Keywords Hyperaccumulation · Phytoremediation · Genetic manipulation · Non-edible plants · Native plant species

Introduction

Arsenic (As), a redox-active metalloid, finds its way to soil and water through geogenic, biogenic, and anthropogenic sources (Fig. 1). Rapid industrialization and globalization have resulted in uncontrolled increase of As contamination. Over past centuries, extensive studies have been done on the hazardous effect of As and successfully grabbed the attention of scientific communities and environmental protection agencies. Owing to its toxic nature, International Agency of Research on Cancer (IARC) has classified it as class I category of carcinogen (Cohen et al. 2019) and also ranked as first

among the most hazardous substance list (ATSDR 2019). Consumption of As-contaminated water and plants has resulted in increased health issues of humans and animals. Furthermore, plant establishment mostly in As-polluted land gets seriously affected (Sharma et al. 2018). To overcome these problems, numerous studies have been conducted to acquire knowledge regarding arsenic speciation, uptake mechanism of As in plant parts, their toxic behaviour, and ultimately cope up and tolerance processes in plants (Meharg and Hartley-Whitaker 2002; Srivastava et al. 2007, 2010; Rai et al. 2011; Tripathi et al. 2012; Sharma et al. 2014; Kumar et al. 2019; Singh et al. 2019a; Singh et al. 2020; Singh et al. 2021).

In recent years, the usefulness of plants in the removal of As from soil and revegetation of As-contaminated land has been recognized. Remediation and utilization of contaminated lands using plants provide economic, social, and environmental solution. Phytoremediation is considered eco-friendly and cost-effective over conventional methods. Therefore, research has been directed towards the use of plants to remediate and revegetate As-contaminated lands. Arsenic tolerance and phytoremediation efficiency of plants can be enhanced by

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Original research article

Slow light in rod type 2D photonic crystal waveguide comprising of cavity: Optimization and analysis

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ABSTRACT

Structure comprising of 2D photonic crystal waveguide and cavity (PhCWC) is designed in this paper and propagation of slow light through it is investigated for its potential application as optical delay device. Rod type 2D photonic crystal structure has been considered here. Two-dimensional finite difference time domain (2DFDTD) method has been used in the present investigations. The proposed PhCWC structure is optimized in two steps. In the first step, Q factor is optimized by varying the number of rods of the cavity. In the second step, number of rods are kept fixed (as optimized for Q in the first step), and the delay is maximized by varying radius of the cavity rods. The resultant structure thus obtained is further investigated for (i) dispersion and group velocity, (ii) variation of optical delay with input pulse width, (iii) variation of optical delay with wavelength and (iv) variation of optical transmission with wavelength.

The present paper proposes optical delay in the one cavity structure that could be manipulated by manipulating the number of cavity rods in the waveguide and radius of the central rod of the cavity. Further, the structure can be designed to operate at a desired wavelength.

1. Introduction

Slowing down of light has potential applications in the field of optics and optoelectronics [1–4]. Since the inception of the idea (of slow light), huge progress has been made during the last one decade [5–8]. Both experimental and theoretical studies on generation and optimization of optical delay are available in literature [9–17] wherein various techniques are proposed and schemes are analysed to produce large group delays with minimal dispersion [15–17]. The first desirable feature of any slow light device is to have large optical delays with high transmission and minimum dispersion. Second desirable feature is the compatibility with the existing technology. Photonic crystal (PhC) waveguides and PhC cavity waveguides are among most suitable structures for slow light due to the possibility of room temperature operation and easy high density on chip integration [18]. Fabrication of PhC waveguide and cavity is possible by electron-beam lithography and holographic techniques. The details on the fabrication processes may be seen in [19]. PhC based optical delays offer manipulation of group velocity ($v_g = \frac{d\omega}{dk}$) to a large extent via band gap formation. The dispersion profile of a single line-defect waveguide shows that v_g of the mode located within the PhC bandgap decreases as the frequency approaches the band edge. Slow light near band edge is referred to as “band-edge slow light” [20]. However, this band-edge slow light is strongly affected by dispersion induced pulse broadening. The major issue with the previous structures is the associated losses viz. propagation

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